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Donation return time at fixed and mobile donation sites

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Abstract

BACKGROUND—This study investigated the effect of blood donation environment, fixed or mobile with differing sponsor types, on donation return time.

STUDY DESIGN AND METHODS—Data from 2006 through 2009 at six US blood centers participating in the Retrovirus Epidemiology Donor Study-II (REDS-II) were used for analysis. Descriptive statistics stratified by whole blood (WB), plateletpheresis (PP), and double red blood cell (R2) donations were obtained for fixed and mobile locations, including median number of donations and median interdonation interval. A survival analysis estimated median return time at fixed and mobile sites, while controlling for censored return times, demographics, blood center, and mandatory recovery times.

RESULTS—Two-thirds (67.9%) of WB donations were made at mobile sites, 97.4% of PP donations were made at fixed sites, and R2 donations were equally distributed between fixed and mobile locations. For donations at fixed sites only or alternating between fixed and mobile sites, the highest median numbers of donations were nine and eight, respectively, and the shortest model-adjusted median return times (controlling for mandatory eligibility times of 56 and 112 days) were 36 and 30 days for WB and R2 donations, respectively. For PP donations, the shortest model-adjusted median return time was 23 days at a fixed location and the longest was 693 days at community locations.

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CONFLICT OF INTEREST

The authors have no conflicts of interest or other financial involvement to declare.

CONCLUSION—WB, PP, and R2 donors with the shortest time between donations were associated with fixed locations and those alternating between fixed and mobile locations, even after controlling for differing mandatory recovery times for the different blood donation procedures.

As the US population ages, and those over 65, who represent 53% of the red blood cell (RBC) transfusion recipients, grows from 40 to 72 million by 2030, it is assumed that there will be an increase in the transfusion needs of the US population.^{1,2} As outlined by Riley and coworkers,³ approximately 37% of the US population is eligible to donate blood but only 5% actually participate in blood donor programs. This raises concern as to the viability of the blood donor pool, because the majority of current donors are older and may make fewer donations and become recipients as they age.

Several studies have investigated the reasons first-time donors do not return for a subsequent donation. These studies have documented the results of age,⁴ sex,^{5,6} education,^{5,7} race/ethnicity,^{8–10} convenience,^{8,9,11} donor intention to return,^{4,8} and donor return patterns.^{7,8} In 2009, Notari and colleagues¹² reported on donor age and its impact on return behavior in first-time donors over a 13-month period. Sixteen- and 17-year-old donors had the highest return rate with 62 and 52% returning, respectively, whereas donors 60 years and older had the next highest return rate at 48%. The frequencies of donations in the 13-month follow-up period were 2.61, 2.46, and 3.09 donations for 16-, 17-, and 60+-year-old donors, respectively, compared to 2.40 to 2.95 for donors aged 18 to 59 years.

Others have summarized the issues related to the donation experience that, if addressed, may change blood donation behavior. These issues include: 1) understanding the motivations of first-time versus long-term donors and their differing responses to incentives;¹⁰ 2) contacting first- and second-time donors in a timely fashion to schedule a repeat donation;^{5,7} and 3) deferral, reactions, pain, or anxiety during the first and second donation, all of which lead to lower return rates.⁴

Since donation frequency in the first year is correlated with an increased likelihood of returning during the next 6 years, encouraging first-time donors to make additional donations in the first year may produce more dedicated lifetime donors.⁷ This could be facilitated by providing these donors information on convenient donation locations for future donations, thereby potentially reducing blood donation barriers, especially among those who are interested and willing to become a regular donor.⁷

Convenience is important for donors. Bringing the donation site closer to the donor by conducting more mobile blood drives is one way to increase convenience, while at the same time contributing to blood center goals of increased numbers of donors and increased donation frequency. Of course, in this scenario, the number of donations is tied to the frequency the mobile site presents itself to the donor. With this in mind, the characteristics of donations at fixed versus mobile locations should be examined. Specifically, more information is needed about donors who visit fixed and mobile sites to better understand donation patterns and behavior for movement within and between these donation locations. This study investigates the demographic characteristics of donors by donation type (whole blood [WB], plateletpheresis [PP], and double RBC [R2]), the median number of donations (frequency), median interdonation interval, and the median return time (controlling for mandatory wait time).

