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Prevalence of Transfusion Transmissible Infections Among Blood Donated At Nyeri Satellite Transfusion Centre In Kenya

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DEDICATION

I affectionately dedicate this research to my husband, Mr. Martin Mbugua for the love and support. I also dedicate it to my loving daughters, Celestine, Claire & Cynthia who had to bear with my absentia. I pledge my very best effort to my darling family.

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I acknowledge Nyeri Satellite Blood Transfusion Centre in-charge Mr.Wachira and entire staffs for the great and overwhelming support they accorded me during data collection.

ABSTRACT: Transfusion transmitted infections (TTI) are a great concern of safety for patients. Since the starting of blood transfusion scientifically in the early 1940s, various transfusion associated problems have come to the forefront for the scientific community. It has been noted that numerous viral, bacterial and parasitic infectious agents are involved as hurdles in blood safety to patients.

There is a long list of viruses, parasites and bacteria, which can be transmitted through blood transfusions. Among them, important transfusion-transmitted viruses are human immunodeficiency virus (HIV-I/II), hepatitis B virus (HBV), hepatitis C virus (HCV), syphilis infection by spirochytes and transfusion associated malaria infection.

The purpose of the study was to determine the point prevalence of TTI among blood donated at Nyeri SBTC. The specific objectives were including determination of the most affected gender and age group among blood donors at the centre. Blood donor details were used among other tools in the study. The study involved screening of the blood units donated at the centre to detect the presence of TTI in the serum.

Sera of all donors, independent of deferral by questionnaire, were submitted to screening with quality-assured rapid or simple assays for HIV, HBV surface antigen (HBsAg), HCV and syphilis. Assays locally used by the blood bank for HBV and syphilis screening were run in parallel to quality-assured external assays.

The findings of this study are expected to highlight the importance of screening blood for presence of TTI using sensitive testing methods in order to minimize misleading results. This will aid in prevention of TTI to the blood recipients via blood and blood products.

Authority to carry out the study was sought from Kenya Methodist University Research Committee and The Director, Kenya National Blood Transfusion Services.

Chi square tests were applied to determine the relationship between dependant and independent variables while presentations were done using graphs and tables.

ACRONYMS AND ABBREVIATIONS

CTL - Cytotoxic T lymphocyte
DNA - Deoxy ribonucleic acid
ELISA -Enzyme linked immunosorbent Assay
HBV - Hepatitis B virus
HBsAg - Hepatitis B surface antigen
HIV - Human immunodeficiency virus
KEMU - Kenya Methodist University
MOH - Ministry of Health
KNBTS- Kenya National Blood Transfusion Service
NIH - National institutes of health
PCR - Polymerase chain reaction
SBTC - Satellite Blood Transfusion Centre
RNA - Ribonucleic Acid
TTIs - Transfusion transmissible infections
WHO - World health organization
RPR - Rapid plasma reagin
HCV – Hepatitis C virus
VDRL - Venereal disease research laboratory
RBC - Red blood cells
NAT - Nucleic acid testing
EIA - Enzyme immunoassy
PCV - Packed cell volume

TERMINOLOGIES

Asymptomatic- With no symptoms
Cirrhosis -Hardening of the liver.
Hepadenavirus-DNA virus that infects the liver.

Hominoidea-Super family of the primate suborder Anthropoidea including recent hominids, gibbons and pongids

Jaundice - Yellow pigmentation of the skin, mucus membranes, or eyes.

I. INTRODUCTION

Every year more than 90 million units of blood are collected worldwide. Each transfusion carries a risk of transmitting blood-borne pathogens, including mainly HIV, HBV, HCV and syphilis (Bihl et al, 2007). To improve blood transfusion safety, the WHO recommends an integrated strategy including establishment of well-organized blood transfusion services, prioritization of blood donation from voluntary non-remunerated donors, screening of donated blood for at least the four major transfusion-transmissible infections with quality-assured assays, rational use of blood and implementation of effective quality control systems (WHO 2008).

Selection of blood donors with low TTI risk followed by effective laboratory screening is the critical part of the process, since it has reduced the risk of transmission to very low levels in the past 20 years (WHO 2002). Nevertheless, particularly in low-resource countries, a significant proportion of donated blood remains unsafe as it is either not screened for all major TTIs or not in a quality-controlled manner. According to Dodd RY (2007) Africa do not only faces the highest transfusion needs in the world, but also has the highest prevalence of blood-borne pathogens and the weakest transfusion programs.

