

Adjusting our management of female blood donors: the key to an adequate blood supply

Bruce H. Newman

A sufficient RBC supply in the US is dependent on the fulfillment of four goals: 1) national RBC collections must exceed demand; 2) all eight ABO-Rh blood groups must be present in sufficient quantities; 3) all eight ABO-Rh blood groups must be present in sufficient quantities at all times; and 4) all eight ABO-Rh blood groups must be present in sufficient quantities at all locations.

Blood centers collect 93 percent of the blood in the US¹ and can be divided into those that always have a sufficient RBC supply for their hospitals and those that do not. Blood centers that have a large nonmetropolitan territory and serve areas of low blood usage are able to collect beyond their needs and can export blood. In contrast, blood centers that supply blood to hospitals in large metropolitan areas often are unable to meet hospital needs all the time because of either undercollection or high blood usage in large cities. Such blood centers rectify the imbalance between demand and supply by contracts with exporting blood centers. Table 1 shows the results of a survey from seven blood centers that serve 7 of the 11 largest metropolitan communities in the US. The survey shows that metropolitan blood centers do not meet the demand within the metropolitan community and must import blood, because the donor pool is inadequate or the cost of incremental donations is too high. Imports work well during the fall, spring, and most of the winter but often are insufficient during the summer and winter vacations, when all blood collection facilities are stressed because schools are closed and many blood donors are away on vacation. Besides the issue of having an adequate

total supply, there is the issue of having a sufficient quantity of all ABO-Rh blood groups. Supplies of some ABO-Rh blood groups are more difficult to sustain because they are overtransfused (Group O+, all D- blood groups) or undercollected (Group B+), whereas other blood groups are overcollected (Group A+, AB+) and thus have higher expiration rates. Thus, blood centers in large metropolitan communities might have RBC shortages for all groups or specific groups, and the probability of such occurrences is greater in the summer and during or after the winter holidays.

Sufficient blood donor recruitment and retention can prevent a blood shortage and the associated patient harm and health-care worker stress. Women, who are more willing to donate blood than men and whose health requirements for donation are ignored, as shown below, are the key to an adequate blood supply. Changes that could be made in how we collect blood from women have the potential to increase the blood supply in the US by as much as 28 percent. This commentary will list the necessary changes that are needed to maximize blood collections from women and will provide data and explanations on the potential benefits from these changes.

Female and male blood donation data at the American Red Cross Southeastern (SE) Michigan Region in Detroit between July 1, 2002, and June 30, 2003, are presented in Table 2. The presentation rate was 56 percent for men versus 44 percent for women at age 17 years, when donors first had an opportunity to donate blood; women had a 57 percent presentation rate through the age of 29 years. These data translate into 31 percent more presentations for women than men. Table 3 shows a similar presentation rate for women for the calendar years 1994 to 1996 at the SE Michigan Region, and 1998 data from eight blood centers show the same pattern.² The presentation percentage for women decreases after age 30 and men predominate in the fifth decade and thereafter. The change is potentially due to two factors. First, women have a much higher deferral rate than men, 21 percent versus 6 percent (Table 2), which is due to a much higher incidence of deferrals for low Hb level in women, 16 percent versus 1 percent in men. Deferral by itself decreases the presentation rate, even if the deferral is for a short-

From the American Red Cross Blood Services, Southeastern Michigan Region, and the Wayne State University School of Medicine, Detroit, Michigan.

Address reprint requests to: Bruce H. Newman, MD, Medical Director; American Red Cross, SE Michigan Region; 100 Mack; Detroit, MI 48201; e-mail: newmanb@usa.redcross.org.

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term temporary reason.³⁻⁵ Two studies showed that a deferral had an even more pronounced effect in first-time blood donors.^{4,5} More importantly, a donor repeatedly deferred for low Hb level might stop presenting altogether.

A second factor contributing to the decrease in the presentation percentage for women with advancing age is that women have more adverse physical effects from

blood donation than men (48% vs. 23%),⁶ and some of these effects are associated with lower presentation rates.⁷ Adverse effects were observed in 1000 randomly selected blood donors, who were interviewed 3 weeks after the blood donation.⁶ The vasovagal reaction rate was 9.0 percent in women vs. 4.5 percent in men based on observation and interview;⁸ the fatigue rate was 11.1 percent vs. 4.0 percent; and the sore arm rate was 12.5 percent vs. 6.9 percent.⁶ Women weigh less than men, and studies show that vasovagal reactions and fatigue are inversely related to weight.^{6,9} A follow-up 1 year later on the 1000 blood donors showed that the return presentation rate was decreased by 45, 37, and 15 percent in donors with a vasovagal reaction, fatigue, or sore arm, respectively, in comparison to donors who had no complaints.⁷ Return rates for women were 16 percent lower than return rates for men

