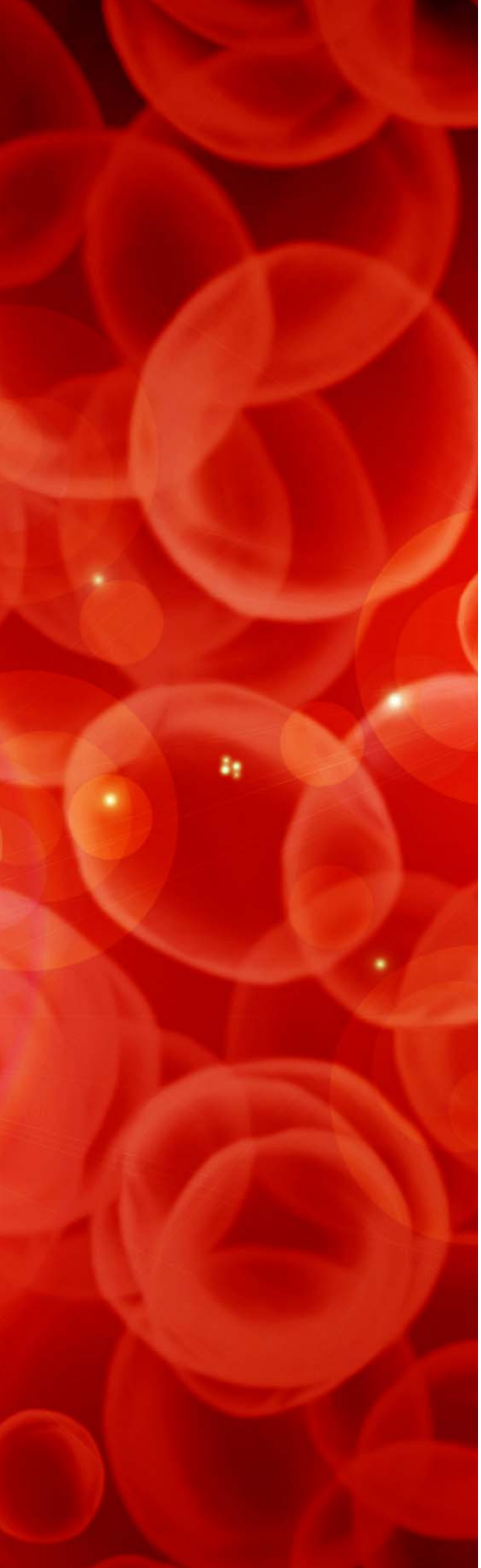

2013

THE AABB BLOOD SURVEY REPORT

Final

Advancing Transfusion and Cellular Therapies Worldwide

The 2013 AABB Blood Collection, Utilization, and Patient Blood Management Survey Report

Report Authors

Barbee I. Whitaker, PhD
Srijana Rajbhandary, BDS, MPH
Andrea Harris, MPH

Table of Contents

List of Tables

List of Figures

1. Executive Summary

The 2013 AABB Blood Collection, Utilization, and Patient Blood Management Survey (Blood Survey) was sponsored by AABB and conducted with AABB member participation. The objectives of this new survey were to gather blood collection and transfusion information about AABB members, both within the United States and internationally, make comparisons with previous US surveys where possible, and provide patient blood management (PBM) benchmarks for AABB members completing the PBM section. The 2013 Blood Survey findings are reported here in total, replacing Part I of the 2013 Blood Survey Report released earlier and including all results. Survey results from AABB members outside of the United States are included.

The facilities surveyed included all AABB member blood collectors (both blood center and hospital-based facilities), hospital transfusion services, and centralized transfusion services, both in the United States and internationally. There was no sampling—all responding AABB institutional members were included, regardless of size and location.

The overall response rate for the 2013 AABB Blood Survey was 54.5% (625/1147). The blood center response rate was 92.4% (73/79) and there was an additional 50.0% response from member US military collectors (2/4). The hospital response rate was 51.7% (552/1068).* Response rates were comparable to the 2009 National Blood Collection and Utilization Survey (NBCUS)† and slightly higher than responses by AABB member institutions for the 2011 NBCUS.

Due to the high response rate of blood collectors, estimates and comparisons to previous data can be made for the entire US blood collection system. However, as AABB institutional members administer only a portion of the transfusions in the United States, comparisons of blood transfusions are limited to activity at AABB member hospitals reporting in 2011 versus 2013.

The international response was less robust, with 35.3% (6/17) of non-US blood centers and 22.9% (8/35) of non-US hospitals reporting. It is possible that the low response was due to inadequate communication to all members that the survey scope included non-US AABB members for the survey year 2013.

US Blood Collection

The 2013 AABB Blood Survey estimates that 13.6 million whole blood (WB) and red blood cell (RBC) units

**Military hospitals were included in this group as they serve military and non-military populations.*

†*Report of the US Department of Health and Human Services. The 2011 national blood collection and utilization survey report. Washington, DC: US Department of Health and Human Services, Office of the Assistant Secretary of Health, 2012.*

were collected, a significant decline of 12.1% ($p<0.0001$) from 2011. In 2013, blood centers were responsible for the collection of 13.1 million units, or 96.1% of the supply; the remaining 3.9% were collected by AABB hospitals. Therapeutic collections that were not intended for transfusion have not been included in this survey.

There was a 5.5% decrease in the total number of RBC apheresis units collected, including both allogeneic and autologous collections, to approximately 1.9 million units ($p=0.001$). The proportion of blood collected in this manner, however, continued to increase to 13.8% of all WB/RBC collections **(Figure 1-1)**.

There was a statistically significant 27.1% increase in the distribution of WB-derived (WBD) platelet concentrate units (164,000 apheresis equivalent units) individually and in pools. However, total platelet distributions decreased 2.4% overall due to a 4.2% drop in apheresis platelet distributions.

US Blood Utilization

The estimated number of WB/RBCs transfused by AABB member hospitals was 6.1 million units, 7.3% fewer than reported in 2011 ($p=0.036$)**.** AABB member facility transfusion of plasma decreased significantly by 9.9% ($p=0.036$), continuing the decline reported in the most recent national survey.

There were 15.4% more platelets transfused by AABB institutional members in 2013, totaling 1.3 million platelet transfusions ($p=0.0423$). Increases in both apheresis platelet transfusions (12.2%) and WBD platelet transfusions (30.7%) contributed to the difference. There was a marked increase in the number of cryoprecipitate units transfused (66.2%; $p<0.0001$).

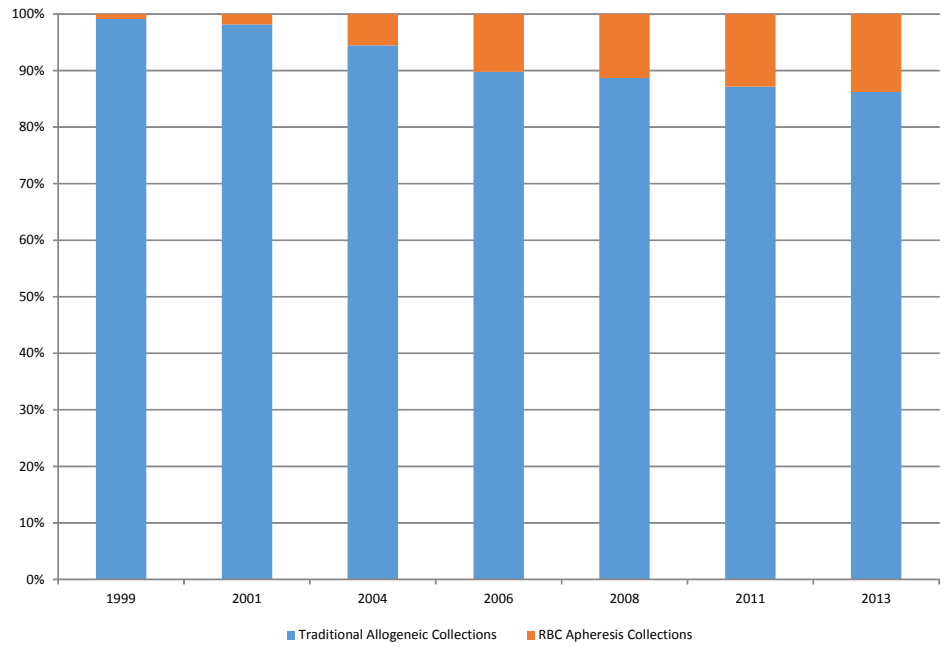

Figure 1-1. Growth in use of RBC apheresis technology.

Some reasons for these increases in WBD platelet and cryoprecipitate transfusion are the addition of critical care beds, acquisition of other facilities, increases in liver and solid organ transplants, and the impact of massive transfusion protocols.

Patient Blood Management (PBM)

The efforts of AABB to promote the adoption of PBM initiatives are well reflected in this year's hospital responses regarding their continued incorporation of various transfusion policies and protocols. This is evidenced by the survey results reflecting that 23.7% of the reporting hospitals had implemented five or more pre-, intra-, or postoperative interventions associated with PBM, and another 22.9% of hospitals reported implementation of at least three PBM interventions.

Over 55.0% of reporting AABB member hospitals indicated transfusion thresholds for RBC transfusion for the general inpatient population between 7 and 8 grams (g) of hemoglobin per deciliter (dL). Transfusion thresholds for other patient populations and components are discussed in Chapter 6.

Of the AABB member facilities responding to the question, 37.8% reported having a PBM program, a slight increase when compared to 35.9% in 2011. Additional survey results expand on the baselines established with the 2011 NBCUS and have allowed the development of individual hospital benchmarks for 2013 data.

2. Key Findings

The results of the 2013 AABB Blood Survey provide information about AABB member blood collection and transfusion services and related activities in the 2013 survey year. Participating members were predominantly from the United States. Comparisons of 2013 US member responses were made to the AABB member cohort from the 2011 NBCUS. Notable findings from the 2013 AABB Blood Survey and comparisons with member responses to the 2011 survey are listed below.

Collection

- Total WB/RBC collections by domestic AABB members decreased significantly ($p<0.0001$) from 15.5 million units in 2011 to 13.6 million units in 2013 (12.1% decrease).
- Total WB Allogeneic collections (including directed) by domestic AABB members decreased significantly ($p<0.0001$) from 13.4 million units in 2011 to 11.7 million units in 2013 (12.8% decrease).
- Ten AABB members located outside of the United States reported collections of 1.2 million units of WB/RBCs.
- In the United States, 14.0 million individuals presented or registered to donate in 2013, a decline of 21.0% from 2011.
- Of the people presenting to donate blood or blood products to US blood collectors, 6.8 million allogeneic donors successfully gave blood compared with 9.1 million allogeneic donors in 2011, a 24.9% decrease.
- The collection of RBCs by apheresis in the United States decreased by 5.5% from 2.0 million in 2011 to 1.9 million in 2013 ($p=0.001$).
- Autologous units collected in the United States (manual and apheresis collections combined) totaled 55,000, a decrease of 47.1% compared with 2011 ($p<0.001$). Non-US collectors reported less than 1000 autologous units collected, suggesting that this practice is not common outside of the United States.
- The number of units rejected for unacceptable test results in the United States decreased by 8.2% to 90,000 in 2013 from 98,000 in 2011 ($p=0.008$). However, the proportion of collections with these reactive infectious disease marker results was 0.7%, the same reported in 2011 and 2008.
- Units of WB/RBCs discarded for other reasons by US blood collectors (not including outdated products) was 629,000, a decrease from 2011 of approximately 38.2% ($p<0.0001$).
- Allogeneic blood collection in the United States among AABB member blood centers and hospitals was 65.5 units per 1000 persons ages 16 to 64 in

2013 compared with 76.2 units per 1000 persons the same ages 16 to 64 in 2011.
- The distribution of WB for transfusion as WB by domestic AABB members decreased significantly ($p<0.0001$) from 48,000 units in 2011 to 6000 units in 2013 (87.5% decrease).
- 5.2 million WB/RBC Group O units were distributed by AABB US member blood collectors in 2013, comprising approximately 41.7% of all WB/RBC distributions. In 2011, 37.6% of WB/RBC distributions were Group O, a total of 5.6 million units.
- The number of apheresis platelets distributed in the United States in 2013 stayed essentially the same, decreasing from 2.1 to 2.0 million units; however, this 4.2% decrease was statistically significant ($p=0.015$).
- There were a total of 4.3 million units of plasma produced for transfusion in the United States in 2013, a decrease of 26.0% from 2011 ($p<0.0001$). Of these, 3.5 million were actually distributed; this was 22.4% fewer units than in 2011 ($p<0.0001$).
- There were 17,600 severe donor adverse reactions reported by blood collectors in 2013 in the United States. These occurred in 0.13% of collection procedures (unchanged from 2011). Another 2700 severe reactions were reported by non-US blood collectors (0.2% of reported collection procedures).
- In 2013, there were 176,000 more WBD platelet concentrates distributed in the United States (either as individual units or combined within pools); this was a 27.4% increase from 2011.
- There were 10,103,000 WB/RBC units collected, prepared, or modified to achieve prestorage leukoreduction in 2013 in the United States, comprising 78.5% of the total WB/RBC products available for distribution.

Transfusion

- In 2013, the total WB/RBC units transfused by US AABB member facilities was 6.1 million units, a 7.3% decrease from the units transfused by US AABB member facilities in 2011.
- Eight AABB member hospitals outside of the United States reported WB/RBC transfusions of 59,000 units.
- There were 13,000 autologous units of WB/RBCs transfused by US AABB member hospitals in 2013, a decrease of 58.1% ($p<0.001$) compared with 2011.
- Transfusion of apheresis platelets in US AABB member hospitals increased by 12.2% from 1.0 million in 2011 to 1.1 million units in 2013.
- Plasma transfusions in US AABB member hospitals decreased 9.9% for a total of 1.8 million units transfused.
- Extrapolation of the US AABB membership data to the total number of transfusions performed throughout the United States, yields a rate of approximately 40.3 WB/RBC units per 1000 (US population), an 8.4% decrease from 44.0 units per 1000 estimated in 2011.
- Approximately 37.8% of responding AABB member hospitals reported having a PBM program in 2013.
- The total number of components transfused by US-based AABB member hospitals in 2013 was 10,962,000, a 1.1% increase over the 2011 AABB member transfusions.

- The number of irradiated RBC units transfused by US-based AABB member hospitals decreased by 16.8% in 2013 compared to 2011, for a total of 817,000 units (13.3% of all RBC units transfused).
- Adverse transfusion reactions were reported to US-based AABB member hospital transfusion services at a rate of 2.5 per 1000 components transfused in 2013.

3. International Report

The international (non-US) AABB institutional member response to the 2013 AABB Blood Survey was 35.3% (6/17) for blood centers and 22.9% (8/35) for hospitals. Members reported from 10 countries. Weights were not applied and estimations of representativeness were not made.

Blood Collected and Produced

The respondents, four of which were hospital collectors, reported collection of 1,249,000 units of WB and apheresis RBCs, with blood centers collecting 1,216,000 units, or 97.4%, of the total. The number of units rejected for unacceptable test results was 8000 units. There were an additional 83,000 units discarded for other reasons than testing. The remaining 1,158,000 units were available for transfusion—representing 92.7% of the total units collected.

Most collections were manual WB collections, totaling 1,240,000 units, 53.3% of which were collected at mobile blood drive sites. There were only 600 units of autologous WB collected (0.05% of collections), a smaller proportion than US autologous collections (0.4%). There were also 10,000 allogeneic RBC units collected by apheresis. Collections were reported from 641,000 allogeneic donors.

There were 2700 severe blood donor reactions reported, giving an aggregate rate of 0.2% reactions per collection procedure.

There were 59,000 plateletpheresis procedures reported by non-US AABB members in 2013. These procedures yielded 70,000 apheresis platelet units, 98.7% of which were collected in plasma. Most collectors reported a single unit yield per apheresis procedure. Blood centers collected 96.0% of apheresis platelets. There were 106,000 WB-derived platelets distributed, 76.0% of which were distributed in pools.

A total of 466,000 units of plasma were produced for transfusion. This total includes WB-derived fresh frozen plasma (FFP; 112,000 units), plasma frozen within 24 hours after phlebotomy (137,000 units), cryoreduced plasma (57,000 units), liquid plasma (89,000 units), and plasma from apheresis collections (71,000 units). A total of 50,000 plasmapheresis procedures generated 60,000 units of apheresis plasma for transfusion; other apheresis procedures produced 11,000 units of plasma. Of all types of plasma, there were 22,000 units of Group AB plasma distributed for transfusion.

In 2013, 87,000 individual units of cryoprecipitate were produced and 411 granulocyte units prepared.

Blood Transfusion

In 2013, nine AABB member institutions located outside the United States reported transfusion data. Transfusions of WB/RBCs of all donation types totaled 59,000 units. All of these institutions reported a policy of universal leukoreduction (LR, 66.7%) or of transfusing LR components to particular types of patients, including neonates, oncology patients, and others (33.3%).

Of the RBC units transfused, 8000 units were Group O-positive (13.6%) and 2000 units were O-negative (3.4%). There were fewer than 100 autologous transfusions reported. There were 19,000 WB/RBC units reported as outdated. However, without a report of all WB/RBC units collected and transfused by country, this number cannot be put into context.

There were 9000 units of platelets transfused by AABB member hospitals located outside of the United States, of these, 55.4% were apheresis platelet transfusions. Only one hospital reported transfusing both apheresis platelets and WB-derived platelets—most hospitals transfused either WB-derived platelets or apheresis platelets. A total of 19,000 units of plasma, 3000 units of cryoprecipitate, and 98 units of granulocytes were reported transfused in 2013.

Five hospitals reported formal, established programs for patients who refuse any or all blood components. Most facilities (7/9) reported having a Transfusion Safety Officer (TSO) or Patient Blood Management Coordinator (PBMC) onsite. As the reporting facilities represented different countries, their responses may not indicate that TSOs and PBMCs are widespread globally; however, the concept of the TSO is modeled on the staff role established in Canada.

A total of 101,000 crossmatch procedures were reported by non-US facilities. There were 18,000 electronic crossmatch procedures, 17.8% of the total procedures reported. Manual tube serologic procedures accounted for 71.3% (72,000 procedures). Only 6.9% were reported to be automated serologic crossmatch procedures. The remaining procedures were not categorized. To calculate the crossmatch-to transfusion ratio (C:T), the total number of allogeneic WB/RBC units transfused (59,000) was used as the denominator. The overall C:T ratio was 1.7 crossmatch procedures per unit transfused.

There were 280,000 patient specimens reported submitted to blood banks for ABO testing. There were 2000 sample collection errors and 564 transfusion reactions reported. Of the transfusion reactions, most were febrile reactions (44.5%) or mild allergic reactions (39.2%); 7.1% were reported to be Transfusion Associated Circulatory Overload (TACO).

4. Blood Collected and Produced in AABB Member Facilities: Trends in US Collections

WB and RBC (by apheresis) collections for the survey years 1989 through 2013 are illustrated in **Figure 4-1**. Total collections reached a high of 17.3 million units in 2008.* For 2011 and 2013, the figure shows total collections data restricted to AABB member facilities; these decreased significantly ($p<0.0001$) between 2011 and 2013 by 12.1% to 13.6 million units.

Autologous collections continued to decline from 2011. In 2013, autologous totals included 48,000 manual collections and 7000 apheresis red cell collections, and amounted to less than 1.0% of total collections. In 2013, collections for the use of a designated patient, or directed donations, which previously had been reported separately, were included in the total for allogeneic blood collection.

Report of the US Department of Health and Human Services. The 2009 national blood collection and utilization survey report. Washington, DC: US Department of Health and Human Services, Office of the Assistant Secretary for Health, 2011.

Total WB/RBC Collections

The total WBD and apheresis RBCs collected in the United States in 2013 was 13.6 million (±207,000) units (**Table 4-1**). Blood centers collected 13.1 million units, or 96.1% of the total. The remaining 527,000 units (3.9%), collected by hospitals, were a slightly smaller proportion compared to previous years. Even RBC apheresis collections, which had previously increased with every survey, declined significantly by 5.5% in 2013. However, in 2013, RBC apheresis collections represented a larger fraction of the total WB/RBC collections (13.7% compared with 12.7% in 2011).

The number of units rejected for unacceptable test results decreased by 8.2% compared to 2011 ($p=0.008$), proportionately less than the drop in collections. There were an additional 629,000 (±32,000) units that were discarded for reasons other than testing, (eg, bag failures). Also, 12.9 million WB/RBC units were reported available for transfusion, 94.7% of the total units collected.

Whole Blood (WB)

Donations of WB in 2013 totaled 11.7 million (±187,000) units. These collections, reported according to the type of donation, are shown in **Table 4-1**. Allogeneic donations totaled 11.7 million, of which 95.7% were collected by blood centers and 4.2% by AABB member hospitals. There was a decrease in allogeneic donations between 2011 and 2013 of 12.8% ($p<0.0001$).