MATERIALS AND METHODS

Data from six US blood centers participating in the Retrovirus Epidemiology Donor Study-II (REDS-II)—Blood Centers of the Pacific (San Francisco, CA); BloodCenter of Wisconsin

(Milwaukee, WI); Hoxworth Blood Center, University of Cincinnati (Cincinnati, OH); Institute for Transfusion Medicine (Pittsburgh, PA); American Red Cross, New England Region (Dedham, MA); and the American Red Cross, Southern Region (Atlanta, GA)—were included in the analysis. The REDS-II centers collectively account for approximately 8% of annual blood collections in the United States. Donation and deferral data were submitted monthly to the coordinating center (Westat, Inc., Rockville, MD) and were compiled into donation and deferral databases. Data collection was approved by all of the blood centers' and the coordinating center's institutional review boards.

Demographic information (age, sex, education, race/ethnicity), donation environment (fixed and mobile), and other characteristics (center ID, sponsor type, donation date, donation procedure, and donor status) were extracted from the REDS-II database, creating an analytic database specific for this study. All allogeneic WB, PP, and R2 donation visits between January 1, 2006, and December 31, 2009, were included in the analysis.

Additional variables not in the original data set were derived as necessary. Based on donation location data, a derived variable of "behavior type" was defined for each donor as: 1) a donor who donated exclusively at a fixed location two or more times; 2) a donor who donated exclusively at a mobile location two or more times; 3) a donor who started donating at a fixed location and then switched to a mobile location (donor gave at least two donations); 4) a donor who started donating at a mobile location and then switched to a fixed location (donor gave at least two donations); and 5) a donor who alternated between fixed and mobile location (donor gave at least three donations). An additional variable, donation environment, was divided into fixed and mobile locations. Mobile locations included business, civic or community, church, high school, military, college, health care, service group, and unknown locations.

Statistical analysis

Descriptive statistics of donor demographics and blood centers were stratified by three donation types, WB, PP, and R2, and further stratified by donation environment (fixed and mobile). All donors who donated exclusively WB, PP, or R2, at each donation visit were included in the analysis. All other donors who donated more than one donation type were excluded from the analysis. Next, the median number of donations given over the 4 years (frequency) for each behavior type as well as the median interdonation interval was stratified by WB, PP, and R2 donations.

Survival analysis of the median return time

Finally, an analysis of donation environment (fixed and mobile) and mobile sponsor type (i.e., business, church, civic or community, college, health care, high school, military and service group) stratified by donation type (WB, PP, and R2) was conducted utilizing a survival analysis. The survival analysis compared the model adjusted median return times between locations and donation type, while controlling for censoring of return times (donors unable to return because study concluded), age, sex, blood center, and varying mandatory recovery times (e.g., 56 days for WB, 112 days for R2, and 7 days for PP). All data analyses were conducted using statistical software (SAS, Version 9.1.3 and 9.2, 2004, SAS Institute, Inc., Cary, NC).

Separate models were developed for each donation environment, including fixed site and each sponsor type for mobile sites (i.e., business, church, civic or community, college, health care, high school, military and service group) to more accurately estimate median return time. The survival analysis used the lognormal distribution when the procedure was modeled. Predictors in the analysis included blood center, sex, age, race, and previous

donation type. Selected interactions between blood center, race/ethnicity, sex, and age group were also included. Records with negative return times (i.e., returning before the mandatory recovery time for the previous donation had expired) were excluded from the analysis (1%). Records missing the procedure type were imputed while a “missing” category was created for demographic variables that were missing. If the previous procedure type was missing, we classified it as WB, because this is the majority of blood donations.

RESULTS

Demographic characteristics of 4,990,619 donations were stratified by WB, PP, and R2 donations and further stratified by fixed and mobile donation locations (Table 1). Among WB donations, slightly more than two-thirds (67.9%) were made at mobile locations, R2 donations were made equally at fixed and mobile location sites, and PP donations were primarily made at fixed locations (97.4%).

A majority of WB and R2 donations were given at mobile sites at Blood Centers C and F (Blood Center C, WB 74.7%, R2 82.4%; Blood Center F, WB 85.2%, R2 69.6%), whereas other centers were evenly split between mobile and fixed sites for WB donations, and more R2 donations were at fixed sites. However, PP donations were primarily made at fixed locations among all the blood centers.

