

ORIGINAL ARTICLE

Transfusion Transmissible Infections among Voluntary Blood Donors at the University Teaching Hospital, Lusaka, Zambia

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ABSTRACT

Background: HIV1&2, HBsAg, anti-HCV and syphilis antibody are mandatory disease marker tests of Transfusion Transmissible Infections (TTIs) conducted on every donated unit of blood in Zambia. Blood is donated by *first time voluntary donors* and *repeat/regular donors* of ages between 16 and 65 years. Both *first time* and *regular blood donors* undergo the same screening eligibility criteria in the form of medical questionnaire, history and physical examination prior to blood donation. Units, which test positive for any of the four TTIs, are discarded. The cost of producing one unit of blood in Zambia is about \$40US and there is need to keep the discard rate to a minimum. The study aimed at finding out which sub-category of donors was responsible for the discards at the Lusaka Blood Transfusion Centre and conversely which was the safest.

Methodology: A cross-sectional study involving retrospective review of all blood donors and screening records of *voluntary non-remunerated donors* at the Lusaka Province/UTH Blood Transfusion Centre covering the period of January to December 2012. For each unit of donated blood, information on donor age, gender, whether *first or repeat donor* and test result of disease marker of the four TTIs was entered on a spreadsheet and

subjected to descriptive and inferential analysis.

Results: Of the 16,027 units donated in 2012, 11,516 (71.9%) were from males, and the majority (77.8%) were aged between 16-24 years. The proportion of *first time donors* was 60.4%. The overall discard rate due to TTIs was 10.1% (1,622). Most discards were for a single disease marker positivity (1526, 94.1%). Disease marker positivity for HIV, Hepatitis B, Hepatitis C, and Syphilis was: 2.9%, 6.0%, 0.6%, and 1.2% respectively. Using multivariate logistic regression, the safest donors (i.e. with a useable unit, not discarded due to a TTI) were females (OR 1.25, 95% CI 1.11-1.41), repeat donors (OR 1.37, 95% CI 1.23-1.53), and those in the age category 16-24 years (OR 2.35, 95% CI 1.95-2.84).

Conclusions: *Repeat/regular*, female, young (16-24 years of age), voluntary blood donors were the safest source of tested blood at the UTH/Lusaka Province Blood Transfusion Centre in 2012. Hepatitis B remains the most common TTI as a cause for discard and points to the need for adequate prevention strategies. There is a small but significant discard rate due to hepatitis C. The overall 10.1% discard rate due to TTIs suggests an inevitable need to consider safer donor retention strategies as drivers for the sustainable blood transfusion program in Zambia.

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INTRODUCTION

The World Health Organization (WHO) recommendation of safe blood transfusion is provision of compatible blood which is cross matched and had been screened at least for five transfusion transmitted infections (TTIs); human immunodeficiency virus (HIV), hepatitis C (HCV), hepatitis B (HBV), syphilis and malaria parasite¹. The seropositivity of disease markers in the donated blood is an indicator of degree of microbiological safety of blood and is directly influenced by the type of blood donor². The two types of voluntary blood donors are *first time voluntary non-remunerated blood donors* and *repeat/regular non-remunerated blood donors*. No person is coerced to donate blood and no-one is remunerated. Donated blood is mandatorily subjected to laboratory tests in accordance with the WHO and other international best practices¹. All donated blood in Zambia is tested for four TTIs using HIV antigen/antibody test, Hepatitis B surface antigen test, anti-HCV antibody test and syphilis antibody test using the ABBOTT architect fully automated blood testing system applying chemiluminescence. All units of blood which test positive for any or all of the TTIs are discarded in accordance with applicable bio-safety protocols. The units of blood which test negative are stored in inventory at appropriate storage temperatures and distributed to transfusion outlets mainly provincial and district hospitals.

The WHO recommends that if 1% of the population donated blood, the country would be self-sufficient in blood¹. However, achieving this aim can be jeopardized if the donated blood is discarded due to TTIs. In Europe by 2004, the reported HIV prevalence levels were lower than 10/100,000 donations. The prevalence of HIV, Hepatitis B, Hepatitis C and syphilis was much lower among *repeat donors* than *first-time donors*³. In the United States of America (USA) the risk for acquiring HIV infection through blood transfusion was estimated conservatively to be one in 1.5 million, based on 2007-2008 data⁴. The prevalence of syphilis