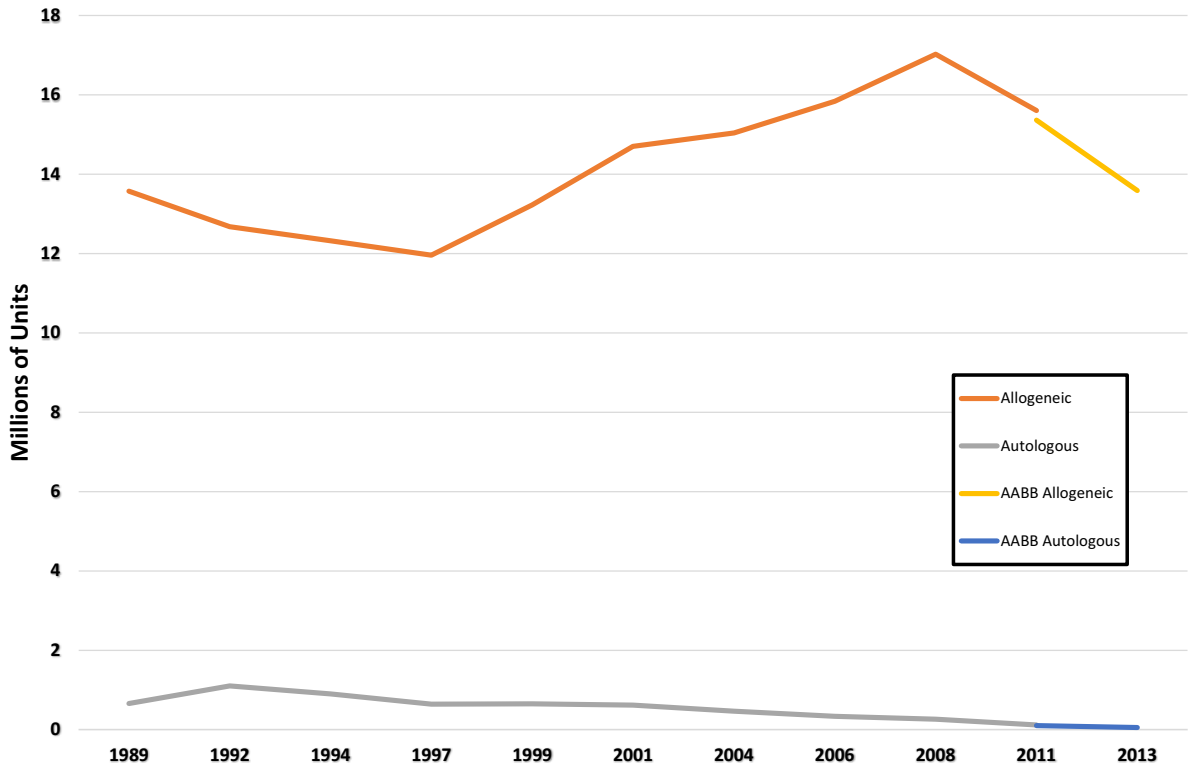

Figure 4-1. Allogeneic and autologous WB and RBC collections, 1989-2013.

Autologous, or self-directed, WB units totaled 48,000 (±3000), a statistically significant decrease of 52.0% compared to 2011 ($p<0.0001$). Hospitals collected 20.8% of all autologous units.

There were only 6418 (±1000) units reported as distributed as WB for transfusion in 2013 by AABB member facilities, compared to a significantly higher number in 2011 (48,000 units; $p<0.0001$).

Red Blood Cell (RBC) Apheresis

In addition to WB collections, 1.9 million (±49,000) RBC units were collected by apheresis. Apheresis RBC collections in 2013 decreased by 5.5% in comparison to 2011, when there were 2 million RBC units collected by AABB member facilities. There were 956,000 RBC apheresis collection procedures, 1.7% fewer than in 2011 (**Figure 4-2**).

While nearly all of the RBC apheresis collections were for allogeneic use, a small number of units collected by RBC apheresis were for autologous use (7000 units).

RBC apheresis collections were performed largely in blood centers, accounting for 98.9% of such units. In 2011, 116 blood centers and 38 hospitals reported RBC apheresis collections. In 2013, 72 blood centers and 25 hospitals reported collecting RBCs by apheresis. The apparent decrease

Table 4-1. Estimated 2013 Collection and Transfusion by AABB US Member Blood Centers and Hospitals for Whole Blood (WB) and Red Blood Cells (RBCs) (expressed in thousands of units)

	Blood Centers	Hospitals	2013 Combined Total*	±95% CI	% of Total Collections/ Transfusions	2011 Total	% Change 2011-2013	p-value
Collection								
WB Allogenic (including directed)	11,183	496	11,679	187	85.9	13,397	–12.8	<0.0001
WB Autologous (manual)	38	10	48	3	0.4	100	–52.0	<0.0001
RBC Apheresis Autologous	7	-	7	0	0.1	4	75.0	<0.0001
RBC Apheresis Allogeneic	1,835	21	1,856	49	13.7	1967	–5.6	0.001
Total Supply	13,063	527	13,590	207	100.0	15,468	–12.1	<0.0001
Rejected on Testing	85	5	90	4	0.7	98	–8.2	0.008
Rejected for Other Reasons	613	16	629	32	4.6	1,018	–38.2	<0.0001
Available Supply	12,365	506	12,871	197	94.7	14,352	–10.3	<0.0001
Distribution								
WB for distribution as Whole Blood	5	1	6	1	<1.0	48	–87.5	<0.0001
RBC units (all groups)	11,850	526	12,376	199	99.9	14,982	–17.4	<0.0001
Group O-positive	5,084	72	5,156	83	41.7	5,648	–8.7	<0.0001
Group O-negative	1,245	18	1,263	23	10.2	1,358	–7.0	<0.0001
WB/RBC Distributed	11,856	527	12,383	200	100.0	15,030	–17.6	<0.0001
Transfusion								
Allogeneic WB/RBC (including directed)	9	6,109	6,118	311	99.8	6,584	–7.1	0.036
Autologous	-	13	13	3	0.2	31	–58.1	<0.0001
Total Transfusions	9	6,122	6,131	312	100.0	6,615	–7.3	0.036

*Significantly different from 2011 data.

in the number of blood centers can be attributed to a large multiregional blood center that reported in aggregate in 2013 but by region in 2011, as well as to blood center mergers and closures. Among the institutions that reported RBC apheresis collections (unweighted data), the mean number of units collected by blood centers was 25,000 (vs. 16,000 in 2011), and by hospitals it was 410 (vs. 745 in 2011).

RBC Distributions

There were 12.9 million (±197,000) WB/RBC units available for distribution in 2013; 12.4 million RBCs (±199,000) were distributed by AABB member blood collectors in 2013, compared with 15.0 million distributed in 2011. Of these, 5.2 million (±83,000; 41.7%) were Group O-positive units, compared to 37.6% (5.6 million) Group O-positive units distributed in 2011. There were 1.3 million (±23,000) Group O-negative units distributed, representing 10.2% of distributions in 2013. In 2011, Group O-negative units accounted for 9.0% of total distributions.

Non-RBC Components

Non-RBC components collected or produced include apheresis and WBD platelets, apheresis and WBD plasma, cryoprecipitated AHF, and granulocytes. The total number of non-RBC components distributed for transfusion in 2013 was 7,646,000 (WBD platelets counted as individual concentrates, not as apheresis-equivalent units), a decline of 5.6% from 2011 distributions.

Platelets

An estimated 1,241,000 platelet apheresis procedures were completed by US-based AABB member blood collectors in 2013. This was 4.3% fewer procedures than reported by AABB members in 2011 **(Figure 4-2)**. These procedures yielded 2.2 million apheresis units (±55,000); 98.3% of which were collected in plasma. Another 38,000 were suspended in platelet additive solution (PAS). Blood centers collected 94.8% of apheresis platelets. This 2.5% decrease in apheresis platelets was not statistically significant.

The split rate is the average number of units produced from an apheresis procedure; each unit must contain a minimum of 3×10^{11} platelets. In 2013, the overall split rate was 1.8 apheresis platelet units per procedure. There was a statistically significant 4.2% decrease in the number of apheresis platelet components distributed by AABB blood collectors in 2013 (2 million units ±50,000).

In 2013, US blood centers distributed 819,000 WBD platelet concentrate units (164,000 apheresis equivalent units) individually and in pools. Compared with 643,000 WBD platelets distributed in 2011, there was a significant 27.4% increase in WBD platelet distributions. This large increase represents a real change in the pattern seen in previous surveys of decreasing WBD platelets being produced and distributed nationally.

In 2013, the average number of WBD platelet concentrates reported to be pooled together for transfusion was 5 units. This is consistent with the pattern seen in previous surveys. For comparison with apheresis platelets, it is assumed that 5 WBD platelet con-

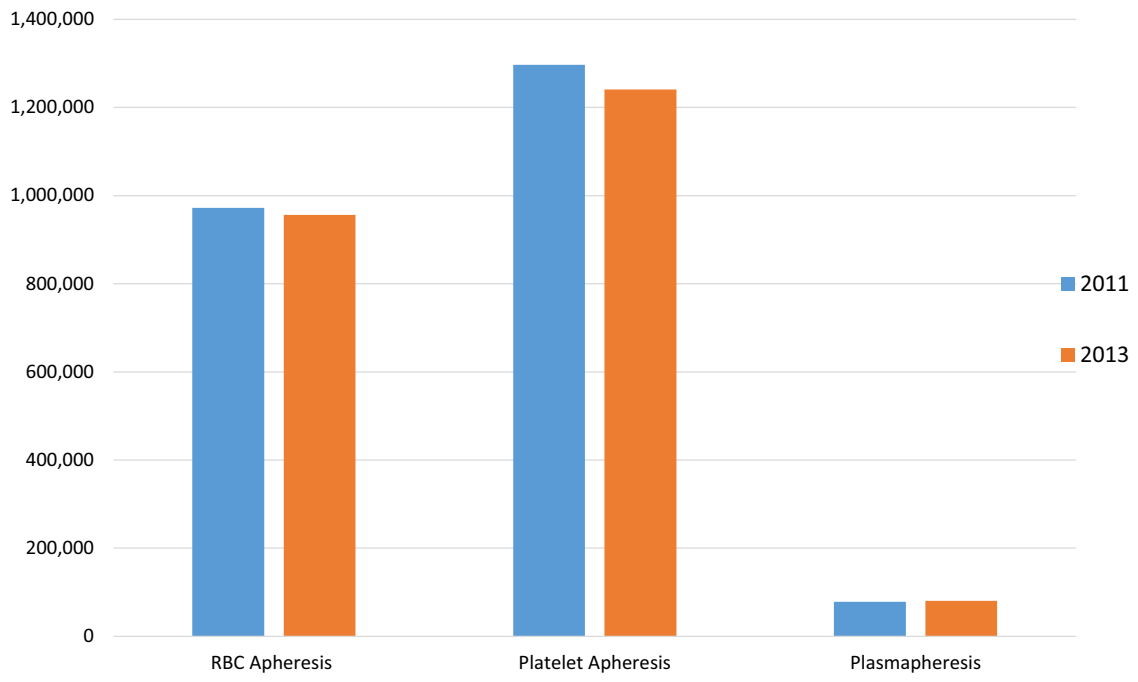

Figure 4-2. Apheresis procedures by primary component.

centrates are equivalent to 1 unit of apheresis platelets.

There were a total of 2,166,000 platelet apheresis equivalent units distributed in 2013, 2.4% fewer than were distributed in 2011—of this total 92.4% were apheresis platelets units (**Table 4-2, Figure 4-3**).

Plasma

A total of 4.3 million units (±118,000) of plasma were collected or produced for transfusion; this is 26.0% fewer units than collected or produced in 2011 ($p<0.0001$). This included several types of WBD plasma: fresh frozen plasma (FFP), plasma frozen within 24 hours after phlebotomy (PF24), cryoprecipitate reduced plasma (plasma cryoprecipitate reduced), liquid plasma, and other plasma for transfusion, as well as plasma from apheresis collections. The total amount of plasma collected by apheresis or produced from WB represents a decrease of 26.0% from 2011. Blood centers produced 93.4% of the plasma (4 million units) and hospitals produced another 283,000 units. Compared to 2011, there was a 29.9% decline in the number of plasma units produced from WB. The largest reported change was in the production of liquid plasma, where only 79,000 units were produced in 2013, compared to 550,000 in 2011 (**Figure 4-4**).

A total of 81,000 plasmapheresis procedures were reported, generating an estimated 266,000 units of apheresis plasma for transfusion and 3500 units of source plasma. Multicom-

Table 4-2. Estimated 2013 Collection and Transfusion by AABB US Member Blood Centers and Hospitals for Non-RBC Components (expressed in thousands of units)

	Blood Centers	Hospitals	2013 Combined Total	±95% CI	2011 Total	% Change 2011-2013	p-value
Collection/Production							
Apheresis Platelets Collected and Produced	2,112	114	2,226	55	2,283	–2.5	0.078
Apheresis Platelets Distributed for Transfusion	1,908	94	2,002*	50	2,090	–4.2	0.015
WB-Derived Platelets Concentrates Distributed†	154	9	164(819)*	9	129(643)	27.1	<0.0001
Total Platelets Distributed for Transfusion	2,062	103	2,166	51	2,219	–2.4	0.249
Plasma Collected or Produced	3,995	283	4,278*	118	5,784	–26.0	<0.0001
Plasma Distributed for Transfusion	3,286	201	3,488*	76	4,495	–22.4	<0.0001
Cryoprecipitate Distributed for Transfusion‡	1,218	117	1,335*	70	867	54.0	<0.0001
Transfusions							
Apheresis Platelets	0	1,143	1,143	104	1,019	12.2	0.112
WB-Derived Platelets Concentrates†	0	167	167(835)	53	116 (581)	30.7	0.142
Total Platelets Transfused	0	1,310	1,310*	121	1,135	15.4	0.0423
Plasma	1	1,796	1,797*	129	1,995	–9.9	0.036
Cryoprecipitate‡	0	1,054	1,054*	132	634	66.2	<0.0001

*Significantly different from 2011 data.
†Apheresis equivalent units; numbers in parenthesis represent individual platelet concentrates produced from whole blood donations.
‡Includes individual units and pools expressed as individual units using weighted average units per pool as reported by the responding facilities.

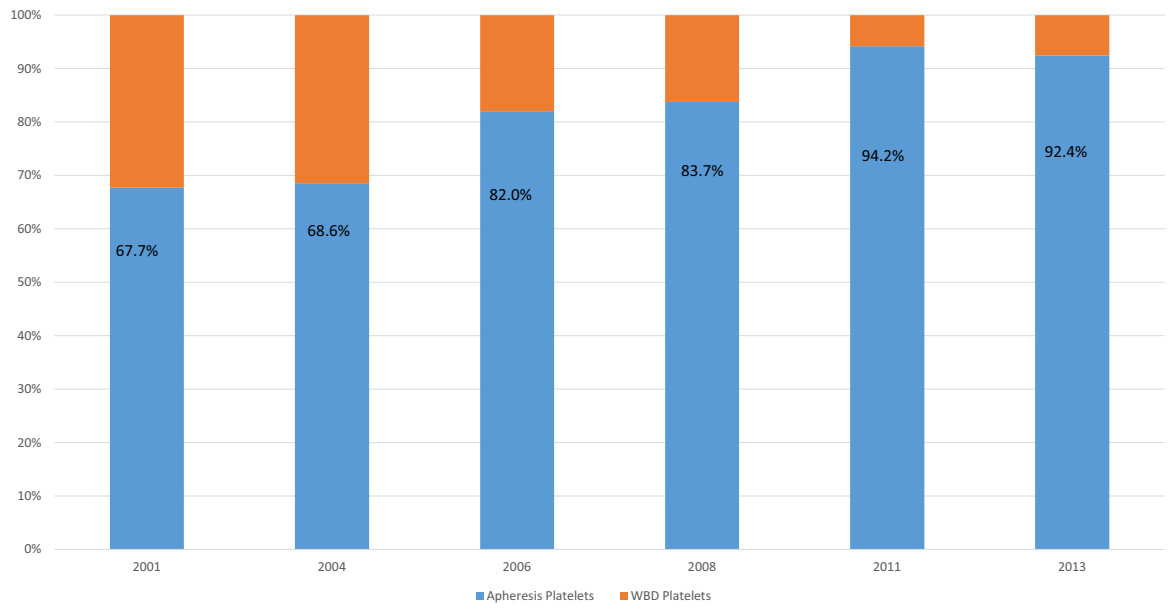

Figure 4-3. Apheresis platelets as percent of total platelets produced.

ponent apheresis procedures resulted in the collection of another 266,000 units of apheresis plasma (**Figure 4-4**). Overall, plasma for transfusion collected by apheresis increased by 21.2% over the amount collected in 2011. However, apheresis plasma collections comprised only 12.4% of plasma for transfusion.

Of the plasma produced, 81.5%, or 3.5 million units (±76,000), were distributed for transfusion. While the number of units distributed decreased by 22.4%, the proportion of plasma distributed to plasma produced increased over that in 2011, when 77.7% of 4,495,000 units were distributed, suggesting improved efficiency of blood collectors. In all, 340,000 units of group AB plasma were distributed. This was an increase of 16.5% from 2011 and represents 9.7% of the plasma distributed for transfusion.

There were 7 million units of plasma distributed for further manufacture, with 98.1% from blood centers. Source plasma, (ie, plasma collected by apheresis and intended for further manufacture into derivatives), comprised only a small fraction (0.1%) of this total. Overall, this was a 14.6% decrease from 2011 levels.

Cryoprecipitate

In 2013, the average cryoprecipitated AHF pool size reported by blood collectors that distributed pools was 5.5 individual units. An estimate based on a weighted average reported pool size of the individual cryoprecipitate units distributed by each collector totaled 1,335,000 individual units distributed singly or in pools by AABB member facilities. This was a significant increase of 54.0%

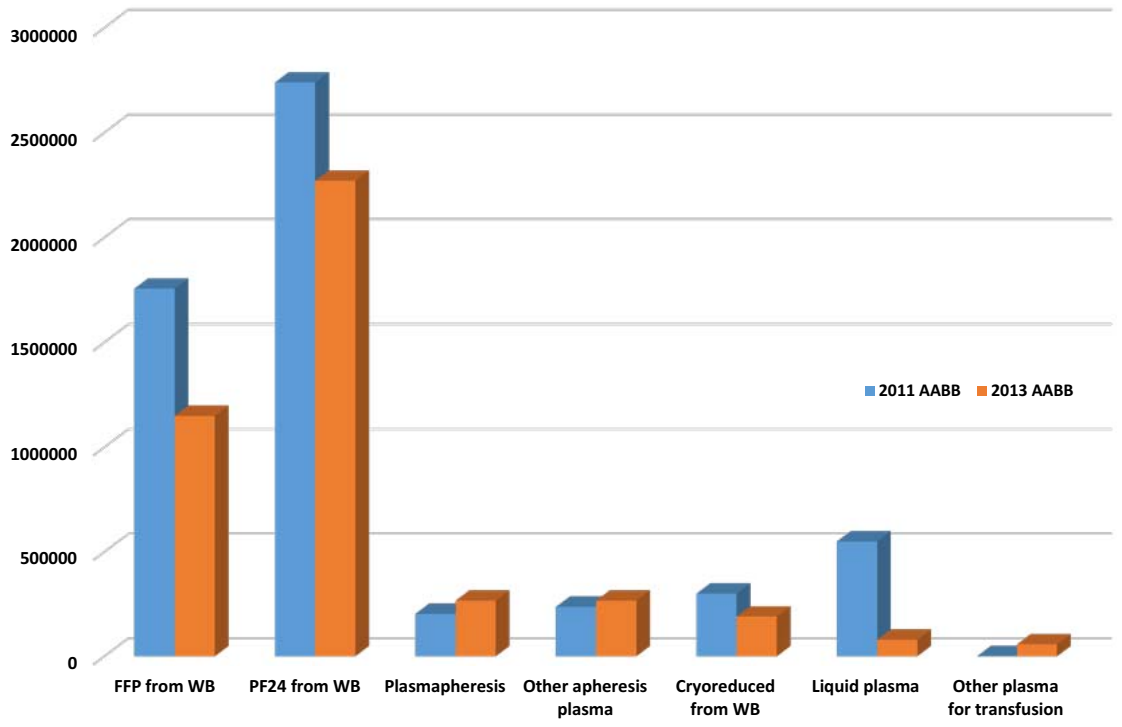

Figure 4-4. Sources of plasma for transfusion.

over that distributed in 2011 (867,000 units; $p<0.0001$).

Granulocytes

There were 1800 granulocyte units distributed; these were prepared from both apheresis and WB buffy coat units. This is a 19.7% decrease from the amount distributed in 2011. Blood centers reported 80.9% of this total.

Blood Center Inventory

In the course of deliberations on how to communicate the status of the blood supply to US Health and Human Services (HHS) during disasters, the AABB Inter-organizational Task Force on Domestic Disasters and Acts of Terrorism settled on a simple quantitative approach that reports the US blood center on-shelf blood supply in days of available supply. AABB has been collecting and reporting on supply daily for task force and HHS use. The organizations that submit data to AABB are America's Blood Centers, the American Red Cross, and Blood Centers of America. The data are aggregated and disseminated through the AABB Research Department. The first complete year for these supply estimates was 2008. **Figure 4-5** indicates the overall national days of Type O red cell supply throughout the 2013 calendar year compared with the 2011 calendar year. These availability

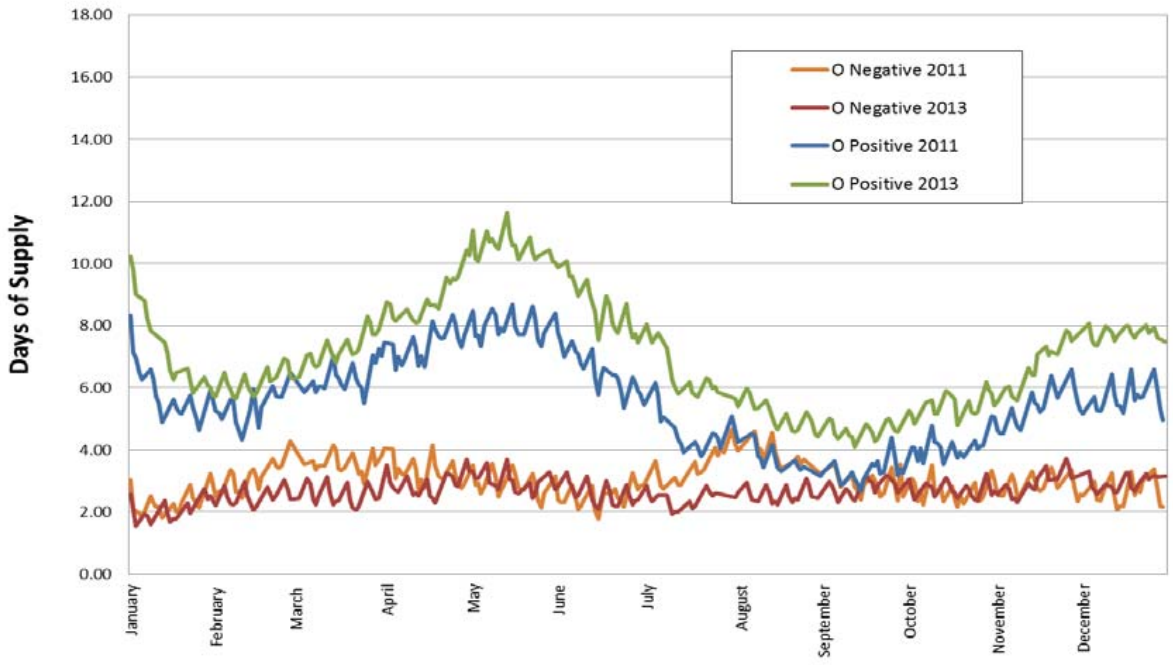

Figure 4-5. Days of Group O supply 2011 and 2013.

data do not represent possible geographic differences in availability; however, blood can be moved quickly from one location to another through various supply networks. In 2011, the available supply of O-negative units remained fairly constant; the supply of O-positive units was comparatively high for the first part of the year, then dropped mid-year and only recovered partially by year end. In 2013, available O-negative units remained fairly constant between 2 and 4 days of supply. However, the O-positive supply followed a cyclical pattern with peaks in January and May and with more robust days of available supply throughout the year than reported in 2011.

