Tropical Biomedicine 36(4): 993–1002 (2019)

Seroprevalence of selected transfusion transmissible infections among blood donors in Region 3, Philippines: A 5-year retrospective study

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Received 18 June 2019; received in revised form 9 August 2019; accepted 14 August 2019

Abstract. Transfusion of blood is a life-saving intervention that saves many lives. Unsafe practices in blood donation and pre-transfusion testing place people's lives at risk of transfusion transmissible infections (TTIs). The study aims to determine the overall seroprevalence of the selected TTIs for the past 5 years (2013-2017) among blood donors from a hospital in Region 3, Philippines. The trend and distribution of the TTIs according to age group, sex, donor category, and number of donations were also determined. Data extracted include the age, sex, donor category, number of donations, and screening results of all donors from January 2013 to December 2017. The overall seroprevalence of the selected TTIs from over the 5-year period is 4.17%. The seroprevalence rates of hepatitis B, hepatitis C, HIV and syphilis from 2013 to 2017 are 2.87%, 0.48%, 0.10%, and 0.62%, respectively. The age group of 25 to 44 years old showed the highest rate of reactive donors. Also, higher rates of reactive donors are seen among male donors, replacement donors, and first-time donors. The overall seroprevalence of TTIs in the study locale is low and it shows a decreasing trend from 2013 to 2017. Donors who are 25 to 44 years old, males, replacement, and first-time donors showed highest seroprevalence rates of TTIs.

INTRODUCTION

Transfusion of blood is an essential life-saving intervention that saves millions of lives each year. Thus, blood donation is essential to provide sufficient blood products to patients in need (Nwankwo *et al.*, 2012). However, unsafe practices related to blood donation and pre-transfusion testing also place people's lives at risk of transfusion transmissible infections (TTIs) (Bhawani *et al.*, 2010; Nwankwo *et al.*, 2012; Nada, 2014). Blood transfusion is an effective mode of transmitting infectious agents, and the chances of acquiring transfusion-associated complications per unit of blood infused is at 1% (Shah *et al.*, 2013; Nada, 2014; Kalpana *et al.*, 2017). Infectious agents that may be transmitted through blood transfusions include the Hepatitis virus, human immunodeficiency virus (HIV), *Treponema* spp., *Plasmodium* spp. (Kulkarni, 2011). The screening of donors before blood donation and of blood donor units may reduce the transmission of such infections (Kulkarni, 2011; Shah *et al.*, 2013; Wamamba *et al.*, 2017). The World Health Organization (WHO) recommends the screening of all donated blood units for infection before utilization. It has been mandated by the said agency to screen blood products for Hepatitis B, Hepatitis C, HIV, and syphilis (Song *et al.*, 2014; Kalpana *et al.*, 2017; Onyango *et al.*, 2018). In the Philippines, the government ensures safe blood donation through the Republic Act No. 7719 or the National Blood

Services Act of 1994, which is "an act promoting voluntary blood donation, providing for an adequate supply of safe blood, regulating blood banks and, providing penalties for violation thereof" ("Republic Act No. 7719," 1994). Reduction of TTIs was observed primarily in countries where serologic screening of blood donors is employed. However, the risks of acquiring TTIs remain due to the limitations of screening techniques. Nucleic acid testing, a more sensitive screening method, must be implemented to detect TTIs at an earlier stage and to avoid the transmission of the infectious agent during the window period of the disease (Song *et al.*, 2014).

The determination and evaluation of seroprevalence rates of the TTIs among blood donors are vital to estimate the effectiveness of blood safety procedures. It may serve as an indicator to measure the safety of blood products, as well as the risk of infection. It will also serve as a basis for policymakers to improve existing guidelines and protocols to guarantee the safety of blood products for transfusion. This study described the seroprevalence of Hepatitis B, Hepatitis C, HIV infections, and syphilis among blood donors in a hospital located in Region 3, Philippines. The hospital was selected due to the high volume of patients, high utilization of blood products, high demands for blood products by in-patients and out-patients, and consistent high number of blood donors. The location of the hospital and its nearby regions have high TTIs, specifically HIV infection.