Most blood banks in Africa are small, hospital-based and relying on an important proportion of replacement donors, in contrast with western transfusion units organized with large pools of voluntary donors (Dodd RY, 2007). In addition, recommended reference screening tests like enzyme immunoassays (EIA) or nucleic acid testing(NAT) are technically, logistically and financially still far beyond reach of many resource-constrained blood banks. In such settings with limited capacity and low throughput, WHO accepts the use of rapid and simple serological assays for TTI screening, provided that they are quality-assured, locally validated and quality-controlled (WHO 2009). Rapid test-based screening protocols tend to be used increasingly in African blood banks.

II. STATEMENT OF THE PROBLEM

TTIs are major global health problems. Transfusion-transmitted infections are increasingly becoming major mode of transmission of various diseases in the high-prevalence areas in sub-Saharan Africa. This is because of the high level of occurrence of blood demanding health conditions. Transfusion transmitted infections are a major concern among health workers (WHO 2008).Patients on blood transfusion therapy are at increased risk of transfusion transmitted infections therefore the need to investigate the prevalence of transfusion transmissible infections among blood donated at Nyeri satellite transfusion centre.

Study Objectives

This study aims at determining the point prevalence of Transfusion Transmissible Infections among blood donated at Nyeri SBTC.

Specific objectives

i. To determine the most affected age and gender group by TTI's at Nyeri satellite transfusion centre in Kenya
ii. To assess the etiology of blood transfusion transmissible infections at Nyeri satellite transfusion centre in Kenya

Research questions

i. What is the most affected age and gender group by TTI's in Nyeri satellite transfusion center in Kenya
ii. What is the etiology of blood transfusion transmissible infections at Nyeri satellite transfusion center in Kenya

Study Justification

The findings of this study will lead to an accurate assessment of transfusion-transmitted infections among the blood donated at Nyeri SBTC. This will enable the Kenya National Blood Transfusion Service in implementation of blood safety strategies aimed at compulsory screening of blood for transfusion transmitted infections and retention of voluntary non-remunerated blood donors. The study will also form a basis for further studies.

Limitations of the study

The researcher couldn`t get the prevalence of many infections like parasitic infections among others since they are not screened.

III. LITERATURE REVIEW

Introduction

Blood transmitted infection is the commonest cause of death after blood transfusion. All patients on regular packed cell volume (PCV) or any blood component are at increased risk of transfusion transmissible infections (Moor et al, 1999). The etiological agents can be virus, bacteria or protozoa. These organisms can cause clinical sickness in recipient, can persist in him as carrier state or can cause asymptomatic infection in him. Every blood bank follows screening procedures to prevent such infections but the infective agents escape detection due to window period – a period where in the infective agent's presence cannot be detected, though it is present in donor's blood(Moor et al, 1999). Blood banks in developed countries are doing Nucleic Acid Amplification Testing (NAT) since 1999 to screen donated blood (Pathak S. et al, 2010). The window period for testing for HIV, Hepatitis B and Hepatitis C has been significantly reduced with NAT.

Historical background

Although there are early reports in the history of medicine that describe attempts to treat patients with human or animal blood products, transfusion medicine is a relatively young field that has developed only since the second half of the last century (Dzieczkowskiet al, 2008). Very rapidly, however, it became clear that these therapeutic approaches also carried their problems, such as the incompatibility of red blood cells and plasma between donors and recipients, and the possibility of transmitting infectious diseases (Dzieczkowski J. S.et al, 2008). While in the past, the risk of transfusion-transmissible infections (TTI) was accepted by patients and physicians as unavoidable, a low-risk blood supply is expected today. Since the early nineteen sixties, blood banks, as well as plasma manufacturing industries, have aggressively pursued strategies to reduce the risks of TTI (Jayaraman et al 2010). In particular, donor exclusion criteria, such as a history of hepatitis or transfusions in the past six months have been in place since early on. Today, donor evaluation, laboratory screening tests and pathogen inactivation procedures are considered crucial tools to reduce the risk of TTI, but do not completely eliminate all risk.