5. Blood Transfused by US-Based AABB Member Hospitals

WB and RBCs Transfused

The 2013 AABB Blood Survey collected data on transfusions performed by AABB member institutions. In this report, comparisons have been made between these 2013 data and the AABB institutional member subset of the 2011 NBCUS and as such, may not be generalizable to all US institutions involved in blood transfusion. In certain circumstances, extrapolations to the entire US hospital community are made, but these should be treated with caution as they are not made with weighted, statistically valid sampling techniques.

AABB member facility transfusions of WB and RBCs, including autologous transfusions, totaled 6,131,000 units (±312,000 units) in 2013 (**Table 4-1**). As compared to the 2011 AABB hospital cohort, this was a statistically significant 7.3% drop in WB/RBC transfusion ($p=0.036$). The number of allogeneic units transfused, including units directed to a specific patient, was 7.1% less than reported in 2011. Of the red cell units transfused among hospitals reporting transfusion totals for Group O components, 40.5% (1,125,000 units) were Group O-positive and 9.6% (266,000 units) were Group O-negative.

The number of autologous transfusions continued to decline significantly ($p<0.0001$) in 2013. There were 58.1% fewer autologous units transfused than in 2011 (13,000 units ±3000 in 2013 vs. 31,000 in 2011). Transfusion of WB, always a small contribution to the total transfusion picture, decreased by 15.4% in 2013 to approximately 13,000 units.

The use of the AABB-only hospital cohort restricts the ability to draw conclusions about the proportion of units collected that were transfused, as in previous surveys. Comparison of the raw (unweighted) data for 181 AABB hospitals reporting to both 2011 and 2013 surveys indicates a "same store" average reduction in WB/RBCs transfusion of 6.1%, a difference consistent with the overall decrease in transfusion of 7.3% described above.

Pediatric Transfusions

In 2013, transfusions to pediatric patients were assessed by asking for the total number of transfusions, including units, aliquots, and/or syringes, to the pediatric or neonatal population.* When quantities reported by AABB member hospitals in 2013 were compared to those reported by AABB member hospitals in 2011 for WB/RBCs and platelets, there

**Pediatric and neonatal populations, as defined by the institution.*

were decreases of 4.1% and 8.7%, respectively (**Table 5-1**). However, there was a 55.4% increase in the amount of plasma reported transfused to this population (87,000 transfusions in 2013) when compared to that transfused in 2011 (56,000 transfusions). Pediatric transfusions comprised 5.0% of all WB/RBC transfusions, 9.4% of all platelet transfusions, and 4.9% of all plasma transfusions in 2013.

Transfusion Recipients

The 2013 AABB Blood Survey captured the number of recipients of transfused WB/RBCs. Based on unweighted data from 316 facilities reporting numbers of transfusion recipients, there were 602,955 recipients of allogeneic WB/RBC units; these patients received 1,638,514 units, or 2.72 units per recipient, very similar to the rate of 2.75 units per recipient reported by all hospitals in 2011. Autologous recipients received an average of 1.4 units per transfusion (vs. 1.3 units in 2011). For pediatric transfusion recipients, the ratio was 3.0 units/aliquots/syringes transfused per recipient in 2013, an increase from the reported rate of 1.9 units per recipient reported by hospitals in 2011.

Non-RBC Components Transfused

AABB member hospital estimates for non-red cell components transfused in 2013 and comparisons with AABB member transfusions in 2011 are presented in **Table 4-2.**

An estimated total of 1,310,000 platelet units (±121,000) were transfused by US AABB member hospitals in 2013, a significant increase of 15.4% in comparison with transfusions by US member hospitals in 2011 [(p=0.04), **Figure 5-1**]. The transfusion of apheresis platelets increased by 12.2%, from 1,019,000 to 1,143,000 units.

In this report, as described in Chapter 4, platelets are reported using apheresis equivalents. For comparison with the transfusion of apheresis platelets, it is assumed that 5 WBD platelet concentrates are equivalent to 1 unit of apheresis platelets. There were 167,000 apheresis-equivalent units of WBD platelets (835,000 individual WBD platelets units) transfused in 2013, an increase of 30.7%. Of these WBD

Table 5-1. Pediatric Transfusions by US Blood Centers and Hospitals in 2013 (expressed in thousands of units)

	2013 AABB Hospitals	2011 AABB Hospitals	
Pediatric Transfusions	Total Number of Transfusions (units, aliquots, and/or syringes transfused)	Total Number of Transfusions (units, aliquots, and/or syringes transfused)	% Change
WB/RBCs	306	319	–4.1
Platelets	105	115	–8.7
Plasma	87	56	55.4

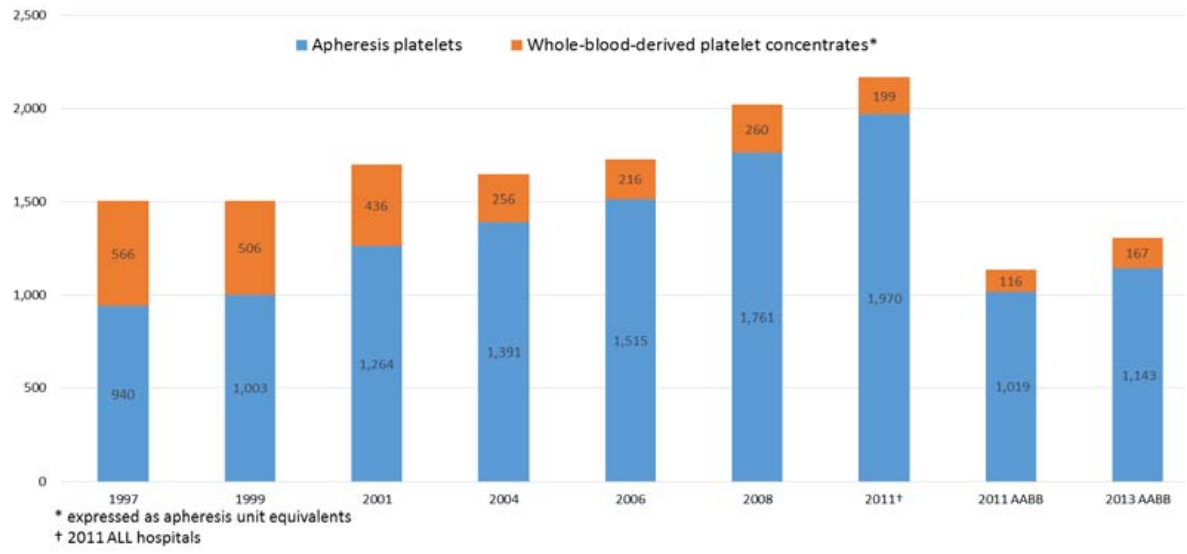

Figure 5-1. Trends in platelet transfusion, 1997-2013.

units, 74,000 platelet concentrates were transfused as individual units and 761,000 platelet concentrates were transfused in pools. There was a change in the ratio of apheresis concentrates to WBD platelet concentrates from 8.8 apheresis units transfused for every pool of WBD concentrates in 2011 to 6.8 apheresis units for every pool of WBD platelets in 2013.

There were approximately 819,000 WBD platelet concentrates (164,000 apheresis equivalents) distributed and 835,000 reported (167,000 apheresis equivalents) transfused by AABB hospitals. While this overall minor discrepancy is within the range of reporting error for a survey this size, a further concern relates to the fact that responding AABB hospitals represent approximately 48% of all transfusing US hospitals; thus the number of transfused WBD platelets substantially exceeds that to be expected from AABB member hospitals. In contrast, the proportion of distributed apheresis platelets transfused by AABB member hospitals is much lower (57.1%) and more in keeping with expectations. These WBD platelet findings were confirmed during the data cleaning process and may have one of two explanations: there was an unequal representation of those that transfused WBD platelets among the reporting AABB hospitals; or there were inaccuracies in tabulating and/or reporting WBD platelet transfusions due to confusion between the use of individual and pooled concentrates. Of interest, a similar proportional discrepancy was reported for cryoprecipitated AHF (which also may be transfused as individual units or in pools) in that AABB member hospitals transfused a disproportionally high percentage (80%) of distributed units.

The combined total of WBD and apheresis plasma transfused in AABB member

hospitals was 1,797,000 units (±129,000), significantly less (9.9%, p=0.04) than the amount transfused in 2011 (1,995,000 units). Reporting institutions indicated the amounts of the various types of plasma transfused as shown in **Figure 5-2**. There was a marked increase in the transfusion of liquid plasma among AABB member hospitals. There were 24,000 units of liquid plasma transfused, compared with only 2000 units of liquid plasma reported transfused in 2011.

Hospitals were asked a separate question about the percentage of plasma issued as Thawed Plasma. Thawed Plasma is derived from FFP or PF24 and thawed at 30° C to 37° C, then maintained until transfusion at 1° C to 6° C for up to 5 days. The average percentage of plasma issued as thawed among member hospitals was 53.0% compared with 24.5% in AABB member hospitals in 2011. The average percentage of plasma issues as Thawed Plasma was positively associated with the annual number of surgeries. (**Figure 5-3**).

Of all plasma transfused, 71,000 units of Group AB plasma were reported transfused in 2013. This is a 9.2% increase over that transfused by AABB hospitals in 2011 (65,000 units) and represents approximately 10.5% of plasma transfused for those facilities that reported both amounts of AB plasma and all plasma transfused.

When asked how institutions routinely order plasma transfusions to non-pediatric patients, most transfusing facilities (56.3%) reported routinely

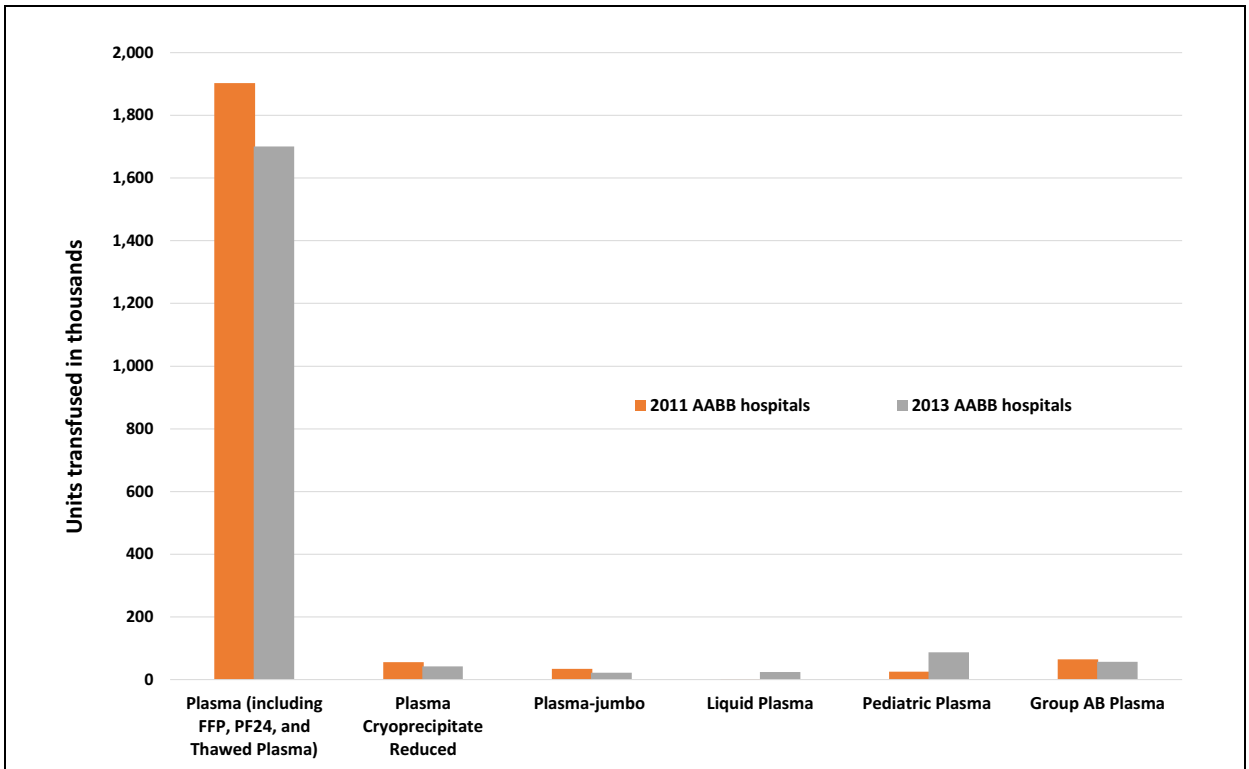

Figure 5-2. Types of plasma transfused in 2011-2013.

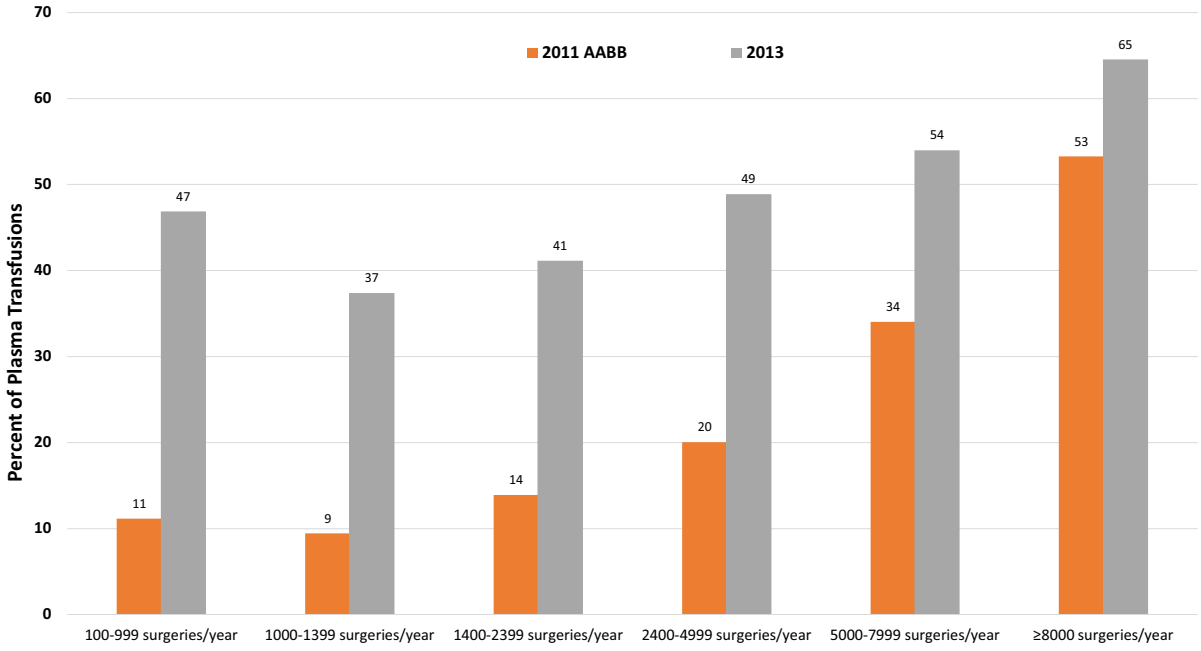

Figure 5-3. Percent of plasma transfused as thawed plasma (2013 average 53%).

transfusing plasma based on perceived level of coagulation factor deficiency or degree of bleeding (compared to 62.0% in 2011). In 5.7% of the transfusing facilities, the dosage was based on patient weight (6.6% reported used this methodology in 2011). Other facilities reported transfusing a standard number of units regardless of the patient's weight (11.3% vs. 12.4% in 2011) and 26.7% reported that the number of units transfused was not consistent with any of the above (10.0% in 2011).

There were approximately 1,054,000 units or unit equivalents of cryoprecipitated AHF transfused in 2013. This is a large and significant increase (66.2%) over the amount transfused in 2011 (634,000 units). Of the total, 164,000 units of cryoprecipitate was transfused as individual concentrates and 890,000 cryoprecipitate concentrates were made into pools and transfused as such.

Among the reasons reported for the large increases in WBD platelet and cryoprecipitate transfusion are the addition of critical care beds, acquisition of other facilities, increases in liver and solid organ transplants, and the impact of massive transfusion protocols.

Transfusion of granulocytes, prepared from both apheresis and WB buffy coat units, decreased by 3.7%, from 2062 units in 2011 to 1985 units in 2013. However, because these numbers are so small, estimates should not be regarded as completely reliable, as illustrated by the data indicating that more units were transfused (1985 units) than were distributed (1800 units).

A total of approximately 20,000 specialized products (HLA matched or

crossmatched) were transfused to alloimmunized patients in 2013.

The total number of units of all components transfused by AABB member institutions in the United States in 2013, both RBC and non-RBC components, was 10,962,000, a 1.1% increase over the AABB member transfusions (10,846,000 units or unit equivalents) from 2011.* This increase was predominantly due to the changes in transfusion of WBD platelets and cryoprecipitate.

Outdated Units

The AABB member estimate for the total number of units of WB and all components outdated by blood centers and hospitals in 2013 was 932,000 units. Outdated WB and RBCs totaled 421,000 units (±14,000 units). This included autologous and allogeneic RBCs as well as WB distributed for transfusion.

**The total transfusions are from 2011 AABB facilities. The total units include WB/RBCs, WBD platelets, apheresis platelets, plasma, cryoprecipitated AHF, and granulocytes.*

There were 18,000 autologous units outdated in 2013 (32.7% of AABB member autologous collections), compared to 20.5% in 2011. In addition, AABB hospitals reported 2000 autologous units as wasted.

A much smaller amount of WB for transfusion as WB was distributed in 2013 compared with 2011. Approximately 12.0% of 6400 WB units distributed were outdated (11.8% in 2011).

Approximately 3.1% of allogeneic red cell donations were reported as outdated in 2013, compared to 1.7% in 2011. As shown in **Table 5-2**, outdated WB/RBCs accounted for 3.4% of all WB/RBC units distributed in 2013. An additional 695,000 units were reported wasted or discarded for non-test result-related reasons.

As in 2011, the current survey inquired about outdates of Group O-positive and O-negative RBC units (**Figure 5-4**). In 2013, they accounted for 16.5% of the total outdated allogeneic RBCs (14.2% O-positive, 2.3% O-negative), higher than 11.3 % in 2011 (AABB facilities). While 3.1% of all allogeneic red cells were outdated, of the Group O-positive units distributed, only 1.1% were outdated and of the Group O-negative units distributed, only 0.7% were outdated.

There were 220,000 apheresis platelets units outdated in 2013. Of the apheresis platelets distributed, 11.0% were outdated compared to the 11.5% outdated in 2011. There were 16,000 units reported wasted or discarded for non-test result-related reasons.

WBD platelet concentrates accounted for 20.8% of total outdated components, or 194,000 units. This represents 23.7% of the WBD platelets distributed in 2013, whereas in 2011, 34.7% of WBD platelets that were distributed were subsequently outdated. In addition to outdates, 2.8% (23,000 units) of distributed WBD platelets were reported as wasted, with the reasons given as breakage, out of temperature, and non-outdated units that could not be transfused.

Due to their limited shelf-life, apheresis platelets and WBD platelets accounted for nearly 44.4% of outdated units in 2013.

Outdated plasma of all types totaled 62,000 units, 1.8% of the plasma units

Table 5-2. Outdated Components as a Percentage of the Total Number of Units of Each Component Distributed for Transfusion in 2013

	WB/RBCs	Apheresis Platelets	WB-Derived Platelets Concentrates (both individual concentrates and pools)	Plasma	Cryoprecipitate (both individual concentrates and pools)	Granulocytes
Outdated Total	421,000	220,000	194,000	62,000	35,000	74
Distributed	12,383,000	2,002,000	819,000	3,488,000	1,335,000	2,000
Overall Percentage Outdated	3.4	11.0	23.7	1.8	2.6	3.7
Reported Wasted*	695,000	16,000	23,000	47,000	67,000	39
Transfused†	6,131,000	1,143,000	835,000	1,797,000	1,054,000	2,000

*Blood centers and AABB member hospitals included.
†AABB member hospitals only.

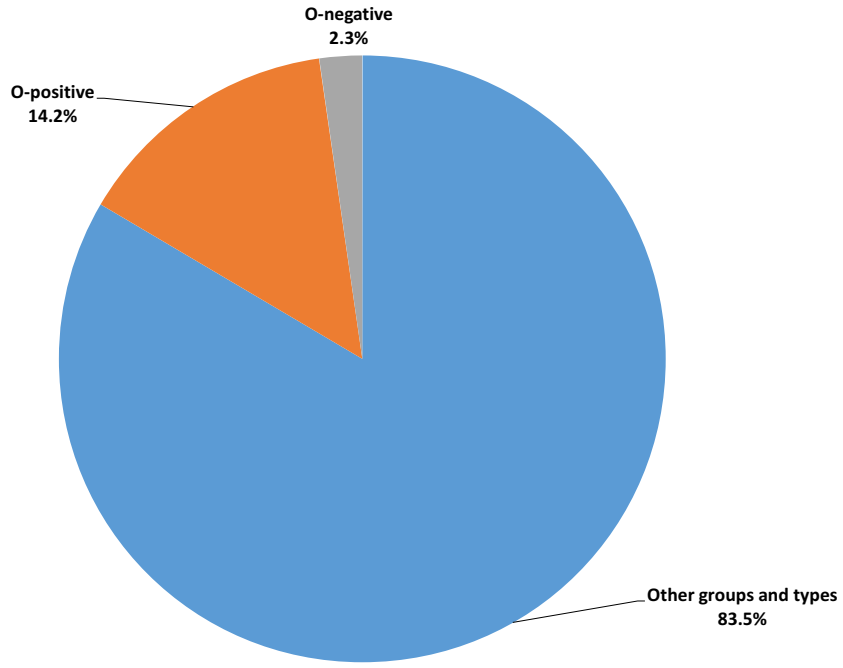

Figure 5-4. Percentage of Group O allogeneic RBC outdates.

distributed for transfusion. This was 6.7% of total outdates. There were 47,000 units reported wasted or discarded.