seropositivity in *first time donors* was 162.6 (95% CI 145.5-181.2) per 100,000 donors and 15.8 (95% CI 10.8-22.3) per 100,000 donors, respectively⁵. In Cambodia, HIV prevalence was found to be 2% amongst blood donors¹. In South Africa, the prevalence of HIV-1 in blood donations declined from 0.17% in 1999-2000 to 0.08% in 2001-2002 after the implementation of the new donor selection and education policy². The likelihood of *first-time donors* being recently infected with HIV-1 decreased from 18% to 14% and respective incidence of high-risk donations collected decreased from 2.6% to 1.7%. In Burkina Faso, Hepatitis B and Hepatitis C were more prevalent than HIV in blood donors⁶. In Zambia, the total national crude sero-prevalence in 2011 amongst blood donors for combined TTIs was 10.0% (ZNBTS records⁷, reported in 2012) with HIV contributing 4%, HBSAg 6%, HCV 1% and syphilis 0.5%. However, this data was not stratified by donor characteristics (ZNBTS records, 2012⁷). This study aimed to determine the seroprevalence of Transfusion Transmissible Infections (TTIs) (HIV, Hepatitis B, Hepatitis C and Syphilis) among *first time voluntary blood donors* and *repeat voluntary blood donors* tested at the Lusaka Province/UTH Blood Transfusion Centre and to assess demographic characteristics of voluntary blood donors with and without TTIs.

METHODOLOGY

This was a cross-sectional study. For each unit of donated blood, information on donor age, gender, whether *first* or *repeat donor* and test result of disease marker was entered onto a spreadsheet and subjected to descriptive and inferential statistical analysis using SPSS v20. Throughout the analysis, '**discard**' and '**useable**' were used as the converse of each other. Chi-square was used to test the association (unadjusted odds ratios) of donor characteristics with discard. A multivariate logistic regression model was developed to control for confounders related to donor characteristics and outcome (discard/useable donor unit). Results were presented as unadjusted and adjusted odds ratios,

95% confidence interval and corresponding p-values.

RESULTS:

A total of 16,027 units of blood were collected from *voluntary non-remunerated blood donors* by the Lusaka Provincial Blood transfusion Centre team during 2012. Of these 1,622 units were discarded due to the presence of any of the TTIs giving a crude discard rate of 10.1%. Most of the discarded units (1,526, 94.1%) were positive to only one of the four TTIs (single infection). The remaining 96 (5.9%) were positive to two or more of the four TTI markers (co infections) (Table 1). The highest proportion of all single infection discard was due to Hepatitis B (917, 56.5%), followed by HIV (381, 23.5%), syphilis (148, 9.1%) and Hepatitis C (80, 4.9%) and (Table 1).

repeat donors (60.4% vs. 39.6%). Under three quarters were male (71.9%) and over three quarters were in the younger age group of 16-24 years (77.8%). TTI disease positivity showed that HIV positivity was 3.5% amongst *first time* and 1.8% amongst *repeat blood donors*. HBV positivity showed little difference between the *first* and *repeat blood donors* (6.0% vs. 6.2%). HCV positivity showed minimal difference between the *first* and *repeat blood donors* (0.5% vs. 0.6%). The corresponding syphilis rates were 1.8% and 0.4% showing a higher proportion amongst *first time donors*. TTI disease positivity by gender and age are also presented in table 2. There were no marked discrepancies noted within males and females though more males were HBV positive (6.7% compared to 4.3% for females). The younger age group (16-24 years) were less infected with HIV and syphilis, but had high HBV and HCV positivity (Table 2).

Reason for discard	HIV Pos	HBV Pos	HCV Pos	Syphilis Pos	Donor units discarded	Percent of discard
	n	n	n	n	n	%
Single reason for discard - HIV	381				381	23.5
Co-infection with HIV, HBV and syphilis	1	1		1	1	0.1
Co-infection with HIV, HBV	34	34			34	2.1
Co-infection with HIV, HCV and syphilis	1		1	1	1	0.1
Co-infection with HIV, HCV	3		3		3	0.2
Co-infection with HIV and syphilis	39			39	39	2.4
Single reason for discard - HBV		917			917	56.5
Co-infection with HBV and HCV		8	8		8	0.5
Co-infection with HIV and syphilis		9		9	9	0.6
Single reason for discard - HCV			80		80	4.9
Co-infection with HCV and syphilis			1	1	1	0.1
Single reason for discard - syphilis				148	148	9.1
Total discards	459	969	93	199	1,622	100.0

Table 2: Donor characteristics, disease maker positivity, Lusaka Province Blood Transfusion Centre, 2012

