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TRENDS IN THE SEROPREVALENCE OF TRANSFUSION–TRANSMISSIBLE INFECTIONS (TTIS) AMONG POTENTIAL BLOOD DONORS IN A TERTIARY HEALTH FACILITY IN SOUTH–SOUTH NIGERIA

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ABSTRACT

Background and Objectives

Transfusion – transmissible infections still pose a formidable threat to blood transfusion safety in Sub-Saharan Africa owing to the endemicity of these infections in the region. Blood donors can be a source of persistent transmission of the infections. This study was conducted to determine the trends and seroprevalence of TTIs amongst prospective donors. **Materials and methods:** The screening records of prospective donors from January 1, 2012 to December 31, 2015 were reviewed with respect to screening outcome for HIV, HBsAg, HCV and Syphilis; age and sex of the donors were also identified. Rapid test kits were used for all screening. All the reactive samples were confirmed using enzyme – linked immunosorbent assay (ELISA). **Results:** A total of 12, 693 prospective blood donors were screened over a 4-year period (2012 – 2015) of which 457 (3.7%), 339(2.7%), 284(2.3%), and 176(1.4%) were positive for HIV, HBsAg, HCV, and Syphilis, respectively. The overall prevalence of TTIs in this study was 10.1%. It declined from 10.7% in 2012 to 10.3% in 2013 but rose slightly to 10.4% in 2014 and reduced to 8.9% in 2015. The infections were more prevalent in males compared to females. The highest HIV, HCV and Syphilis seroprevalence rates were observed among donors aged 36 – 45 years, while for HBsAg, the rate was highest among donors between 26 and 35 years of age. The prevalence of the infections among different age groups was statistically significant ($p<0.05$). **CONCLUSION:** These results show that TTIs are not uncommon in our blood donors. Thus, there is the urgent need to educate the blood donors on avoiding risky lifestyles while also intensifying voluntary blood donor motivation strategies and increase community surveillance of the infections.

KEYWORDS: Transfusion – transmissible infections, prospective blood donors, HIV, HBsAg, HCV, Syphilis.

INTRODUCTION

Blood transfusion is an invaluable component of modern healthcare worldwide. It is a veritable therapeutic intervention in many life – saving situations if utilized appropriately and judiciously.[1] This therapy, however, is not without risks and may lead to the transmission of infectious agents, principally human immunodeficiency virus (HIV), hepatitis B virus (HBV), hepatitis C virus (HCV) and syphilis – causing Treponema pallidum. With every one unit of blood transfused, there is a 1% chance of transfusion – related complications including transfusion transmissible infections (TTIs).[2] The TTIs are a serious threat to blood safety particularly in developing economies such as ours where the existing national blood transfusion services and policies, infrastructure, trained personnel, political structure and financial resources are inadequate. This situation is further exacerbated by the predominance of family replacement and commercially remunerated blood donors, non-priortization of blood donation from regular, voluntary and altruistic, non-remunerated donors and lack of stringent screening of donated blood for the transfusion transmissible infectious agents.[3]

In the quest for global blood safety, the World Health Organization (WHO) recommends universal and quality – assured screening of blood donations for at least the four major transfusion – transmissible infections: human immunodeficiency virus (HIV), hepatitis B virus (HBV), hepatitis C virus (HCV) infections and syphilius.[4] Undetectable transmission of infectious agents is a major challenge in transfusion medicine. Majority of the risks are due to blood donation during the serologically negative window period. Under this circumstance, blood transfusion is capable of transmitting infection inspite of negative serological screening tests. Providentially, this unnoticeable infection is preventable through application of nucleic acid amplification techniques (NATs) such as polymerase chain reaction (PCR). Currently, NAT has been adopted in many industrialized nations whereas the

developing countries including Nigeria still depend on the traditional antibody screening methods. With the use of the latter method, the risks and implications of TTIs remain a major problem.[5]

About 35 million people worldwide are living with HIV.[6] Annually, global infection rate of HIV through blood transfusion alone ranges from 80, 000 to 160,000.[7] HBV infection affects over 400 million individuals worldwide and is associated with chronic morbidities.[8] 3% of the world's population is chronically infected with HCV.[8] According to WHO, there are 12 million new cases of syphilis each year, with more than 90% occurring in developing countries where prevalence can reach 25% among blood donors.[9]

Sub-Saharan Africa (SSA) has the highest prevalence of blood-borne infections in the world.[3] The regional prevalence of HIV infection is about 23.5 million which accounts for 69% of the global burden.[10] Blood transfusion is responsible for 5 – 10% of HIV infection in this region.[11] Most of sub-Saharan Africa is endemic for HBV infection.[12] The chronic carriage rate of HBV infection among blood donors ranges between 3% and 22%.[13] HCV prevalence rate in SSA is 5.3% while the West Africa sub-region has an estimated prevalence of 2.4%.[14,15] The prevalence of syphilis is one of the highest amongst the TTIs screened in Africa. Existing evidence shows varied reports on the prevalence rates in different countries on the continent.[16-18]