For each age category (see Table 1), the majority of WB donations were made at mobile locations (range, 52.7%–87.8%), whereas a majority of R2 donations were made at mobile locations for only two age categories (18–21 years, 84.0%; and 22–31 years, 54.0%). A majority of all race/ethnicities made WB donations at mobile locations (range, 68.5%–77.6%). For R2 donations, a majority of donations by blacks (70.5%), Hispanics (59.3%), and “other” (61.9%) were at mobile locations, whereas a small majority of whites gave at fixed locations (51.3%). Among first-time and repeat donors, an overwhelming majority (86.6%) of first-time WB donations were at mobile location sites, and nearly two-thirds (62.5%) of WB repeat donations were made at mobile location sites. First-time R2 donations were generally made at mobile location sites (83.5%), while a majority of repeat donations were at fixed locations (55.6%).

For donations made at mobile location sites (Table 2), the largest proportion of WB donations were made at civic or community (20.2%) and business (15.6%) locations. In contrast, R2 donations were primarily made at civic or community (13.4%), high school (10.5%), and business (9.8%) locations. PP donations were less concentrated across the mobile donation locations (range, 0.1%–1.1%).

The 4,990,619 donations were made by 1,636,238 donors; 1,438,714 donors made exclusively WB donations, 46,857 donors made exclusively R2 donations, 15,871 donors made exclusively PP donations, and the remaining 134,796 donors made a mixture of donation types. Table 3 includes the median donation count and interdonation interval (in days) for exclusively donating WB, PP, and R2 donors. The median number of WB donations was nine visits at both fixed-only locations and among those who alternated between mobile and fixed locations, with a median interdonation interval of 84 and 93 days, respectively (Table 3A). Mobile-only and mobile-to-fixed donations both had a median of four visits, while moving from fixed to mobile locations was five visits; median interdonation intervals ranged from 119 to 140 days.

When PP donations were considered (Table 3B), the largest median donation frequency was made by those alternating between fixed and mobile locations (29) while the fewest donations were made at mobile-only locations (nine). The median interdonation interval ranged from 28 to 70 days.

The largest median donation frequencies for R2 donations were made by those giving at a fixed site only and by those who alternated between mobile and fixed locations (Table 3C; eight visits). The median interdonation interval was shortest for fixed-only donation locations and longest at mobile-only locations (range, 133–180 days).

The survival analysis (Table 4) generated reports model-adjusted median return times stratified by WB, PP, and R2 donations. The model-adjusted median return time at fixed and mobile sponsor types, after controlling for the mandatory wait period for WB donations, ranged from 36 (fixed) to 243 (community or civic mobile sites) days. The model-adjusted median return time for PP ranged from 23 (fixed) to 693 (community or civic mobile sites) days and R2 ranged from 30 (fixed) to 270 (community or civic mobile sites) days.

Among service group donations, the model-adjusted median return times for WB, PP, and R2 were similar, 104, 108, and 110 days, respectively, as were the median return times for college donations, R2 (180 days), WB (186 days), and PP (208 days). PP and R2 donations were equivalent (111 and 113 days, respectively) when made at church locations and WB and/or R2 donations were similar when made at civic or community mobile donation locations (243 and 270 days, respectively). No overlap of median donation return time among the three donation types (WB, PP, and R2) was found for the remaining donation location sites (i.e., fixed, business, health care, high school, and military).

DISCUSSION

When donation location was stratified by donation type (WB, PP, or R2) and donation environment (fixed or mobile), WB donations were primarily given at mobile locations and R2 donations were given equivalently at mobile and fixed locations, whereas PP donations were given almost exclusively at fixed locations. All of the REDS-II blood centers included RBC automation on their mobile blood drives during the observation period; however, only two of the six offered platelet automated collections on mobile blood drives during this time.

