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Demographic Characteristics and Prevalence of Serologic Markers among Blood Donors Who Use Confidential Unit Exclusion (CUE) in São Paulo, Brazil: Implications for Modification of CUE Policies in Brazil

Cesar de Almeida-Neto¹, Jing Liu², David J. Wright², Alfredo Mendrone-Junior¹, Pedro L. Takecian⁴, Yu Sun², Joao Eduardo Ferreira⁴, Dalton de Alencar Fischer Chamone¹, Michael P. Busch³, and Ester Cerdeira Sabino¹ on behalf of For the NHLBI Retrovirus Epidemiology Donor Study-II (REDS-II), International Component

¹Fundação Pró-Sangue - Blood Center of São Paulo, São Paulo, SP, Brazil

²Westat, Rockville, MD, USA

³Blood Systems Research Institute, San Francisco, CA, USA

⁴Mathematics and Statistics Institute, University of São Paulo, São Paulo, SP, Brazil

Abstract

Background—This study evaluated demographic profiles and prevalence of serologic markers of donors who used CUE in order to assess the effectiveness of CUE and guide public policies regarding the use of CUE for enhancing safety versus jeopardizing the blood supply by dropping CUE.

Material and Methods—We conducted a cross-sectional analysis of whole blood donations at a large public blood center in São Paulo from July 2007 through June 2009, and compared demographic data and confirmed serologic results among donors who used and who have never used CUE (CUE never).

Results—There were 265,550 whole blood units collected from 181,418 donors from July 2007 through June 2009. A total of 9,659 (3.6%) units were discarded, 2,973 (1.1%) because CUE was used at the current donation (CUE now) and 6,685 (2.5%) because CUE was used in the past (CUE past). The CUE rate was highest among donors with less than 8 years of education (OR=2.78; CI = 2.51–3.08). CUE now donations were associated with higher positive infectious disease marker rates than CUE never donations (OR= 1.41; CI = 1.13–1.77), whereas CUE past donations were not (OR=1.04; CI = 0.75–1.45).

Conclusion—The CUE process results in a high rate of unit discard. CUE use on an individual donation appears predictive of a high risk marker positive donation and, thus appears to contribute modestly to blood safety. The policy of discarding units from donors, who have previously CUE positive donations, does not improve safety and should be discontinued.

Keywords

HIV; blood donors; Brazil; donor selection; risk reduction behavior

Address reprint requests to: Cesar de Almeida Neto, MD, PhD. Avenida Dr Enéas de Carvalho Aguiar, 155 1º andar, bloco 12. Cerqueira Cesar. São Paulo, SP, Brazil; zip code 05403-000. cesarnt@uol.com.br, Phone: +55-11-3061-5544 extension 376, fax: = +55-11-3088-2747.

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INTRODUCTION

Confidential Unit Exclusion (CUE) had minimal effectiveness in reducing transmission of infectious diseases by window-period units in the United States^{1–3} and was discontinued in most US blood centers beginning in 1992 (FDA memorandum). Moreover, the value of donor deferral strategies such as CUE were further diminished with the advent of Nucleic Acid Technology (NAT) screening which improved blood safety by reducing the residual risk of HIV transmission from 1:600.000⁴ to 1:2.000.000⁵ in the United States. In Brazil, HIV incidence estimates are about 10-fold higher in first-time donors compared to US and Europe first-time donors⁶. NAT screening for HIV is not performed routinely by most Brazilian blood centers, resulting in a longer infectious window period and substantially greater residual transfusion risk than exist in the US and Europe. Thus, CUE may potentially have a different role on interdiction of units donated during the HIV window-period. Based on this premise, the Brazilian Ministry of Health mandated implementation of CUE in 2004⁷.

In our blood center in São Paulo, Brazil, we sought to increase the effectiveness of CUE option on transfusion safety by implementing a policy such that if a donor had ever used CUE option, all subsequent donations by that donor would be discarded, even if he/she does not use the CUE again. Consequently, the number of units discarded due to CUE has increased progressively over the years and the CUE-related discard rate will increase even more considering the target of enhanced efforts to expand the repeat donor pool as a source of safe blood supply⁸.

