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ABSTRACT:

Transfusion Transmissible Infections (TTI) in blood donors continue to be a threat to recipients, therefore, to increase accessibility to infection-free donor blood, voluntary non-remunerated donation has been recommended. This was a retrospective observational study aimed at establishing a data base for transfusion transmissible infections in family replacement and voluntary donors at the Alotau Provincial Health Authority (PHA) Blood Bank Service using donor data recorded from 2015 to 2018. Statistical significance was determined using the chi-square test with p-values of <0.05 considered significant. Ethical clearance was approved by the School of Medicine and Health Sciences Research Ethics Committee. Consent to collect data from the Alotau PHA Blood Transfusion Service and the Blood Bank Laboratory was granted on the 17/06/2019 reference #: RCO1/6/19. A total of 2852 blood donors were analyzed, of which 90% (n=2567) were males and 10% (n=285) were females. Of these, 69% (n=1959) were Family-Replacement-Donors (FRDs) and 31% (n=893) were Voluntary Donors (VDs). Donations by FRDs increased with increasing years from 2015 to 2017 and declined slightly by 1% in 2018. The complete opposite was observed in VDs. TTIs were higher in FRDs than in VDs (20.1% vs 16.8%, p=0.04), in single infections, (18.6% vs 15.2%, p=0.03), infection with HBV (9.9% vs 7.2%, p=0.02), and in those aged over 45 years (2.7% vs 0.1%, p=<0.01). The differences were statistically significant. TTI was significantly higher in male FRDs than VDs (19.1 vs 14.3, p=0.00) and in females, it was significantly higher in VDs than in FRDs (2.5% vs 1.0%, p=0.00). TTIs were significantly high in older male FRDs which seem to indicate that the primary route of transmission in this setting could be mostly sexual. This calls for establishment of effective educational awareness about risk factors in the older population, and promotion of voluntary non-remunerated donations in this setting.

Key words: Transfusion Transmissible Infections (TTI), HBV. HIV, Syphilis, Family Replacement Donors, Voluntary Donors, Blood Donation.

INTRODUCTION:

Globally, Transfusion Transmissible Infections (TTIs) are higher in Lower Middle-income countries (LMIC) and Low-income countries (LIC) compared to both High Income countries (HIC) and Upper-Middle-income countries

(UMIC) [1]. In the quest to reduce transmission of TTIs through donor blood, the World Health Organization (WHO) recommended 100% Voluntary Non-Remunerated Donation (VNRD) from low-risk individuals in all blood bank settings [2-3]. Although countries have tried to promote this type of donation, Family Replacement Donation (FRD) is still occurring at high frequency. It is as high as 87% in Amman and Jordan [4] to 100% in Northern State of Sudan [5]. FRD may still be necessary especially during acute shortages and emergencies, during which these types of donors are easily accessible.

In addition, because of social [6], cultural practice [7] and religious beliefs [8], potential donors are not willing to give blood voluntarily. In such situation, family members or friends of the patient needing blood often feel obliged to give blood for fear of losing that person from lack of blood transfusion. According to Ehsan et al**.** [9], this type of donors should be encouraged to become voluntary donors to maintain blood supply pools in hospitals. However, in situations where these donors are geographically isolated from the blood bank settings, and only come once in a while when relatives are admitted in hospitals, it can be hard to convert them to VDs because of the distance and also financial constraints they may face.

Compared to the rest of the world, Papua New Guinea (PNG) is one of the countries that has the highest rate of sexually transmitted infections (STIs) [10]. According to a report by the PNG Director for National Blood Transfusion Services, National Department of Health in September 8th, 2022 (11), the current TTI prevalence in PNG is 24.4%, representing about a quarter of wastage of donor blood, 11.4% of which is due to the hepatitis B virus infections [Ref]. Furthermore, the percentage of VD is below 50%; similar to those seen in sub-Sahara Africa [8].

Currently there is no published data on the prevalence of infections among blood donors in Alotau Provincial Health Authority Blood Transfusion Service (APHA BTS); this study was done to establish a data base to help policy makers develop effective strategies to ensure blood safety in this setting.

METHODOLOGY:

Study area**:** The APHA BTS is part of the Alotau Provincial Health Authority Hospital (APHA) which serves the Milne Bay province. It is situated in a maritime location and therefore caters for the many outlying Islands which make up the province of Milne Bay. It has a population of 269 347, served by 188 health centres and aid posts, scattered throughout the province [12], and whose patients are referred to APH Hospital for blood transfusion when in need of blood. Additionally, transportation coverage in the province is 85%, mainly by road and sea.