There were 35,000 units of cryoprecipitated AHF that were outdated, 2.6% of the cryoprecipitated AHF distributed. An additional 5.0% (67,000 units) were reported wasted.

Lastly, 3.7% of granulocytes distributed were outdated. Some components were included in both the outdated and wasted totals; therefore, it may appear that more products were available than were reported distributed.

6. Patient Blood Management (PBM) in AABB Member Facilities

This is the second survey of PBM activities by hospitals and blood centers. A PBM section was included as Chapter 5 of the 2011 NBCUS report. Data were not weighted or imputed and are summarized here as reported. Denominators reflect the number of facilities that answered each of the questions.

This report reflects changes in the field of transfusion since 2011 among AABB member hospitals. PBM is an evidence-based, multidisciplinary approach to optimizing the care of patients who might need a blood transfusion. It encompasses all aspects of patient evaluation and clinical management surrounding the transfusion decision-making process, including the application of appropriate transfusion indications, as well as minimization of blood loss and optimization of patient red cell mass. As a consequence of better management, patients may require fewer blood transfusions, potentially avoiding transfusion-associated complications and reducing health care costs, while ensuring that blood components are available for the patients who need them. The questions in the PBM section of the AABB Blood Survey were designed to build on the 2011 NBCUS questions and address current topics of interest.

In 2013, 607 US AABB member institutions responded to the initial survey question that asks whether the facility had a PBM program in 2013, 547 (90.1%) were hospitals. Of the hospitals that responded to the question of whether their institution had a PBM program in 2013, 37.8% responded affirmatively.

In addition, six non-US AABB member hospitals reported having PBM programs. Eight other non-US facilities provided responses to some of the questions in the PBM section. Their detailed results are not included here.

In 2011, 591 AABB member facilities, including 529 (89.5%) hospitals, responded to the initial survey question that asks whether the facility had a PBM program in 2011. In both surveys, many facilities that did not report having a PBM program provided responses to some of the questions in the PBM section.

Many combinations of medical professionals were reported to coordinate PBM programs. In 2013, the majority of PBM programs (90.8%) were coordinated by a medical director alone or as part of a team.* The medical specialty of these directors was most often reported to be pathology (33.5%), transfusion medicine (7.4%), and anesthesiology (13.8%). Other

**Of hospitals responding to this question.*

specialties coordinating PBM programs included surgery, hematology, and in a few facilities, the hospital's chief medical officer. A total of 27.1% of hospitals with PBM programs reported nursing staff involvement in the coordination of the program, and 42.0% reported involvement of other non-nursing staff including blood bank staff, risk management staff, health care improvement staff, transfusion committees, blood utilization committees, quality assurance, and patient safety officers.

There were 74 AABB member hospitals (13.5% of all reporting hospitals) that reported having transfusion safety officers (TSOs); of these, 51.4% reported a PBM program in 2013. Most hospitals (35.1%) with TSOs reported having one full-time TSO on staff and another 55.4% reported having at least one part-time TSO. More hospitals reported that TSOs were hospital employees (57.4%) than blood center employees.

There were 55 hospitals (10.1% of all reporting hospitals) that reported having a PBM coordinator (PBMC); of these, 86.6% reported having a PBM program. Of hospitals with PBMC staff, 30.9% reported a single PBMC on staff, another 52.7% reported at least one part-time PBMC. All hospitals with PBMCs reported them to be hospital employees.

In 2013, 41.9% of responding hospitals reported participating in performance benchmarking programs relating to transfusion medicine (43.7% in 2011).*

Sixty-six percent of hospitals reported providing formal transfusion training and/or education to their staff, compared to the 70.1% reported in 2011. This training was required for anesthesiologists and other physicians who transfuse blood at 37.5% of these facilities. Of hospitals reporting PBM programs in 2013, 42.0% provided formal PBM training to physicians and 39.6% provided training to nurses.

The use of transfusion guidelines was reported by 78.2% of reporting hospitals. This was a significant decline from the number reported in 2011 (92.8%; $p<0.001$). Of the hospitals using transfusion guidelines, 89.5% reported using one or more of the national guidelines (**Figure 6-1**), with hospitals reporting the use of guidelines from AABB (76.4%), College of American Pathologists (29.2%), American Society of Anesthesiologists (2.8%), American Red Cross (8.6%), and others (17.7%). Other guidelines used included recommendations from the US Food and Drug Administration (FDA), the National Institutes of Health (NIH), The Joint Commission, the New York State Department of Health, internal transfusion committees, and/or multiple sources of evidence-based practice literature.

Of the institutions with transfusion guidelines, 77.5% reported that their hospital guidelines had been incorporated into paper or electronic order-sets. Sixty-five percent reported that their computerized physician order entry (CPOE) included transfusion guidelines. Of these, 53.8% have guidelines that are a "hard stop," where the physician/provider must select a choice before the order is accepted. Only 45.9% of these hospital CPOE systems included an algorithm or clinical decision support that warns or alerts the physician/provider if they are ordering a blood product outside of guidelines.

**Of hospitals responding to this question.*

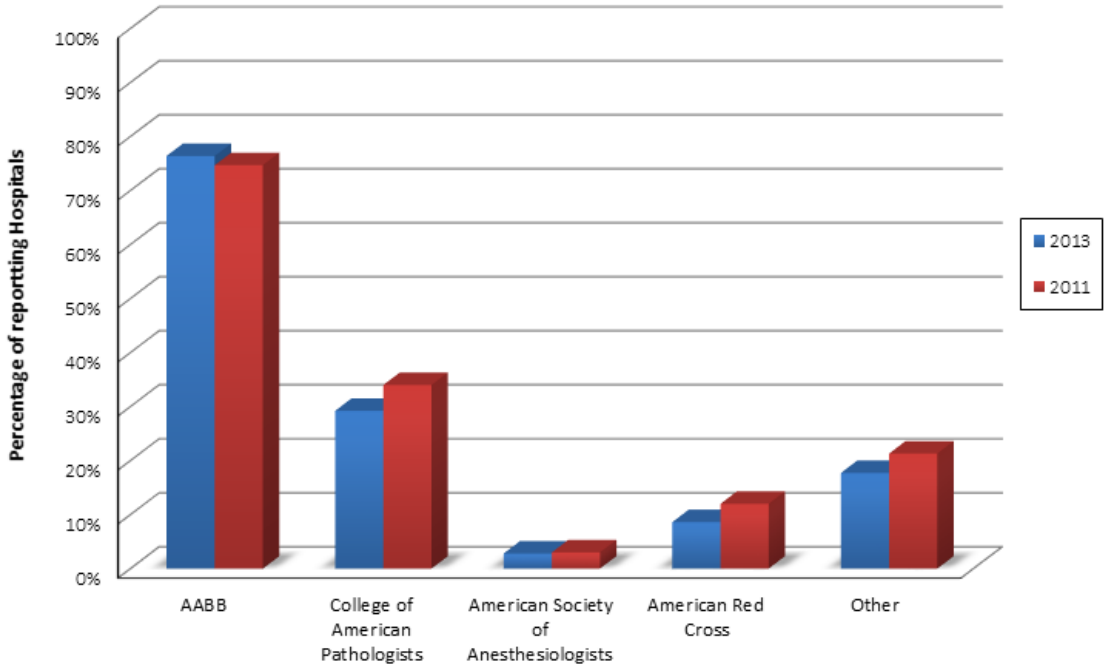

Figure 6-1. Use of national transfusion guidelines, 2011-2013.

Most reporting hospitals (71.9%) required that a physician document the reason or clinical justification for transfusion in the medical record based on guidelines developed by the hospital transfusion or quality committee. As compared to 2011, in 2013 fewer hospitals (52.8% vs. 68.5%) required that relevant pre-transfusion laboratory results be documented for non-emergent transfusions. Fifty-two percent of hospitals reported promoting the use of single RBC transfusion orders in 2013.

In 2013, only 28.4% of hospitals reported the evaluation of factors predictive of pre- and postoperative anemia for patients facing elective surgical procedures associated with a high likelihood of blood loss, a drop of 35.2% from that reported in 2011 (63.6%). Twelve percent of hospitals reported evaluating all of these patients and 16.9% reported such evaluations for only some types of surgery (eg, cardiac). Of the hospitals conducting these evaluations, 34.3% reported having a program or formal service in place to manage a patient's anemia before surgery.

PBM Interventions

Many hospitals, both those with and without PBM programs, have formally implemented interventions to reduce the need for transfusion. In 2013, 199 AABB member hospitals reported implementation of at least one preoperative intervention. The specific interventions are displayed in **Figure 6-2**. Laboratory assessment for anemia was

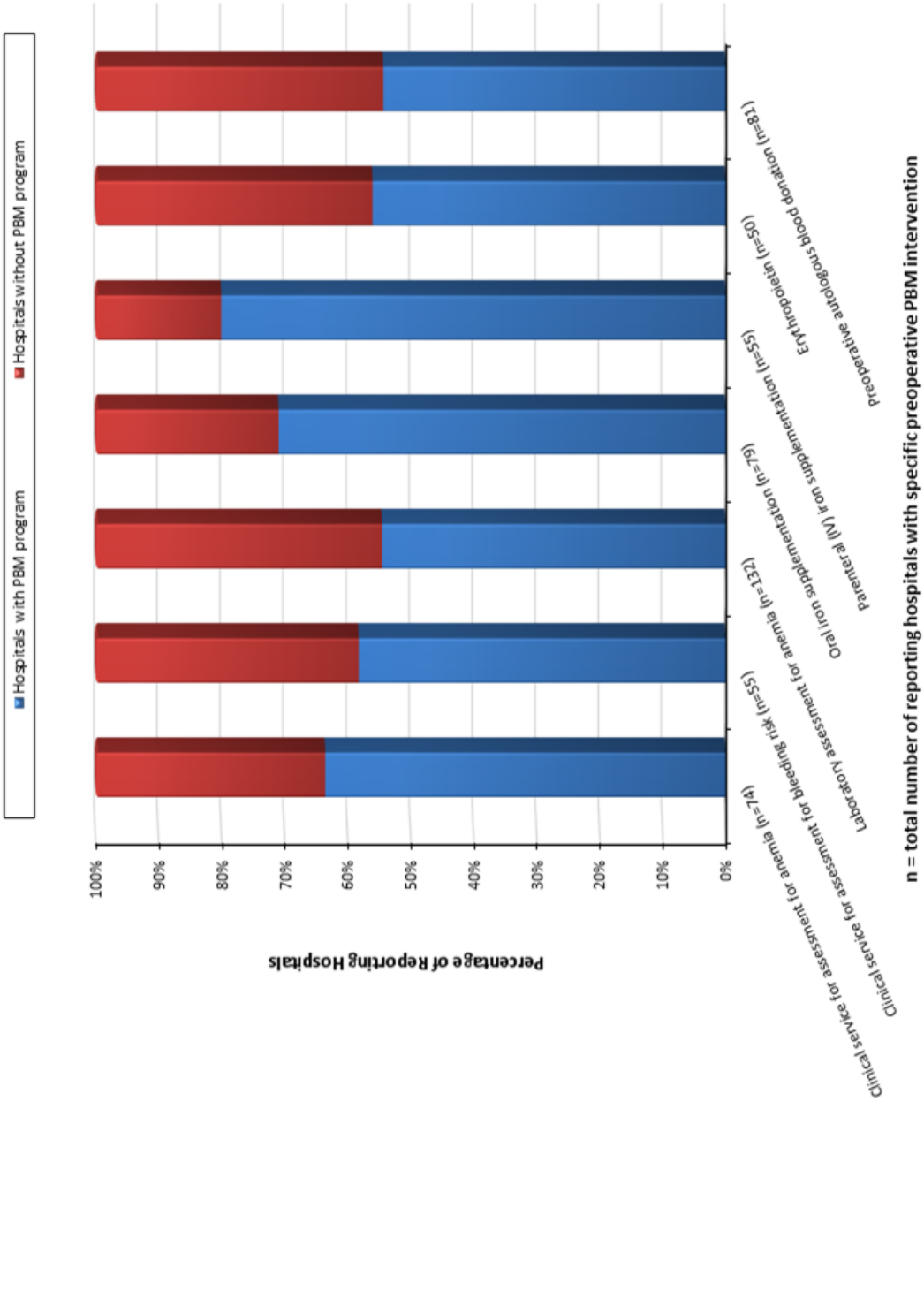

Figure 6-2. Preoperative PBM interventions implemented, 2013 (n=199).

the most common intervention reported by 66.3% of hospitals, and of these 54.5 % were hospitals that had a PBM program. Other preoperative interventions implemented included the use of the clinical service for assessment for anemia (37.2% of those reporting preoperative interventions), the use of the clinical service for assessment for bleeding risk (27.6% of those reporting preoperative interventions, 58.2% of which also reported having a PBM program), oral iron supplementation (39.7% of those reporting preoperative interventions, 70.9% of which also reported a PBM program), parenteral (IV) iron supplementation (27.6% of hospitals reporting preoperative interventions), erythropoietin administration (25.1% of those reporting preoperative interventions) and preoperative autologous blood donation (40.7% of those reporting preoperative interventions, 54.3% of these also reported having a PBM program).

As shown in **Figure 6-3**, 226 hospitals reported implementation of intraoperative interventions in 2013. Of these, the majority had implemented intraoperative blood recovery (n=206 or 91.2%), 55.3% of which did not report having a PBM program. Among the 67 hospitals (29.6%) reporting implementation of acute normovolemic hemodilution, 52.2% did not have a PBM program in place. Use of topical/systemic hemostatic agents was reported by 108 hospitals (47.8%) and 50.9% of them reported having a PBM program.

In 2013, 203 hospitals reported the use of postoperative interventions. **Figure 6-4** shows that the most common postoperative

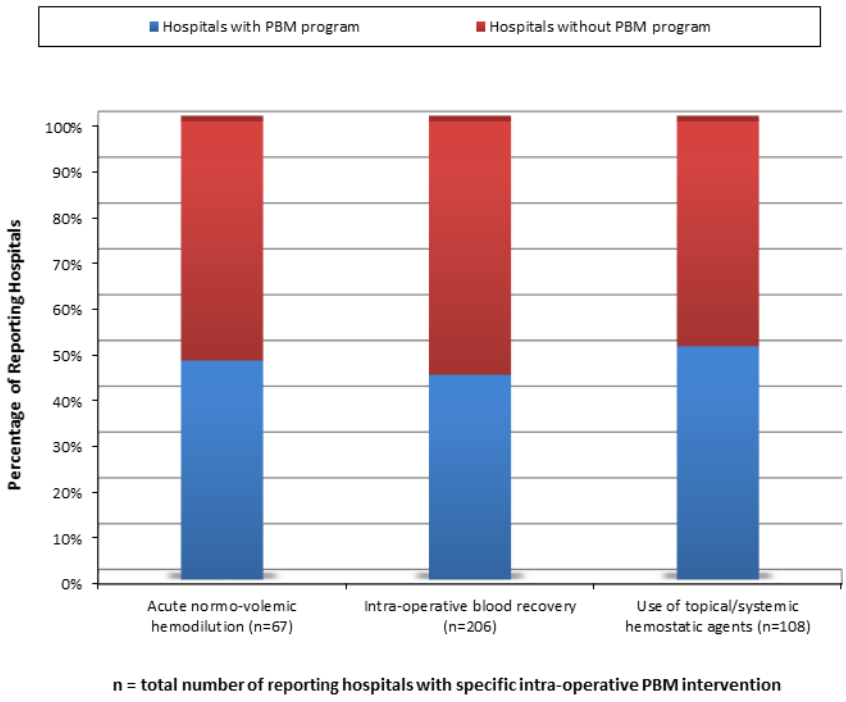

Figure 6-3. Intra-operative PBM interventions implemented, 2013 (n=226).

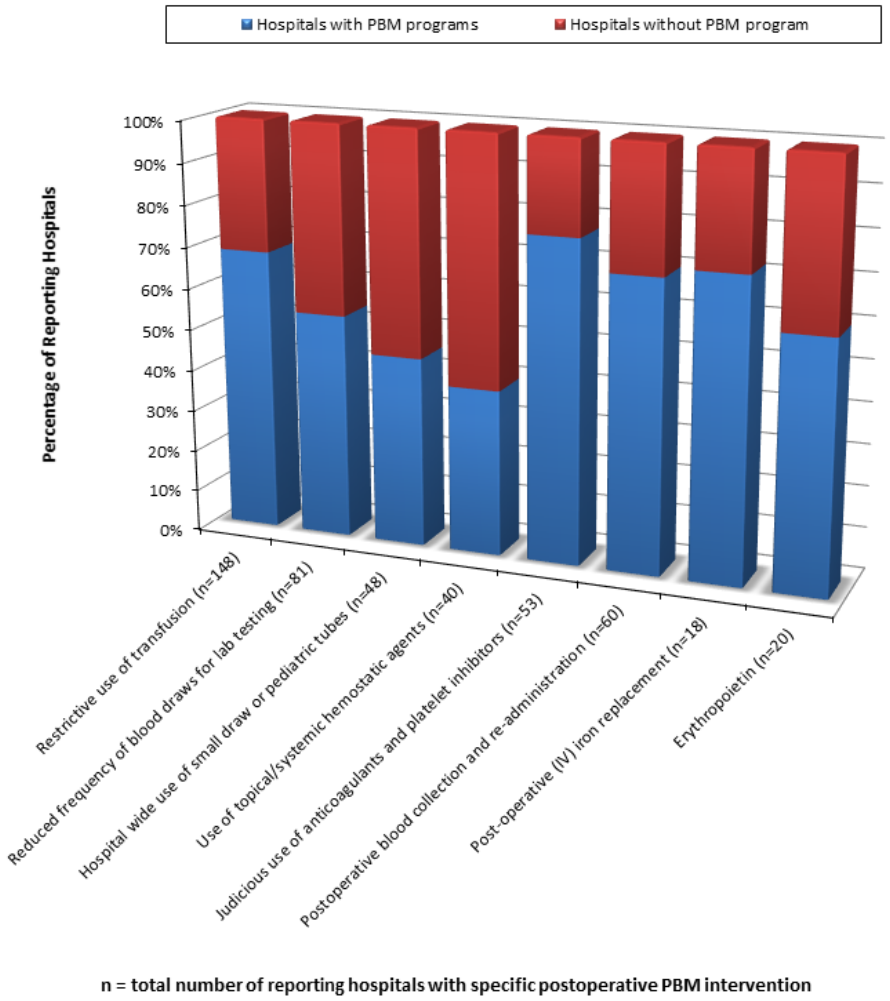

Figure 6-4. Postoperative PBM interventions implemented, 2013 (n=203).

intervention reported was the restrictive use of postoperative transfusion (72.9% or 148 of 203 respondents); 68.2% of these hospitals reported having a PBM program. Other postoperative interventions frequently reported by hospitals included the reduction in the frequency of blood draws for lab testing (39.9% of hospitals reporting postoperative interventions) and postoperative blood collection (eg, from chest tubes) and re-administration (29.6% of those reporting postoperative PBM activities).

Measure of Intervention Success

Fifty-six percent of hospitals that completed some or all of the PBM questions provided information on the metrics used by their institution to measure the success of interventions intended to improve PBM **(Figure 6-5)**. The two most common measures (which are similar) reported by hospitals in 2013 were total RBCs, platelets, and plasma transfused (71.5%) and the total number of components transfused (57.3%); the latter was the most common measure reported by hospitals in 2011. Other

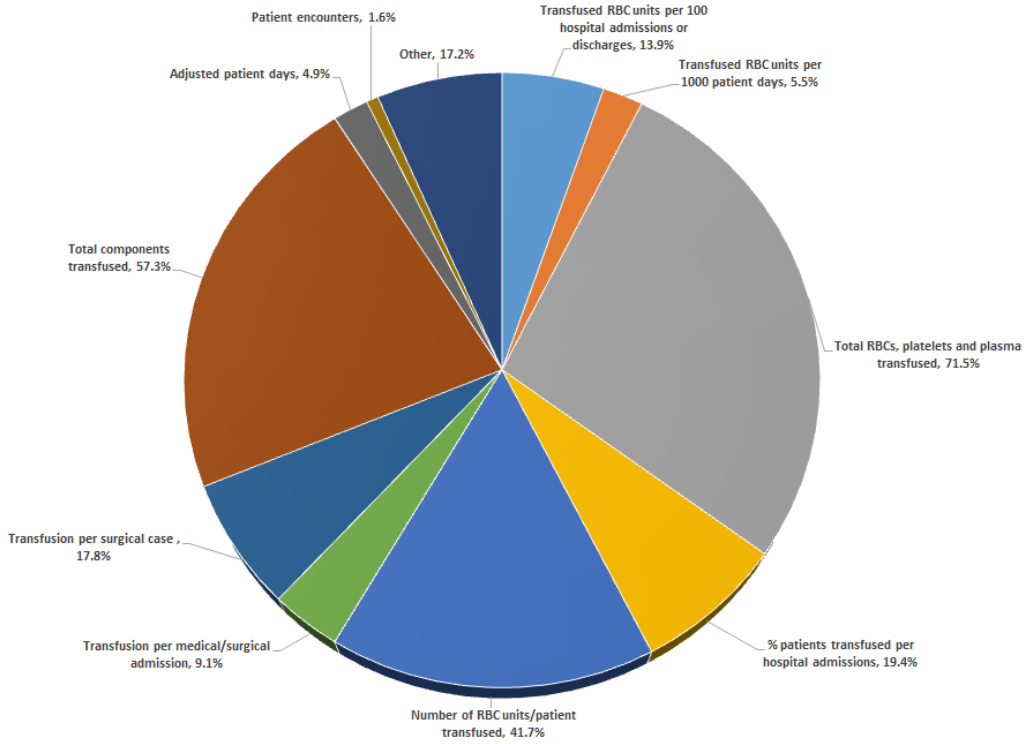

Figure 6-5. Methods hospitals use to measure the success of implementations to improve PBM.

measures were the number of RBC units per patient transfused (41.7%), and the percentage of patients transfused per hospital admission (19.4%).