This study evaluated the demographic profiles and prevalence of serologic markers among donors who used CUE. We analyzed two years' donation data and 10 years' CUE records in order to assess the effectiveness of CUE and guide public policies regarding use of CUE for enhancing blood safety without seriously jeopardizing the blood supply by dropping CUE.

METHODS

Overall study design and setting

We conducted a cross-sectional analysis of all consecutive whole blood donations at Fundação Pró-Sangue, Blood Center of São Paulo (FPS), from July 2007 through June 2009, and compared demographic data and confirmed serologic results for donations made by donors who used and who have not used CUE.

FPS, in São Paulo, Brazil, is located in the largest public hospital in Brazil. FPS collects roughly 137,000 units of blood annually, representing six percent of the blood donated in all Brazil. The study was approved by the local and federal Review Boards Committees.

Study subjects and procedures

Only allogeneic/homologous whole blood donations made by voluntary donors in July 2007 through June 2009 were selected. Donors between 18 and 65 years went through the usual steps of vital sign assessments, hematocrit check, and medical history and risk behavior interviews which are routinely done face-to-face by a trained nurse under a physician's supervision. At the time data were collected, deferral risk factors for HIV/AIDS included: 1) five or more sex partners in the past 12 months, 2) men who had sex with another man (MSM) in the past 12 months, 3) use of intravenous drugs ever, 4) receipt or payment of money for sex in the past 12 months, 5) sex with a partner who had more than five partners or who had sex worker contact in the past 12 months, 6) sex with an HIV-positive partner in

the past 12 months, 7) sex with an intravenous drug user partner ever, and 8) women who had a MSM sex partner in the past 12 months.

All donors receive an explanation about the importance of the CUE option after the pre-donation interview. They are informed that CUE is confidential and independently of their answer all donated blood will be tested, but, in case, they answer YES, their blood unit will not be released for transfusion. A nurse explains to the donors about the CUE option, showing a printed, colored and plasticized template and, asks them to go to a private room where he/she can answer the CUE option using a touch screen computer, on which the donors answer YES or NO, to the question “Have you had a risk behavior for sexually transmitted diseases?” The answers, YES or NO, are graphically painted in red and green, respectively, to help illiterate donors to correctly answer the CUE option. The CUE option is a mandatory step before blood collection. If the donor does not answer the CUE option he/she cannot proceed to the collection. Once a donor answers YES the donated unit and all subsequent units will be discarded, but the donor is not notified unless a positive marker is detected on one or more donations.

Measures

We recorded the following information for each donation: Donor’s gender, age, education level, donation status (first-time versus repeat) and donation type (community versus replacement). Although paying donors is forbidden in Brazil, volunteer donors can give either at the request of or on behalf of a specific donor (defined as replacement donation) or to the general blood supply (defined as community donation). Serologic results of each donation were also recorded including the screening tests for anti-HBc, syphilis and Chagas, and screening plus confirmatory tests for anti-HIV-1/2, anti-HCV, HTLV-1/2, HBsAg. The historical use of CUE among all donors in the past ten years (1996–2006) was linked to donations collected during the cross-sectional study period (July 2007 through June 2009). Donations from donors who have ever used CUE were distinguished into two groups: CUE now and CUE past. CUE now was defined as a donation that originated from a donor who used the CUE option for the current donation from July 2007 through June 2009. A donation was defined as CUE past if it was from a donor who did not use CUE for the current donation but had used CUE, at least once, either in the past ten years or previously in the study period. Donors, who have never used CUE, from 1996 to June 2009, were classified as CUE never. Demographic data, donation status, donation type and screening and confirmed serologic data were compared among donations that were CUE now versus CUE never and among repeat donors who were CUE past versus CUE never. HIV seroconversion was defined as a donation that tested reactive on two parallel EIAs and was positive by Western blot during the two year study period but all previous donations from the same donor were nonreactive.