The most affected age and gender group by TTI's

Infections of HBV and human immunodeficiency virus (HIV) are a rapidly growing issue of public health concern. It has been observed that HBV and HIV co infection interferes with the natural history of HBV infection and is associated with higher HBV DNA levels (Gibson et al., 1997; Colin et al., 1999). Also, a more common progression to cirrhosis, despite milder histological necro-inflammatory activity, has been reported in cases of HBV and HIV co-infection (Colin et al., 1999). Although the prevalence of HBV and HIV infections have been reported in both gender and across age groups, the age group of 20 to 29 years are more affected (Umolu et al., 2005; Okonko et al., 2012). This age group constitutes the main bulk of prospective blood donors. Many of the high risk groups for hepatitis C are easily identified, due to practices resulting infrequent exposures to blood or risk factors for transmission. An ethnic analysis in one earlier, somewhat underestimated study (1994) determined that Caucasian Americans statistically accounted for the most number of infected persons, while the highest incidence rates were among African and Hispanic Americans. The highest prevalence of the disease was found in middle-aged people (30 to 49 years old) who accounted for 3% -4% of the cases. Prevalence among black men in this age group approached 9% to 10%. Gender, however, did not emerge as a significant risk factor in the population as a whole.

Etiology of blood transmissible infections

The etiological agents can be virus, bacteria or protozoa. These organisms can cause clinical sickness in recipient, can persist in him as carrier state or can cause asymptomatic infection in him(Moor et al, 1999). Every blood bank follows screening procedures to prevent such infections but the infective agents escape detection due to window period – a period where the infective agent's presence cannot be detected, though it is present in donor's blood.

IV. VIRUSES

I. Human immune deficiency

Human immune deficiency virus (HIV) infection causes a broad spectrum disease and has a varied clinical course, from mild, flulike symptoms to AIDS; which is life threatening and the end stage of HIV infection (M O H Mozambique 2007). HIV is transmitted through sexual contact, sharing of HIV contaminated needles and/or syringes, transfusion of blood components, and nosocomial exposure to HIV contaminated blood or bodily fluids, and can be passed vertically from a mother to her infant(Laperche et al, 2009). Factors that can contribute to HIV transmission through blood transfusion include the window period (i.e. a short viraemic period in which the donor is infected with HIV at a very early stage and often tested negative in a donor screening test), HIV-antibody negative chronic carriers and HIV mutant infection (M O H Mozambique 2007). The primary source of transfusion transmitted HIV infection, however, is donations collected during the window

period(Moor et al, 1999). Donated blood is tested for antibodies to HIV-1, HIV-1 p24 antigen test and HIV RNA test using NAT. Window period has been reduced from 42 days by HIV antibody assays in the 1980s to 16 days by HIV-1 p24 antigen test and 11 days by HIV NAT (El Ekiaby et al, 2010).

II. Hepatitis B virus

Hepatitis B surface antigen testing was introduced in 1970's and its transmission was consistently reduced since then (WHO 2004). Still 300 million individuals are infected worldwide. HBV surface antigen is routinely included in donor screening but it fails to detect presence of HBV during window period. Chronic carriers of HBV may have low level viremia and may not have detectable HBsAg level, so some centres have started testing antibodies against HBV core protein(Diarra et al, 2009).

Today, the residual risk of transfusion transmitted HBV infection varies between 0.75 per million blood donations in Australia, 3.6 – 8.5 in the USA and Canada, 0.91 – 8.7 in Northern Europe, 7.5 – 13.9 in Southern Europe up to 200 per million donations in Hong Kong, largely reflecting the global epidemiology of HBV(Matee et al, 2006). Some countries with low level prevalence of HBV have implemented HBV NAT testing in plasma pools. The kinetics of viral antigen and antibody appearance during HBV infection create two different window periods in which one or the other test may fail: the "early acute phase", when serological markers are still negative and the "late chronic phase" when HBsAg may become gradually undetectable, although infectivity remains. NAT can potentially identify and can be of particular benefit in detecting HBV DNA in latent HBV infection in early acute phase/occult HBV infection, when HBV DNA is present in plasma (Biswas et al., 2003).