Multiple studies done within Nigeria have shown a wide variation in the seroprevalence rates of the TTIs.[19-35] To the best of our knowledge, no similar study has been carried out in Uyo, South-South Nigeria. With this background, the objectives of this study were to determine the prevalence and trends of HIV, HBV, HCV and syphilis among blood donors in South-South Nigeria during a 4-year period from 2012 to 2015. It is hoped that the findings of this study would permit an assessment of the risks of TTIs in the region, evaluate the effectiveness of the blood safety strategies employed in our blood bank as well as engender the formulation and implementation of measures to prevent spread of these infections.

MATERIALS AND METHODS

Study Site

The study was done at the University of Uyo Teaching Hospital, a tertiary referral hospital in Akwa Ibom State, South-South Nigeria. The hospital provides specialized health care services to the indigenes of the oil rich state of about 4 million people[36] and neighbouring states of Cross River, Rivers and Abia.

Study Design

A descriptive cross-sectional study design was used to achieve the set objectives.

Study Population

The screening records of 12,693 consecutive prospective blood donors from January 1, 2012 to December 31, 2015 were restrospectively reviewed with respect to screening outcome for HIV, HBsAg, HCV and syphilis.

Laboratory methods

HIV status of blood donors were determined using Determine (HIV - 1/2) (ABBOTT – Japan), an immunochromatographic test kit with 97.96% specificity and 100% sensitivity. Indeterminate results were further tested using UNI-GOLD (Trinity Biotech PLC, Ireland) with 99.70% specificity and 100% sensitivity and /or GENIE II HIV – 1/HIV – 2 (BIO-RAD – France) which has 100% specificity and sensitivity, before being eventually discarded. HBsAg status was determined using commercially available third generation Diaspot HBsAg test strips (Sam – Tech Diagnostics, USA), which is an immunochromatographic test designed for quantitative determination of Hepatitis B surface antigen in plasma and serum. It has a sensitivity of 99.8% and specificity of 100%. Anti-HCV was similarly tested using Diaspot test strips. Antibodies (1gG and 1gM) to Syphilis were tested using Syphilis Ultra Rapid Test Strip (Global strips, USA), which utilizes a double antigen combination of a Syphilis antigen immobilized on the membrane to detect Treponema pallidum antibodies (1gG and 1gm) qualitatively in whole blood, serum, or plasma. It has a sensitivity of 99.7% and a specificity of 99.6%. All the reactive samples were confirmed using enzyme – linked immunosorbent assay.

Statistical analysis

The data were analyzed using statistical package for social sciences (SPSS) windows version 20.0 (SPSS Inc; Chicago, IL, USA) and presented in simple tables. The comparison was carried out with chi square test as appropriate and the level of significance was set at 5% ($p < 0.05$).

RESULTS

A total of 12,693 prospective blood donors were screened during the study period (2012-2015) of whom 9579 (75.5%) were males while 3114 (24.5%) were females giving a ratio of 3.1.1 (table 1).

Table 1: Distribution of blood donors with TTIs according to Gender

Variables	Frequency (%) n = 12, 693			
	HIV	HBsAg	HCV	Syphilis
Gender	Negative Positive Total	Negative Positive Total	Negative Positive Total	Negative Positive Total
Males	9031 (96.1) 368(3.9) 9399	9244(97.3) 256(2.7) 9500	9185(98.0) 192(2.0) 9377	9446 (98.6) 133(1.4) 9579
Females	2999(97.1) 89(2.9) 3088	2899(97.2) 83(2.8) 2982	3022(97.0) 92(3.0) 3114	2862(98.5) 43(1.5) 2905
Total	12030(96.3) 457(3.7) 12487	12143 (97.3) 339(2.7) 12482	12207 (97.7) 284(2.3) 12491	12308 (98.6) 176(1.4) 12484
X^2	7.04	0.067	8.65	0.14
P – valve	0.008	0.79	0.003	0.71

The overall seroprevalence of HIV, HBsAg, HCV, and Syphilis during the study period was 3.7%, 2.7%, 2.3% and 1.4%, respectively (table 2). The prevalence of hepatitis B, hepatitis C and syphilis was higher among females compared to males, while for HIV, it was higher among the females, the difference in prevalence by sex was statistically significant ($p < 0.05$) for HIV and hepatitis C but not for the rest (table 1).