MATERIALS AND METHODS

The study is a retrospective descriptive study of data from blood donors in a hospital located in Region 3, Philippines. The data collected were from January 2013 to December 2017. Ethics clearance (ERC Ref No. 121) was granted by the Angeles University Foundation-Center for Research and Development Ethics Review Committee (AUF-CRD ERC). Participation of the hospital is purely voluntary, and informed consent was given to the institution representative. All data collected were treated as strictly confidential in accordance with the provisions of the Data Privacy Act of 2012. A letter of request with the informed consent were given to the Head of the Laboratory. Upon approval of the request, data were collected using a data abstraction form. Data collected include the following: donor number, age, sex, donor category, number of donations, and screening test results for hepatitis B surface antigens (HBsAg), hepatitis C virus (HCV), HIV, and syphilis. The donor category refers to whether the donor is a walk-in donor or a replacement donor while number of donations refers to whether the donor is a first-time donor or repeat donor. Names of the donors were no longer included in the data collection to ensure confidentiality. Donors who did not pass the pre-donation screening were not included in the study because these donors were no longer subjected to serological screening.

Donated blood units were screened for HBsAg, HCV, HIV and syphilis using an accredited automated machine. DiaSorin reagents were used for screening TTIs. The specificity and sensitivity of the screening tests were 99.5% and 100%, respectively.

The seroprevalences of HBsAg, HCV, HIV, and syphilis and its distribution among various age groups, sex, donor category, and number of donations are expressed in frequency and percentages. The distribution of among age group, sex, donor category, and number of donations were among the reactive donors only and not among the total number of blood donors screened. A line graph was used to show the trend in seroprevalences.

RESULTS

Potential donors answered the donor medical questionnaire and were subjected to physical examination. Each donor must first meet all the requirements prior to whole blood collection. After blood donation, blood units were screened for TTIs simultaneously by an accredited machine that employs enzyme-linked immunoassay (ELISA). The hospital has been using the same accredited

machine from 2013 to 2017. For hepatitis B screening, HBsAg were detected, while the *Treponema pallidum* antibodies were detected for syphilis screening. For Hepatitis C and HIV screening tests, fourth generation ELISA was employed wherein both antigens and antibodies were detected. Reactive blood samples were re-tested with another machine using the similar method before sending the blood samples to the Transfusion Transmissible Infections National Reference Laboratory (TTI-NRL) of the Research Institute for Tropical Medicine (RITM) for confirmatory testing. When confirmatory results were received by the hospital laboratory, blood donors with confirmed positive results for infection were contacted by the doctor assigned in the hospital's blood collecting unit for counseling and referral. Also, donors with confirmed positive results to any TTIs are permanently deferred from donating blood. The hospital adapts the testing algorithm by Department of Health (Figure 1). The Department Circular No. 2013-0132 states that all whole blood and apheresis donations shall be tested for evidence of TTIs before release for compatibility testing and transfusion. It is also stated in this document that blood units that are reactive to syphilis were not be referred nor sent to TTI-NRL.

Table 1 shows the overall seroprevalence of the four TTIs, for the past five years (2013 to 2017). Hepatitis B displays the highest seroprevalence, followed by syphilis, hepatitis C, and HIV. There are also co-infections detected among the donors.

The overall seroprevalence rates of reactive blood donors per year from 2013 to 2017 is shown in Figure 2. Overall rates of reactive donors from 2013 to 2017 shows a decreasing trend.

