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# Medical Students' Knowledge, Familiarity, and Attitudes towards Hematopoietic Stem Cell Donation Stem Cell Donation Behaviors

Praveena Narayanan, Alexandra Wolanskyj, Shawna L. Ehlers, Mark R. Litzow, Mrinal S. Patnaik, William J. Hogan, Shahrukh K. Hashmi *

*Department of Internal Medicine, Mayo Clinic, Rochester, Minnesota*

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A B S T R A C T

Hematopoietic stem cell transplantation (HSCT) is a potentially curative treatment for patients with blood disorders and genetic diseases. Approximately 70% of the HSCTs currently performed in the United States use stems cells from an unrelated donor who donated voluntarily. Medical students (MS) are a young, diverse, influential population whose willingness to engage in altruistic acts, such as donating stem cells, may be correlated with knowledge on the topic. A literature gap exists in MS perspectives towards HSCT and the bone marrow registry (BMR) and prior studies suggest that misconceptions about donation deter MS from participation on the BMR, which may decrease opportunities to educate other potential donors. We performed a cross-sectional survey among the 4-year cohort of MS at Mayo Medical School in Rochester, Minnesota. The questionnaire evaluated multiple areas including whether MS were current members of the BMR and/or prior blood donors, MS current knowledge on donor eligibility (DE) and the donation process (DP), MS familiarity with HSCT and the DP, and MS attitudes towards joining the BMR and towards donating stem cells. The responses were analyzed and assessed alongside a self-reported, standardized scale measuring students' altruistic behaviors. There were 99 out of 247 potential respondents (40%), with 45% (n = 44) of MS in preclinical years 1 or 2, 37% (n = 37) in clinical years 3 or 4, and 18% (n = 18) in research or alternative portions of their training, of which 43% (n = 41) in total were current BMR members. BMR status correlated positively with prior blood donation ($P = .015$) and female sex ($P = .014$). Respondents had a 57.7% and 63.7% average correct response rate regarding knowledge of DE and DP, respectively, with knowledge of DE not surprisingly higher in BMR members ($P < .0001$). The majority of MS surveyed, 68% (n = 65), had learned about HSCT during medical school. BMR status correlated with the following attitudes towards donating stem cells: lower concern with all evaluated aspects of HSCT—time, cost, pain, and side effects (for all subsections, $P < .05$) but not with the altruism score ($P = .32$). The mean altruism score for respondents was 59.9 ± 11.3 (of a possible 100 points) with no significant difference in age, race, sex, level of training, or participation in the BMR. Altruism scores did not directly correlate with lower concern with aspects of time, cost, and pain of HSCT but did with long-term side effects ($P = .021$). This latter correlation was regardless of BMR status. Among MS, positive predictors for participation in the BMR included prior blood donation and female sex. BMR status did not ensure knowledge of all aspects of donating stem cells, but it correlated with less concern regarding the DP and was unrelated to altruism score. Improving knowledge gaps regarding the BMR and HSCT for the next generation of physicians and health care providers through expanded medical education curriculum may be beneficial to for the recruitment and retention of donor populations to the BMR.



## INTRODUCTION

Allogeneic hematopoietic stem cell transplantation (HSCT) is the curative treatment for a number of blood disorders, including leukemia, genetic diseases, and autoimmune disorders [1]. Peripheral blood stem cell donation, a simpler and less invasive alternative, has replaced bone marrow harvest in 75% of cases [2]. Thus, the term *bone marrow transplantation* has since become a misnomer and is more accurately referred to as HSCT.

Of the > 8000 allogeneic transplantations performed yearly in the United States, over one-half rely on the supply of hematopoietic stem cells (HSC) from unrelated donors [3]. The

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* Correspondence and reprint requests: Shahrukh K. Hashmi MD, MPH, Department of Internal Medicine, Mayo Clinic, 200 First Street SW, Rochester, MN 55905.

*E-mail address:* Hashmi.shahrukh@mayo.edu (S.K. Hashmi).

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National Marrow Donor Program has created a network of more than 12 million potential donors through Be The Match, the national bone marrow registry (BMR), to connect patients with an HLA-matched donor [4]. However, the mixing of genes in the population has resulted in a significant linkage disequilibrium that may make the process of finding a full donor match increasingly difficult in the future [5]. The current make-up of the BMR is 60% Caucasian, leaving a limited pool of potential donors for patients of ethnically and racially diverse backgrounds [3]. Furthermore, current recruitment, retention, and utilization rates of potential minority donors are not sufficient to meet projected demands for HLA-matched unrelated donors [6-8].

Many non-HLA factors contribute to the success of the BMR. Young, healthy donors are preferred for their longer eligibility on the BMR and have documented better transplantation outcomes [9]. Because joining the BMR is not a binding agreement to donate, it is imperative that donors are well informed and willing to donate. Misconceptions of stem cell donation as a painful, time-consuming, and costly process may account for the substantial attrition rates on the BMR [8,10]. Individuals' intrinsic commitment to donate and the establishment of realistic expectations at the time of joining the BMR are attributed to lower attrition rates [10,11]. Thus, educational efforts are a crucial component of the recruitment and retention process for the BMR.