All other measures were reported to be used by 17.8% or fewer hospitals. These included transfusions per surgical case (17.8%), transfused RBC units per 100 hospital admissions or discharges (13.9%), transfusions per medical/surgical admission (9.1%, but previously reported by 23.3% of facilities in 2011), transfused RBC units per 1000 patient-days (5.5%), adjusted patient-days (4.9%), and patient encounters (1.6%). Measures reported in the "Other" category (17.2%), included the crossmatch-to-transfusion ratio; reviews of clinical waste, blood utilization, and other audits; the percentage of patients transfused per selected ICD-9 code (ie, coronary artery bypass graft [CABG] only or knee/hip replacement); average blood components use per case (CABG only); and percentage of transfusions that were deemed inappropriate.

Informed Consent

Most AABB member hospitals required the ordering provider to obtain and document informed consent for transfusion in 2013 (91.4%). Among the hospitals requiring transfusion informed consent, 86.6% have a separate consent form for transfusion. Of these, 63.5% of hospitals reported that both the physician and patient sign the informed consent, whereas 24.2% reported that the informed consent form was signed by the patient/representative only. A very small

number of hospitals (2.8%) reported that only the physician signs the transfusion consent form.

Type and Screen before Procedures

In 2013, 82.9% of responding hospitals reported that they did not track the percentage of "Type and Screens" that were completed before the start of a surgical procedure. Of the 86 hospitals that reported tracking that Type and Screens were completed prior to surgery, most (n=72) tracked all surgical cases and fewer tracked selected high-blood loss surgical cases (n=14). Among those hospitals that did track this factor, two thirds of the hospitals had over 80 percent of patients with a Type and Screen on record before a surgical procedure.

Transfusion Thresholds

Hemoglobin

For the 2013 survey year, questions were added to evaluate policies for the use of hemoglobin, platelet, International Normalized Ratio (INR)/Partial thromboplastin time (PTT), and fibrinogen thresholds for determining when to transfuse blood products. Although many hospitals did not report having a PBM program, 75.3% of hospitals responding to this part of the survey reported having a policy for a hemoglobin threshold for transfusion for hemodynamically stable, non-bleeding patients. **Figure 6-6** displays the AABB member survey responses when asked about specific aspects of their hemoglobin threshold policy. Of the 341 hospitals that reported thresholds for the general inpatient population, 55.1% reported a policy to transfuse at a threshold of between 7 and 8 g of hemoglobin per dL of blood. Among 282 hospitals reporting thresholds for surgical (postoperative) patients, 50.7% reported that their policy was to transfuse at a threshold of between 8 and 9 g/dL. Of the 270 hospitals that reported thresholds for the intensive care unit (ICU) patient populations (exclusive of acute coronary syndrome), 47.7% reported a policy to transfuse between 7 and 8 g/dL; another 40.0% reported that their policy was to transfuse between 8 and 9 g/dL. A total of 274 hospitals reported hemoglobin threshold policies for patients with acute coronary syndrome; 45.3% reported a policy to transfuse between 8 and 9 g/dL and 41.6% reported policies to transfuse at more than 9 g/dL. Of 272 hospitals reporting hemoglobin transfusion thresholds for the general outpatient population/clinic, most policies were to transfuse at a hemoglobin rate between 8 and 9 g/dL (46.3%) or between 7 and 8 g/dL (44.1%).

Platelets

Of hospitals that responded to questions about platelet transfusion thresholds, 73.1% reported having policies for platelet transfusion thresholds. **Table 6-1** displays the AABB member survey responses when asked about platelet transfusion thresholds for specific patient populations. Among the 314 hospitals that reported thresholds for the general, non-bleeding inpatient population, 62.4% of hospitals reported a policy to transfuse platelets at thresholds between 5000 and 10,000 per microliter (mcL) (n=196). Of the 179 hospitals that reported their thresholds for inpatients with fever, 61.5% reported a policy to transfuse at a threshold between 11,000 and 20,000 per mcL (n=110). Of the 151 hospitals that

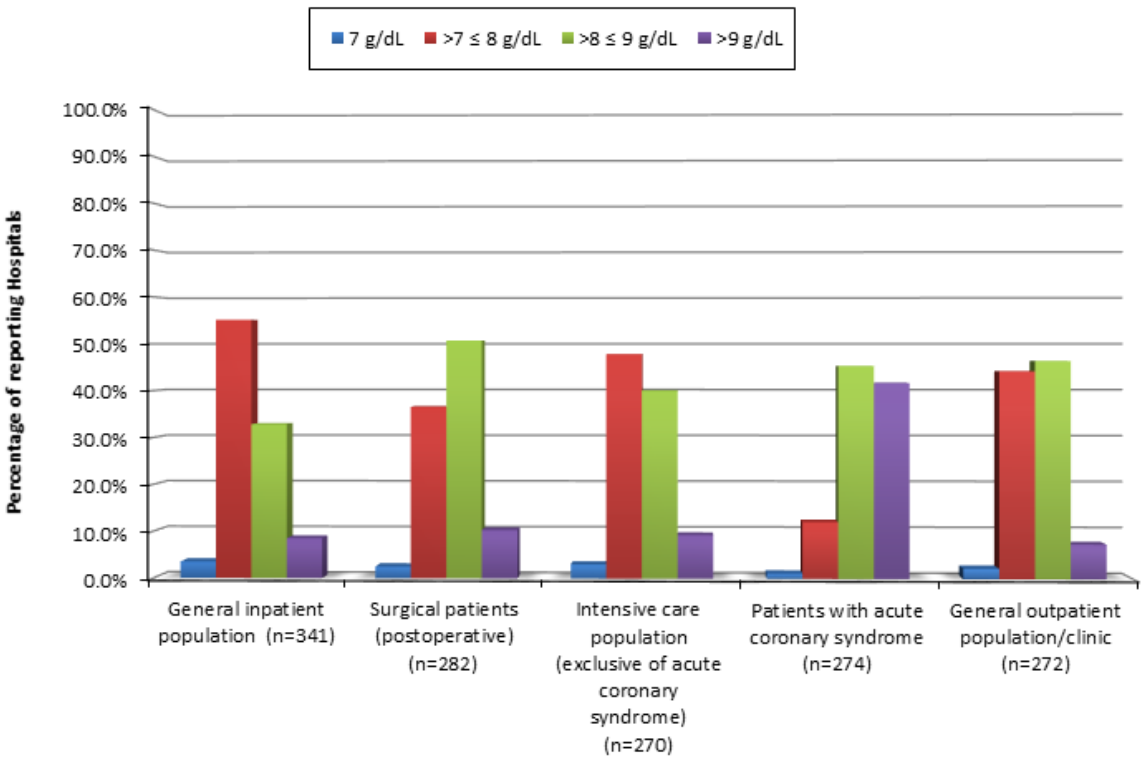

Figure 6-6. Reporting hospitals policy for a hemoglobin threshold for transfusion for hemodynamically stable non-bleeding patients.

reported on inpatients receiving anticoagulants, 51.7% reported transfusion thresholds between 11,000 and 20,000 per mcL (n=78). Of hospitals that reported thresholds for patients with planned bedside invasive procedures (eg, line placement, [n=265]), 81.9% transfuse platelets at thresholds between 21,000 and 50,000 per mcL (n=217). Of the 309 hospitals that reported thresholds for patients with planned operating room (OR) procedures (eg, major surgery), 69.6% reported a policy to transfuse platelets at a threshold between 21,000 and 50,000 per mcL (n=215). Of 268 hospitals reporting thresholds for bleeding patients, 72.4% reported a policy to transfuse platelets at a threshold of 21,000 to 50,000 per mcL (n=194). Among the 224 hospitals that reported thresholds for patients with central nervous system (CNS) bleeding, 73.7% reported a policy to transfuse platelets at thresholds of 80,000 per mcL or greater (n=165). Only 98 hospitals reported thresholds for bleeding patients who had been receiving antiplatelet medication. Of these, 62.2% reported thresholds of 21,000 to 50,000 per mcL (n=61).

Plasma

Of hospitals that responded to questions about plasma transfusion thresholds, 63.6% reported having an INR/PTT threshold policy for the transfusion of plasma. **Figure 6-7** presents the AABB member survey responses when asked

Table 6-1. Reporting Hospitals Policy for Platelet Threshold for Transfusion

	# Hospitals Responding					
	(<5000/mcL)	(5000 - 10,000 /mcL)	(11,000 - 20,000/ mcL)	(21,000 - 50,000 /mcL)	(51,000 - 80,000/mcL)	(>80,000/mcL)
Platelet threshold for transfusion	N	N	N	N	N	N
General, non-bleeding inpatient population	2	196	94	22	–	–
Inpatient with fever	–	53	110	16	–	–
Inpatient receiving anticoagulant	–	40	78	27	6	–
Patient with planned bedside invasive procedure	–	23	16	217	9	–
Patient with planned OR procedure	–	21	12	215	14	47
Bleeding patient	1	9	35	194	7	22
Patient with CNS bleeding	1	6	7	43	2	165
Bleeding patient who has been receiving antiplatelet medication	–	8	9	61	2	18

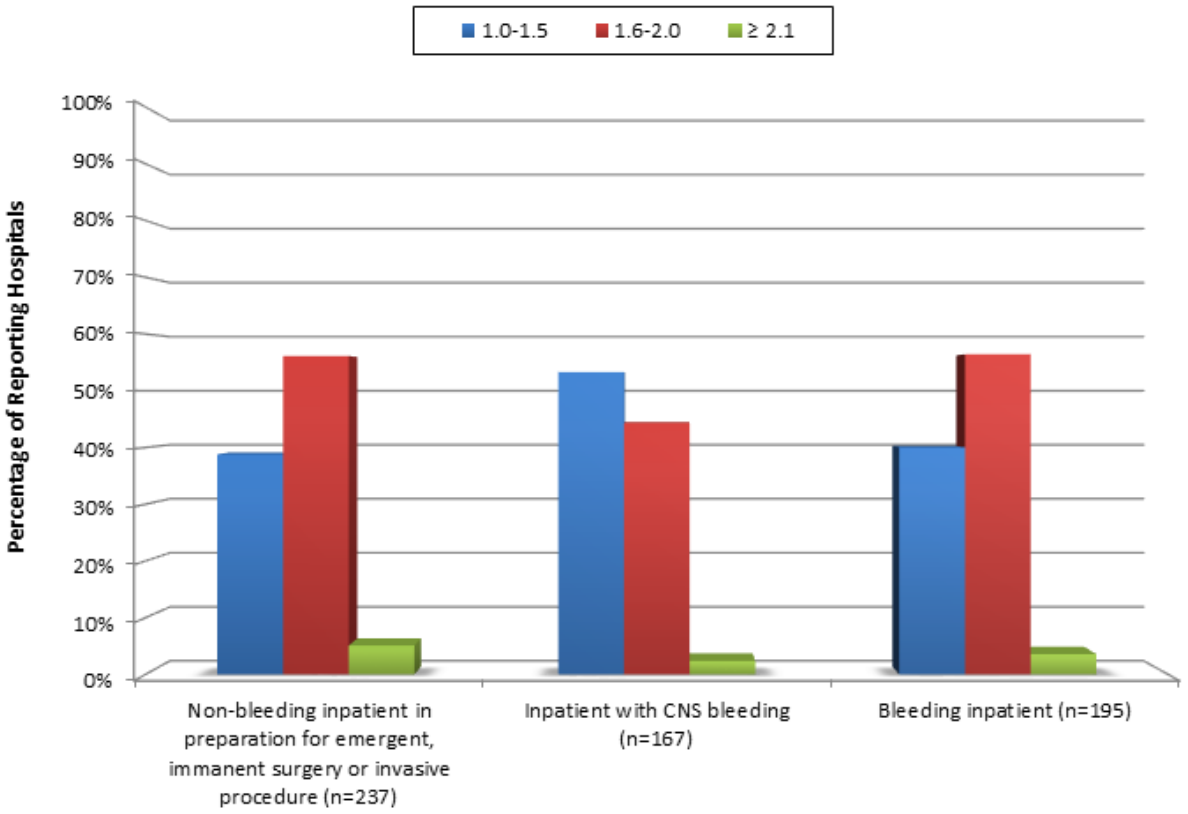

Figure 6-7. INR threshold for transfusion of plasma.

about specific aspects of their plasma transfusion thresholds. Of the 237 hospitals that reported thresholds for plasma transfusion to the non-bleeding inpatient population in preparation for emergent, imminent surgery or an invasive procedure, 56.1% reported a policy to transfuse plasma at an INR of 1.6 to 2.0 and 38.8% reported a policy to transfuse plasma at an INR of 1.0 to 1.5. Among the 167 hospitals that reported thresholds for inpatients with CNS bleeding, 53.3% reported a policy to transfuse plasma at an INR of 1.0 to 1.5 and 44.3% reported they transfuse plasma at an INR of 1.6 to 2.0. Of the 195 hospitals who reported thresholds for plasma transfusion for bleeding patients, 56.4% reported a policy to transfuse plasma at an INR of 1.6 to 2.0 and 40.0% reported that they transfuse plasma at an INR of 1.0 to 1.5.

PTT thresholds for bleeding patients are shown in **Figure 6-8**. Of the 174 hospitals that reported PTT thresholds, 27.6% reported that they transfuse plasma at a PPT of 30 seconds or less and 25.3% reported transfusion of plasma when the PTT is between 41 and 50 seconds. PTT normal values differ from lab to lab and often are considered not in seconds but as a ratio of patient to control value (with abnormal being defined as >1.5 times the control value).

When asked about policies for transfusion of cryoprecipitate, 57.5% of hospitals

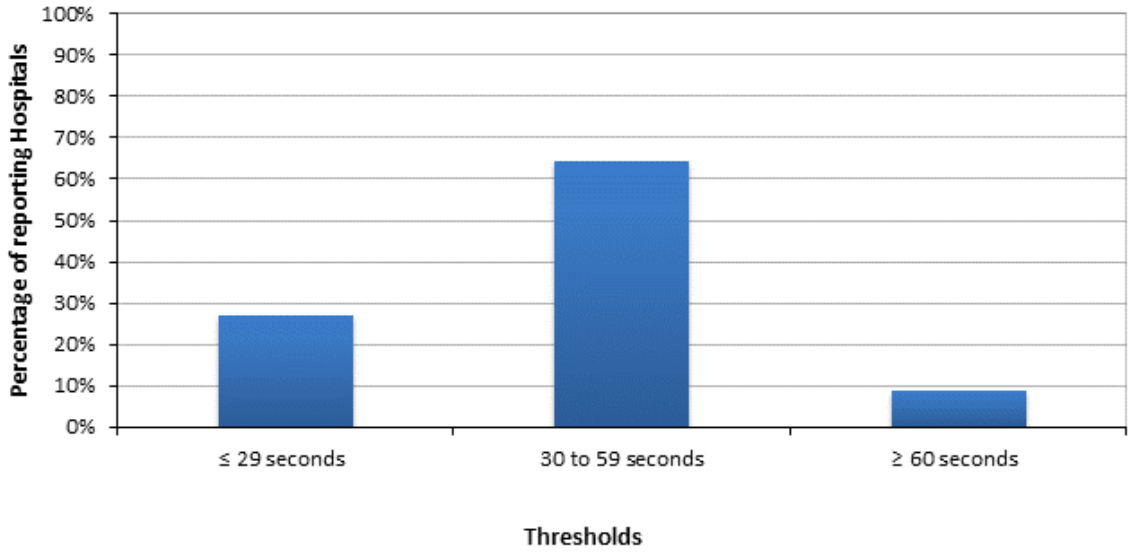

Figure 6-8. Reported PTT threshold for bleeding patients (n=174).

reported having a policy on fibrinogen thresholds for the transfusion of cryoprecipitate. Of these, 80.0% reported a threshold of less than or equal to 100 milligrams (mg) per dL and 20.0% reported a threshold between 100 and 200 mg/dL.

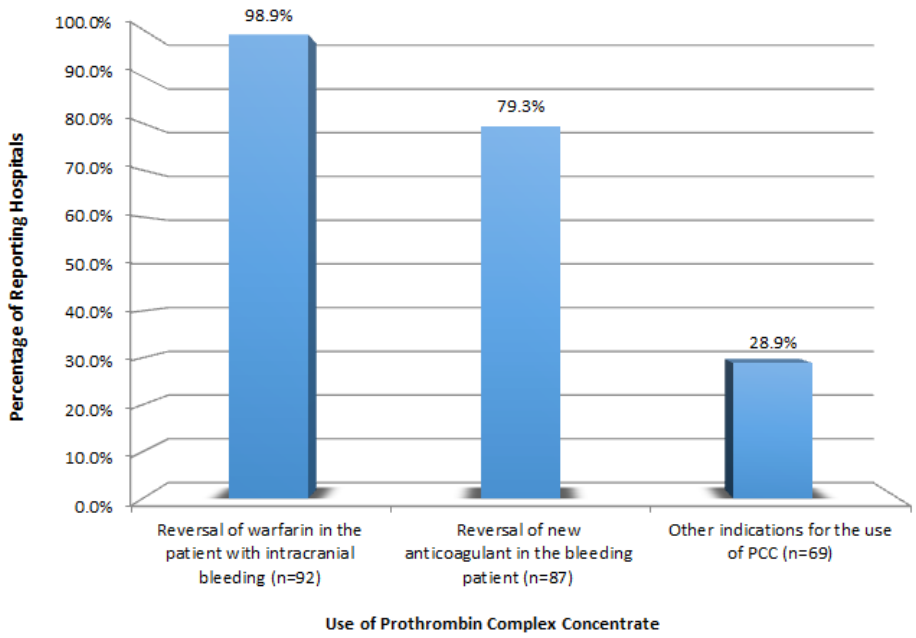

Figure 6-9. Use of prothrombin complex concentrates (4-factor or 3-factor) by hospitals reporting a policy for their use.

Only 20.3% of hospitals reported having policies for the use of 4-factor or 3-factor prothrombin complex concentrates (PCCs). **Figure 6-9** displays the hospital use of PPC by patient population. Of hospitals with a policy for PCC use, 98.9% reported using PCCs for reversal of warfarin in patients with intracranial bleeding, 79.3% reported using PCCs for reversal of newer anticoagulant drugs (eg, target-specific oral anticoagulants) in bleeding patients, and 28.9% reported use of PCCs for other indications, which included liver failure, when FFP is ineffective, massive hemorrhage, emergency surgery, and when the physician specifically ordered its use.

Only 21.2% of responding hospitals (n=116) reported having a policy on the use of recombinant Factor VII.

7. Current Issues in Blood Collection and Donor Screening

In 2013, there were 13,975,000 individual visits, presentations, or registrations to donate blood at AABB member blood centers and hospital blood collection sites; this was a 21.0% decrease from AABB facilities reporting in 2011. As reported in earlier surveys, most donors presented at blood centers (95.8%), and only 4.2% presented to donate at hospital donor centers. Of the registrations, there were 6,847,000 allogeneic (directed and community combined) donors who successfully gave blood at AABB facilities in 2013, compared to 9,127,000 allogeneic donors in 2011,* a 24.9% decrease. In 2013, there were 2,210,000 (32.3%) first-time donors and 4,626,000 (67.6%) repeat donors.† These repeat allogeneic donors provided 7,415,000 donations, the equivalent of 1.6 donations per repeat allogeneic donor, compared with 1.5 from AABB institutions in 2011.

There were only 35,000 autologous donors (ie, donors who successfully donated a unit intended for themselves) reported by AABB facilities in 2013. This is 56.6% fewer autologous donors than reported in 2011. Facilities reported 55,000 units collected (manual and apheresis red cell collections combined), a rate of 1.6 units per autologous donor. Autologous donations are collected at a higher rate in hospital blood banks, with autologous units representing 1.9% of all units collected, as compared to 0.3% in blood centers.

There were 2,035,000 donors reported as deferred for various reasons (14.6% in 2013, compared to 13.6% among AABB blood collectors in 2011). An additional 892,000 deferrals were reported for which no specific deferral reason were identified. Donors were most commonly deferred for low hemoglobin (51.8% of deferrals vs. 48.9% in 2011), defined as not meeting FDA blood hemoglobin level requirements for blood donation. As seen in **Figure 7-1**, other categories for deferral included high-risk behavior associated with men who have sex with other men (MSM; 0.4% of deferrals both years), other high-risk behavior (as identified on the Donor History Questionnaire, or DHQ; 0.7% vs. 1.0% in 2011), prescription drug use (2.8% vs. 3.6% in 2011), tattoos/piercings (3.4% vs. 3.9% in 2011), specific foreign travel (7.5% vs. 7.3% in 2011), and other medical

**In the past, many blood centers and hospitals reported that they were unable to specify which donors had directed their donations; therefore, in 2013, all allogeneic donations were grouped and specific questions about directed donation were eliminated.*

†*Repeat donors as defined by the reporting facility.*

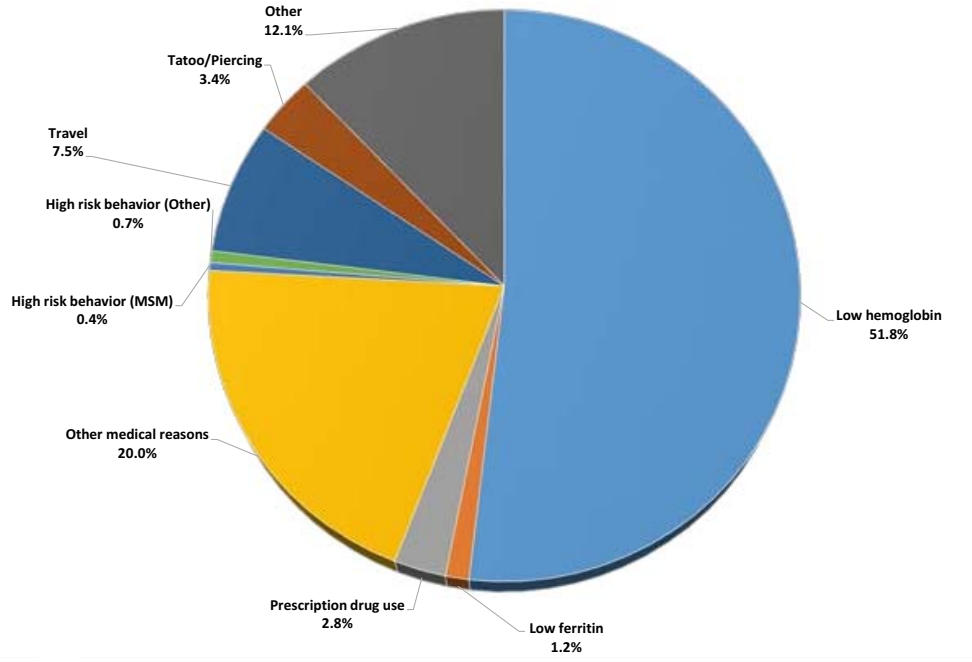

Figure 7-1. Donor deferrals 2013.

reasons (20.0% vs. 19.1% in 2011). Newly reported on this survey were deferrals for low ferritin, which amounted to 1.2% of deferrals. High-risk behavior deferrals are intended to reduce the risk of transmission of infectious diseases, including HIV and hepatitis viruses. Deferrals for other medical reasons may include exposure to human-derived growth hormone, bovine insulin, hepatitis B immune globulin, unlicensed vaccines, or those presenting with physical conditions or symptoms that disqualify a person from donating blood. Another 11.9% of donors, a decrease from the 15.7% reported in 2011, were deferred for other reasons, which included low weight, inadequate interdonation interval, being under the donation age, and language.