Study design: This was an observational retrospective study using data collected from the APHA BTS recorded for the year 2015-2018. The information extracted from their archive included the year of donation, age, gender, frequency of donation, type of donation and serological status for Hepatitis B virus (HBs-Ag), Human Immunodeficiency Virus (HIV), Treponema pallidum (TPHA – Treponema pallidum Haemagglutination Test).

Study population: The study population included all donors recorded from January 2015 to December 2018, and who have passed a pre-donation screening procedure before donation. This includes screening of haemoglobin (HB) level, weight (wt), blood pressure (BP), and pulse rate (PR), medical history including social status.

Data Analysis: All data were entered and analyzed in Excel program (Microsoft Office 2010 version). Statistical significance between categorical variables was calculated using the chi-square test, 95%CI was calculated for prevalence and a p-value of 0.05 was considered significant.

Ethical approval: Ethical clearance was obtained from the University of PNG (UPNG) School of Medicine and Health Sciences (SMHS) Research Ethics Committee. The consent to collect data from the Alotau Provincial Health Authority was granted on the 17/06/2019 reference #: RCO1/6/19 by the APHA Research Ethics Committee.

RESULTS:

In this retrospective study, data for a total of 3071 blood donors were collected from archived records at the Alotau Provincial Hospital Blood Transfusion Services from 2015 to 2018. Of these, 7% (n=219) were excluded. Thus, the data for 2852 blood donors were analysed. Of those that were analysed 31% (n=882) were donated in 2015, 25% (n=711) in 2016, 24% (n=695) in 2017, and 20% (n=564) in 2018. In these four years period, 90% (n=2567) donors were males and 10% (n=285) were females (Table 1).

From 2015-2018, the total number of Family Replacement Donors (FRDs) were 69% (n=1959) and Voluntary Donors (VDs) were 31% (n=893). Of the FRDs, 63% (n=1800) were males and 6% (n=159) were females. Of the VDs, 27% (n=767) were males and 4% (n=126) were females. In both groups, male donors comprised the majority of the donors.

The mean age of all the donors was 32.4 ± 10.1 years and the age range was 16 - 87 years. The donors in the 30 years age group frequently donated blood during the study period, in the overall population and also among males and FRD donors. Female donors in the 28 years age group frequently donated blood compared to the

other age groups. In VDs, females in the 32 years age group frequently donated.

Over the four-year period, male donations steadily increased from 87% in 2015 to 93% in 2018, while female donors declined from 13% to 7% in the same period (Table 1). In the same way, FRD donations steadily increased from 53% in 2015 to 82% in 2017 but slightly declined to 81% in 2018, while VDs steadily declined in the same period to 2017, and in 2018, a slight increase to 19% was observed. These changes are illustrated in Figure 1.

A significant difference in TTIs was observed between FRDs and VDs (20.1% vs 16.8%, *p*=0.037 respectively). The same scenario was also observed in single infections (18.6% vs 15.2%, *p*=0.027) with HBV (9.9% vs 7.2%, *p*=0.021), males (19.1% vs 14.3%, *p*=0.02) aged over 45 years old (2.7% vs 0.1%, *p*=<0.001) respectively. Transfusion transmissible infections were significantly high in female voluntary donors than FRDs (2.5% vs 1.0%, *p*=0.003) respectively (Table 2). Single infections with HIV and syphilis, dual and triple infections showed no significant difference between FRDs and VDs (Table 2).

Table 1: Annual distribution of blood donors by gender at APH BTS from 2015 – 2018

Years	Total Donors	Females % (n)	Males % (n)
2015	882	13% (118)	87% (764)
2016	711	11% (79)	89% (632)
2017	695	7% (48)	93% (647)
2018	564	7% (40)	93% (524)
2015 - 2018	2852	10% (285)	90% (2567)