Statistical analysis

Univariate methods (chi-square statistics) were employed to compare demographic data, HIV confirmatory results, and overall screening and confirmatory test results for HIV, HTLV-1/2, hepatitis B and C, syphilis and Chagas’ disease, in blood donations that were CUE now, CUE past, and CUE never status. Predictors that were statistically significant in the univariate analyses were considered for inclusion in a multinomial logistic regression model (PROC LOGISTIC) predicting CUE now, CUE past vs. CUE never. A second multivariable logistic regression was performed to evaluate the association of demographic data and CUE use on predicting infectious disease marker status.

Laboratory methods

Laboratory screening was performed at the Serology Division of Fundação Pró-Sangue following the Brazilian regulation that mandates:

- a. one test for: Hepatitis B virus surface antigen (EnzygnostAgHBs 5.0, Siemens, Newark, DE; Enzygnost AgHBs 5.0, Siemens, Marburg, Germany; Monolisa HBs Ag Ultra, Bio-Rad, Marnes-la-Coquette, France or Hepanostika HBsAg Ultra, bioMérieux, Boxtel, The Netherlands); anti-HCV (Murex anti-HCV version 4.0, Abbott Murex, Kyalami Boulevard, South Africa and Monolisa HCV Ag-Ab Ultra, Bio-rad, Marnes-la-Coquette, France), anti-HTLV-I/II (Murex HTLV I+II, Abbott Murex, Dartford, United Kingdom and HTLV-I/HTLVII Ab-Capture ELISA Test System, Ortho, Raritan, New Jersey), Chagas disease (ELISA cruzi, bioMérieux, Rio de Janeiro, Brazil) and, syphilis (Enzygnost Syphilis, Siemens, Marburg, Germany and Trepanostika Tprecombinant, bioMérieux, Boxtel, The Netherlands). As part of the REDS program, if any of these screening tests resulted reactive, the kit that was not used for screening was used as confirmatory EIA. The confirmatory EIA used for Chagas Disease was Chagatek ELISA, bioMérieux, Buenos Aires, Argentina.
- b. One test for HBV core antibody (Enzygnost Anti-HBc Monoclonal, Siemens, Marburg, Germany or Monolisa anti-HBc Plus, Bio-Rad, Marnes-la-Coquette, France). We did not perform a confirmatory test for anti-HBc.
- c. two parallel tests for anti-HIV-1 and -2 (Vironostika HIV Uni-Form II, bioMérieux, Boxtel, The Netherlands and Genscreen Ultra HIV Ag-AB, Bio-Rad, Marnes-la-Coquette, France). If either of the screening EIA tests for HIV gave a repeat reactive result, a Western HIV blot (HIV Blot 2.2, MP Diagnostics, Singapore) was performed as a confirmatory test.

All kits used were approved by the Brazilian Ministry of Health and had sensitivity higher than 99 percent as described in the manufacturers' information.

RESULTS

There were 265,550 whole blood units collected from 181,418 donors from July 2007 through June 2009. A total of 9,658 (3.6%) units were discarded due to the CUE option during the study period; these included 2973 (1.1%) units that were discarded because CUE was used on the current donation (CUE now) and 6,685 (2.5%) because CUE was used in the past (CUE past). Among the 181,418 donors, 2768 (1.5%) used CUE on at least one occasion during the study period. Overall, 2601 (1.4%) used CUE once, and 167 (0.1%) used CUE two or more times. After a donor used CUE for the first time, the chance that he/she will use CUE again in a follow up donation is 17% for those who returned.

CUE now versus CUE never donations

As shown in Table 1, donations that were scored as CUE now were more likely to be from male (OR=1.25; CI =1.16–1.35), less educated (OR=2.78; CI =2.51–3.08, among donors with less than eight years), non-white (OR=1.31; CI = 1.17–1.47, in black; OR=1.10; CI = 1.01–1.19, in mixture race, and OR=1.06; CI = 0.80–1.42 in other), first-time (OR=1.33; CI = 1.22–1.44), and community (OR=1.24; CI = 1.12–1.37) donors.