To our knowledge, this is the first study to examine mobile sponsor type and its effects on the frequency of donor return. When mobile operations were separated by mobile sponsor type, the largest proportion of WB donations was given at civic or community (20.2%) followed next by business (15.6%) and high school (10.0%) locations. No a priori assumption was made for mobile sponsor type and donation return time. However, the majority of first-time WB (86.6%) and R2 (83.5%) donations were made at mobile locations. Donors less than 32 years old made the majority of their WB and R2 donations at mobile locations. With such a large number of first-time and younger donors, mobile collections may present opportunities to increase the pool of younger donors and move these first-time donors toward repeat donor behavior such as donations at fixed-site locations. As reported, the frequency of donation during the first 12 months after initial donation increases the likelihood of becoming a regular (“committed”) donor.^{7,8}

Although first-time and repeat donations were more likely at mobile locations for WB donors, the estimated number of median donations (frequency) was highest for those donating at fixed only and those who alternated between fixed and mobile locations. While first-time R2 donors primarily gave at mobile locations and repeat donors gave at fixed sites, the estimated number of median donations was nearly identical to WB donors. Similarly, for WB and R2 donors the median interdonation interval time was lowest for those donating at fixed-only and those who alternated between mobile and fixed sites. This suggests that when donors at mobile sites are aware of a fixed donation location in their community and alternate between mobile and fixed sites, they are more likely to return for a subsequent donation and more likely to return sooner after that donation. All but one of the six centers

offered donor information about donating at fixed sites and four have a program encouraging donations between mobile visits. Although the numbers were small, the increase in frequency of donations from donors who alternated donations between mobile and fixed-site locations was noticeable.

Taking this one step further to explore donation return time for WB, PP, and R2, among the donation locations for fixed and mobile sponsor types, the shortest model-adjusted median return time (controlling for mandatory wait times) was found at fixed sites (range, 23 days [PP] to 36 days [WB]). It may be that fixed location sites have the shortest median return time because the opportunity to donate on mobile sites is less frequent. On the other end, the longest estimated median interdonation interval time for WB, PP, and R2 donations was civic- or community-type mobile drives (range, 243 days [WB] to 693 days [PP]). These large intervals may be due to mobile scheduling resulting in fewer opportunities to donate in that mobile setting, or those donors are unaware of fixed site locations nearby. The excessively long time between PP donations is more a function of mobile capabilities to perform PP donations rather than the absence of mobile sites or interest of the donor. To shorten the return time between PP donations, donors should be informed of their date of eligibility and given information on when and where they can make their next donation making note of fixed sites, especially if the donation is provided in a mobile environment. Providing this information could potentially reduce the interdonation interval, especially among those who only make PP donations. However, to determine if this information is productive in reducing time between donations, further studies are needed.

An interesting outcome from the review of donation location is that service group and college return times are similar for WB, PP, and R2 donations (service group, 104–110 days; college, 180–208 days). PP and R2 return times are equivalent for donations that were provided at church locations, 111 and 113 days, respectively, whereas return times at civic or community sites were similar for WB (243 days) and R2 (270 days). This suggests that return time is most likely impacted by the mobile schedule and the ability of the location to accommodate the time and the equipment needed for longer donation procedures such as PP donations.

Our study has some limitations. While we could track donor movement between fixed versus mobile donation locations, we could not track the frequency that donors who donated at a mobile site returned to a specific location and were thus unable to determine if donors had the ability to donate more often at mobile locations. If some donors did donate more frequently than observed, such as donating at non-REDS blood centers, our estimates of median return time would be somewhat inflated over what might actually exist. Based on the distance of the majority of REDS-II centers from other blood centers this is unlikely. Therefore, we made the assumption that all donations were made at the six REDS-II blood centers. Notwithstanding these issues, our data characterize all WB, PP, and R2 donations made at fixed and mobile locations at each of the six centers during the time frame of analysis. The six centers might not reflect the experience in the US as a whole but they do provide data from centers located in different regions of the country with different demographics that are informative about these issues. They are representative of practices in these six different centers since median return times were calculated giving equal weight to each center.

Limited studies have been conducted investigating donor return at fixed versus mobile locations, and none have compared fixed and mobile sponsor types. The results from our study indicate that the largest number of donations (nine) and the shortest time between donations (28–140 days) occur at fixed-only sites and by donors who alternate between fixed and mobile site locations for WB or PP or R2 donations. This suggests that mobile

donation sites should provide information about fixed-site locations to donors to encourage donation during mobile intervals or that blood centers create more frequent mobile opportunities for donor participation. All such considerations would need to be balanced against cost and efficiency issues. Finally, the estimated median return time, after adjusting for demographics and select characteristics, was shortest (23–36 days) for donations at fixed sites and among mobile locations with service groups (104–110 days).