TABLE 1. Whole-blood collections and RBC transfusions in seven large metropolitan communities (2002-2003)

Metropolitan region	Metropolitan population (millions)	Total number of urban collections (thousands)	Total number of urban transfusions (thousands)	Net deficit (thousands)
1	15.4	591	729	138
2	7.2	258	347	89
3	5.9	217	340	123
4	4.8	253	273	20
5	4.4	213	251	34
6	3.6	135	173	43
7	3.0	148	281	133

TABLE 2. Donor presentations, deferrals, and productive units for July 1, 2002, to June 30, 2003,* American Red Cross, SE Michigan Region, Detroit, Michigan

	Age group (years)							Total	
	17	18-19	20-29	30-39	40-49	50-59	60-69		70-79
Women									
Number of presentations	10,023	6,606	18,111	23,481	35,461	25,229	9,420	3,373	131,704
Number of deferrals	2,324	1,497	3,969	5,252	7,584	4,392	1,693	653	27,364
Deferral percentage	23	23	22	22	21	17	18	19	21
Number of productive units	7,699	5,109	14,142	18,229	27,877	20,837	7,727	2,720	104,340
Men									
Number of presentations	7,836	5,279	13,309	24,695	37,544	30,966	12,074	4,448	136,151
Number of deferrals	528	270	672	1,209	1,757	1,728	858	496	7518
Deferral percentage	7	5	5	5	5	6	7	11	6
Number of productive units	7,308	5,009	12,637	23,486	35,787	29,238	11,216	3,952	128,633
Percentage of presentations from women	56	56	58	49	49	45	44	43	49
Percentage of productive units from women	51	50	53	44	44	42	41	41	45

* Hb deferral based on capillary sample from finger tested by copper sulfate screening test with microhematocrit follow-up on failures.

TABLE 3. Donor presentations, deferrals, and productive units for 1994 to 1996,* American Red Cross, SE Michigan Region, Detroit, Michigan

	Age group (years)							Total
	17-19	20-29	30-39	40-49	50-59	60-69	70-79	
Women								
Number of Presentations	39,880	61,600	84,487	88,886	45,851	21,855	8,170	351,670
Number of deferrals	6,303	7,639	9,245	9,469	4,131	1,771	875	39,433
Deferral Percentage	16	12	11	11	9	8	11	11
Number of productive units	33,577	53,961	75,242	79,417	41,720	20,084	7,295	312,237
Men								
Number of presentations	28,946	49,127	82,663	96,966	59,821	29,863	9,191	357,119
Number of deferrals	3,194	3,810	4,315	5,193	3,874	2,155	816	23,357
Deferral Percentage	11	8	5	5	6	7	9	7
Number of productive units	25,752	45,317	78,348	91,773	55,947	27,708	8,375	333,762
Percentage of presentations from women	58	56	51	48	43	42	47	50
Percentage of productive units from women	57	54	49	46	43	42	47	48

* Hb deferral based on capillary sample from ear tested by copper sulfate screening test with microhematocrit follow-up on failures.

and specific issues such as vasovagal reaction and fatigue decreased return presentations in women by 53 and 34 percent in comparison to similar groups of men, respectively.⁸ Thus, the data show that the blood donor's physical experience does affect return rates and that return presentations for women are lower than those for men and are particularly affected by adverse effects that relate to lower weight.

It is clear overall that women are affected by the Hb issue and by their smaller size. Therefore, actions to increase female participation must: 1) improve access to blood donations by lowering the Hb acceptance standard, 2) improve retention through iron repletion for menstruating female donors, and 3) improve return rates for women by decreasing vasovagal reactions and fatigue. Each of these will be reviewed.

HB ISSUES

Increase female eligibility—lower the Hb acceptance standard

The high deferral rate in women is due to the high percentage of deferrals for low Hb level. These deferrals ranged from 16 to 19 percent at the SE Michigan Region over the past 2 years. In comparison, the Hb deferral rate for men for the same period was less than 1 percent. These differences are due to the Hb acceptance standard of 12.5 g per dL, which is set by the FDA. The 12.5 g per dL cutoff is in the normal range for Caucasian women (11.6-15.7 g/dL), but below the normal range for Caucasian men (13.3-17.2 g/dL). The normal range is defined as being in the middle 95 percent for the 18- to 64-year-old population with data from the 1976 to 1990 National Health and Nutrition Examination Survey (NHANES II).¹⁰ In contrast to Caucasian women, African-American women have a lower normal range for Hb level (10.5-15.0 g/dL),¹⁰ and their deferral rate is in the 25 to 30 percent range based on a study of 729 African-American women at the SE Michigan Region. The SE Michigan Region's deferral rates are consistent with data from other American Red Cross blood centers and the projected deferral rates with NHANES II data.¹⁰ Data from 200 consecutive deferrals for low Hb level in 2001 at the SE Michigan Region, with a finger stick capillary sample, showed that 97 percent of the low Hb level deferrals occurred in women, and 64 percent of the women had Hct levels of 36 and 37 percent. Hct levels of 36 and 37 percent are within normal limits (36%-48%) for Caucasian women. It is clear that a high percentage of women with normal Hb concentrations are being deferred. Based on SE Michigan Region data and NHANES II data, a change in the Hb cutoff from 12.5 to 12.0 g per dL for women would increase the blood supply in the US by approximately 5 to 5.5 percent, and this would occur without any additional recruitment.