Table 2: Yearly seroprevalence of HIV, HBsAg, HCV and Syphilis from 2012 to 2015

Variables	Frequency (%) n = 12, 693			
	HIV	HBsAg	HCV	Syphilis
Year	Negative Positive Total	Negative Positive Total	Negative Positive Total	Negative Positive Total
2012	3019 (96.0) 130(4.0) 3221	3105 (96.6) 108 (3.4) 3213	3140(97.6) 76(2.4) 3216	3188 (99.1) 30(0.9) 3218
2013	2845 (95.8) 125(4.2) 2970	2897 (97.5) 75(2.5) 2972	2907 (97.6) 70(2.4) 2977	2935 (98.8) 35(1.2) 2970
2014	2936 (96.9) 95(3.1) 3031	2952 (97.4) 78(2.6) 3030	2951 (97.3) 81(2.7) 3032	2969 (98.0) 61(2.0) 3030
2015	3158 (87.4) 107(3.3) 3265	3187 (97.6) 78(2.4) 3267	3209 (98.3) 57(1.7) 3266	3216 (98.5) 50(1.5) 3266
Total	12030(93.7) 457(3.7) 12487	12143(97.3) 339(2.7) 12482	12207 (97.7) 284 (2.3) 12491	12308(98.6) 176(1.4) 12484
X^2	7.56	7.05	6.46	14.71
P – valve	0.06	>0.05	>0.05	<0.05

The highest HIV, HCV and Syphilis seroprevalence rates were observed among donors aged 36 – 45 years while for HBsAg, it was highest among donors between 26 and 35 years of age. The prevalence of the infections among different age groups was statistically significant ($p < 0.05$) table 3.

Table 3: Prevalence of the TTIs among different age groups

Variables	Frequency (%) n = 12, 693			
	HIV	HBsAg	HCV	Syphilis
Age (years)	**Negative Positive Total**	**Negative Positive Total**	**Negative Positive Total**	**Negative Positive Total**
18 – 25	4243 (98.6) 62(1.4) 4305	4303(99.4) 25(0.6) 4328	4297(99.8) 10(0.2) 4307	4352(99.95) 2(0.05) 4354
26 – 35	5212 (98.1) 100(1.9) 5312	4907(95.6) 224(4.4) 5131	4917(96.6) 171(3.4) 5088	4973(98.0) 100(2.0) 5073
36 – 45	1814(96.8) 276(13.2) 2090	2436(96.8) 80(3.2) 2516	2475(96.1) 100(3.9) 2575	2473(97.2) 72(2.8) 2545
46 – 55	741(97.6) 18(2.4) 759	488 (98.0) 10(2.0) 498	503(99.4) 3(0.6) 506	492(99.6) 2(0.4) 494
56 – 65	20(95.2) 1(4.8) 21	9(100) 0(0) 9	15(100) 0(0) 15	18(100) 0(0.0) 18
Total	12030(96.3) 457(3.7) 12487	12143(97.3) 339(2.7) 12482	12207(97.7) 284(2.3) 12491	12308 176(1.4) 12484
X^2	651.5	130	144	110.5
p-valve	<0.001	<0.001	<0.001	<0.001

DISCUSSION

Acquisition of transfusion – transmissible infections in the course of therapeutic blood transfusion is a pervasive global health challenge in transfusion medicine; thus all hands must be on deck to eliminate or reduce this complication to its lowest ebb. This is particularly important because of the chronic morbidity and mortality associated with these infections. It is therefore utterly expedient to continue to monitor the trends in the prevalence of transfusion transmissible infections in order to evaluate the risk of TTIs in our prospective blood donors, and by extrapolation, the risk in the general population receiving such blood, taking into cognizance the peril of bleeding donors during the "window period" when they may be negative for the offending antigens or antibodies being screened for.

The overall prevalence of HIV, HBsAg, HCV, and Syphilis during the period under review was 3.7%, 2.7%, 2.3% and 1.4%, respectively. The prevalence of HIV observed in this study is higher than the estimated national HIV seroprevalence which is put at 3.4% but lower than the 6.5% found in the general population.[37] It is however consistent with a 3.5% prevalence rate reported by Chukwuwurah and Nneil[19] in Enugu. Conversely, our figure is at variance with other figures reported in the country; Hassan and Colleagues in Kaduna (2.8%), Ejele and Colleagues[21] in Port Harcourt, South-South, Nigeria (1%), Offor and Colleagues[22] in Benin City (0.5%), Musa and Colleagues[23] in Osogbo (3.1%), Irena et al[24] in Lagos Island (8%), Amadi et al[25] in Abia State (10.6%) and Baba et al[26] in Maiduguri (5.5%). In other countries, 3.1% has been reported from Ghana[28] and 2.92% from the United States.[39] In Saudi Arabia, El-Hazmi[40] observed a zero percent HIV prevalence among their cohort of 24,173 blood donors, while in Egypt, El-Gilany and associates[41] observed HIV seroprevalence of 6.9% among 1, 257 voluntary donors. A study of 213,666 blood donors in Brazil[42] yielded an overall HIV prevalence of 0.149%. The variation in prevalence rates reported in different studies might be attributed to the differences in geographical locations, age range of donors, sample sizes, the period of time the studies were conducted, ethno-religious and socio-cultural factors. The socio-cultural and religious practices implicated in the risk of HIV transmission include indiscriminate sexual relations, handling of childbirth by unskilled birth attendants outside health facilities (churches/mosques), use of unsterilized instruments for circumcision, scarification and tattoo and obnoxious practice like female genital mutilation.