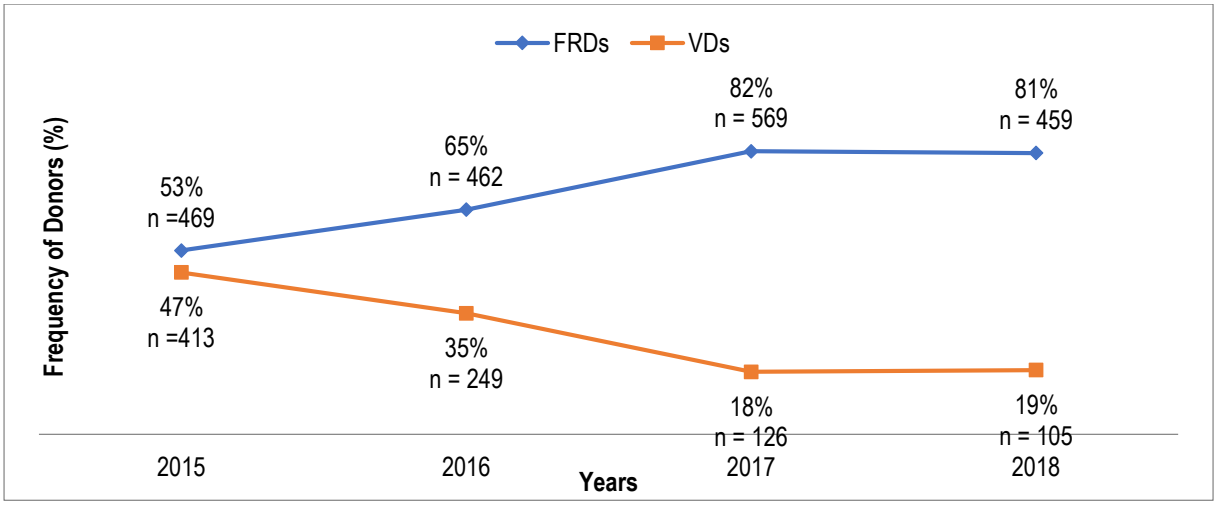

Figure 1: Annual distribution of FRDs and VDs at APHA BTS from 2015 – 2018, Milne Bay Province, Papua New Guinea. FRDs is showing a steady increase from 2015 to 2017 and slightly declined in 2018, while VDs showed a decline in the same period and a slight increase in 2018.

Table 2: Distribution of 2852 donors according to the prevalence of infection with TTIs among FRDs and VDs.

	FRDs (n=1959)		VDs (n=893)			
	Proportion Positive	Prevalence (%)	Proportion Positive	Prevalence (%)	X^2	p=value
	(%)	95%CI	(%)	95%CI		
Total # of TTIs	394	20.1 (18.3-21.9)	150	16.8 (14.4-19.3)	4.367	0.04
Single Infection	365	18.6 (16.9-20.4)	136	15.2 (12.9-17.6)	4.90	0.03
HBV	194	9.9 (8.6-11.2)	65	7.2 (5.6-9.0)	5.3	0.02
HIV	25	1.3 (0.8-1.8)	9	1.0 (0.4-1.7)	0.38	0.54
SYPHILIS	145	7.4 (6.2-8.6)	63	7.0 (5.4-8.7)	0.11	0.74
Dual Infection	29	1.5 (1.0-2.0)	14	1.6 (0.8-2.4)	0.03	0.86
HBV/HIV	2	0.1 (-0.0-0.2)	3	0.3 (-0.0-0.7)	1.92	0.17
HBV/SYPHILIS	24	1.2 (-0.7-1.7)	11	1.3 (0.5-2.0)	0.00	0.99
HIV/SYPHILIS	2	0.1 (-0.0-0.2)	0	0.0 (0.0-0.0)	0.91	0.34
Triple Infection	1	0.1 (-0.1-0.2)	0	0.0 (0.0-0.0)	0.46	0.5
Sex						
Males	374	19.1 (17.4-20.8)	128	14.3 (12.0-16.6)	9.57	0.00
Females	20	1.0 (0.6-1.5)	22	2.5 (1.5-3.5)	8.80	0.00
Age-Group						
15-29	169	8.6 (7.4-9.9)	88	9.9 (7.9-11.8)	1.13	0.29
30-44	172	8.8 (7.5-10.0)	61	6.8 (5.2-8.5)	3.11	0.08
≥45	53	2.7 (2.0-3.4)	1	0.1 (-0.1-0.3)	22.21	<0.01

DISCUSSION:

The results showed 9 to 1 ratio of male to female donors during the study period. Similar studies done in different parts of India reported similar ratios of male to female donors [13-14], however, this is in contrast to Mamu and Varpit [15] whose study showed a lower male to female ratio of 4:1. The low number of donor population and type of donor selection in this latter study could be the reason for its low ratio. However, male donor dominance in all of these studies is similar, possibly due to their willingness to donate blood compared to females [16]. Moreover, the trend of male donations in this current study increased with increasing years, while female donors showed an opposing trend (Table 1). A study done in Port Moresby General

Hospital Blood Transfusion Service (PMGH BTS) in PNG, also showed a similar trend [15]. No explanation was offered for this scenario; however, the low number of female donors could be attributed to their low haemoglobin level reported in 1983 by Talonu [17] at PMGH BTS in PNG, or it could be due to social factors such as ignorance, social taboos [18] or normal physiological reasons such as child bearing age, pregnancy and menstrual flow [19], or religious and cultural beliefs [7-8].