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ABBREVIATIONS

PP	plateletpheresis
R2	double red blood cell (donation)
WB	whole blood

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TABLE 1

Frequency of blood center and demographic factors by WB, PP, and R2 donations among the six REDS-II blood centers, 2006 through 2009*

	WB		PP		R2	
	Fixed	Mobile	Fixed	Mobile	Fixed	Mobile
Total	1,400,624 (32.1)	2,957,059 (67.9)	322,395 (97.4)	8732 (2.6)	150,745 (49.9)	151,064 (50.1)
Blood center						
A	361,081 (53.1)	319,219 (46.9)	50,373 (90.4)	5368 (9.6)	33,420 (75.8)	10,695 (24.2)
B	199,854 (52.1)	183,590 (47.9)	28,373 (99.6)	128 (0.4)	29,991 (59.4)	20,545 (39.6)
C	277,493 (25.3)	818,671 (74.7)	69,697 (100)	14 (0)	8,173 (17.6)	38,407 (82.4)
D	136,982 (47.5)	151,336 (52.5)	8,684 (95.3)	431 (4.7)	29,207 (69.2)	13,025 (30.8)
E	215,651 (43.9)	275,462 (56.1)	18,735 (100)	0 (0)	33,880 (51.7)	31,605 (48.3)
F	209,563 (14.8)	1,208,781 (85.2)	146,533 (98.1)	2791 (1.9)	16,074 (30.4)	36,787 (69.6)
Sex						
Male	713,464 (50.9)	1,424,873 (49.1)	200,210 (96.8)	4665 (3.2)	134,135 (49.8)	134,987 (50.2)
Female	687,151 (49.1)	1,532,167 (50.9)	122,185 (97.7)	4067 (2.3)	16,607 (50.8)	16,072 (49.2)
Age (years)						
18-21	94,844 (12.2)	685,865 (87.8)	8,030 (83.2)	1617 (16.8)	8,186 (16.0)	43,000 (84.0)
22-31	151,612 (28.9)	373,416 (71.1)	24,924 (97.1)	752 (2.9)	16,361 (46.0)	19,209 (54.0)
32-41	186,367 (30.1)	433,184 (69.9)	36,956 (97.4)	994 (2.6)	22,199 (50.5)	21,783 (49.5)
42-51	356,339 (35.5)	648,428 (64.5)	92,711 (97.8)	2044 (2.2)	42,377 (57.4)	31,404 (42.6)
52-61	378,227 (41.3)	538,033 (58.7)	104,695 (98.2)	1929 (1.8)	41,358 (62.1)	25,265 (37.9)
62-71	175,915 (45.1)	214,150 (54.9)	44,450 (97.6)	1074 (2.4)	16,561 (65.4)	8,780 (34.6)
72	57,320 (47.3)	63,983 (52.7)	10,629 (97.1)	322 (2.9)	3,703 (69.5)	1,623 (30.5)
Race/ethnicity						
White	1,266,719 (33.1)	2,562,905 (66.9)	304,030 (97.3)	8423 (2.7)	138,461 (51.3)	131,247 (48.7)
Asian	28,241 (31.5)	61,356 (68.5)	3,064 (99.4)	18 (0.6)	3,224 (50.0)	3,231 (50.0)
Black	47,234 (22.4)	163,519 (77.6)	5,650 (98.6)	79 (1.4)	2,919 (29.5)	6,979 (70.5)
Hispanic	37,451 (27.4)	99,080 (72.6)	4,884 (97.4)	133 (2.6)	3,997 (40.7)	5,824 (59.3)
Other	16,173 (25.2)	47,960 (74.8)	4,443 (98.3)	77 (1.7)	1,634 (38.1)	2,657 (61.9)
Donor status						
First-time	128,642 (13.4)	828,880 (86.6)	16,292 (92.1)	1390 (7.9)	7,163 (16.5)	36,299 (83.5)