A reduction in the aforementioned practices through motivational and educational campaign and pretest counseling for donors to allow them to self-defer might have accounted for the declining infection rate observed in our work. It is also possible that improvement in technology might have made current screening reagents more specific and sensitive. However, we observed a higher prevalence rate in 2015 compared to 2014. The trend might probably be a reflection of a surge in incidence in our society due to the prevailing economic recession which may push some unemployed persons to source for money through selling their blood as has been reported earlier by Durosinmi[43] and which calls for continuous stringent and meticulous measures at donor recruitment. The rise might also suggest a laxity in activities and programmes to stem the spread of HIV. It may also be due to an increase in the number of new infections in the general population. It is pertinent to note that the use of HIV – P24 antigen testing has reduced the residual risk of HIV infection from 0.38 to 0.24 per million[44] in industrialized nations. Regrettably, this is not the case in developing economies like Nigeria that still depend on antibody screening methods. Therefore, as long as the resource – constrained economies continue to transfuse HIV infected blood which may be HIV negative as a result of antibody screening during the "window phase of infection", the residual risk of HIV may continue to rise in our environment.

The 2.7% seroprevalence of HBsAg found in this study is much higher than figures reported by Polizzotto et al[45] in Australia (0.01%), Gupta et al[46] in India (0.66%), Amini et al[47] in Iran (0.56%), El-Hazmi[40] in Saudi but similar to that reported by Gulia et al[48] (2.48%). However, our rate is lower than prevalence rates reported by Uneke et al in Ilorin, Nigeria (21.70%), Baba et al[26] in Maiduguri, Nigeria (14.0%) Mustapha et al[28] Buseri et al in Osogbo, Nigeria (18.6%), Ampofo et al[38] in Ghana (15.0%), Glynn et al[39] in the United States (10.4%) and Diro et al[49] in Ethiopa (8.2%). Differences in sexual behaviour and practices, cultural practices, geographical variation, test methods employed for HBV detection and the level of health education on prevention of HBV infection, may all play significant roles in the wide variations of HBsAg seroprevalence noted in the literature.

Furthermore, in order to mitigate the residual risk of transfusing hepatitis B virus during the window period, many advanced economies have adopted the nucleic acid amplification test (NAT). By contrast, the developing economies are yet to add this highly sensitive screening test to their donor screening menu. With the use of NAT, low levels of HBV-DNA are detected in serum and liver tissues of some patients who cleared HBsAg following acute self-limiting infection[50] and can cause overt hepatitis especially when immunocompromised patients are transfused with such blood.[51] The use of NAT could have probably been responsible for the decline in the prevalence of the TTIs in the industrialized world as shown by the significantly low rates reported.

The prevalence of HBsAg observed in this study is one of the lowest ever reported from Nigeria. This is a testament to the fact that efforts of both government agencies and non-governmental organizations at

reducing the scourge of hepatitis B virus infection are yielding impressive results. The incorporation of HBV vaccination in the childhood immunization schedule in the last 15years, education and public enlightenment campaign on the importance of HBV vaccination might have accounted for the reduction in the infection rate in the general population which is being reflected in the donor population.

Sub-Saharan Africa has some of the highest reported global rates of HCV seroprevalence, ranging from 2.1% to 2.8%, with the highest in West Africa, approximately 2.8%.[28] However, studies on HCV prevalence among blood donors in this region showed that blood donors consistently had lower prevalence (1.9%) than the general population.[53] A prevalence of 0.8 to 12.3%[23,29-32] has been reported among blood donors in Nigeria. The seroprevalence of 2.3% obtained from our study is comparable with the 2.8% and 2.9% found among blood donors in Ghana[54] and Port Harcourt,[33] Nigeria, respectively, though much higher than the figure obtained in a study done in USA (0.072%).[55] Higher rates than ours have been recorded among blood donors in Tanzania (8.0%),[56] Ghana (8.4%),[38] Central African Republic (5.0%)[57] and Egypt (15.8%).[58] The reduction in the prevalence rate from 2.7% in 2014 to 1.7% in 2015 in the present study is a desirable development. Hopefully the decline will be a sustained downward trend in infection rate of the blood donors. Such decline could be as a result of a combination of Factors including a change in screening reagent used, diminution in population risks, or effectiveness of prospective donor screening measures. In the absence of NAT screening method for HCV, efforts should be geared towards reducing false negative anti-HCV cases to the barest minimum through stringent donor selection criteria and excluding high – risk subjects as studies have shown that the most efficient mode of transmission of HCV is blood to blood contact,[59,60] less efficiently through sexual route unlike HBV and HIV infection.[61,62]