Increase retention of women—iron repletion for menstruating women who successfully donate whole blood

Data from the SE Michigan Region show that 71 percent of the female blood donors are under 50 years of age (Table 2) and most can be presumed to be premenopausal. Premenopausal women have lower iron storage levels than men, 300 mg versus 1000 mg. A single blood donation depletes approximately 200 to 250 mg of iron¹¹ and can prevent already iron-depleted women from adequately replacing the blood lost. In addition, iron depletion is not always benign. Female blood donors sometimes present to physicians with symptoms of fatigue or lack of energy after one or more blood donations and are evaluated for blood loss. Medical evaluations can lead to invasive endoscopic procedures to determine whether the blood loss is from the gastrointestinal tract. It is imperative therefore that iron stores be repleted. This replacement should be performed under the philosophy of "do not harm" and to allow adequate and quick replacement of RBCs in women. A diet high in iron is helpful, but short-term iron supplementation with carbonyl iron is clearly superior and has been shown to be effective in cohort studies.¹²⁻¹⁵ This practice is standard for autologous blood donation but is not yet standard of practice for allogeneic blood donation in menstruating women.

The approach in menstruating women should be short-term iron replacement for those who successfully donate, not for those who are deferred. Treatment of deferrals has the risk of masking blood loss and some deferred donors might have a serious underlying condition that needs to be evaluated and managed. A study found that a single carbonyl iron dose of 100 mg per day for 56 days effectively replaced the blood loss in 85 percent of the donors.¹⁵ Carbonyl iron is well tolerated and superior to the ferrous form relative to gastrointestinal symptoms. It is also less toxic relative to massive ingestion, which is no longer an issue for small children because every iron pill is now individually packaged. It is important that blood centers emphasize to donors that the iron is for short-term replacement therapy and not for ongoing usage.

In summary, a Hb cutoff standard of 12.0 g per dL is important to allow access to blood donation, but short-term carbonyl iron supplementation is critical to replete iron stores, allow replacement of the blood, and keep female blood donors within the active donor pool.

IMPROVE THE FEMALE BLOOD DONOR'S EXPERIENCE

Increase return rates for women—decrease vasovagal reactions and fatigue

Women have more risk for a vasovagal reaction and fatigue than men because they weigh less.^{6,16} There are

several potential methods to reduce the vasovagal reaction rate, which could improve the blood donation experience and consequently the blood donor return rate. Methods that reduce the vasovagal reaction rate may also reduce the fatigue rate because both are inversely related to weight.⁶

The following is a review of three potential methods for reducing vasovagal reactions and fatigue. Each potential method has its advantages and disadvantages and differs in feasibility and proven efficacy. The alternative of not doing anything will also be reviewed.

Use automated machines to collect from first-time blood donors and blood donors who complain of a vasovagal reaction or fatigue

Automated equipment is currently being used to collect double RBC units if the donor has a Hct level of 40 percent or greater and meets the weight and height requirements. The phlebotomy time is longer (25-40 min vs. 4-20 min for manual collection), but double RBC procedures are associated with a lower vasovagal reaction rate owing to the blood donor's larger size, volume repletion with saline, and possibly the longer collection time.¹⁷

One could use these machines in first-time blood donors and in donors who complain of a vasovagal reaction or fatigue on a previous blood donation. The availability of this option would need to be communicated to all donors, so that blood donors were aware of an alternative option and did not just stop donating blood after having a vasovagal reaction or fatigue. The disadvantages of automated methods are the increased labor and disposable-equipment costs and an increased phlebotomy period. The feasibility of this approach is unclear.

Load blood donors with water, isotonic fluids, or caffeine before blood donation to potentially decrease vasovagal reactions

Several articles have shown that water temporarily increases blood pressure in elderly patients with orthostatic hypotension for several hours and also increases blood pressure in normal adults for several hours.¹⁸⁻²⁰ It has been suggested that water might be beneficial to prevent vasovagal reactions in blood donors.²¹ If so, other fluids that contain salts might also be beneficial and perhaps more so. Two other articles^{22,23} suggest that caffeine might be beneficial, but there is a theoretical concern that caffeine might increase vasoconstriction and decrease successful phlebotomies. These three options should be tested in a large clinical trial.