The drive to increase awareness and participation in the BMR parallels similar efforts in blood [12,13] and organ donation [14-18]. Research in the latter has revealed that an individual's attitudes and beliefs towards organ donation positively correlate with his or her willingness to register as organ donors and follow through with donation [14-16]. These studies have been conducted on both the general population as well as within targeted populations, such as medical students (MS). For MS, a correlation between willingness to donate solid organs and years of medical education has been documented [17,18].

MS are a unique and powerful study group to consider. They represent an ideal donor demographic for stem cells as young, diverse, and motivated individuals. As future health care leaders, MS will be sources of information or misinformation and may influence patient behavior via social norms [19]. Despite these qualities, MS remain a particularly overlooked population in the assessment of knowledge, attitudes, and behaviors regarding stem cell transplantation. Studies of university students in Turkey and Poland have shown that even brief educational efforts can generate more interest and positive attitudes towards the BMR [20,21]. Among MS as a study population, there is evidence to suggest that the use of emotional appeal and tailored health communications has a positive effect on intentions to donate [22]. Overall, however, previous polling of MS who are not on the BMR suggests they hold significant misconceptions that deter them from participation [23]. Among all newly recruited unrelated potential donors, an intrinsic commitment to donate without external pressure or concerns about donation risks has been found to be associated with less uncertainty about carrying through with donation [14].

A question that remains unanswered is how MS' behaviors are shaped by factors such as medical school curriculum and inherent altruistic tendencies. To answer this, we specifically asked our cohort of MS about their exposure thus far to HSCT and their willingness to register as bone marrow or stem cell donors. We hoped to locate deficits in knowledge of HSCT and identify motivators or barriers to participation on the BMR. We anticipated that MS' willingness to donate stem cells would increase in time and duration of their medical studies.

## METHODS

The study population was composed of 247 MS at Mayo Medical School in Rochester, Minnesota. Participation in the study was voluntary and careful consideration was taken in reporting findings to protect student confidentiality.

A cross-sectional survey was created using Qualtrics Online Survey Software and the resources of the Mayo Clinic Survey Research Center. A team of HSCT experts (hematologists), a medical school educator, a psychologist, and a MS collaborated to design the study and the study questionnaire (Figure 1). Approval by the Mayo Clinic institutional review board was obtained for all components of the study. The final questionnaire, including a statement of consent, was administered electronically via email between November 2014 and December 2014. MS were given 30 days to participate in the study and provide their responses. A single email reminder was sent halfway through the month. Participants received no compensation or reward in return for completing the questionnaire.

Age, sex, race, and level of training were recorded for all respondents. The questionnaire items were intentionally constructed to evaluate the knowledge, experience, and attitudes of MS towards HSCT and the BMR. Knowledge of the BMR was assessed in a series of 6 true/false questions. This included 3 items on current knowledge of donor eligibility (DE) and 3 items on current knowledge of the donation process (DP). Students were asked about their experience learning about HSCT before and during medical school (yes/no). Attitudes towards the BMR were evaluated by a Likert scale (strongly disagree [0] to strongly agree [5]), by which subjects rated responses reflecting views on the personal and public decision to join the BMR. An open-ended question was added to the end of the survey: *"Have you considered being a donor, but have a condition (medical or other) that disqualifies you from donating?"* allowing respondents to provide a written explanation for their reason(s) not to join the BMR.

Because the stem cell or bone marrow donors do not receive any compensation for volunteer donation for unrelated patients, it is presumed that the donation is being done purely for altruistic purposes. For this reason, a 20-item validated self-reported altruism scale (Altruistic Personality Scale, Fetzer Institute) was included in which participants indicated the frequency in which they have engaged in everyday acts of altruism from never (0) to very often (4) [24]. This scale has been used in a prior study of altruism and stem cell donation [22].

### *Statistical Analysis*

Chi-square testing was used to compare outcomes for categorical data and continuous variables were assessed using a 2-sample *t*-test. A 2-sided *P* value of less than .05 was considered statistically significant. To further evaluate positive predictors of BMR status, multivariable analysis was conducted using a logistic regression model with output of odds ratios, confidence intervals, and *P* values.

## RESULTS

Among 247 MS, 99 subjects completed the questionnaire (Figure 1) (response rate, 40%); however, the number of responses to each individual component of the questionnaire varied (n = 94 to n = 99). Demographics, including sex, age, race, and level of training, did not significantly differ between the 99 respondents and 148 nonrespondents. The majority of respondents were female (n = 54, 56%), between the ages of 21 and 25 (n = 54, 56%), and Caucasian (n = 70, 73%). Forty-one respondents (n = 41, 43%) were already on the BMR. Forty-five percent (n = 44) of students were in preclinical years 1 or 2, 37% (n = 37) in clinical years 3 or 4, and 18% (n = 18) in research or alternative portions of their training. Level of training showed no significant correlation with BMR status (Supplementary Table S1). Female sex (n = 29, 71%) was a distinguishing factor between respondents on the BMR and not on BMR ($P = .014$) (Table 1). Prior blood donation rates were higher in those subjects on the BMR ($P = .015$) (Table 1) but did not vary by sex alone ($P = .702$). On multivariable logistic regression analysis by BMR status (n = 91), both female sex (odds ratio, 2.00; 95% confidence interval, .64 to 6.44; $P = .233$) and prior blood donation (odds ratio, 2.97; 95% confidence interval, .97 to 9.76; $P = .057$) were no longer of