Over the four years period of the current study, the proportions of FRDs steadily increased from 53% in 2015 to 82% in 2017 and in 2018, it slightly declined by 1%. On the other hand, the proportions of VDs declined with increasing years from 47% in 2015 to 18% in 2017, and then slightly increased to 19% in 2018. The decline of VDs to 17% in 2017 (Fig 1) was probably due to theft; blood bags were stolen from the blood bank during the year and were not retrieved. This may have caused fear in VDs, which may have induced family members and friends to donate more frequently for family members and friends in the hospital for fear of losing them. Another reason for the decline in voluntary donation could be lack of effective awareness campaign drives to promote voluntary donation, because of geographic isolation of these islands from the main blood collection centre. These are of course assumptions which should be substantiated by further research.

The prevalence of TTIs in this study was significantly high in FRDs than in VDs (20.1% vs 16.8% p=0.04); especially prominent in FRD males (19.1%, p=0.00), and those over 45 years old (2.7%, p=<0.01); although among female donors, it was significantly high in VDs (2.5% vs 1.0%; p=0.00) (Table 2). This finding is similar to Mohamed *et al.* [20] who reported TTIs to be twice as high in FRDs (9.0%) as compared to VDs (4.0%). Similarly, in Eritrea [21], in Egypt [19] and at PMGH BTS in PNG [14], high TTI proportions were reported in FRDs; all of which were however, in contrast to the findings of Siraj *et al.* [22] and Varpit & Malana [23], who reported high TTI frequencies in VDs. This could have been due to the high numbers of VD donor populations and also the study duration in the latter two studies, whose studies included data collected over longer periods of time.

However, in this current study, most of these FRDs come from the outlying Islands in Milne Bay province and therefore they either do not always go back to the blood transfusion centre to collect their results, or are not notified of their serological status. This is similar to a study in Tanzania who, despite reporting high TTI prevalence, only less than 10% of the donors positive for TTIs were notified of their results [20], owing to lack of resources, inadequate contact and difficulties encountered by individuals having to travel long distances. These factors could have applied to donors in this present study, given the geographic

isolation of the donors. However, this remains to be substantiated by further prospective study to look at possible reasons, and to develop ways of reaching out to these Islands to promote voluntary unpaid blood donation.

The global prevalence of TTIs in blood donations categorized according to income groups is reported to be higher in Lower middle-income (LMIC) and Low-income countries (LIC), compared to High-income (HIC) and Upper middle-income countries (UMIC) [1]. Because of the risk of transmission of TTI through blood transfusion, the WHO recommends collection of blood from low-risk, regular and voluntary unpaid donors. It is quite disturbing that this is contrary to this current study in which the majority are FRDs.

Single infections were higher in FRDs as compared to dual infections which were slightly higher in VDs, however the difference was not statistically significant (1.6% vs 1.5%, p=0.86) respectively (Table 2). This is similar to a study done in Eritrea who found the odds of FRDs being contaminated with at least one TTI to be high (OR=1.56, 95%CI 1.10-2.21 [24].

The significantly high TTI rates in male FRDs, female VDs and in the older population (Table 2) seen in this current study could be due to lack of adequate understanding of the risks of TTIs among the older population as demonstrated by Keleta *et al.* [24]. In fact, the mean age for FRDs and VDs in this current study indicates an older population (32.8±9.7 years and 31±11 years) respectively, suggesting that the modes of TTI transmission is more likely to be sexual.

In single infection, TTI with the hepatitis B virus was significantly high in FRDs than VDs (9.9% vs 7.2%, p=0.02). The high prevalence of HBV infection in FRDs in this study is in concordance with Ahmed *et al.* [25] and Mohamed et al. [20] but in contrast to other studies [26-27], who reported statistically insignificant differences in HBV infections between FRDs and VDs. Although HIV and syphilis infections were higher in FRDs compared to VDs in this study, the difference in infection between the two was not statistically significant (1.3% vs 1.0%, 0.54; 7.4% vs 7.0%, p=0.74) respectively. However, according to a study in Tanzania [28], FRDs were reported to be 1.22 times more likely to be detected with HIV than VDs, and 1.35 times more likely to be detected with HBV infections than VDs. Additionally, male donors were 1.19 times more likely to be positive for syphilis than females. Similarly, another study [15] reported a lower risk of VDs being infected with HBV (OR = 0) and syphilis (OR =0.9) than FRDs, although the risk of VDs being positive for HIV was high (OR = 1.16, 95%CI 0.813-1.65). These results suggest the need to promote voluntary non remunerated donations and strict adherence to thorough pre-screening protocols during pre-donation screening to reduce the window period and thus increase safety to recipients.

CONCLUSION:

Transfusion transmissible infections are prevalent in blood donors in MPHA BTS and are significantly high in male FRDs, female VDs and in the older population (over 45 years old). Single infections with HBV are significantly higher than dual and triple infections. This calls for establishment of effective educational awareness about the risks of infection among the older population, and promotion of voluntary non remunerated donations among the population in this area is paramount.

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