HBV causes the following changes in liver tissue:

- Necrosis and inflammation at the edge of the portal areas, so-called "piecemeal necrosis or "interface hepatitis"
- Necrosis of hepatocytes and focal inflammation in the liver parenchyma
- Inflammatory cells in the portal areas (portal inflammation)

III. Hepatitis C virus

Hepatitis C virus currently affects over four million people in USA. There, it is the commonest transfusion transmitted infection and main indication for liver transplantation. High risk group is constituted by those who received transfusion prior to 1991 or the ones who were IV drug abusers using shared needles(Laperche et al, 2009). Incubation period can be as long as decades and this contributes to high rate of infection. Route of infection is by and large intravenous/injection pricks. Sexual transmission is also possible. Other routes are nosocomial exposure to contaminated blood and body fluids and mother to child transmission. Hepatitis C virus subtype varies worldwide (Laperche et al, 2009).

Approximately 90% of individuals infected with HCV are either asymptomatic or have only mild symptoms (Matee et al, 2006). However, about 80% of acute infections progress to chronic infection, and almost half of those chronically infected individuals eventually develop cirrhosis or hepatocellular carcinoma after a few decades (Public Health Agency of Canada 2003). In Europe, predominant genotypes are 1, 2 and 3. Types 1a and 3a are seen in north-western countries, whereas 1b is in Hungary, Germany, Russia and Turkey. Types 1a and 1b are common in North America. Types 1b, 2a and 2b predominate in Japan (Blood Book, 2011). After infection, antibodies against Hepatitis C virus take 54-192 days to appear. There is high risk of transfusion transmitted infection in this window (Diarra et al, 2009).

Other Viral agents that are capable of being transmitted through blood transfusion but they are rare are: Cytomegalovirus, Human T-Cell Leukemia Virus, Parvovirus, Epstein Barr virus, Human herpes virus and West Nile virus.

V. BACTERIAL CONTAMINATION

Approximately 57% of all Transfusion Transmissible infections and 16% of transfusion related deaths have been associated with bacterial contamination(Wagner 2004). Blood components may be contaminated with bacteria at many stages of preparation, including blood collection, processing, pooling, and transfusion. Bacteria may enter into blood components from many sources: donors' bacteremia, exposure to donor skin bacteria by venipuncture, contaminated bags and infected environment of blood banks or hospitals(Wagner 2004). The load of bacteria is determined by the storage time. Platelet units that are stored over 3 days and red cell units that are stored over 21 days are strongly associated with an increased risk of bacterial reactions (Blajchman et al, 2004).

Platelet concentrates are stored at room temperature and are more likely to contain the skin contaminants including coagulase-negative staphylococci. Both staphylococcus and streptococcus infections can be transmitted through stored platelets. It is estimated that 1 in 1,000-2,000 platelet component is contaminated with bacteria. Risk of death is 1 in 17,000 cases of sepsis associated transfusion with RDP's (random donor platelets) and 1 in 61,000 when transfused platelets by apheresis(Blajchman et al, 2004).

Recipients of blood contaminated with bacteria may develop fever with chills, followed by development of septic shock, and death(Wagner 2004). Symptoms may develop within minutes of initiation of transfusion or may take several hours. The course may be abrupt, fast and fulminant. When reaction is suspected, transfusion should be immediately stopped. Broad spectrum antibiotics should be stopped. Shock should be treated. Blood bank should be notified. Blood component bag should be sent for Gram staining and culture (McDonald et al 2001). Among all possible bacterial infections, syphilis is the only infection that is screened in Kenya.

i. Syphilis

Syphilis is caused by infection with Treponemapallidum. It is spread primarily through sexual contact. T. Pallidum can also be transmitted by vertical transmission from mother to fetus or through blood if donor is already infected(Peeling et al 2004). Its transmission through transfusion has become extremely rare after implementation of the serological tests for antibodies to T. Pallidum.

2.4.3 Parasites

Parasites are common infectious agents worldwide, and several protozoans have been shown to be transmitted via blood transfusion (Kitchen et al 2006).

1. Malaria

Malaria is endemic in tropical and sub-tropical regions of Africa with up to 300 million infections and one million deaths annually(Kinde et al. 2000). It is caused by four species of Plasmodium, namely vivax, ovale, malariae and falciparum. P. Falciparum may result in severe complications and/or death. It is spread primarily by bite of the infected female Anopheles mosquito(Kitchen et al 2006). It can also be transmitted from infected mother to her fetus or from an infected blood donor to the recipient. They are intraerythrocytic parasites that infect liver and red blood cells (RBC) causing periodic episodes of fever and flu-like symptoms, along with massive lysis of erythrocytes. The risk of transfusion transmissible malaria differs widely between low-endemic countries, where the infection is "imported" from outside (e.g. travel to or immigration of individuals from highly endemic regions) and regions of high prevalence of plasmodium infection in the general population (Kinde et al. 2000).