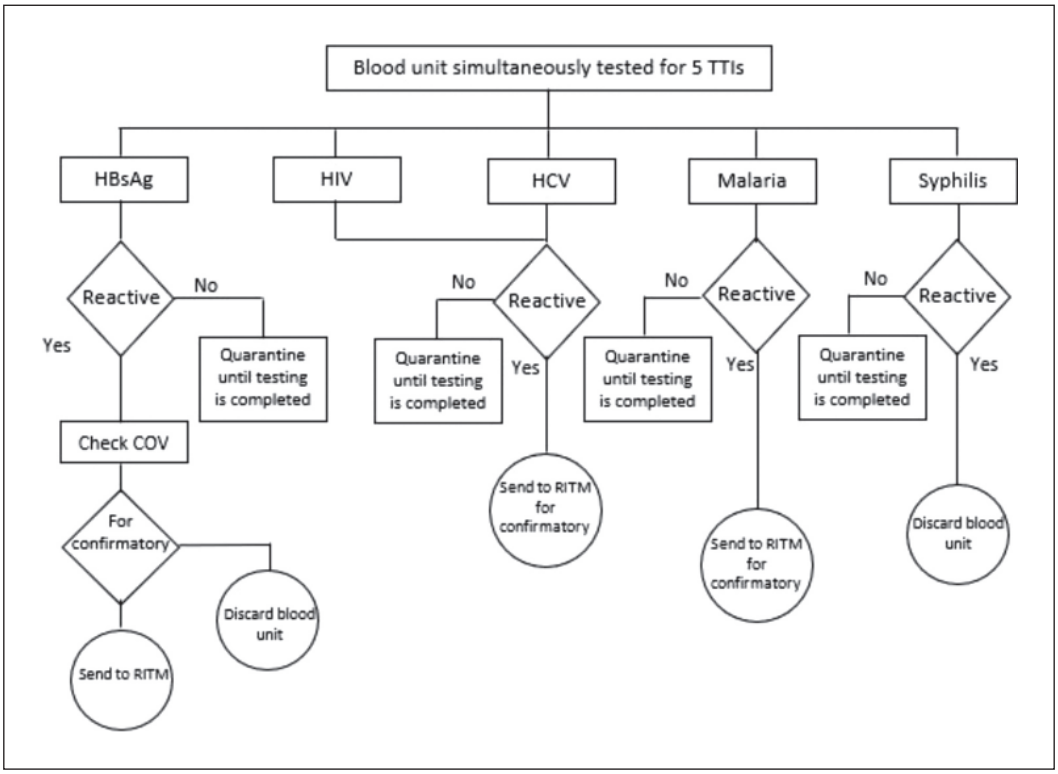

Figure 1. Testing algorithm for transfusion transmissible infections.
(Source: Department of Health Department Circular No. 2013-0132. Retrieved from http://dmas.doh.gov.ph:8080/Rest/GetFile?id=348255. Accessed November 15, 2018).

Table 1. Frequency and overall seroprevalence of TTIs in blood donors of the hospital from 2013-2017

TTIs	No. of Donors	Seroprevalence
Hepatitis B	1,638	2.87%
Syphilis	352	0.62%
Hepatitis C	276	0.48%
Human Immunodeficiency Virus	58	0.10%
Co-infections	58	0.10%
Reactive donors	2,382	4.17%
Non-reactive donors	54,710	95.83%
TOTAL	57,092	100%