In 2013, 2,758,000 units were collected from donors aged 16 to 24. This number represents approximately one-fifth of all allogeneic collections (20.4%), as it did in 2011. Of these donations, 1,333,000 were collected from high school-aged donors (16 to 18 years old), representing 9.9% of allogeneic donations. This survey also determined that 1,194,000 donations, or 8.8% of donations, were collected from donors over the age of 65 years, an increase from 7.8% in 2011.

AABB members collected 1,533,000 units from minority populations (including African American, Asian, and/or Hispanic). Although some facilities were unable to specifically categorize their donors by race or ethnicity, it is clear that donations from minority populations continue to contribute substantially to the nation's blood supply (11.3%), the same percentage reported for 2011.

Table 7-1. Donor Adverse Reaction Rate by AABB Facility and Procedure Type

	Reaction Rate by Manual Collection Procedure (%)		Reaction Rate for Automated Collection Procedures (%)		Overall Rate (%)	
	2013	2011	2013	2011	2013	2011
Blood Center	0.13	0.14	0.13	0.10	0.13	0.13
Hospital	0.12	0.10	0.02	0.15	0.10	0.11
Total	0.13	0.13	0.12	0.11	0.13	0.13

Mobile blood drive sites were the source of 9,634,000 units, or 70.9% of collected WB/RBC units. Of these, approximately 12.2%, or 1,172,000 donations, were from automated collections. As has been the historical pattern, in 2013, blood centers obtained the greatest proportion of their collections through mobile blood drives (71.5%, an increase over the 67.6% in 2011). Hospitals reported higher use of mobile blood drives for collection in 2013, 56.3% of WB/RBC collections compared to 50.9% in 2011.

Donor Hemovigilance

In the past year, internationally harmonized definitions for donor adverse reactions have been established.* Their widespread adoption is anticipated and should contribute to reporting consistency in the future.

This survey continues to track donor hemovigilance reports for the US donor population. For the purposes of this survey, severe donor adverse events (AEs) were defined as AEs occurring in donors that were attributed to the donation process, including major allergic reaction, loss of consciousness of a minute or more, loss of consciousness with injury, and nerve irritation. Among AABB members, 17,600 of these events were reported by collection organizations for 2013 (**Table 7-1**). The rate of severe AEs was 17,600/14,005,000 collection procedures (0.13%) in 2013 and 21,000/15,721,000 collection procedures (0.13%) in 2011. These rates were not statistically different and indeed were almost identical.

As in 2011, the rate of severe AEs per unit collected in 2013 was the same statistically as that by procedure. Blood donation, either through traditional manual WB collection processes or using automated procedures, is a very safe procedure, rarely resulting in adverse consequences.

**http://www.aabb.org/research/hemovigilance/Documents/Donor-Standard-Definitions.pdf. Last accessed October 5, 2015.*

8. Current Issues in Blood Transfusion

US Collection Trends

Figure 8-1 illustrates the trends in the estimated rates of WB/RBC collection and transfusion in the United States from 1980 to 2013. This year, the survey estimates AABB member rates of collection and transfusion and compares these with AABB member rates from 2011.

The rate of collection was calculated from the national estimate of total allogeneic WB/RBC units collected per 1000 donors aged 16 to 64 for a given survey year. The figure also includes the collection rate for allogeneic WB/RBC units collected per 1000 total population (all ages) since 1997. Population estimates were obtained from the US Bureau of the Census.*

Allogeneic blood collection in the United States among AABB member blood centers and hospitals was 65.5 units per 1000 persons aged 16 to 64 in 2013, compared with 76.2 units per 1000 persons of that age in 2011,† a decline of nearly 12.0%. Extrapolated to include non-AABB hospital collections, the US collection rate is estimated to be 67.2 units per 1000 persons of donation age (not shown in figure). This rate is slightly inflated since we know that in 2013, 1.2 million donations were collected from donors over the age of 65. Most of these donors are likely to be aged 65 to 69. If we include this population in the population of potential donors, the rate of collection drops to approximately 61.2 per 1000 persons aged 16 to 69.

As there was only a 0.8% increase in this US population cohort between 2011 and 2013, the decline in the collection rate should be attributed primarily to the 12.1% decrease in the number of units collected. Furthermore, this collection rate is the lowest rate per unit of potential donor population reported since these large surveys have been conducted in 1980. According to the number of donors reported in the 2013 survey year, only 3.3% of the US population aged 16 to 64 donated in 2013, a drop from the 4.5% of the total age-eligible US population reported to have donated in 2011.

The rate of donation in the population aged 16 to 24 was 69.1 units per 1000 persons in 2013, which is much lower than the same cohort's rate in 2011 (80.8 per 1000 persons) but higher than the eligible population overall (65.5 units per 1000 persons) and the rate for persons aged 25 to 64 (64.7 units per 1000 persons. For persons aged 65 or older, the donation rate was a much lower 26.7 units per 1000 persons.

**http://www.census.gov/popest/data/index.html.*

†*Allogeneic blood collection per 1000 total population in 2013 was 42.8 units per 1000.*

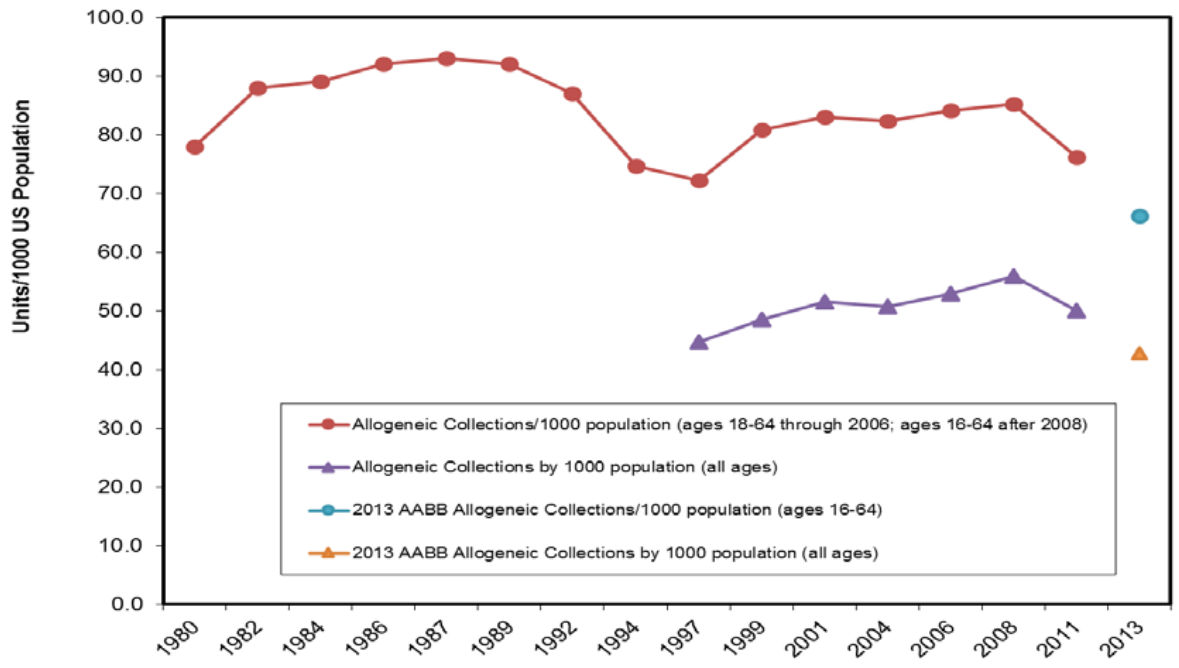

Figure 8-1. Trends in estimated rates of WB/RBC collection United States, 1980-2013.

US Trends in Utilization

The rate of transfusion was calculated from the national estimate of allogeneic WB/RBC units transfused per 1000 total population of all ages (**Figure 8-2**). For this report, a new trend line has been initiated to show the rate of transfusion for AABB US members beginning with 2011.

The US AABB member WB/RBC transfusion rate in 2013 was 19.3 allogeneic RBC units transfused per 1000 overall population, a decline of 8.5% when compared to the member rate of approximately 21.1 units per 1000 in 2011. Extrapolation of the US AABB membership data to the number of transfusions throughout the United States* yields a rate of approximately 40.3 units per 1000 population (compared to 44.0 units per 1000 in 2011).

**Assuming that the proportion of AABB member contribution is equivalent in 2013 to that of 2011.*

Blood Availability

Figure 8-3 illustrates the relationship between allogeneic WB/RBC collections and transfusions from 1989 to 2013, as well as the margin between units collected and those transfused.

The trend of increasing numbers of collections reported since 1997 was reversed between 2008 and 2011, and the decline continued in 2013, with only 13.6 million allogeneic RBC units collected by AABB member facilities, for

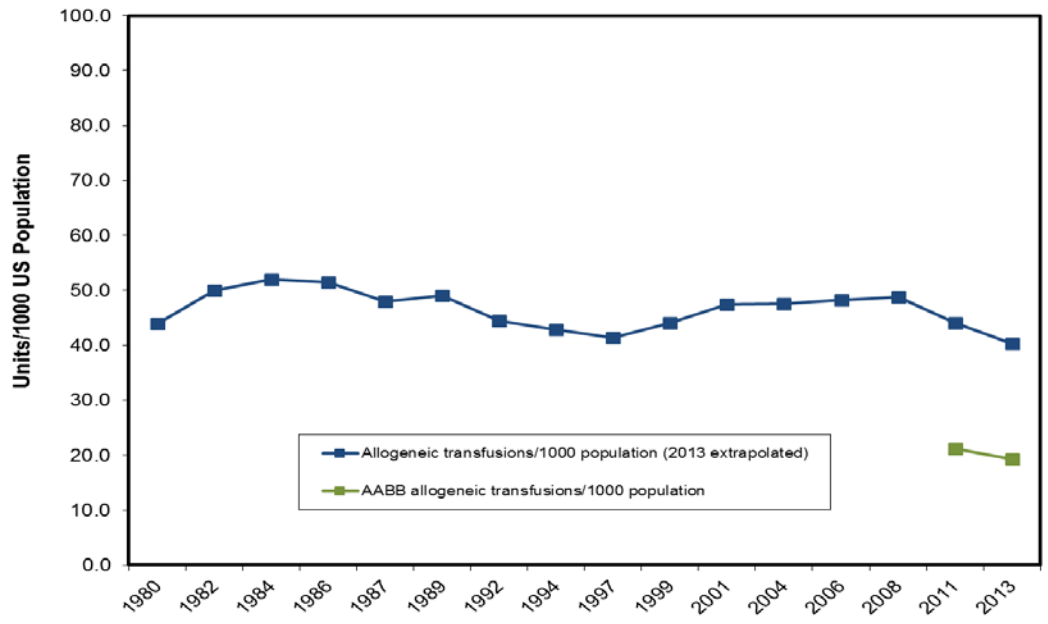

Figure 8-2. Trends in estimated rates of WB/RBC transfusion in the United States, 1980-2013.

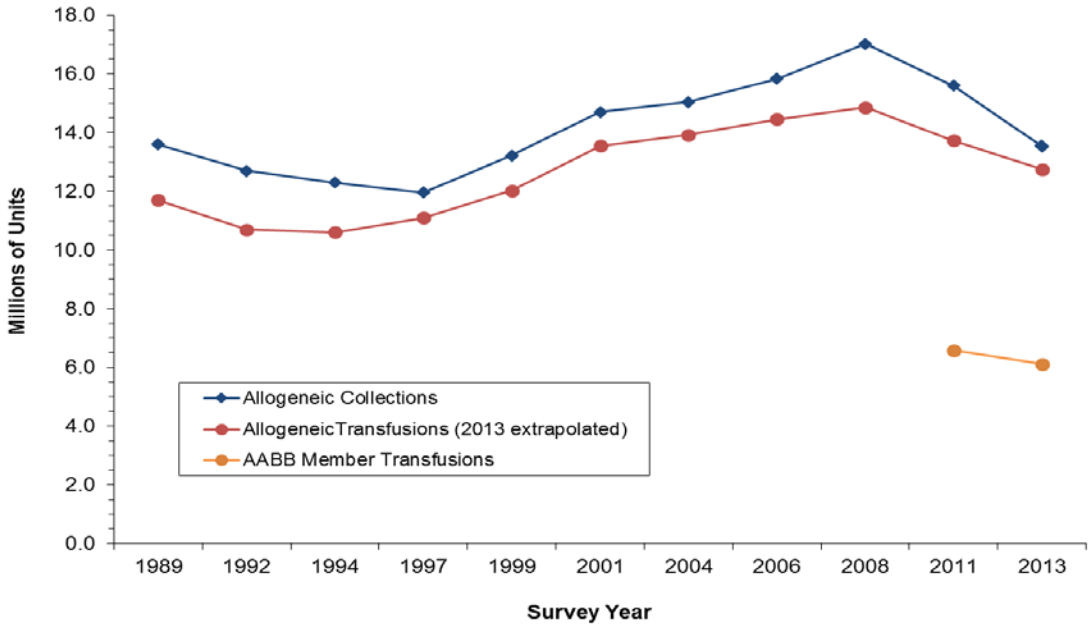

Figure 8-3. US allogeneic WB/RBC collections and transfusions, 1989-2013.

a 12.1% decrease from 2011. Allogeneic collections in 2013 were slightly higher than those reported in 1999. Reported amounts transfused in 2013 are only slightly higher than those reported in 1999.

The available supply of both WB/RBCs and non-RBC components was just sufficient to meet overall transfusion demands in 2013. The margin between allogeneic WB/RBC supply and demand depicted in **Figure 8-3** suggests a correction to the oversupply of WB/RBC components observed in previous years and a clear movement toward more restricted blood availability.

Allogeneic collections in the United States peaked in 2008, with 17 million WB/RBC units collected, with a supply of available units (ie, units that have passed all lab tests, were not wasted, and are available for transfusion) of 16.9 million. The margin between collection and transfusion at that time was 2 million units or 12.1% of available collections. In 2013, there was a decrease of 10.3% in available allogeneic collections to 12.9 million units. With an extrapolation of the AABB number of units transfused to the total hospital population (approximately 12.8 million units), there appears to be only a very small margin between collection and transfusion of WB/RBCs.

A total of 34 hospitals (6.7%) reported that elective surgery was postponed due to RBC inventory shortages in 2013. Non-surgical RBC needs were unmet in 3.4% of reporting hospitals and special order needs were unmet in 6.1% of reporting hospitals. When asked about platelet inventory shortages in 2013, 54 hospitals (10.5%) reported that elective surgery had been postponed. Of responding hospitals, 22.7% (115 hospitals) reported that they were unable to meet other non-surgical blood requests. Non-surgical platelet needs were unmet in 13.2% of reporting hospitals.

Blood Use

Hospitals were asked to indicate the number of RBC and platelet units distributed to individual hospital services (eg, surgery, hematology/oncology, transplant, and ICU) in 2013 (**Figures 8-4** and **8-5**). The services responsible for the highest use of RBCs were general medicine (28.5%), surgery (19.9%; general, orthopedic, cardiac surgery, and any other surgery reported but not included in these three categories combined), hematology/oncology, including stem cell transplant (19.2%), and the ICU, including both medical and surgical (12.5%). While the actual percentages changed somewhat from those reported in 2011, the largest RBC users remained general medicine (29.1% in 2011) and surgery (18.2% in 2011). Hospitals able to report these data by hospital service accounted for only 17.5% of the US AABB member WB/RBC transfusions.

The services reporting the greatest use of platelet products were hematology/oncology (43.6%), surgery (15.9%; general, orthopedic, and cardiac surgery combined), the ICU, including both medical and surgical (13.0%), and general medicine (12.8%). Cardiac surgery comprised 54.5% of the overall platelet use in surgery. As with RBCs, the largest platelet users in 2013 were the same as in 2011: hematology/oncology (34.4% in 2011) and surgery (17.6% in 2011).

Of the 219 hospitals that reported blood use by hos-

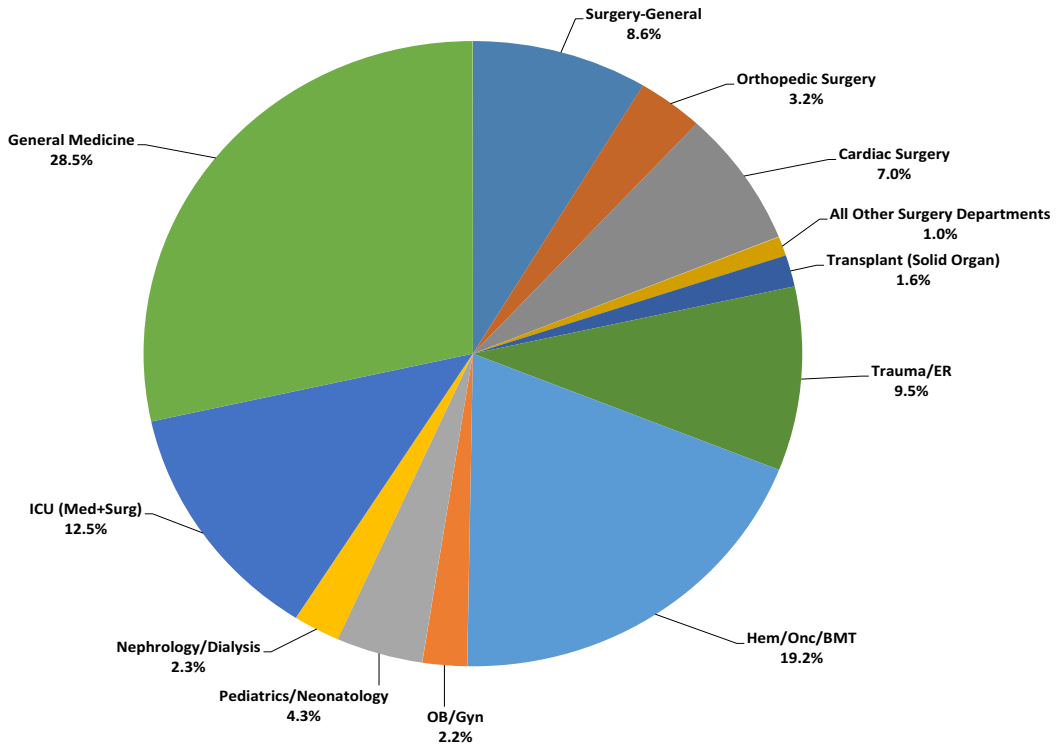

Figure 8-4. RBC use by hospital service in 2013.

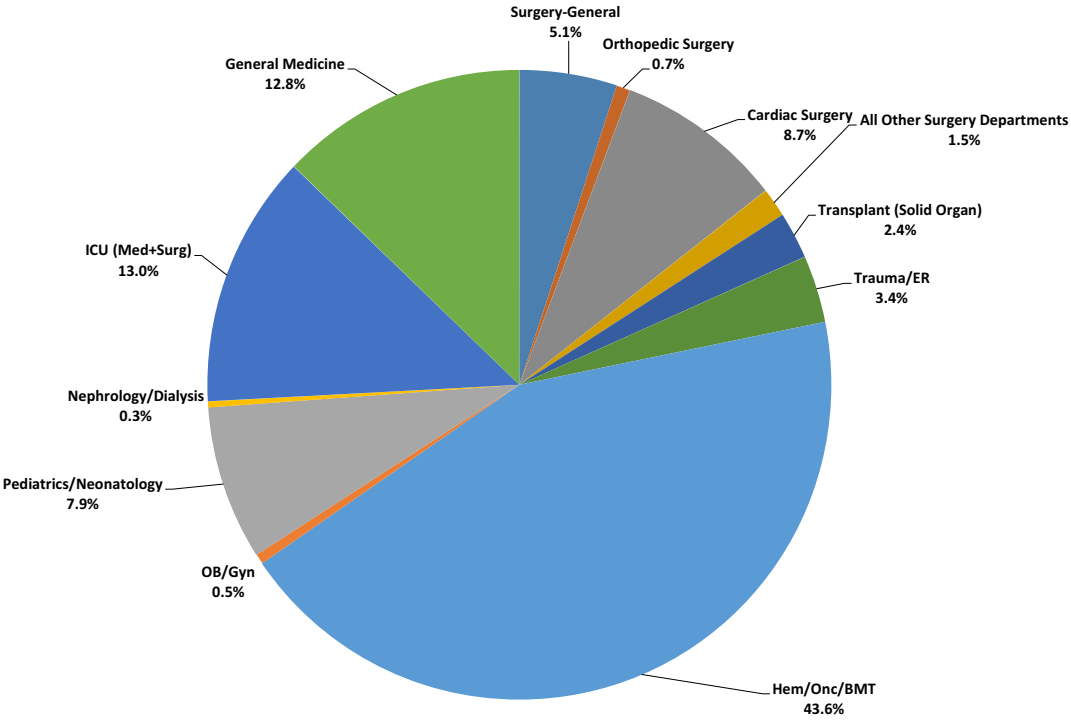

Figure 8-5. Platelet use by hospital service in 2013.

pital service or department, 53.0% determined this by location within the hospital. The other 47.0% used the physician service or department.

Crossmatch Procedures

AABB member hospitals and transfusion services reported the total number of crossmatch procedures. Weighted hospital data on crossmatch procedures indicate that 8,331,000 procedures were performed in 2013, a decline of 17.4% from the number reported by AABB member facilities in 2011 (10,079,000 procedures) and a reflection of the overall reduction in blood transfusion.