	WB		PP		R2	
	Fixed	Mobile	Fixed	Mobile	Fixed	Mobile
Repeat	1,270,954 (37.5)	2,119,351 (62.5)	305,944 (97.7)	7338 (2.3)	143,556 (55.6)	114,483 (44.4)
Education						
High school	48,201 (10.1)	429,720 (89.9)	4,715 (78.4)	1298 (21.6)	4,644 (13.8)	29,084 (86.2)
High school or GED	192,527 (30.9)	430,379 (69.1)	35,082 (96.8)	1172 (3.2)	19,695 (48.5)	20,944 (51.5)
Some college	423,452 (33.0)	860,435 (67.0)	92,291 (97.1)	2771 (2.9)	48,079 (52.2)	44,014 (47.8)
College	616,824 (37.7)	1,019,374 (62.3)	130,747 (98.4)	2145 (1.6)	69,923 (59.5)	47,616 (40.5)

* Data are reported as number (%).

TABLE 2

Number of donations made at fixed and mobile location sites by WB, PP, and R2 donations among the six REDS-II blood centers, 2006 through 2009*

Location	WB	PP	R2
Fixed	1,400,624 (32.1)	322,395 (97.4)	150,745 (50.0)
Mobile	2,957,059 (67.9)	8,732 (2.6)	151,064 (50.0)
Business	679,925 (15.6)	1,017 (0.3)	29,466 (9.8)
Church	238,018 (5.5)	941 (0.3)	12,745 (4.2)
Civic or community	881,975 (20.2)	1,196 (0.4)	40,401 (13.4)
College	266,277 (6.1)	287 (0.1)	12,663 (4.2)
Health care	187,291 (4.3)	3,594 (1.1)	7,448 (2.5)
High school	436,397 (10.0)	1,454 (0.4)	31,762 (10.5)
Military [†]	24,512 (0.6)	0 (0.0)	1,389 (0.5)
Service group	133,038 (3.1)	194 (0.1)	3,994 (1.3)
Unknown	109,626 (2.5)	49 (0.0)	11,196 (3.7)

* Data are reported as number (%).

[†] PP collections are not performed at military donation locations.

TABLE 3

Median donation frequency for WB, PP, and R2 visits at the six REDS-II participating blood centers, 2006 through 2009

Behavior type	Number of donors	Number of donation intervals	Median donation frequency	Interdonation interval (in days)
A. WB				
1. Fixed only (many)	108,675	611,015	9	84
2. Mobile only (many)	454,696	1,345,280	4	140
3. Fixed to mobile	25,499	91,832	5	130
4. Mobile to fixed	56,791	194,285	4	119
5. Alternates between mobile and fixed	55,676	479,005	9	93
B. PP				
1. Fixed only (many)	10,618	196,796	28	28
2. Mobile only (many)	108	1,284	9	70
3. Fixed to mobile	29	4,776	12	36
4. Mobile to fixed	61	21,107	16	28
5. Alternates between mobile and fixed	224	46,388	29	28
C. R2				
1. Fixed only (many)	10,618	196,796	28	28
2. Mobile only (many)	108	1,284	9	70
3. Fixed to mobile	29	4,776	12	36
4. Mobile to fixed	61	21,107	16	28
5. Alternates between mobile and fixed	224	46,388	29	28

TABLE 4

Model-adjusted median return time after a WB, PP, and R2 donations standardized for center, age, and sex across fixed and mobile locations at the six REDS-II blood centers, 2006 through 2009^{*}

Location of donation	WB	PP	R2
Fixed	36 (35.8–36.0)	23 (22.8–23.2)	30 (29.6–30.4)
Business	124 (123.2–124.7)	161 (158.0–164)	118 (116.8–119.2)
Church	133 (131.9–134.6)	111 (108.6–113.5)	113 (111.6–114.4)
College	186 (183.5–189.2)	208 (181.1–191.0)	180 (178.1–181.9)
Civic or community	243 (191.5–293.8)	693 (684.7–701.3)	270 (264.5–275.5)
Health care	107 (100.8–113.3)	34 (33–35)	93 (91.4–94.6)
High school	187 (185.7–188.9)	255 (251.4–258.6)	110 (104.1–107.9)
Military [†]	117 (112.7–122.2)	N/A	146 (143.0–149.0)
Service group	104 (97.1–110.5)	108 (104.3–111.7)	110 (108.1–111.9)

^{*} Data are reported as median return time in days (95% CI). Return time accounts for the mandatory wait time between donations.

[†] PP collections are not performed at military donation locations.