Other parasitic transfusion infections which are transmissible includes: Chagas, Toxoplasmosis, Leishmaniasis, Babesiosis and Microfilariasis.

VI. PREVENTION OF TRANSFUSION TRANSMISSIBLE INFECTIONS

1. **Transfusion of non-infected blood/blood products**: Etiological agent present indonor's blood can escape detection. Development of antibodies against the etiologicalorganism takes time. So screening tests dependent on antibody detection fail to detectinfection in early period. After use of NAT testing, this window period for HIV,Hepatitis B and Hepatitis C is reduced.

2. **Encouraging voluntary blood donation**: In developed countries, the majority of blooddonors are voluntary, whereas in developing countries, majority of blood donors arereplacement donors. The incidence of blood transmitted infections is much lower in thecountries having majority of transfusions from voluntary donation(Moor et al, 1999).

3. **Donor deferral**: Current strategies to prevent transfusion transmitted malaria are basedon risk group assessment and donor deferral for 4-12 months for visitors from lowendemic areas to high endemic countries and 3-5 years (or permanently) for donorswith a history of residence in an endemic area (Matee et al, 2006). However, this policy may lead tounaffordable loss of blood donation. That is why the policy of travel based riskassessment is combined with serological screening tests in some countries.

4. **Immunization**: Hepatitis B should be prevented by vaccination. HIV vaccine is beingdeveloped. Hepatitis C vaccine is not available at present. More vaccines should bedeveloped to prevent transfusion of transmissible infections(Laperche et al, 2009).

5. **Prevention of infection of stored blood/blood products**: Storage system in blood bank has to provide infection free environment.

6. **Use of infection free equipment for transfusion**: Use of disposable syringes/needlesetc will decrease the risk of transmission of infections (Moor et al, 1999).

7. **Education**: HIV transmission can be prevented by increasing awareness, and first AIDeducation of health workers. Unnecessary blood transfusions should be avoided todecrease the risk factor.

VII. RESEARCH METHODOLOGY

The study was carried out at Nyeri Satellite Blood Transfusion Centre situated at NyeriCounty Hospital one km from Nairobi-Nyeri road in Nyeri County about 190 km from Nairobi. Nyeri County borders Laikipia to the west, Muranga to the east and Nyandarua counties to the north. It covers an area 3,356sq.km and has a total population of 693,558 people according to KNBS 2009 census report. Nyeri Satellite Blood Transfusion Centre supplies blood and blood products to public, mission and private transfusing facilities. This research employed retrospective study method in which sample analysis was done on selected blood samples. This has been

achieved by Stratified random sampling among blood donated at Nyeri SBTC. The study population was the blood donors who donated blood at Nyeri Satellite Blood Transfusion Centre between January and December 2014.

The selection criteria used was inclusion and exclusion: Blood donated at Nyeri SBTC by donors aged 16-65 years irrespective of sex.

Exclusion Criteria: Blood donated and screened elsewhere apart from Nyeri SBTC.

While determining the sample size the formula of Paler-Calmorin and Calmorin (2006) was utilized. This method was used because it is one of the best formulae in determining the sample size in probability sampling (Bayissa and Zewdie, 2010). The study assumed the sampling error of 1% and 99% reliability. It is assumed that the standard value at 1% level of probability is 2.58 with 99% reliability and a sampling error of 1% or 0.01.

Then the sample size for donors is calculated as follows:-

$$n = \frac{NZ + (Se)^2 x(1-P)}{NSe + Z^2 xP(1-P)}$$

Where

n = sample size

N = total number of population of 9950

Z= the standard value (2.58) of 1% level of probability with 0.99 reliability

Se= Sampling error (0.01)

p = the population proportion (0.5)

Application:-

$$n = \frac{9950\ (2.58) + (0.01)^2 x(1-0.5)}{9950\ (0.01) + 2.58^2 x0.5(1-0.5}$$

$$n = \frac{25,671 + 0.0001\ x0.5}{99.5 + 6.6564\ x0.25}$$

$$n = \frac{25,671 + 0.00005}{99.5 + 1.664}$$

$$n = \frac{25,671\ .00005}{101\ .164}$$

$$n = 253\ .75$$

The sample size was rounded off to nearest ten which is 250 donors

The stratified random sampling technique was used where donors were divided into strata and then samples taken using systematic random sampling from each group.