The finding of 1.4% seroprevalence for syphilis observed in this study is similar to the observation made by Buseri and others[23] from Osogbo, the South-West region of Nigeria who reported a value of 1.1% in their blood donors. However, higher values have been reported in other parts of Nigeria and some African countries including Maiduguri (12.8%)[17] and Tanzania (12.7%).[16] In more advanced economies, Syphilis seroreactivity is lower,[63-67] being less than 1.0% in many of the reports. Similar lower value (0.1%) has been reported by Ejele et al[21] in Port Harcourt, Nigeria. The wide variation in the Syphilis infection rate among the blood donors reported in multiple studies may be due to differences in the testing methodologies, sample sizes, geographical locations and socio-cultural practices such as sexual behaviour and conjugal practices which are peculiar to some parts of the world. The risk of contracting Syphilis is closely related to risk factors in the prospective blood donor, particularly sexual habits since the disease like the other TTIS are primarily transmitted by the sexual route. Risky lifestyles such as prostitution, homosexuality, lesbianism, bisexuality, intravenous drug abuse and skin scarification (tattooing, blood rituals), have been known to heighten the risk of syphilis transmission.[68]

Majority of our study population were males (75.5%), with females representing a proportion of 24.5%. This observation shows that more males donate blood than females in our environment. The reason for this gender imbalance may, in part, be cultural where men in Africa are perceived as being healthier than women,[69] as well as physiological where iron deficiency anaemia from monthly menstrual flow, pregnancy and lactation preclude women from joining the donor pool.[7] It could also be due to lack of proper public health awareness (education) on the essence of blood donation. Similarly, male dominated donor pool was noted by Okocha[71] and Matee[56] in studies done in South-East Nigeria and Tanzania, respectively. In contrast, a study in China showed higher rate of female donors (44.5%).[72]

The present study observed that the male donors had a higher prevalence of all the TTIs than their female counterparts. This is consistent with a study done by Matee et al[56] in Tanzania. The explanation for this male gender – related predisposition to TTIs is not far-fetched. Socio-cultural practices and beliefs may play a significant role. In most African settings, men are culturally permitted to have multiple sexual partners, mistresses and concubines, whereas it is a taboo for women to follow suit. Men are also more sexually active and more likely to adopt high-risk lifestyles (having unprotected sexual intercourse, intravenous drug abuse, tattooing or engaging in blood rituals) that put them potentially at risk for acquiring HIV, HBsAg, HCV and Syphilis.[73]

The highest prevalence of HIV, HCV and Syphilis was found in the 36-45 years age group, while HBsAg infection was more common in donors aged 26 – 35years. Our finding is in agreement with previous results reported by Baba and associates,[26] Ejele and colleagues,[21] Buseri, et al[23] and Karmakar et al[74] in which highest prevalence rates were observed among blood donors within these age brackets. The high prevalence of HIV, HBsAg, HCV and syphilis observed among these donors in this present study could be as a result of lack of adequate educational enlightenment about the modes of transmission and prevention of these infections. It may also be due to prevalence of high risk behaviour among these persons. This observation is appalling since the most productive and economically viable age group of the population are afflicted. There is the fervent need for renewed intensification of prevention programmes targeted at changing high-risk behaviour in our society.

CONCLUSION

This study has shown that transfusion – transmissible infections are not uncommon in our blood donors and that HIV infection is the most common and syphilis the least common TTI. A declining trend in prevalence of all the infections occur during the years under study. Lower seroprevalence rates of the TTIs in our work compared to previous studies in other centres, particularly in sub-Saharan Africa, lends credence to the effectiveness of our donor screening measures. However, education of the blood donors on avoiding risky lifestyles, voluntary blood donor motivation strategies and community surveillance of the infections should be intensified and in addition, efforts should be geared towards adding NAT to the donor screening menu to further reduce the number of blood donors likely to donate during the window period and by extension improve the access to safe blood.