CUE past versus CUE never donations

Among repeat donors, those who CUE'd in the past were more likely to be male (OR= 1.26; CI = 1.19–1.33), older (OR=1.19; CI = 1.08–1.32 among those ≥55 years-old), non-white (OR=1.46; CI = 1.35–1.58, in black; OR=1.20; CI = 1.13–1.26, in mixture race), less

educated (OR=2.22; CI = 2.07–2.37, among donors with less than eight years), and community donors (OR=1.33; CI = 1.21–1.45).

Univariate Association between CUE Use and Serological Markers

CUE now units during the study period was also associated with higher rates of reactive serologic markers for HIV, HCV, HTLV-1/2, HBV (HBsAg, anti-HBc) and syphilis (overall rates of 2.92% versus 1.64%, $p<.001$). When analyzed CUE past and CUE never units among repeat donors only, the overall infectious disease markers prevalence was not different (0.56 versus 0.41, $p=0.07$). Considering first-time donors, there was no HIV positive donation among CUE now group and a 0.08% prevalence of HIV donations among the CUE never group ($p<.001$). On the other hand, when analyzing donations by repeat donors during the study period the prevalence of HIV positive donations was 0.05% and 0.03% for CUE now and CUE never, respectively ($p<.001$) (Table 2).

Logistic Regression Analysis on Serological Marker Reactivity Predicted by CUE Use

In the multivariable logistic regression analysis examining the association between CUE use and positive infectious disease markers adjusting for demographic data, donation type and status (Table 4), it was found that CUE use at the current donation (CUE now) was still associated with positive infectious disease markers (OR= 1.41; CI = 1.13–1.77). On the contrary, units from donors who used CUE in the past (CUE past) were not associated with positive infectious disease markers (OR=1.04; CI = 0.75–1.45). Additionally, a higher positive marker rate was associated with male donors (OR=1.18; CI =1.10–1.25), first time donors (OR= 14.90; CI =13.69–16.21), black (OR =1.48; CI =1.34–1.64) and mixed races (OR = 1.30; CI = 1.21–1.39) as compared with white. When compared with donors with 11 years of education, lower education was associated with higher marker rate (OR= 1.51; CI =1.38–1.65 for < 8 years of education, OR = 1.30; CI =1.19–1.42 for 8 years of education, and OR = 0.73; CI = 0.66–0.80 for completing university). Units from community donors were related to higher positive marker rates than those from replacement donors (OR = 1.09; CI =1.02–1.17). As expected, infectious markers increase with age.

CUE sensitivity, specificity and positive predictive value

Considering the association of CUE and infectious disease markers, it is noteworthy that among the 4284 positive infectious disease marker donations only 123 donations were from donors who used CUE (and among the remaining 261,266 negative infectious disease marker donations, 9536 donors were from donors who CUE'd). Hence, CUE sensitivity, specificity, positive and negative predictive values were respectively, 0.0287, 0.9635, 0.0127 and, 0.9837.

HIV rates vs. CUE Use

The HIV positive rate among repeat donors was 0.03% (52/172,063), 0.05% (1/1,842) and 0.02% (1/6,685) for those who never used CUE, currently used CUE and used CUE only in a past donation (Table 3).

DISCUSSION

This analysis focused on two issues related to the CUE process in Brazil: 1) what are the demographic characteristics of donors who used CUE compared to those who did not use CUE, and 2) whether donors who used CUE on their current donation, or individuals who previously used CUE but have continued to donate without using CUE, have a higher rate of positive markers for transfusion-transmitted infections.