Laboratory Analysis

HIV testing was done using Elisa (vironostika) method which is an immunoassay. The Vironostika HIV-1 Plus O Microelisa System assay was designed to be highly sensitive for a spectrum of HIV-1 serotypes, including group O virus. As a result, nonspecific reactions may occasionally be seen in specimens from people who have prior pregnancy, blood transfusion, or exposure to human cells or media containing cultured HIV antigen(Kuhnl et al, 1985). Because of these and other potential nonspecific reactions, specimens reactive with the Vironostika HIV-1 Plus O Microelisa System assay should be confirmed with a confirmatory test ,e.g., Western Blot testing.

Diagnosis of HCV was done using Murex anti-HCV (version 4.0) which utilises antigens from the core, NS3, NS4 and NS5 regions of the virus. Antigens have been carefully developed and selected to provide a sensitive and specific diagnostic test. This technique is dependent on the direct detection of viral RNA by PCR or by detection of anti-HCV antibodies. Recombinant DNA techniques have been used to develop structural and non-structural proteins derived from HCV RNA with utility for antibody screening. Anti-HCV assays have evolved from first generation products incorporating NS4 proteins only through to third generation assays incorporating core (structural), NS3 protease/helicase (non-structural), NS4 (non-structural) and NS5 replicase (non-structural) proteins. Studies report that the third generation assays demonstrate significant improvements in sensitivity, particularly with regard to increased reactivity with the NS3 antigen and earlier detection of seroconversion8.

Murex HBsAg Version 3 which is a rapid and sensitive enzyme immunoassay forthe detection of hepatitis B surface antigen in human serum or plasma was used.
Testing of the syphilis was done using RPR (rapid plasma reagin) kit which is a rapid analyzer. It looks for antibodies that are present in the blood of people who may have the disease. The test is similar to the venereal disease research laboratory (VDRL) test. The samples which gave positive results for the syphilis were referred to KNBTC for confirmation.

Materials
Blood bags, Elisa, Murex and RPR kits, Centrifuge, Test tubes, Micropipettes and Multichannel micropipettes, Gloves, Biohazard disposal container, Freshly distilled or high quality deionised, Moulded heating blocks, Sodium hypochlorite for decontamination, Stop solution (0.5m to 2m sulphuric acid), Incubator, Disposable Reagent Troughs, Instrumentation (automated microplate strips washer, microplate reader).
Reagents
Impregnated Strips,Coated Wells,Sample Diluent,Negative Control,Positive Control,Conjugate,Substrate Concentrate, Substrate Diluent and Wash fluid.
Data analysis and management
The Data was cleaned, coded, stored in a handbook and entered using MS-excel spread sheet then analyzed using the Statistical Package for Social Sciences (SPSS) Version 16.0.
Presentation was done using pie charts, bar graphs, and tables.
Data Analysis, Presentation and Interpretation
The focus of this chapter is to analyze, present and interpret the results of the research study according to the stated objectives and research questions. It discusses the background information of the donors. Data obtained was analyzed quantitatively and qualitatively to determine the prevalence of transfusion transmissible infections.
Background information of the donors
The researcher sought to find out which gender donate more often and at what age group most people donate. The data was collected from 250 donors who were selected using stratified random sampling method. All donors who donated blood in 2014 ranged from 16 to 55 years of age including both males and females.
Gender of the donors
It was found out that more women donated blood in 2014 compared to men. Out of the 250 donors sampled, 128 were female which is 51.2% and 122 were male which is 48.8% as shown in the table 4.1

Table 1: Gender of the donors

Gender	Frequency	Percentage (%)
Female	128	51.2
Male	122	48.8
Total	250	100

This implies that female donate blood more in Nyeri County compared to men.