Collect a 250-mL unit from some blood donors

A proven method to reduce vasovagal reactions is to reduce the volume of blood removed.²⁴ This concept may

be particularly efficacious in first-time and small blood donors who have more risk for a vasovagal reaction.²⁵ Figure 1 shows the vasovagal reaction rate for first-time and repeat blood donors from a general donor pool of 1000 blood donors, based on observation and interview. Both first-time and repeat blood donors have a vasovagal reaction rate that is inversely related to weight, and the rate is very pronounced in first-time donors who weigh 110 to 139 lb. In contrast, a first-time blood donor who weighs 185 lb. (84 kg) has a low vasovagal reaction rate, and based on a 525-mL phlebotomy, the collection volume is 6.25 mL per kg. Donations of less than 6.25 mL per kg should result in a low vasovagal reaction rate. A 250-mL donation, plus an additional 44 mL for testing and waste in the tubing, for a total of 294 mL falls below the 6.25 mL per kg collection volume for blood donors who weigh 110 to 174 lb. (50-79 kg). It would therefore markedly decrease vasovagal reactions in first-time blood donors who weigh less than 175 lb.

A blood center could potentially mandate a 250-mL blood donation for all first-time blood donors who weigh less than 175 lb. (79 kg) and allow choice for other donors. A blood center could limit the percentage of 250-mL units collected to 10 or 15 percent, thus preventing vasovagal reactions but limiting the number of small units.

This type of dual system is in place in Japan (Hisami Ikeda, Hokkaido Red Cross Blood Center, Japan and Masahiro Satake, Tokyo Red Cross Blood Center, Japan, written communications, 2003).²⁶ First-time donors, small donors (40-50 kg), and donors with a Hb level between 12 and 12.5 g per dL can only donate 200-mL units of whole blood. Donors over 50 kg with a Hb level of at least 12.5 g per dL have a choice. Approximately 70 percent of the donations in Japan are 400-mL donations and 30 percent are 200-mL donations. The vasovagal reaction rates are similar in both groups, being quite low at 0.6 to 0.7 percent, based on 3.3 million whole-blood

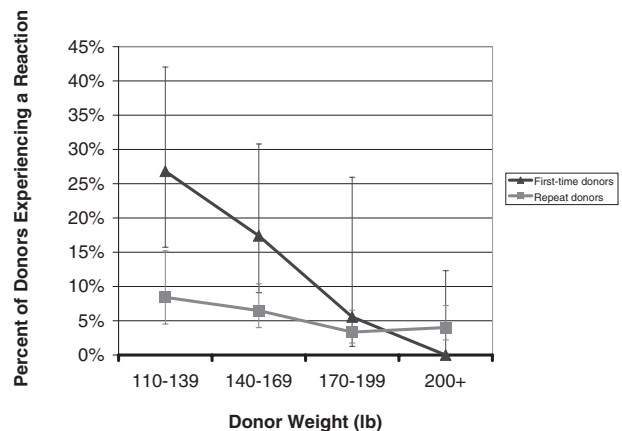


Fig. 1. Vasovagal reactions versus weight. (▲) First-time donors; (■) repeat donors.

donations (Hisami Ikeda, Hokkaido Red Cross Blood Center, Japan and Masahiro Satake, Tokyo Red Cross Blood Center, Japan, written communications, 2003). Japanese blood centers encourage 400-mL donations because of issues related to increased costs, double inventory, and donor exposures, but recognize the smaller donation as being useful for small and first-time blood donors.

The alternative—continue to collect large whole-blood units and make no changes to alleviate vasovagal reactions and fatigue

Increasing access to female blood donors and iron repletion might by themselves provide a sufficient number of blood donations to ensure an adequate RBC supply in the US. Other approaches such as more innovative recruitment or better-organized recruitment could also increase the number of blood donations. Yet, continuing the current approach is to accept that blood donor discomfort and reactions are part of the process for first-time and smaller donors when measures could be taken to ease the discomfort and improve blood donor safety. At present, 12 percent of all donors who weigh less than 150 lb. and 22 percent of all first-time donors who weigh less than 170 lb. have a vasovagal reaction.^{6,7} Thirteen percent of all donors who weigh less than 150 lb. develop fatigue.⁶

In summary, increasing access for women through a lower Hb level acceptance standard and retaining them through iron repletion and a better physical experience could increase the RBC supply significantly. If we could maintain the women's initial presentation rates of 57 percent and collect equally from women and men on a per-presentation basis, the blood supply could be increased by as much as 28 percent, based on the current male productivity rate (Table 2). Making changes related to the Hb issue and not the physical experience would significantly increase the blood supply but not as much.

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