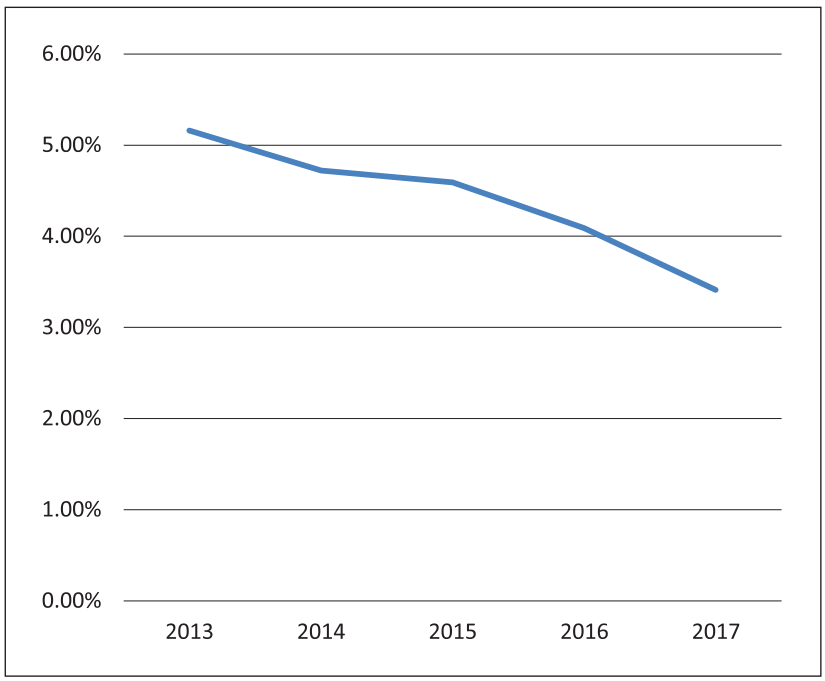

Figure 2. Overall seroprevalence rates of reactive blood donors in the hospital from 2013 to 2017.

Figure 3 shows the seroprevalence rates of hepatitis B surface antigen, hepatitis C virus, HIV, syphilis and co-infections in blood donors from the hospital from 2013 to 2017. HBsAg, hepatitis C, and syphilis showed a decrease in seroprevalence from 2013 to 2017. Whereas, the rates of HIV reactive donors increased from 2013 to 2017.

Table 2 shows the distribution of reactive donors according to age group, sex, donor category, and number of donations. The distribution was among the reactive donors and not among the total number of donors screened. Age grouping is based on the age group utilized in National Voluntary Blood Services Program annual reporting. The age group of 25 to 44 years old shows the highest overall rate of reactive donors as well as the highest rate of reactive donors in each of the TTIs. Higher rate of reactive donors was observed among male donors. The institution started to indicate in their blood donors' records the number of donations last January 2017 and the donor category last August 2017.