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REFERENCES

1. Nwogoh B. Ikpowem OD, Isoa EM. Donor Procurement and risk of transfusion transmissible viral infections in a tertiary health facility in south-south Nigeria. Nig med. J., 2011; 52: 227-230.
2. Chaurasia RK, Kumar A, Singh P. Pattern of Transfusion transmitted infections in blood donors around Bhopal – A 5 – year retrospective study. Annals of International Medical and Dental Research, 2016; 2: 12-15.
3. Tagny CT, Mbanya D, Tapko JB Blood safety in sub-Saharan Africa: a multi-factorial problem. Transfusion, 2008; 48: 1256-1261.
4. World Health Organization: Aide – mémoire: Blood safety 2014, World Health Organization, Geneva.
5. Editorial Improving Blood Safety Worldwide. Lancet, 2007; 370: 1879–1974.
6. UNAID, World AIDS Day Report, 2016
7. Goodnough LT, Shander A, Spenc R. Bloodless medicine: Clinical Care without allogeneic blood transfusion. Transfusion, 2003; 43: 668-676.
8. Hepatitis B. World Health Organization Fact sheet 204. Available http://www.who.int/mediacentre/factsheets/Fs204/en/
9. Gagandeep K, Paramijit K. Syphilis testing in blood donors: an update. Blood transfuse, 2015; 13: 197-204.
10. World Health Organization. Screening Donated Blood for Transfusion Transmissible Infections: Recommendations. WHO; Geneva, 2010.
11. Lackritz EM. Prevention of HIV transmission by blood transfusion in the developing world: achievements and continuing challenges. AIDS, 1998; 12: 81-86.
12. Klingler C., Thoumi Al, Mrithinjayam VS. Cost – effectiveness analysis of an additional birth dose of Hepatitis B Vaccine to prevent perinatal transmission in a medical setting in Mozambique. Vaccine, 2012; 31: 252-259.
13. Centre for Disease Control and Prevention. Public Health Service Inter-Agency Guidelines for Screening Donors of Blood, Plasma, organs, Tissues, and Semen for Evidence MMWR, 1991; 40: 1-17.
14. Raza SA, Clifford GM, Franceschi S. Worldwide variation in the relative importance of hepatitis B and hepatitis C viruses in hepatocullular carcinoma: a systematic review. British Journal of Cancer, 2007; 96: 1127–1134.
15. Madhava V. Burgess C, Drucker E. Epidemiology of Chronic hepatitis C virus infection in sub-Saharan Africa, The Lancet Infectious Diseases, 2002; 2: 293–302.
16. Matee ML, Lyamuya EF, Mbena EC, Magessa P.M. Prevalence of transfusion – associated viral infections and syphilis among blood donors in mulimbi Medical Centre, Dar es Salam, Tanzania. East Afr. Med. J., 1999; 76: 167–171.
17. Rahlenbeck SL, Yohhanes G, Molla K. Infection with HIV, Syphilis and HBV in Ethiopia: a survey in blood donors. Int JSTD/AIDS, 1997; 8: 261-4
18. Adjei AA, Kudzi W, Amah H, Adiku T, Ansah J. Prevalence of antibody to syphilis among blood donors in Accra, Ghana Jpn. J. Infect Dis., 2003; 56: 165-167.
19. Chukwurah EF, Nneli RO. Prevalence of transfusion transmissible infectious disease markers among blood donors in a South Eastern State of Nigeria. Niger Biomed Sci J., 2005; 1: 114-7.
20. Hassan A. Mukhtar HM, Ahmed AJ, Isa AH, Mamman Al. The incidence of HIV among blood donors in Kaduna, Nigeria. African Health Sciences, 2008; 8: 60.
21. Ejele OA, Erhabor O, Nwauche CA. Trends in the prevalence of some transfusion – transmissible infections among blood donors in Port Harcourt, Nigeria. Haema, 2005; 8: 273–277.
22. Offor E, Okafor L, Osunde I. Changes in HIV seroprevalence among blood donors in Benin City Nigeria AIDS, 1994; 8: 1352-1353.
23. Musa AM, Buseri FI, Jeremiah ZA. Sero-epidemiology of transfusion – transmissible infectious diseases among blood donors in Osogbo, South-West Nigeria Blood Transfus, 2009; 7: 293–299.
24. Irena PA. Prevalence of HIV/AIDs among blood donors in Lagos Island. A Nigerian experience. Int Conf AIDS, 2002; 12: 14.
25. Amadi AN, Mba LE. Distribution of HIV infection in Abia State, Nigeria. Niger J. Med Invest Pract, 2001; 2: 38-40.
26. Baba MM, Hassan AW, Gashan W. Prevalence of hepatitis B. Antigenaemia and human immunodeficiency virus in blood donors in Maiduguri, Nigeria. Niger J. Med., 2000; 9: 10–12.