It is important to emphasize that the rate of CUE use is very high in Brazil (1.1% of current donations are CUE'd, and an additional 2.5% of units are discarded due to previous use of CUE by the donor) compared to a 0.22% rate of CUE use in the U.S. where CUE was used prior to discontinuation of the process³. Compared with donations from donors who never used CUE, both CUE now and CUE past donations were more likely to be from males, less educated, black or mixed race groups, and from community donors. The CUE rate was highest among donors with less than 8 years of education. These donors were twice as likely to CUE than those who had at least 11 years of education.

Our data show that the current donation CUE process seems to be predictive of higher rates of ID marker positive donations; however the sensitivity (almost 3% of marker positive donations are CUE'd) and PPV (1.27% of CUE donations have one or more positive markers) of CUE are very low. If positive ID marker rates correlate with the incidence of window period infection or with risky behaviors common to transfusion transmitted agents which are not tested for, then our data suggest that CUE appears to contribute to blood safety, but only modestly. In contrast, when data from units discarded due to previous CUE use (CUE past) were analyzed separately, there was no association with serological markers, suggesting that this procedure does not enhance blood safety. In this context it is important that the very high rate of discarded units is mainly driven by the discard of subsequent donations of donors who used CUE, perhaps erroneously, on a previous donation. Modification of policies to only discard donations for which a donor used CUE would reduce the loss of donations due to CUE to one third of the current level.

Undisclosed risk factors that should have been reported during pre-donation interview can represent a threat to the safety of the blood supply^{9,10}. Although, face-to-face interviews could increase donor attention and help donors with poor literacy to answer the screening questions, some studies have demonstrated the lack of effectiveness of this process, especially for high-risk behaviors^{11,12}. CUE was introduced as a tool to interdict units from donors who are at HIV risk but do not respond accurately to high risk questions during the pre-donation interview. The association between CUE use and higher prevalence of serologic markers has been described before in the United States¹⁻³ but the effectiveness of CUE was very limited. Indeed, studies in other countries including Germany^{13,14} and Canada¹² showed that the sensitivity and positive predictive values of CUE were low and had minimal impact on transfusion safety. In another context, Amini Kafi-Abad et al.¹⁵ found that CUE positive units were 3.7 to 14 times more likely to be seropositive and concluded that CUE helps to enhance blood safety in Iran. Few studies evaluated the effectiveness of CUE option in previous donations. Zou et al.³ found a higher prevalence of HIV among donors who have used CUE in the past. Conversely, we have not found any association of CUE use in a previous donation and serologic markers suggesting that the policy of discarding donations based upon a previous selection of CUE should be discontinued.

Our findings suggest that the CUE process appears to be misunderstood by some donors, as evidenced by increased CUE use by first time and less educated donors who tested negative for infectious disease markers and who did not use CUE on subsequent donations. However, the design of our study cannot rule out the possibility that less educated and first-time donors may have used CUE more frequently because these characteristics are associated with high risk behaviors and test-seeking, as has been previously documented in the Brazilian donor population^{6,16}.

Certainly, it is important to consider that the overall CUE process (i.e. questions and language used, explanation given to the donor about the process, and colors associated with the answers), should be reviewed to determine if we can improve the accuracy of responses,

particularly for first-time and less educated people. Sümnig et al.¹⁷ showed that the CUE rate was higher when nurses instead of physicians were involved in the process, and when the CUE form was submitted anonymously rather than being handed to a person. The authors also found that CUE format and color of writing also increased the clarity of the process. A randomized study would be useful to test the best option enhancing the CUE process in centers where CUE is applied. In conclusion, our results indicate that units from donors who used CUE at the current donation are more likely to have markers of transfusion-transmitted infections than those units from donors who did not use CUE. However, when donors who used CUE in the past did not use CUE for a new donation, the infectious disease marker rates among these subsequent donations were the same the rates in donors who never used CUE. Therefore, we recommend that the procedure of discarding units because of CUE in the past should be discontinued. Although CUE may be modestly enhancing blood safety, this occurs at the cost of discarding a substantial number of units. Thus efforts to improve the CUE process are necessary, especially among less educated individuals. Finally, more detailed analysis focused on the effectiveness of CUE to detect recent or incident infections, are needed to decide whether the mandatory use of CUE should be retained following implementation of future HIV and HCV NAT.