Donor type	n		%		HIV Pos	HBV Pos	HCV Pos	RPR Pos		
	n	%	n	%						
First	9,681	60.4	342	3.5%	577	6.0%	52	0.5%	175	1.5%
repeat	6,345	39.6	117	1.8%	392	6.2%	41	0.6%	24	0.4%
all	16,027	100.0	459	2.9%	969	6.0%	93	0.5%	199	1.2%
Gender	n		%		HIV Pos	HBV Pos	HCV Pos	RPR Pos		
	n	%	n	%						
male	11,516	71.9	320	2.8%	775	6.7%	66	0.5%	140	1.2%
female	4,511	28.1	139	3.1%	194	4.3%	27	0.6%	59	1.3%
all	16,927	100.0	459	2.9%	969	6.0%	93	0.6%	199	1.2%
Age (yrs)	n		%		HIV Pos	HBV Pos	HCV Pos	RPR Pos		
	n	%	n	%						
16-24	12,472	77.8	210	1.7%	755	6.1%	80	0.6%	52	0.4%
25-34	2,185	13.6	158	7.2%	143	6.5%	8	0.4%	71	3.2%
35-44	1,236	7.7	86	7.0%	66	5.3%	4	0.3%	69	5.6%
45-54	31	0.2	2	6.5%	1	3.2%	0	0.0%	3	9.7%
55+	103	0.6	3	2.9%	4	3.9%	1	1.0%	4	3.9%
all	16,027	100.0	459	2.9%	969	6.0%	93	0.6%	199	1.2%

Donor characteristics

Donor characteristics stratified by TTI/disease marker positivity are presented in Table 2 showing that there were slightly more *first* compared to

Discard rates by donor characteristics

Further analysis within the donor type category revealed consistently lower positivity in all disease markers in *repeat* compared to *first time*

donors(65.8% compared to 34.2%) (Table 3). Considering the entire donor pool, *first time donors* had a 6.7% discard rate (1,067 out of 16,027). The 1,067 discarded units from *first time donors* represented 11% of all *first time donor* units (1,067/9,681). The same held true for gender in which males had a greater proportion of discard. Considering age, most of the discards were from the 16-24 year age category (65.2%) since they were also the largest group. However, they had the least discard rate (1,058 out of 12,472, [8.5%]) within that age characteristic (Table 3).

Table 3: Discard rates by donor characteristics Lusaka Province Blood Transfusion Centre- 2012

Donor Type	discard	useable	all	discard	within	discard	within
				donor	category	by donor	donor
				(discard/1,622)	as	(discard/16,027)	as
				percent	percent	percent	percent
First	1067	8614	9681	65.5%	6.7%	11.0%	
repeat	555	5791	6346	34.2%	3.5%	8.7%	
all	1,622	14,405	16,027	100.0%	10.1%	10.1%	
Gender							
male	1229	10,287	11,516	75.8%	7.7%	10.7%	
female	393	4,118	4,511	24.2%	2.5%	8.7%	
all	1,622	14,405	16,027	100.0%	10.1%	10.1%	
Age (yrs)							
16-24	1,058	11,414	12,472	65.2%	6.6%	8.5%	
25-34	346	1,839	2,185	21.3%	2.2%	15.8%	
35-44	200	1,036	1,236	12.3%	1.2%	16.2%	
45-54	6	25	31	0.4%	0.0%	19.4%	
55+	12	91	103	0.7%	0.1%	11.7%	
all	1,622	14,405	16,027	100.0%	10.1%	10.1%	

Multivariate logistic regression:

When 'useable' unit of blood was considered as outcome of interest (converse of discard), plausible determinants to explain reasons contributing to usability were explored using logistic regression to control for potential confounders. The analysis showed that the safest donors (i.e. with a useable unit not discarded due to disease marker positivity) were females (AOR 1.25, 95% CI 1.11-1.41), repeat donors (AOR 1.37, 95% CI 1.23-1.53), and those in the age category 16-24 years (AOR 2.35, 95% CI 1.95-2.84) (Table 4).

Table 4

factor	unadjusted			adjusted		
	OR	95%CI	p value	OR	95%CI	p value
Repeat						
donor	1.29	1.16 to 1.44	P<0.001	1.37	1.23 to 1.53	P<0.001
female	1.24	1.1 to 1.39	P<0.001	1.25	1.11 to 1.41	P<0.001
16-24y	2.03	1.82 to 2.27	P<0.001	2.35	1.95 to 2.84	P<0.001
25-34y	0.54	0.47 to 0.61	P<0.001	1.15	0.94 to 1.42	P=0.174
35-44y	0.55	0.47 to 0.65	P<0.001	1.11	0.89 to 1.38	P=0.353
45-44y	0.47	0.19 to 1.14	P<0.096	0.79	0.37 to 1.67	P=0.532
55+y	0.85	0.47 to 1.56	P=0.606	1.63	0.96 to 2.75	P=0.069

DISCUSSION

The results showed that the discard rate was 10.1%, mostly due to single disease marker positivity. Disease marker positivity in this donor pool for HIV, HepB, HepC, Syphilis was 2.9%, 6.0%, 0.6%, and 1.2% respectively. Largely, the TTI discards were due to a single infection leading to discard, which contributed 94.1 % and multiple infections for discard which was only 5.9%. This has posed an operational challenge in that there is no single question during the initial screening which would address all possible infections but rather the medical questionnaire needs to be designed more elaborately with questions tailored to address each specific infection amongst the TTIs.