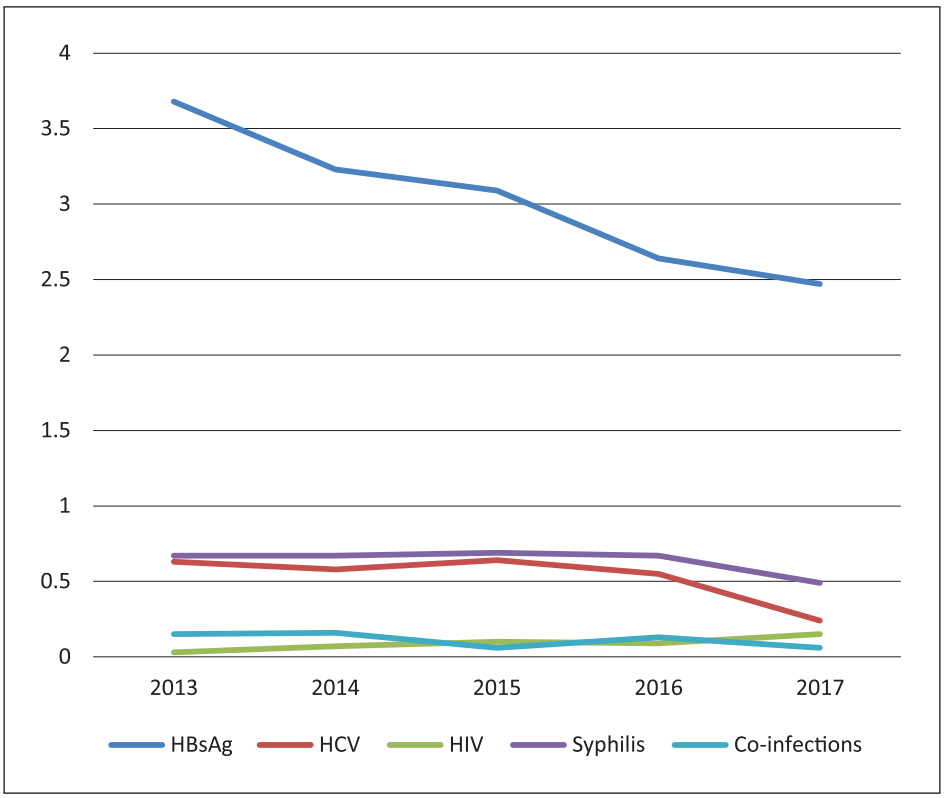

Figure 3. Seroprevalence rates per year of HBsAg, HCV, HIV, Syphilis and Co-infections in reactive blood donors in the hospital from 2013 to 2017.

Table 2. Distribution of seropositive* blood donors in the hospital from 2013-2017 according to age, sex, donor category and number of donations

Characteristics	HBsAg (%)	HCV (%)	HIV (%)	Syphilis (%)	Co-infection (%)	TOTAL (%)
Age Group						
18–24	199 (8.35)	32 (1.34)	17 (0.71)	28 (1.18)	4 (0.17)	280 (11.75)
25–44	1192 (50.04)	203 (8.52)	38 (1.60)	231 (9.70)	43 (1.81)	1707 (71.66)
45–64	243 (10.20)	41 (1.72)	3 (0.13)	93 (3.90)	11 (0.46)	391 (16.41)
65 and above	0	0	0	0	0	0
No age indicated	4 (0.17)	0	0	0	0	4 (0.17)
Sex						
Male	1507 (63.27)	267 (11.21)	53 (2.23)	316 (13.27)	57 (2.39)	2200 (92.36)
Female	131 (5.50)	9 (0.38)	5 (0.21)	36 (1.51)	57 (0.04)	182 (7.64)
Donor Category***						
Family/ Replacement	130 (54.85)	15 (6.33)	13 (5.49)	26 (10.97)	0	184 (77.64)
Walk in	38 (16.03)	2 (0.84)	6 (2.53)	7 (2.95)	0	53 (22.36)
Number of Donations**						
First time	243 (39.45)	13 (2.11)	9 (1.46)	53 (8.60)	4 (0.65)	322 (52.27)
Repeat	203 (32.95)	31 (5.04)	18 (2.92)	35 (5.68)	7 (1.14)	294 (47.73)

* Seropositivity in percentage among respective groups (characteristics), not among total units.
** From January to December 2017.
*** From August to December 2017.

Most reactive donors are replacement and first-time donors. There were no co-infections reported from August to December 2017.

DISCUSSION

The overall seroprevalence of the four TTIs, for the past five years (2013 to 2017) is low (4.17%) as related to the prevalence (4.50%) for 2002 to 2004 in the study of Yanase *et al.* which included blood donors' data reported to the STD/AIDS Cooperative Central Laboratory in Manila, Philippines (Yanase *et al.*, 2007). It is also lower compared to the result obtained by Rodenas *et al.* in a similar study wherein there is 7.67% seroprevalence for HBsAg among blood donors in East Avenue Medical Center, Quezon City, Philippines from December 2003 to November 2004 (Rodenas *et al.*, 2006). In the current study, Hepatitis B showed the highest seroprevalence (2.87%) among the selected TTIs. This observation is consistent with other reports from India (Unnikrishnan *et al.*, 2011), sub-Saharan Africa (Okoroiwu, 2019) and North America (Brien *et al.*, 2007) where hepatitis B has been the leading transfusion transmissible infection and major cause of blood donation deferral. The results of the study are similar with other related studies in Africa and India wherein the highest seroprevalence is seen in Hepatitis B (Diarra *et al.*, 2009; Bhawani *et al.*, 2010; Shah *et al.*, 2013; Mohammed & Bekele, 2016). On the other hand, studies by Xie *et al.* and Yang *et al.* showed the highest prevalence in syphilis (Xie *et al.*, 2015; Yang *et al.*, 2016). Increased number of reactive hepatitis B surface antigen screening tests among the donors may reflect a high prevalence of hepatitis B infection in the community (Song *et al.*, 2014). According to WHO Western Pacific Region Hepatitis Data and Statistics, as of July 2018, the Philippines has 10,600,000 individuals positive for hepatitis B surface antigen (World Health Organization Western Pacific Region, 2018). But comparing the current seroprevalence for HBsAg (2.87%) with the result of Rodenas *et al.* in 2005 (7.67%), there was a decrease in the seroprevalence of HBsAg. This may be credited to the government's efforts in reducing the transmission of hepatitis B through vaccination of newborns, school aged children and pregnant women which started in 1992 and implementation of hepatitis B policy and program in the workplace (Department of Health, 2007, 2011; Department of Labor and Employment, 2010; World Health Organization (WHO) Western Pacific Region, n.d.).