There were 3,717,000 electronic crossmatch procedures reported, or 44.6% of the total procedures reported, a 29.9% increase over the number of electronic crossmatch procedures reported in 2011. Manual serologic procedures accounted for 36.7% of the crossmatch procedures. Only 2.3% were reported to be automated serologic crossmatch procedures. The remaining procedures were not categorized.

To calculate the crossmatch-to-transfusion ratio (C:T), the total number of allogeneic WB/RBC units transfused (6,118,000) was used as the denominator. The overall C:T ratio was 1.4 crossmatch procedures per unit transfused, a ratio equal to the C:T ratio reported in 2011.

Red Cell Age

The 2013 survey queried hospitals to determine the average age of a unit of RBCs at the time of transfusion. In this survey, 253 hospitals responded, representing approximately 45.8% of reporting hospitals. The overall mean age for a red cell unit at transfusion was 19.9 days, comparable to 2011 (19.2 days). Hospitals were asked to indicate whether they reported a calculated or estimated age. The estimated mean age was comparatively younger at 17.8 days than reported in 2011 (18.3 days). The calculated mean age at transfusion was 22.7 days, older than reported in 2011 (19.4 days). Only 24.5% (96 hospitals) of AABB hospitals responding to this question in 2013 were able to calculate the RBC age at transfusion.

Platelet Age

Overall, 286 hospitals (51.8%) responded with an age for apheresis platelets at the time of transfusion. Overall, the average age was 3.2 days at transfusion. The mean reported age was 3.4 days for the calculated average and 3.1 for the estimated average.

Hemovigilance

An estimated total of 27,000 transfusion-related adverse reactions occurred in US AABB member facilities in 2013, the same number reported by AABB member hospitals in 2011. Reactions are defined as an undesirable response or effect in a patient that is temporally associated with the administration of blood or blood component(s) and that may or may not be the result of an incident or an interaction between a recipient and the blood product. The rate of adverse reactions is 0.25%, or 2.5 per 1000 units transfused, the same rate reported by AABB member hospitals in 2011. This rate is below the range of other national hemovigilance reporting systems (3 to 7 events per 1000 units transfused). It is almost certain that the explanation for the lower

US rate is that many adverse reactions are not reported to the transfusion service at all. Additional education is needed at all levels of the transfusion chain regarding adverse transfusion reactions and the ways to report them for full implementation of hemovigilance in the United States.

Participants reported whether they had an electronic system for tracking events, which were defined as unplanned, unexpected, and undesired occurrences. Nearly 58% of AABB member hospitals reported having such a system to track events, which is an increase from 48.0% reported in 2011. Of these, most hospitals reported systems to track both adverse reactions and incidents/mistakes (39.9%), while 10.0% of hospitals reported having a system to track adverse incidents/mistakes only, and 8.1% reported having a system to track adverse reactions only. Overwhelmingly, facilities had written definitions for adverse transfusion reactions (96.7%). However, only 33.7% used the CDC National Healthcare Safety Network, Hemovigilance Protocol definitions. Most AABB facilities reported that their clinical teams review reported reactions against the written definitions (72.6%).

The rates reported for the various types of transfusion-related adverse reactions are included in **Table 8-1**. The most commonly reported transfusion reactions were febrile, nonhemolytic transfusion reactions (1:1244 transfusions) and mild to moderate allergic reactions (1:1462 transfusions) followed by the non-specific "other" reported transfusion reactions (1:1644 transfusions). There were significantly more severe allergic reactions reported to US AABB member hospitals in 2013 than in 2011, as well as more post-transfusion viral infections and sepsis reported. There were significantly fewer reports of transfusion-associated dyspnea (TAD), delayed hemolytic transfusion reactions, febrile, hypotensive transfusion reactions, delayed serologic transfusion reactions, and post-transfusion purpura (**Figure 8-6**).

AABB member hospitals reported 10,130,000 samples received in the blood bank in 2013, 4.8% more than reported in 2011. These included specimens submitted for ABO testing, type and screen, type and crossmatch, prenatal samples, and cord blood samples. Approximately 80% of AABB member hospitals reported having a policy to perform an ABO recheck before issuing ABO-specific blood products (eg, a second patient sample from a separate sample collection). Most hospitals (89.3%) collect data on sample collection errors, including mislabeled samples and wrong blood in tube errors. Hospitals reported 105,231 sample collection errors. Of these errors, 3339 were wrong blood in tube (WBIT) errors, accounting for 3.2% of sample collection errors; this rate was only 0.03% of all samples processed by the laboratory, the same proportion reported in 2011. Higher rates of WBITs per sample collected (0.05%), as well as rates of WBITs out of all sample collection errors (11.2%) were seen in the smallest hospitals (those with surgical volumes of ≤99 surgeries per year). The overall error rate per specimen submitted was 1.04%, the same as reported by AABB member hospitals in 2011.

Table 8-1. Transfusion-Related Adverse Reactions Reported to the Transfusion Service

Adverse Transfusion Reactions	Number of Occurrences 2013	2013 Reactions: Components Transfused (n=10,962,000 total components)	2011 Reactions: Components Transfused (n=10,846,000 total components)
Total number of reactions that were reported to the transfusion service	27,077	1:405	1:396
Febrile, nonhemolytic transfusion reactions	8815	1:1244	1:1039
Mild to moderate allergic reactions	7499	1:1462	1:1418
Delayed serologic transfusion reactions	1406	1:7797	1:6557
Transfusion-associated circulatory overload (TACO)	834	1:13,144	1:12,054
Delayed hemolytic transfusion reactions	376	1:29,154	1:16,207
Hypotensive transfusion reactions	371	1:29,547	1:18,870
Severe allergic reactions	323	1:33,938	1:46,173
Transfusion-associated dyspnea (TAD)	258	1:42,488	1:26,730
Transfusion-related acute lung injury (TRALI)	175	1:62,640	1:55,312
Post transfusion virus transmissions	149	1:73,570	1:658,287
Acute hemolytic transfusion reactions (non-ABO antibodies)	86	1:127,465	1:99,322
Post transfusion sepsis	85	1:128,965	1:276,962
Acute hemolytic transfusion reactions (ABO)	22	1:498,273	1:412,753
Post Transfusion Purpura	9	1:1,218,000	1:132,843
Transfusion-associated graft-vs-host disease	2	1:5,481,000	--
Other reported transfusion reactions	6667	1:1644	N/A

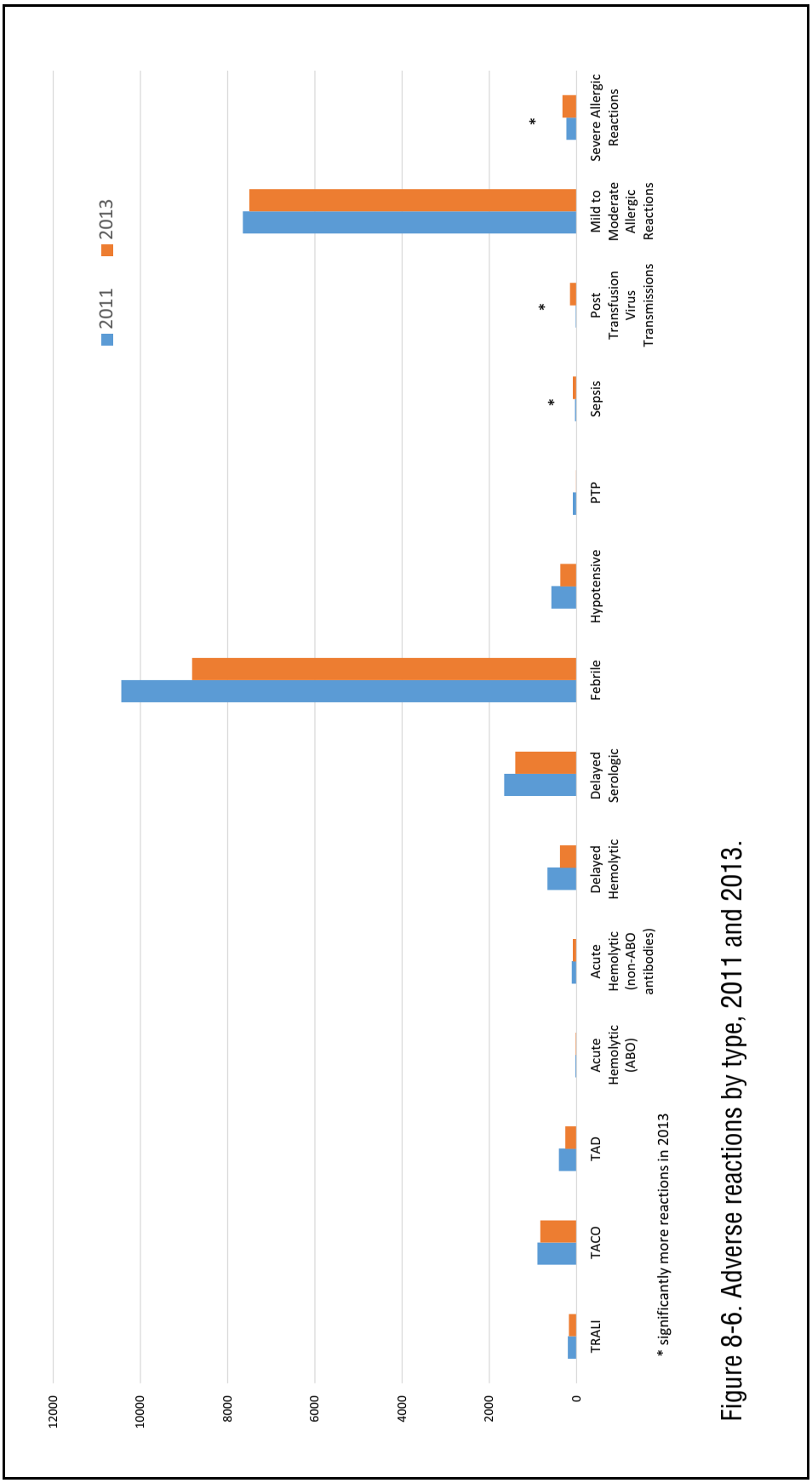

Figure 8-6. Adverse reactions by type, 2011 and 2013.

9. Component Costs

For the 2013 AABB Blood Survey, AABB member hospitals reported the average whole dollar amount their institution paid per unit for the following components: (1) plasma single donor frozen within 8 hours of phlebotomy (FFP), (2) plasma frozen between 8 and 24 hours of phlebotomy (PF24), (3) red blood cells leukoreduced (LR RBC), and (4) apheresis platelets leukoreduced (LR). **Table 9-1** displays a statistical comparison of the mean AABB hospital cost for each component in 2013 and 2011. The 2011 NBCUS estimated average costs (AABB member and non-member combined) are noted in the text. In **Table 9-2**, the average AABB hospital component cost by hospital surgical volume is compared to the overall AABB member average. **Table 9-3** displays the Centers for Medicare and Medicaid Services (CMS) hospital outpatient prospective payment system rates for the components.

All calculations are based on weighted estimates. Component costs are weighted in two parts. First, each component cost is weighted according to the number of units transfused by each facility. As a result, facilities that transfuse larger volumes of a specific component will contribute more toward the estimated average component cost for that component than will facilities with smaller transfusion volumes. Second, the sampling weights are applied when calculating the average, resulting in the final weighted estimates. Year-to-year comparisons are made between AABB member hospitals reporting in 2011 and AABB member hospitals reporting in 2013.

RBCs

In 2013, the mean of the average amounts paid reported by AABB member hospitals for a unit of LR RBCs was $218.87 (**Table 9-1**) a statistically significant decrease of 2.8% from the 2011 reported AABB member average of $225.21. The 2011 NBCUS reported (all hospital) average estimated cost for a unit of LR RBCs was $225.42. There were no significant differences in LR RBC costs by hospital size, although hospitals with higher surgical volumes tended to pay less per unit than those with lower surgical volumes (**Table 9-2**).

Plasma

The 2013 average dollar amount paid for plasma frozen within 8 hours of phlebotomy (FFP) reported by AABB member hospitals was $54.26 per component unit (**Table 9-1**). This decrease of 20.8% compared to the 2011 average $68.55 was statistically significant. The 2013 AABB average was 6.3% lower than that reported for all hospitals in 2011 ($57.91). There were no significant differences in costs by hospital size, although hospitals with higher surgical volumes tended to pay less

Table 9-1. Mean AABB Member Hospital Amount ($) Paid per Selected Component Unit in 2011-2013*

Component	AABB 2013*	AABB 2011*	% Change 2011-2013	p-value
Red Blood Cells, leukoreduced	$218.87	225.21†	–2.8	0.005
Plasma, frozen within 8 hours of phlebotomy (FFP)	$ 54.26	68.55‡	–20.8	<0.001
Plasma, frozen between 8 and 24 hours of phlebotomy (PF24)	$ 53.03	59.75§	–11.2	<0.001
Apheresis platelets, leukoreduced	$516.96	571.62‖	–9.6	<0.001

*Calculations are based on weighted estimates, which generally differ from the unweighted estimates by less than $1.00.
†2011 All hospitals LR RBC average cost $225.42.
‡2011 All hospitals FFP average cost $57.91.
§2011 All hospitals PF24 average cost $56.08.
‖2011 All hospitals apheresis platelets average cost $535.17.

per unit than those with lower surgical volumes (**Table 9-2**).

The hospital cost for plasma frozen between 8 and 24 hours (PF24) after phlebotomy averaged $53.03 for AABB member hospitals (**Table 9-1**). This is significantly lower (11.2%) than the 2011 AABB member hospital average of $59.75. The average cost reported for all hospitals in 2011 was $56.08 (5.3% greater than that reported by AABB hospitals in 2013). There were no significant differences in costs by hospital size for plasma frozen between 8 and 24 hours.

Apheresis Platelets

For a unit of apheresis platelets, in 2013 AABB member hospitals paid an average of $516.96, which was a statistically significant reduction of 9.6% compared to the $571.62 cost of a unit reported by AABB member hospitals in 2011 (**Table 9-1**). The 2011 NBCUS reported average cost for a unit of apheresis platelets was $535.17. Again, there were no significant differences in hospitals costs reported by AABB member hospitals of different surgical volume (**Table 9-2**).

Reimbursement

The 2013 CMS hospital outpatient prospective payment system (OPPS)* reimbursement rates for the blood components assessed are reported in **Table 9-3**. Changes to hospital costs for the different components ranged from decreases of 2.8% to 20.8% between 2011 and 2013 (**Table 9-1**). The CMS OPPS reimbursement rate adjustments ranged from decreases of 0.8% to 5.1%.

**Department of Health and Human Services. Medicare Program; Changes to the Hospital Outpatient Prospective Payment System and Calendar Year 2013 Payment Rates; Final rule with comment period.*

Table 9-2. Average AABB Member Hospital Component Cost ($) by Surgical Volume, 2013

Annual Surgical Volume	No. of Hospitals*	(LR) RBCs	Plasma, frozen within 8 hours	Plasma, frozen between 8 and 24 hours	Apheresis Platelets (LR)
		Avg ($)	Avg ($)	Avg ($)	Avg ($)
≤99	8	229.27	65.11	64.95	417.38
100-999	38	229.93	61.05	57.03	555.56
1,000-1,399	30	238.17	65.65	58.46	548.82
1,400-2,399	52	226.33	60.10	58.15	542.94
2,400-4,999	90	220.37	54.99	55.43	545.17
5,000-7,999	61	215.67	54.77	54.46	538.42
≥8,000	65	216.18	52.84	50.52	499.88
Unknown	15	219.67	59.93	59.58	523.47
All Hospitals	359	218.87	54.26	53.03	516.96
Range of average hospital costs		215.67 to 238.17	52.84 to 65.65	50.52 to 64.95	417.38 to 555.56

*The number of responses for each blood component varies because some hospitals did not provide answers to all questions. The number reported here is the maximum number of responses over the six survey questions.

Table 9-3. CMS Hospital Outpatient Prospective Payment System Rates for Selected Blood Components

Blood Component	Reimbursement Code		AABB Hospital Average $ Paid	Reimbursement Rate			% Difference Between Hospital Average Paid and Reimbursement Rate
	CPT/HCPCS	APC	2013	2011*	2013†	% Change (2013-2011)	
Red Blood Cells (leukoreduced)	P9016	0954	218.91	194.86	193.24	–0.8	–11.7
Plasma frozen within 8 hours of phlebotomy	P9017	9508	54.26	79.35	78.71	–0.8	45.1
Plasma frozen between 8 and 24 hours of phlebotomy	P9059	0955	53.03	73.15	75.53	–3.3	42.4
Apheresis platelets (leukoreduced)	P9035	9501	516.96	538.51	511.27	–5.1	–1.1

*Department of Health and Human Services. Medicare Program; Changes to the Hospital Outpatient Prospective Payment System and Calendar Year 2011 Payment Rates; Final rule with comment period.
†Medicare Program; Changes to the Hospital Outpatient Prospective Payment System and Calendar Year 2013 Payment Rates; Final rule with comment period.
APC = Ambulatory Patient Classification; CMS = Centers for Medicare and Medicaid Services; CPT = Current Procedural Terminology; HCPCS = Health-care Common Procedure Coding System.

Table 9-3 shows that a unit of apheresis platelets was reimbursed at approximately 98.9% of the average cost paid by AABB hospitals. The reimbursement for a unit of LR RBCs in 2013 was approximately 88.3% of the average hospital cost. A unit of FFP was reimbursed at 45.1% more than the reported average amount paid by AABB member hospitals in 2013. PF24 was reimbursed at 42.4% more than the reported average cost to AABB member hospitals in 2013.

CMS OPPS rates are reported here because they are the only clearly identifiable measure of Medicare reimbursement for individual blood components. Most Medicare reimbursement for blood is part of the diagnosis-related group (DRG) payment made for inpatient services and is impossible to tease apart from the other aspects of the DRG. Other payers besides Medicare pay for blood by using various mechanisms that are not included in this report.

Summary

The average hospital costs for blood components were lower in 2013 compared to 2011. Average AABB hospital costs for LR RBCs, FFP, PF24, and apheresis platelets were significantly lower in 2013 compared to AABB member hospitals in 2011.

In the US, the most commonly transfused blood product is RBCs, a large proportion of which are LR. Hospitals are underreimbursed by 11.7% per unit for the acquisition cost alone of this product, not including other costs associated with its transfusion. In 2013, AABB members hospitals transfused over 6.1 million RBCs, this alone represents an underpayment to hospitals of $157 million.

10. Component Modification

Leukocyte Reduction

Blood components are leukocyte reduced (LR) to decrease the risk of febrile non-hemolytic reactions, transmission of cytomegalovirus (CMV) infection, and HLA alloimmunization that may lead to platelet refractoriness. Leukocyte reduction can be performed during collection, at some time before components are placed into inventory, and after storage; these are categorized as "before or after storage, but not at bedside" leukocyte reduction. A total of 12,804,000 blood components (80.4% of all RBCs and platelets) were LR before storage in 2013 by AABB member blood centers and hospitals that collect blood (**Table 10-1**). Components can also be LR bedside during the time of transfusion, though this practice is waning (**Figure 10-1**).

It is important to focus on the percentage of LR components rather than the actual number of LR components due to the overall decline in collections. There was a drop in the percentage of WB/RBC units undergoing LR (78.5%) compared to 2011, when 85.2% of the WB/RBC units were LR. More WBD platelets were reported to be LR in 2013 both in number (638,000) and in percentage of those distributed (77.9% vs. 57.2% in 2011). Nearly all apheresis platelets were LR (92.7%). There were few reports of other LR components in the 2013 survey data.

In comparison with 2011, blood centers produced 11.2% fewer LR components than in 2011; this is consistent with the 12.1% decline in WB/RBC collection overall. AABB member hospitals produced 29.4% fewer LR components in 2013 when compared with 2011 (**Table 10-2**). Overall, the number of LR components prepared decreased by 12.1% from 2011, however, the percentage of WB/RBC and platelet components that were LR decreased by only 2.7%.

AABB Member Transfusion of Irradiated and LR Components

Table 10-3 summarizes the types and number of irradiated and LR blood component units transfused during 2013. Blood centers and AABB member hospital transfusion services reported transfusion of a total of 1,796,000 irradiated units in 2013, representing 32.9% of all components transfused by facilities reporting irradiated units.