Using multivariate logistic regression, the safest donors (i.e. with a useable unit not discarded due to disease marker positivity) were females, repeat donors, and those in the age category 16-24 years. This illustrated that repeat/regular, female, young, voluntary blood donors were the safest source of blood donors tested at the UTH/Lusaka Province Blood Transfusion Centre in 2012.

The crude TTI discard rate of 10.1% recorded at the Lusaka Provincial Blood Centre in 2012 was high compared to similar centres in the neighboring country of Zimbabwe which had a crude discard rate of 5% in 2012. The implication of such high discard rate for the Lusaka Centre meant wastage of money as each time a unit of blood is discarded, 40USD goes to waste. However, in terms of blood safety, it

means there was a significant prevention of passage of infections such as HIV, Hepatitis B hepatitis c and Syphilis through blood transfusion. This is the reason why a well- structured blood transfusion program is an effective preventive strategy for HIV and other TTI infections⁸.

The prevalence of HIV recorded in the donors (3%) is believed to be due to an increase in numbers of *repeat blood donors*, improvement in pre-donation screening techniques as well as use of a laboratory-testing platform that has high sensitivity and specificity. When within category analysis was done, the discard rates due to HIV were found to be less in *repeat blood donors* (1.8%) compared to *first time donors* (3.5%). This finding was consistent with Murphy et al's (2010) findings in Europe between 1996 and 2004, which revealed that discard rates were higher in *first time blood donors* compared to *repeat blood donors*³. Similar findings in first time donors compared to repeat donors Kathmandu Nepal, in 2009⁹. However, in Brazil, a study did not reveal any significant difference between *first time and repeat blood donors*. The prevalence of HIV among blood donors similar among *first time blood donors* and *repeat donors*¹⁰. By gender category, discard rates in male blood donors was 2.8% whereas in females it was higher at 3.1%. The discard rates in Brazil were the opposite – higher amongst men compared to women¹⁰.

Hepatitis B remains the most common cause for discard and points to the need for adequate prevention strategies. There was no difference in terms of seroprevalences for Hepatitis B in *first time* and *repeat blood donors*. (6.0% and 6.2%). However, the prevalence was higher in male blood donors compared to female blood donors (6.7% and 4.3%) respectively. Comparison by age category showed that the Hepatitis B sero-prevalence was the lowest in the age category 45-54 years and the highest prevalence was in the age category 25-34 years. There are several postulated reasons for this. The number of donors in the age category 45-54 was small (31/16,027) whereas in the age category 25-34

years, was much larger (2,185/16,027). As to whether the high numbers of blood donor in the 25-34 years age category had an effect on the outcome needs further exploration.

There is a relatively low percentage in discard rate due to hepatitis C justifying its testing (0.6% overall prevalence rate amongst blood donors). There was no difference in sero-prevalence rates in *first time* and *repeat blood donors* irrespective of gender and age categories (at 0.6%). Much as HCV was the lowest prevalent marker amongst the four TTI markers, the consequences of passage of HCV through blood transfusion is so serious that there is need to continue testing for it as one of mandatory tests for TTI markers. Syphilis, had a prevalence rate of 1.8% in the *firsttime donors* and 0.4% in *repeat blood donors*. The prevalence was comparable in both male and female donors (1.2% and 1.3%). However, under stratified age categories, the highest prevalence was found in the category 45-54 years where it was 9.7% and the lowest was in the 16-24 years which was 0.4% reflecting the longer duration of exposure.

Findings from this study suggest that the selection criteria results in *repeat blood donors* with a lower discard rate than *first time donors*. Female blood donors and in the age category of 16-24 years are safest source of blood at Lusaka Blood transfusion centre than any other group.

The limitations of this study were that this study focused on donor characteristics of units of blood only. Some individuals may have donated more than once in a 12-month period. There was no follow up on each individual donor. This could have led to a slight over-estimate. Other demographic and geographical characteristics, apart from those mentioned in the results were not used in this study, as they are not routinely collected. This could be a pointer for future research.

CONCLUSIONS

Repeat/regular, female, voluntary blood donors were found to be the safest category of blood donors

at the UTH Blood Transfusion Centre. Hepatitis B remains the most common cause for discard and points to the need for adequate prevention strategies in that regard. There is a small but significant discard rate due to Hepatitis C. The 10.1% crude discard rate suggests a need for Ministry of Health (MOH) and the Zambia National Blood Transfusion Service to consider safer donor retention strategy as driver for the sustainable safe blood program in Zambia.

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