Abbreviations

CUE	Confidential Unit Exclusion
EIA	enzyme immunoassay
FPS	Fundação Pró-Sangue, Blood Center of São Paulo
SOP	Standard Operational Procedures
NAT	Nucleic Acid Tests

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Figure 1. Touch screen computer showing the Confidential Unit Exclusion Options. If the donor were at HIV risk he/she should touch SIM (YES), if not he/she should press NÃO (NO). CUE option has different colors to help illiterate donors to properly answer the question and is a mandatory step before donation.

TABLE 1

CUE Use by Donor Demographics, Donation Status, and Donor Type and Odds Ratios Predicting CUE Use in Multivariable Logistic Regression Analysis (July 2007– June 2009)

	CUE now [*] N (%)	CUE never [†] N (%)	Odds Ratios predicting CUE now vs. CUE never
TOTAL[‡]	2973 (1.2)	255892 (98.8)	
Gender[‡]			
Female	945 (.97)	96929 (99.0)	1
Male	2028 (1.3)	158962 (98.7)	1.25 (1.16–1.35)
Age (years)[§]			
≥18 <25	664 (1.1)	57713 (98.9)	0.99 (0.90–1.11)
≥ 25 <35	1094 (1.2)	93157 (98.8)	1
≥ 35 <45	680 (1.1)	61477 (98.9)	0.82 (0.74–0.91)
≥ 45 <55	402 (1.2)	32817 (98.8)	0.84 (0.75–0.95)
≥ 55	133 (1.2)	10721 (98.8)	0.75 (0.62–0.91)
Race[‡]			
Black	384 (1.5)	25096 (98.5)	1.31 (1.17–1.47)
Mixed	1137 (1.3)	86201 (98.7)	1.10 (1.01–1.19)
White	1379 (.99)	137625 (99.0)	1
Other	50 (.93)	5307 (99.1)	1.06 (0.80–1.42)
Education (years)[‡]			
< 8	688 (2.4)	27751 (97.6)	2.78 (2.51–3.08)
at least 8	523 (1.6)	31904 (98.4)	1.75 (1.57–1.94)
at least 11	1413 (.97)	143919 (99.0)	1
complete	316 (.64)	49272 (99.4)	0.72 (0.64–0.82)
Donation status[‡]			
First-time	1131 (1.3)	83829 (98.7)	1.33 (1.22–1.44)
Repeat	1842 (1.1)	172063 (98.9)	1
Donor type^{//}			
Community	2497 (1.2)	213388 (98.8)	1.24 (1.12–1.37)
Replacement	476 (1.1)	42504 (98.9)	1

* CUE now = a donation that originated from a donor who used the CUE option for the current donation during the study period

[†] Cue never = a donation that originated from donors who never used CUE (study period and past ten years)

[‡] P < .001

[§] P = 0.479;

^{//} P = 0.383

TABLE 2

CUE Use among Repeat Donors by Donor demographics, Donation Status, Donor Type and Odds Ratios Predicting CUE Use in Multivariable Logistic Regression Analysis (1996–2009)