27. Uneke CJ, Ogbu O., Inyama PU, Anyanwu GI, Njoku MO, Idoko JH. Prevalence of hepatitis –B surface antigen among blood donors and human immunodeficiency virus – infected patients in JOS, Nigeria. Men Inst Oswaldo (Rio de Janeiro), 2005; 100: 13-16.
28. Mustapha SK, Jibrin YB. The prevalence of hepatitis B surface antigenaemia in patients with human immunodeficiency virus (HIV) infection in Gombe, Nigeria. Ann Afr. Med., 2004; 3: 10-12.
29. Motayo BO, Faneye AO, Udo UA. Seroprevalence of transfusion transmissible infections (TTI), in first time blood donors in Abeokuta, Nigeria. African Health Sciences. 2015; 15: 19-24.
30. Aminwero C, Prescott RJ, Okuku AG. Seroprevalence of transfusion transmissible infections in blood donors attending the federal medical center, Bida Int J Mod Bio Res 2013; 1: 1-7.
31. Shittu AO, Olawumi HO, Adewuyi JO. Pre-donation screening of blood for transfusion transmissible infections: the gains and the pains-experience at a resource limited blood bank. Ghana Medical Journal, 2014; 48: 158-62.
32. Halim NK, Ajayi OI. Risk factors and seroprevalence of hepatitis C antibody in blood donors in Nigeria. East Afr. Med J., 2000; 77: 410-12.
33. Koate BB, Buseri FI, Jeremiah ZA. Seroprevalence of hepatitis C. Virus among blood donors in Rivers State, Nigeria. Transfuse Med., 2005; 15: 449-51.
34. Chikwem JO, Mohammed I, Okara GC. Prevalence of transmissible blood infections among blood donors at the university of Maiduguri Teaching Hospital, Maiduguri, Nigeria. East AFr. Med. J., 1997; 4: 213-6.
35. Nwabuisi C, Aderinola CI, Ibegbulam OG. The seroprevalence of syphilis in unscreened and unstored blood transfused in Ilorin, Nigeria. Medipharm Med. J., 2005; 2: 7-9.
36. National population commission census 2006 results, Nigeria
37. National HIV/AIDs and Reproductive survey 2012. Available online: www.informationng.com/.../2012-hivaids-and-reproductive-hea.
38. Ampofo W, Nil-Trebi N, Ansah J. Prevalence of blood borne infectious diseases in blood donors in Ghana Journal of Clinical Microbilogy, 2002; 40: 3525-3525.
39. Glynn SA, Kleinman SH, Schreiber GB, Busch MP, Williams AE. Trends in incidence and prevalence of major transfusion – transmissible viral infections in US blood donors, 1991 to 1996. Retrovirus Epidemiology Donor Study (REDS). JAMA, 2000; 284: 229-235.
40. El – Hazmi MM. Prevalence of HBV, HCV, HIV-1, 2 and HTLV – I/II infections among blood donors in a teaching hospital in the central region of Saudi Arabia. San di Med. J., 2004; 25: 26-33.
41. El-Gilany AH, El-Fedawy. Blood borne infections among student voluntary blood donors in Mansoura University Egypt. East Mediterr Health J., 2006; 12: 742-748.
42. Andrade Neto, José Luiz. HIV prevalence among blood donors in a blood bank in Ouritiba (Brazil). Braz J Infect Dis., 2002; 6: 15-21.
43. Durosinmi MA, Mbabayoje VO, Akinola NO, Adegunloye AB, Alabi AO. A retrospective study of prevalence of antibody to HIV in blood donors in ILE-IFE, Nigeria. Niger Postgraduate Med J., 2003; 10: 220-223.
44. Chiavetta JA, Escobar M. Newman A, He Y, Sher G. Incidence and estimated rates of residual risk for HIV, hepatitis C, hepatits B and human T-cell lymphotropic viruses in blood donors in Canada, 1999-2000. Canadian Med Asso J., 2003; 169: 767-773.
45. Polizzotto MN, Wood EM, Ingham H. Keller AJ. Reducing the risk of transfusion transmissible viral infection through blood donor selection. The Australian experience 2000 through 2006. Transufsion, 2008; 48: 55-63.
46. Gupta N, Kumar V, Karr A Seroprevalence of HIV, HBV, HCV and syphilis in voluntary blood donors. Ind. J. Med. Scie, 2004; 58: 255-256.
47. Amini Kafi-abad S, Rezvan H, Abolghasemi H, Talebian A. Prevalence and trends of human immunodeficiency virus, hepatitis B virus, and hepatitis C virus among blood donors in Ivan, 2004 through 2007. Transfusion, 2008; 10: 1111 – 1537.
48. Gulia SP, Panda S, Staramam E, Reddy KP. Seroprevalence of Hepatitis B Virus infection Among Blood Donors in Local Population. Internet J. of Pathol, 2011; 12: 1.
49. Diro E, Alemu S, Yohannes A. Blood Safety and prevalence of transfusion transmissible viral infections among blood donors at the Red Cross Blood Bank in Gondar University Hospital. Ethiop Med. J., 2008; 46: 7-13.
50. El-Zayadi AR, Ibrahim EH, Badran HM, Ahmady AM. Anti-HBc screening in Egyptian blood donors reduces the risk of hepatitis B virus transmission. Transfus Med., 2008; 18: 55-61.
51. Hu K-Q. Occult hepatitis B virus infection and its clinical implication. J viral Hepatitis, 2002; 9: 243-257.
52. Mohd Hanafiah K, Groeger J, Flaxman AD. Global epidemiology of hepatitis C virus infection: new estimates of age-specific antibody to HCV seroprevalence, Hepatology, 2013; 57: 1333-42.
53. Mora N, Adams WH, Kliethermes. A synthesis of Hepatitis C prevalence estimates in sub-Saharan Africa: 2000 – 2013. BMC Infect Dis., 2016; 16: 283.
54. Wansbrough – Jones MH, Frimpong E, Cant B. Prevalence and genotype of hepatitis C virus infection in pregnant women and blood donors in Ghana. Trans R Soc Trop Med Hyg, 1996; 92: 496-9.
55. Murphy EL, Fang J, Tu Y. Hepatitis C virus prevalence and clearance among US blood donors,