The total number of reactive blood donors from 2013 to 2017 was increasing, while the seroprevalence of the selected TTIs from 2013 to 2017 showed a decrease in trend. This is due to the growth in the total number of blood donors subjected to serological screening tests. In 2013, there was 5.16% overall seroprevalence rate of TTIs, and in 2017, there was only 3.41% overall seroprevalence rate of TTIs. The seroprevalence trend results of the current study are similar with the trend results in the retrospective study by Kalpana in Maharashtra, India, where it shows a 33.33% decrease in the seroprevalence among donors from 2013 to 2017 (Kalpana *et al.*, 2017). This is also true with the studies of Bhawani *et al.* in India and Elbjeirami *et al.* in Saudi Arabia which show a gradual decrease in the rates of TTIs over the years (Bhawani *et al.*, 2010; Elbjeirami *et al.*, 2015). A decrease in seroprevalence may be attributed to effective intervention programs and more public awareness about the diseases which decreased the transmission of such diseases (Tessema *et al.*, 2010; Nada, 2014; Okoroiwu *et al.*, 2018). This may also be due to higher number of voluntary donors because of increased public awareness about voluntary blood donation (Rawat *et al.*, 2017). In the current study, the total number of donors subjected to serological screening tests has constantly increased through the years. The number of donors screened in 2013, 2014, 2015, 2016 and 2017 were 7,330, 6,849, 9,957, 14,882 and 18,074, respectively. The increase in blood donors may be credited to the effective campaign in promoting voluntary blood donation. However, the

number of reactive donors to HIV is increasing over time. This may be because of the increasing number of HIV infected individuals in the community. This is evident in the Department of Health HIV-AIDS & ART Registry of the Philippines, wherein there are 954 newly diagnosed cases of HIV reported in September 2018. Sexual contact remains the primary mode of transmission and mostly are among males who have sexual contact with males (Department of Health, 2018).

The gradual decrease in the overall seroprevalence may be due to the effective blood donation program of the Department of Health in the Philippines. The National Voluntary Blood Services Program started in 1994 and this eliminated commercial blood banks and paid donors which are found to provide unsafe practices and blood supply. This program guaranteed the safety of blood supply through implementing blood donor screening and serological screening of blood units. It also encourages regular voluntary blood donation which is found to provide safer blood supply because donors tend to live a healthy lifestyle due to time to time screening (Tessema *et al.*, 2010; Sethi *et al.*, 2014). However, an increase in HIV seroprevalence was observed in the study. This may be due to the increasing HIV cases in the country. There were only 16,516 HIV cases reported in 2013 but in 2017, there were already 50,725 HIV cases reported to the Department of Health (Department of Health, 2013, 2017). The increase in the number of HIV cases may be attributed to the HIV/STI program of the Department of Health wherein it raises awareness and knowledge in the community and provides free counseling and HIV testing. Thus, more individuals were encouraged to get tested and more patients join the program which provides antiretroviral drugs (Department of Health, n.d.).