	CUE past* N (%)	CUE never† N (%)	Odds Ratios predicting CUE past vs. CUE never
TOTAL ‡	6685 (3.7)	172063 (96.3)	
Gender ‡			
Female	1759 (2.9)	58205 (97.1)	1
Male	4926 (4.2)	113858 (95.8)	1.26 (1.19–1.33)
Age (years) ‡			
≥18 <25	463 (1.8)	25571 (98.2)	0.51 (0.46–0.57)
≥ 25 <35	2431 (3.6)	64835 (96.4)	1
≥ 35 <45	2148 (4.3)	47733 (95.7)	1.06 (1.01–1.13)
≥ 45 <55	1141 (4.3)	25401 (95.7)	1.01 (0.93–1.08)
≥ 55	502 (5.6)	8519 (94.4)	1.19 (1.08–1.32)
Race ‡			
Black	914 (5.1)	17030 (94.9)	1.46 (1.35–1.58)
Mixed	2659 (4.4)	58170 (95.6)	1.20 (1.13–1.26)
White	2997 (3.1)	92625 (96.9)	1
Other	81 (2.4)	3366 (97.7)	0.90 (0.72–1.13)
Education (years) ‡			
< 8	1652 (7.8)	19605 (92.2)	2.22 (2.07–2.37)
at least 8	1165 (5.0)	22064 (95.0)	1.45 (1.35–1.56)
at least 11	3020 (3.2)	92951 (96.8)	1
complete	738 (2.1)	35282 (97.9)	0.64 (0.59–0.70)
Donor type ‡			
Community	6122 (3.8)	154502 (96.2)	1.33 (1.21–1.45)
Replacement	563 (3.1)	17561 (96.9)	1

* CUE past = a donation that originated from donors who did not use CUE for the current donation but had used CUE, at least once, either in the past ten years or previously in the study period

† Cue never = a donation that originated from donors who never used CUE (study period and past ten years)

‡ P < .001

Table 3

HIV Positive and Overall Positive Marker Rates for Infectious Diseases (HIV, HBV, HCV, HTLV-1/2, Syphilis) By CUE Use

	CUE now [*]	CUE never [†]	P-Value
Overall Infectious Diseases			
First Time	6.24%	4.17%	<.001
Repeat	0.88%	0.41%	<.001
HIV Positive			
First Time	0%	0.08%	<.001
Repeat	0.05%	0.03%	<.001
Repeat Donors Only			
	CUE past [‡]	CUE never [†]	P-Value
Overall Infectious Diseases	0.56%	0.41%	0.07
HIV Positive	0.02%	0.03%	0.48

* CUE now = a donation that originated from a donor who used the CUE option for the current donation during the study period

† CUE never = a donation that originated from donors who never used CUE (study period and past ten years)

‡ CUE past = a donation that originated from donors who did not use CUE for the current donation but had used CUE, at least once, either in the past ten years or previously in the study period

TABLE 4

Odds Ratios and 95% Confidence Intervals Predicting Infectious Disease Markers in Multivariable Logistic Regression Analysis of Donations.

Variables in the Model	OR (95% CI)	P-Value
CUE		
CUE now* vs. CUE never†	1.41 (1.13–1.77)	<0.001
CUE past‡ vs. CUE never†	1.04 (0.75–1.45)	0.82
Gender		
Male vs. Female	1.18 (1.10–1.25)	<0.001
Age		
<25 vs. 25–34 yrs	0.42 (0.38–0.47)	<0.001
35–44 vs. 25–34 yrs	1.73 (1.59–1.87)	<0.001
45–54 vs. 25–34 yrs	2.53 (2.31–2.77)	<0.001
≥55 vs. 25–34 yrs	3.42 (3.02–3.88)	<0.001
Education		
<8 yr vs. 11 yr	1.51 (1.38–1.65)	<0.001
8 yr vs. 11 yr	1.30 (1.19–1.42)	<0.001
Complete University vs. 11 yr	0.73 (0.66–0.80)	<0.001
Race		
Black vs. White	1.48 (1.34–1.64)	<0.001
Mixed vs. White	1.30 (1.21–1.39)	<0.001
Asian vs. White	1.08 (0.86–1.37)	<0.001
Community vs. Replacement	1.09 (1.02–1.17)	0.01
First time vs. Repeat	14.90 (13.69–16.21)	<0.001

* CUE now = a donation that originated from a donor who used the CUE option for the current donation during the study period

† CUE never = a donation that originated from donors who never used CUE (study period and past ten years)

‡ CUE past = a donation that originated from donors who did not use CUE for the current donation but had used CUE, at least once, either in the past ten years or previously in the study period