2006-2007: associations with birth cohort, multiple pregnancies and body mass index. J infect Dis., 2010; 202: 576-84.
56. Lyamuya EF, Magesa PM, Matee MN. Seroprevalence of human immunodeficiency virus, hepatitis B and C viruses and syphilis infection among blood donors at the Muhimbili National Hospital in Dar Es Salaam, Tanzania. BMC Public Health, 2006; 6: 21.
57. Batina A. Kabemba S, Malengena R. Infectious markers among blood donors in Democratic Republic of Congo. Rev. Med. Brux. 2007; 28: 145-149.
58. Rehman K, Khan AA, Haider Z. Prevalence of Serological markers of HBV and HCV in health care personnel and apparently healthy blood donors. J Pakistani Med Assoc, 1996; 46: 152-4.
59. Garcia FB, Pereira Gde A, Martins PR, Moraes – Souza H. Epidemiological profile of hepatitis C in blood donors at the Uberaba regional blood centre. Revistat da Sociedade Brasileira de medicina Trop., 2009; 42: 1-4.
60. Fejza H, Telaku S. Prevalence of HBV and HCV among blood donors in Kosovo. Virol J., 2009; 6: 21.
61. Neumavr G. Propst A, Schwaighofer H, Vogel W. Lack of evidence for the heterosexual transmission of hepatitis C. QJM., 1999; 92: 505–508.
62. Kao JH, Liu PJ, Chen PJ, Chen W, Lai MY, Chen DS. Low incidence of hepatitis C virus transmission between spouses: a prospective study. J. Gastrointestinal Hepatol, 2000; 15: 391–395.
63. Kocak, N. Hepgul S. Ozbayburtlu S, Altunay H, Kosan E. Pahsa A. Trends in major transfusion – transmissible infections among blood donors over 17 years in Istanbul, Turkey J Int. Med. Res., 2004; 32: 671-675.
64. Nanu A, Sharma SP, Chatterjee K, Iyoti P. Markers of transfusion – transmissible infection in North Indian voluntary and replacement blood donors. Prevalence and trends 1989-1996. Vox Sang, 1997; 73: 70-73.
65. Sharma RR, Cheema R, Vajpayee M, Rao U, Kumar S. Prevalence of markers of transfusion transmissible diseases in voluntary and replacement donors. Nat. Med. J. India, 2004; 17: 19-21.
66. Cho YH, Kim HO, Lee JB, Lee MG. Syphilis prevalence has rapidly decreased in South Korea. Sex Trans Infect, 2003; 79: 323 – 324.
67. Dilek I, Demir C, Bay A, Akdeniz H, Oner AF. Seropositivity rates of HBsAg; anti-HCV, anti-HIV, and VDRL in blood donors in Eastern Turkey Turk. J. Haematol, 2007; 24: 4-7.
68. Vera L, Milka D, Nurith SL, Eilat S. Prevalence and incidence of syphilis among volunteer blood donors in Israel. J Blood Transfus, 2014; 10: 40-48.
69. Tagny CT, Diarra A, Yahaya R. Characteristics of blood donors and donated blood in sub-Saharan Francophone Africa. Transfusion, 2009; 49: 1592-9.
70. Tagny CT, Owusu – Ofori S, Mbanya D. The blood donor in sub-Saharan Africa: A review. Transufs Med., 2009; 20: 1-10.
71. Okocha EC, Aneke JC, Ezeh TU, Ibeh NC, Nwosu GA, Okorie 10. The epidemiology of transfusion – transmissible infections among blood donors in Nnewi, South-East Nigeria. African J Med Health Sci., 2015; 14: 125-129.
72. Changqing Li, Xiaopu Xiao, Huimin Yin. Prevalence and prevalence trends of transfusion transmissible infections among blood donors at four Chinese regional blood centers between 2000 and 2010. J Transl Med., 2012; 10: 176.
73. Osaro E, Ismaila U, Abubakar W, Hauwa B, Festus O, Emmanuel Uko et al. Prevalence of transfusion transmissible HIV infection among blood donors in Sokoto, North Western Nigeria. American Journal of Microbiology and Biotechnology, 2014; 1: 36-42.
74. Karmakar PR, Shrivastava P, Ray TG. Seroprevalence of transfusion transmissible infections among blood donors at the blood bank of a medical college of Kolkata. Indian J. Public Health, 2014; 58: 61-64.