A total of 5,486,000 LR components were transfused by blood center and hospital transfusion services. Of all LR units transfused, 99.5% were LR before or after storage (not at bedside), and only 0.5% were leukocyte filtered at bedside. In 2013, substantial proportions of all transfused RBCs and platelets were reported to have been LR. Among the hospitals reporting both numbers of units transfused and those transfused which had been

Table 10-1. Blood Components Modified to Achieve Prestorage Leukocyte Reduction in US AABB Facilities

	2013			2011		
Blood Component	**Leukocyte-Reduced Prestorage**	**Total Available Components**	**Leukocyte-Reduced % of Total Available Components**	**Leukocyte-Reduced Prestorage**	**Total Available Components**	**Leukocyte-Reduced % of Total Available Components**
WB/RBCs	10,103,000	12,871,000	78.5	12,229,000	14,352,000	85.2
WB-Derived Platelets	638,000	819,000	77.9	368,000	643,000	57.2
Apheresis Platelets	2,063,000	2,226,000	92.7	1,967,000	2,283,000	86.2
Other Component Units	<1,000	4,825,000	0.0	7,000	5,364,000	0.1
Total Components	12,804,000	20,741,000	61.7	14,571,000	22,642,000	64.4
Total WB/RBCs + Platelets	12,804,000	15,916,000	80.4	14,564,000	17,278,000	84.3

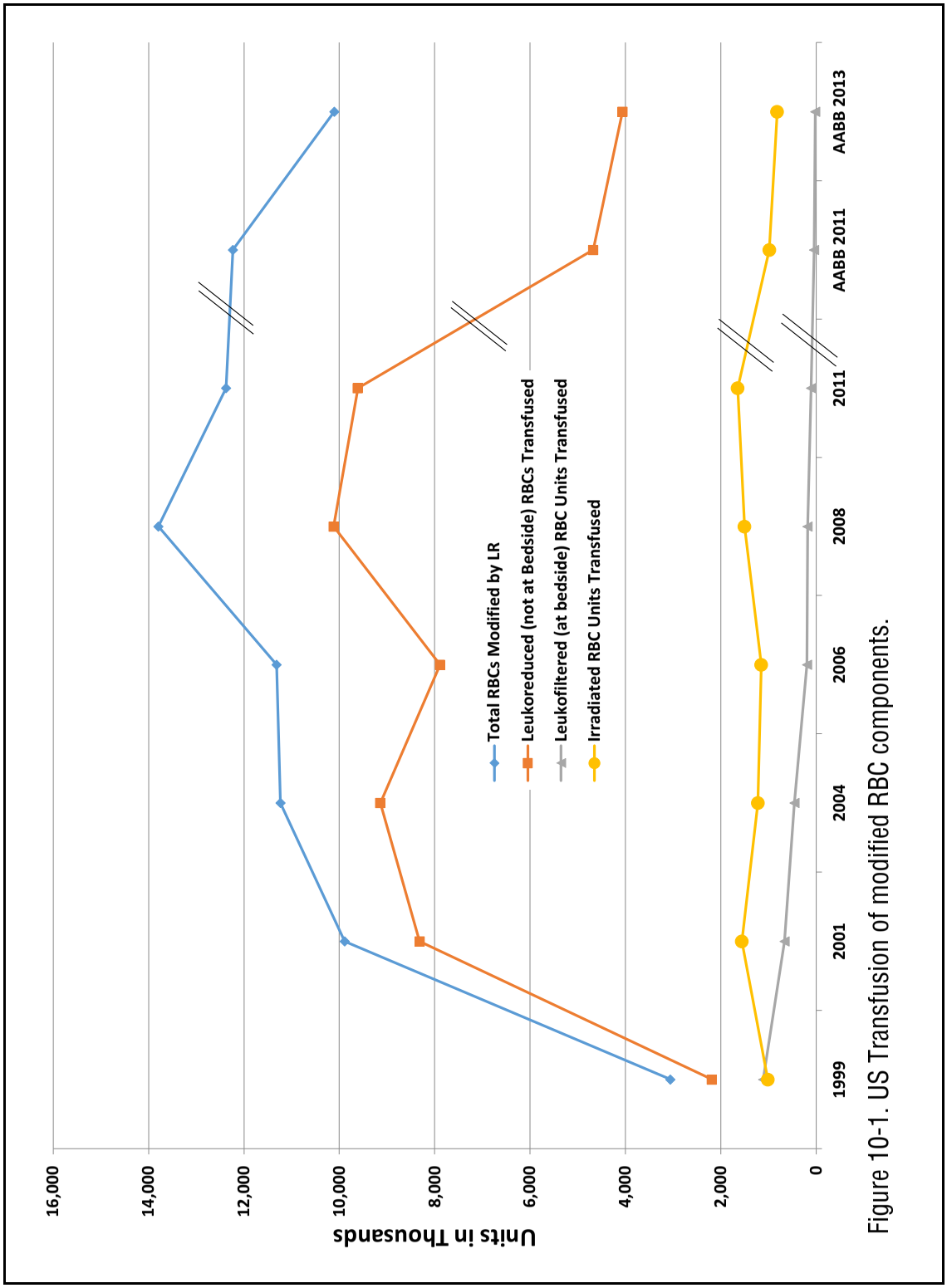

Figure 10-1. US Transfusion of modified RBC components.

Table 10-2. Change in Number of Blood Components Modified to Achieve Pre-Storage Leukocyte Reduction by Facility Type from 2011 to 2013

	Blood Centers			AABB Hospitals			All AABB Facilities		
	2013	2011	% Change	2013	2011	% Change	2013	2011	% Change
Components leukocyte reduced before storage (not at the bedside)	12,286,000	13,837,000	–11.2%	518,000	734,000	–29.4%	12,804,000	14,571,000	–12.1%

Table 10-3. Estimated Number of Blood Component Units Modified by Irradiation or Leukocyte Reduction and Transfused by US AABB Member Facilities in 2013*

Blood Component	Components Irradiated	Components Leukocyte Reduced Before or After Storage (not at the Bedside)	Components Leukocyte (Reduced by Filtration at the Bedside)	Total Leukocyte Reduced Units	Total Transfused (only includes facilites that reported Irradiated components)	Total Transfused (only includes facilites that reported Leukoreduced components)	Irradiated: % of Total Units Transfused	Leukocyte Reduced: % of Total Units Transfused
WB/RBCs	817,000	4,058,000	16,000	4,074,000	3,972,000	4,531,000	20.6	89.9
WB-Derived Platelets (individual units)	332,000	389,000	8,000	397,000	422,000	440,000	78.7	90.2
Apheresis Platelets	508,000	846,000	<1,000	847,000	837,000	884,000	60.7	95.8
Pediatric RBC Units or Aliquots	102,000	122,000	1,000	123,000	175,000	173,000	58.3	71.1
Pediatric Platelet Units or Aliquots	35,000	37,000	<1,000	37,000	57,000	58,000	61.4	63.8
Pediatric Plasma Units or Aliquots	2,000	8,000	<1,000	8,000	3,000	34,000	66.7	23.5
Total Components	1,796,000	5,460,000	26,000	5,486,000	5,466,000	6,120,000	32.9	89.6

*Includes facilities that reported transfusion of irradiated/leukoreduced units as well as total components.

LR, 89.9% of WB/RBCs, 90.2% of WBD platelets, and 95.8% of apheresis platelets were LR. While the percentage of transfused apheresis platelets appears discrepant to the apheresis platelet collection process and the numbers of LR apheresis platelets reported produced, transfusion services, or those completing the survey, may not have been aware of the LR processing that occurs during collection.

Table 10-4 and **Figure 10-1** summarize the trends in irradiated and LR RBC components transfused. Between 2011 and 2013, while the number of irradiated units transfused decreased by 16.8%, the percentage of all RBC units transfused that were irradiated (13.3%) decreased by 1.5% from 2011 (14.8%) among AABB member hospitals. Both the total number and percentage of all units transfused that were LR declined in 2013. There were 13.7% fewer LR RBC units transfused and the proportion of RBC units transfused as LR declined by 4.1%. Reports of bedside LR of RBCs declined to only 16,000 total transfusions, a 62.8% decrease from 2011.

Transfusing facilities were asked whether they had a policy in 2013 to transfuse only LR components: 71.8% responded they did have such an LR-only policy in place; this was unchanged from 2011. Another 11.7% of hospitals had a policy to transfuse only LR components to particular types of patients. Among institutions with these patient-specific LR policies, 84.6% reported LR policies for oncology patients, 81.5% for neonates, 47.7% for cardiovascular surgery patients (compared to 13.8% in 2011), and 61.5% for other patients.

Table 10-4. Total Number of Irradiated and Leukocyte Reduced Red Blood Cell (RBC) Units Transfused by US AABB Member Hospitals in 2013, compared with RBC Units Transfused by AABB Member Hospitals in 2011

	Red Blood Cell Units			
Modification	**2013**	**2011**	**Change 2013 - 2011**	**% Change**
Irradiated	817,000	982,000	–165,000	–16.8
Leukocyte-Reduced, total	4,074,000	4,719,000	–645,000	–13.7
Before or After Storage (not at the bedside)	4,058,000	4,676,000	–618,000	–13.2
At the bedside	16,000	43,000	–27,000	–62.8

11. Appendix I: Methods

Survey Population

The 2013 AABB Blood Survey was distributed through a web-based survey tool* from November 7, 2014, to February 16, 2015, to all AABB institutional members. The two broad categories of participants were:

- Blood Centers
- Hospitals

Non-US AABB Member Response

Response rates for the non-US facilities are presented in **Table A-1**. Because data received from these members were sparse, data from these facilities were neither imputed nor weighted. In future surveys, AABB will approach non-US members directly to ensure it is understood that all members are invited to participate.

**http://www.qualtrics.com.*

US Military Blood Program Response

Response rates for the official US military blood program or the Armed Services blood programs are presented in **Table A-2**. Data from these facilities were analyzed separately from the US blood center analysis.

AABB US Member Data Analysis

The US hospital population included hospitals located within the 50 states and the District of Columbia.† The report includes weighted aggregate reported results.

For the purpose of stratification, the AABB member hospitals were matched with the American Hospital Association (AHA) hospital membership information database to record the number of inpatient surgeries performed in 2013. Hospitals were stratified into eight categories based on the 2013 annual inpatient surgical volume: ≤99 surgeries; 100-999 surgeries; 1000-1399 surgeries; 1400-2399 surgeries; 2400-4999 surgeries; 5000-7999 surgeries; ≥8000 surgeries; and those having unknown surgical volume.

Blood Centers were stratified into three categories based on the number of WB/RBCs collected in 2013: >250,000 units; 50,000 to 249,999 units; and <50,000 units. **Table A-3** summarizes the survey population and response rates.

†Includes hospitals from the US Department of Veterans Affairs.

Response Rates and Weights

A responding institution could provide data for itself and also for other institutions. This resulted in inclusion of some institutions that were not in the original survey population (eg, not current AABB members). Information collected about

Table A-1. AABB Blood Survey 2013: Survey Population and Response Rates—Non-US Members

Institution Type	Respondents	Total	Response Rate (%)
Non-US Blood Centers	6	17	35.3
Non-US Hospitals	8	35	22.9

Table A-2. AABB Blood Survey 2013: Survey Population and Response Rates—US Military Blood Program

Institution Type	Respondents	Total	Response Rate (%)
US Military Blood Program	2	4	50.0

Table A-3. AABB Blood Survey 2013: Survey Population and Response Rates

Institution Type	Respondents	Total	Response Rate (%)
Blood Centers			
WB/RBC Collections 250,000+	7	7	100.0
WB/RBC Collections 50,000 to 249,999	33	36	91.7
WB/RBC Collections <50,000	33	36	91.7
Hospitals			
≤99 surgeries per year	48	62	77.4
100 - 999 surgeries per year	73	127	57.5
1000 - 1399 surgeries per year	38	67	56.7
1400 - 2399 surgeries per year	68	141	48.2
2400 - 4999 surgeries per year	122	284	43.0
5000 - 7999 surgeries per year	86	178	48.3
≥8000 surgeries per year	84	152	55.3
Unknown surgical volume	33	57	57.9
Total Facilities	625	1147	54.5

these institutions was not as complete as it would have been if these hospitals had completed an individual survey. Overall response rates for 2013 and for previous blood survey years are summarized in **Table A-4** and discussed in the section below. In the 2013 survey, a blood center that had previously reported by regions or sub-units, reported in the aggregate. This represents more than 50.0% of the decrease in the total population of blood centers from 136 to 79.

Table A-4. Response Rate Summary and Comparison with Previous Surveys

Facility Type	2013	2011 AABB Cohort	2011†	2009†	2007†
Blood Centers	92.4% (73/79)	96.3% (131/136)	96.3% (131/136)	93.3% (126/135)	91.4% (128/140)
Hospitals (all)	51.7% (552/1068)	49.5% (581/1173)	42.3% (1342/3175)	51.5% (1529/2970)	59.9% (1707/2848)
Total	54.5% (625/1147)	54.4% (712/1309)	44.1% (1493/3381)*	53.1% (1660/3129)*	61.3% (1849/3015)*

*Includes Cord Blood Banks.
†NBCUS Total population.

Blood Centers

After excluding blood centers that ceased operations, were unable to provide complete data, merged with other blood centers, or were affiliated with the US Armed Force services, the final survey population included 79 blood centers. The weights were calculated as the inverse of the probability of response. The weights were adjusted for nonresponse by stratifying the blood centers by the number of WB/RBC collections (estimated from 2011 survey data or obtained separately for the nonrespondents) as shown in **Table A-5**.

Hospitals

It was difficult to weight hospital data because some data were reported by other hospitals. In addition, blood centers could also report transfusion information for hospitals when they served as centralized transfusion services. Data for 146 hospitals were reported by blood centers and data for 15 hospitals were submitted by other responding hospitals. For the purpose of weighting, these 15 hospitals were treated as if they were in the original survey population.

Table A-6 summarizes the weights for 2013 hospitals by inpatient surgical volume. The weight is the inverse of the probability of response.

Table A-5. Weights for Blood Centers

Volume of RBC Collections	Total	Respondents	Weight
WB/RBC Collections 250,000+	7	7	1.0000
WB/RBC Collections 50,000 to 249,999	36	33	1.0909
WB/RBC Collections <50,000	36	33	1.0909
Total	79	74	

Table A-6. Weights for 2013 Hospitals

Surgical Volume	Non-Respondents	Respondents	Total	Weight
≤99 surgeries per year	14	48	62	1.2917
100 - 999 surgeries per year	54	73	127	1.7397
1000 - 1399 surgeries per year	29	38	67	1.7632
1400 - 2399 surgeries per year	73	68	141	2.0735
2400 - 4999 surgeries per year	162	122	284	2.3279
5000 - 7999 surgeries per year	92	86	178	2.0698
≥8000 surgeries per year	68	84	152	1.8095
Unknown surgical volume	24	33	57	1.7273
Total	516	552	1068	

Imputation of Data Items

Data Apportionment

A responding institution could provide data for itself and also for other institutions. A new record was created for each institution for which information could be obtained and verified as being a population of interest (reported by an AABB member but not necessarily an active AABB institutional member). For each new record created, certain categorical data elements from the responding institution's response were copied (eg, "Were any elective surgeries postponed due to RBC inventory shortages in 2013 (yes/no)?") and other data were apportioned (eg, total number of allogeneic RBCs transfused). In some cases, the data collected in this manner were not as complete as they would have been if an individual survey had been completed separately.

Item Imputation

Facilities were contacted to verify if the submitted data reflected their current blood collection and transfusion model/program, to avoid inappropriate imputation. This restricted item imputation to only two critical questions on responding blood center and hospital surveys: total numbers of allogeneic units discarded in 2013 for reactive infectious disease markers and for all other reasons. Missing values were imputed on 12 responding blood centers and 19 responding hospitals, for a total of 46 imputed data items. In all cases, the imputation was based on models of relationships between variables for the 2013 survey responses.

Characterization of Respondents

Among the responding blood centers, 18 blood centers (24.3%) self-defined as centralized transfusion services, which was a numeric decrease from the 21 blood centers reporting this characteristic in 2011, but was an increased percentage of centers conducting this activity (18.3% in 2011). Among the 21 blood centers with centralized transfusion service activity in 2011, 12 centers reported continuing this activity in 2013.

A total of 65 (11.8%) responding hospitals reported collection data and characterized themselves as a hospital-based

blood bank and transfusion service that collects blood. Among 2011 AABB hospitals, 94 (16.2%) of the responding hospitals reported collecting blood products.

Comparison with Previous Surveys

The results from 2013 AABB Blood Survey were compared with the AABB member cohort from the 2011 NBCUS. All AABB member institutions from the 2011 NBCUS were considered for analysis. Although some mergers occurred among blood centers since 2011, we were able to collect separate data for most of the blood centers that were active individually in 2011. A large blood center with multiple regions reported 2013 data in the aggregate rather than by region as had been done previously. This suggested an apparent, but not an actual drop in the number of blood centers reporting.

For hospitals, the results from the 2013 AABB Blood Survey were compared with adjusted 2011 NBCUS results, so as to include AABB member hospitals only. The weights* for 2011 AABB respondent hospitals were adjusted by calibrating their final weights by the AABB member hospital population for the year 2011 as shown in **Table A-7**.

**Weight calibration ratio=0.902(1173/1301)*

Table A-7. Calibrated Average Final Weight by USPHS Region and Inpatient Surgical Volume – 2011 AABB Hospital Respondents

By USPHS Region

Region	Average Original Weight	Average Calibrated Weight
I	2.5561	2.3056
II	2.1217	1.9138
III	2.2184	2.0010
IV	3.1917	2.8789
V	3.2788	2.9575
VI	3.7305	3.3649
VII	3.0672	2.7666
VIII	3.5883	3.2366
IX	3.5486	3.2008
X	3.0833	2.7811

By Inpatient Surgical Volume

Surgical Volume	Average Original Weight	Average Calibrated Weight
100 - 999	6.7204	6.0618
1,000 - 1,399	2.3875	2.1535
1,400 - 2,399	2.5096	2.2637
2,400 - 4,999	2.2815	2.0579
5,000 - 7,999	1.9086	1.7216
≥8,000	2.015	1.8175
Unknown	2.213	1.9961

Data Quality Control

Approximately 11 data elements from survey Section B (blood collection, processing, and testing), and four data elements from survey Section C (blood transfusion) were analyzed rigorously for data quality. Any facility that reported values beyond the expected threshold was contacted via email and telephone to confirm data accuracy. Thirty-four blood centers and 77 hospitals reported corrected values during the data quality control process.

Outliers for all quantitative variables were also reviewed. Any data which were uncharacteristic outliers were investigated with the reporting facility.

Statistical Analysis

The final weighted estimates for the 2013 AABB Blood Survey were compared with the weighted estimates from the AABB cohort of 2011 NBCUS. Continuous variables were compared using student-t tests. Categorical variables were compared using chi-square tests of proportions with $p<0.05$. Statistical analyses were carried out using SAS 9.4.

Limitations

The relatively low response rate of hospitals in the 2013 AABB Blood Survey was a limitation. Non-response increases the uncertainty of, or variability in, the estimates, and it may also introduce bias to the estimates, the extent of which is very difficult to assess.

The timing of the 2013 AABB Blood Survey release (November 2014) competed with the release of the 2013 NBCUS released through the Centers for Disease Control and Prevention (CDC) in December 2014. This was a major limiting factor for data collection. In addition, the 2013 AABB Blood Survey was conducted only among AABB institutional members; therefore, the estimates from this survey are predictive of AABB member transfusion activity in the United States, but not necessarily of overall US national transfusion activity. The uncertainty due to non-sampling errors such as measurement errors (eg, data entry errors, misreading of questions, or missed entry) and the variability due to item imputation are not reflected in the estimates.

12. Appendix II: Glossary of Terms

Terms	Definition
Apheresis Donation	A procedure where WB is removed from the body and desired component(s), such as plasma or platelets is retained and the remainder of the blood is returned to the donor.
Autologous Blood Donation	Self-directed donations. Blood collected from an individual with the intention to be given back to the same individual.
Centralized transfusion service	A hospital or blood center that collects blood from donors and supplies blood, components, medical services and/or cross matched blood products to multiple transfusing facilities.
Collected	Successful whole blood or apheresis collections placed into production (not QNS, or other removals).
Community	In this survey refers to those allogeneic donations not directed to a specific patient.
Deferrals	The number of individuals who present to donate blood or blood components and are unable to donate for specific reasons (eg, low hemoglobin, high risk behavior).
Directed Donation	Allogeneic donations intended for a specific patient.
Donation	The collection of a unit of blood or blood component from a volunteer donor.
First-time allogeneic donor	A donor who is donating for the first time at your center.
INR/PTT	INR (international normalized ratio)/PTT (Partial thromboplastin time). INR is a system established by the World Health Organization (WHO) and the International Committee on Thrombosis and Hemostasis for standardizing the results of prothrombin time tests. PTT is a blood test that measures the time for a patient's blood to clot. Generally, a PTT test is used to detect and diagnose a bleeding disorder or excessive clotting disorder, while INR is calculated from a PTT result to monitor the effectiveness to anticoagulants.
Modify	Used in this survey to refer to procedures applied by a blood center, hospital blood bank, or transfusion service that may affect the quality or quantity of the final product (eg, irradiation, leukofiltration, or production of aliquots of lesser volume).
Outdated	Units that expire on your shelf.
Patient Blood Management	An evidence-based, multidisciplinary approach to optimizing the care of patients who might need transfusion. PBM encompasses all aspects of patient evaluation and clinical management surrounding the transfusion decision-making process, including the application of appropriate indications, as well as minimization of blood loss and optimization of patient red cell mass.
PCC	Prothrombin complex concentrates (PCC) are an inactivated concentrate of Vitamin-K dependent blood clotting factors II, VII, IX and X, as well as protein C and S, prepared from fresh-frozen human blood plasma, used to reverse the effects of anticoagulants.

Performance benchmarking programs	A program designed to compare the performance of an individual hospital on one or more metrics with others on a national, regional, or hospital system-wide basis (eg, Q-Probes, Premier).
Plasma	**A) Plasma frozen within 24 hours After phlebotomy:** plasma separated from the blood of an individual donor and placed at –18 C or colder within 24 hours of collection from the donor. Sometimes also referred to as PF24. **B) Plasma, Jumbo:** for the purposes of this survey, FFP having a volume greater than 400 mL. **C) FFP:** Fresh Frozen Plasma. Plasma frozen within 8 hours of collection.
Present to Donate	A person presents to donate when he or she initiates the donation process through appearance and registration at a donation site.
Produced	Blood component manufactured from a unit of whole blood.
Recipient	A unique individual patient receiving a transfusion one or more times in a calendar year.
Released for Distribution	Units that have fulfilled all testing and processing requirements and have been made available to customers for transfusion.
Repeat allogeneic donor	A donor who has previously donated a blood component for community use, using your facility's definition.
Severe Donor-Related Adverse Reactions	Severe adverse events occurring in donors attributed to the donation process that include, for example, major allergic reaction, arterial puncture, loss of consciousness of a minute or more, loss of consciousness with injury, nerve irritation, etc.
Transfusion Related Adverse Reactions	An undesirable response or effect in a patient temporally associated with the administration of blood or blood components. It may or may not be the result of a mistake.
Transfusion Service	A facility that performs, or is responsible for the performance of, the storage, selection, and issuance of blood and blood components to intended recipients.
Wasted components	Include components that were ordered but not used, out of temperature, broken bags, etc. Do NOT include outdated components.
Whole Blood (WB) Donation	A blood donation or sample of blood taken from the venous or arterial circulation that is composed of blood cells, platelets, and plasma.

13. Acknowledgements

AABB acknowledges the following individuals who contributed their time and expertise to this project:

AABB Staff

Frank Berry
Russell Cotten
Erika Hastings
Nina Hutchinson
Dr. Naynesh Kamani
Dr. Stephen Kleinman
Miriam A. Markowitz, MSc
Laurie Munk, MLS

AABB Volunteers

Dr. James P. AuBuchon
Dr. Richard Benjamin
Greg Bishop
Dr. Kelley Capocelli
Dr. Claudia Cohn
Dr. Louis Katz
Dr. Naomi Luban
Dr. Kathleen Puca
Nina Salamon
Dr. Beth Shaz
Dr. Zbigniew Szczepiorkowski
Dr. Lynne Uhl
Dr. Jonathan Waters

Other Contributors

Dr. Susan Hinkins, NORC