The current study showed highest seroprevalence rate of TTIs in age group of 25 to 44 years old. This finding is similar with the results of other studies that reported high seroprevalence rates of transfusion transmissible infection in age groups of 25-35 years (Elbjeirami *et al.*, 2015), 28-37 years (Xie *et al.*, 2015; Kalpana *et al.*, 2017), 35-49 years (Lopez-Balderas *et al.*, 2015), and 36-45 years (Mohammed & Bekele, 2016). Most high prevalence of TTIs is observed in sexually active age groups which may also include individuals with high-risk behavior (Kalpana *et al.*, 2017). For age group 35-45 years, the increased seroprevalence rate may be due to unsafe blood transfusion practices before 1992, tattooing, high-risk behavior, surgeries and other risk factors associated with HBV and HCV (Lopez-Balderas *et al.*, 2015). In the Philippines, Republic Act No. 7719, "An act promoting voluntary blood donation, providing for an adequate supply of safe blood, regulating blood banks, and providing penalties for violation thereof" was implemented in 1994. Unsafe blood transfusion practices which include commercial blood banks may have contributed to the high seroprevalence in certain age groups. A study by Cao *et al.* in China reported that the prevalence of HBsAg was found to be lowest in donors who are 20 years old or younger. The decrease in HBsAg prevalence in young individuals may be attributed to the national vaccination program for newborns in China, which includes HBV vaccination (Cao, 2018). This may be also be observed in the Philippines wherein Hepatitis B vaccine was introduced and made available in the Expanded Program on Immunization since 1992. This program aims to control the transmission and increase in hepatitis B cases in the country through 100% vaccination of newborns and infants (World Health Organization (WHO) Western Pacific Region, n.d.). Also, the Department of Labor and Employment issued Department Advisory No. 05 Series of 2010 which states the guidelines for the implementation of a workplace policy and program on hepatitis B. This includes education on hepatitis B, prevention strategies, and screening for hepatitis B. It aims to reduce the transmission hepatitis B especially in the workplace and provide appropriate medical evaluation and counseling to the workers (Department of Labor and Employment, 2010).

The current study observed higher value of reactive donors in males than in females. This is because more male individuals are accepted for blood donations. This may be possibly due to the reason that women are

confined to home settings, and therefore, are comparatively less exposed to the risk factors associated with TTIs as compared to males (Okoroiwu *et al.*, 2018). The study also observed that family or replacement donors had a high rate of reactive donors to TTIs. This result is similar with the results in Mozambique, India, and Ethiopia (Stokx *et al.*, 2011; Mohammed & Bekele, 2016; Biadgo *et al.*, 2017) that reported a high infection rate in replacement donors compared to voluntary donors. Another study assessed the prevalence of HBsAg among first-time blood donors in Gabon, Central Africa, and it showed that replacement donors have a higher prevalence rate compared to voluntary donors (Eko Mba *et al.*, 2018). Higher prevalence of TTIs in replacement donors was also described in other studies (Diarra *et al.*, 2009; Bhawani *et al.*, 2010; Shah *et al.*, 2013). This may be attributed to the environmental and socioeconomic factors, and replacement donors tend to conceal their actual health status (Nwankwo *et al.*, 2012). Higher rates of seropositivity were also observed in first-time donors. The finding is similar with the results of Diarra *et al.*, Sethi *et al.* and Farshadpour *et al.* The increase in TTIs in first-time donors may be due to access to free screening tests that encourages some individuals to donate blood (Siraj *et al.*, 2018). While those who regularly donate blood have a profile of low-risk TTIs because of time to time screenings and selection process in blood donation (Tessema *et al.*, 2010; Sethi *et al.*, 2014).

Conflict of Interest

The authors have no conflicts of interest associated with the material presented in this paper.

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