Age of the donors
The legal age of donating blood in Kenya is 16 to 65 years. The researcher found out that in the year 2014 only those aged between 16 and 55 years donated blood. No one above 55 years volunteered to donate or even to replace. In the data of 250 donors, majority of donors were between the age of 16 and 25 years amounting to 141 (56.4%) donors. Most of them were secondary school students who volunteered to donate. Those aged between 26 to 35 were second with a total of 62 (24.8%) donors followed by those aged between 36 and 45 with 38 (15.2%) donors. The group that aged between 46 and 55 had only 9 (3.6%) donors as it is illustrated in the figure 4.1.

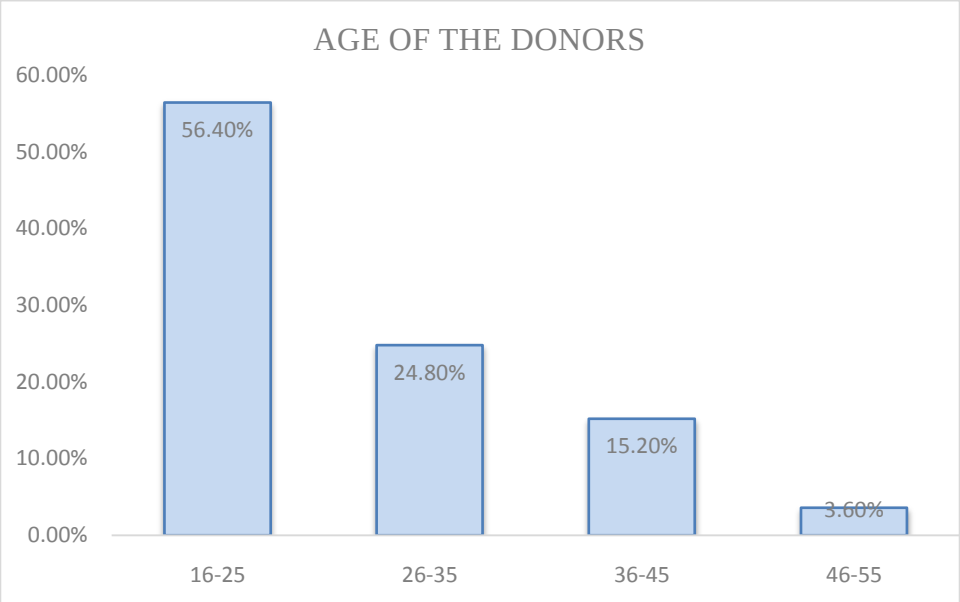

Figure 1: Age group of the donors

From the figure 1, the majority of the blood donors was the younger generation aged between 16-25 (56.4%) years, most of them are students. This implies that the younger generation is eager and readily available to donate blood than the older generation.

The prevalence and distribution of TTIs in different age groups

All sampled 250 donors were screened for TTIs. Donors who aged between 16 and 25 years (141 donors), 9 were seropositive for HIV, 4 were seropositive for HCV, HBV also had 4 positives. There was no donor who turned positive for Syphilis. In the age of 26 to 35 years (62 donors), 3 were seropositive for HIV, 3 were seropositive for HCV, 2 were seropositive for HBV and another 2 donors turned positive for Syphilis. Those who ranged between 36 to 45 years (38 donors), 1 donor turned seropositive for HIV and another 1 was positive for Syphilis. There were no cases in both Hepatitis. The age of 46 to 55 (9 donors), only 1 donor who turned seropositive for HCV others were negative as shown in the table 2.

Age	Frequency	HIV	HCV	HBV	Syphilis
16 - 25	141	9	4	4	0
26 - 35	62	3	3	2	2
36 - 45	38	1	0	0	1
46 - 55	9	0	1	0	0
Total	250	13	8	6	3

Table 2 Prevalence and distribution of TTIs in different age groups

From the figures of table 2, more donors are ranged at the age of 16 to 35 and they are also the most affected group by the transfusion transmissible infections.

VIII. THE MOST OCCURRING TRANSFUSION TRANSMISSIBLE INFECTION

According to this research, it was found that Human immune deficiency virus is the most common disease especially from the age of 16 to 45 years with a percentage of 5.2. Hepatitis C virus follows with a percentage of 3.2 giving a difference of 0.8% to Hepatitis B virus which comes third. In the data of 250 donors, only 3 had Syphilis which is 1.2% as shown in figure 4.2

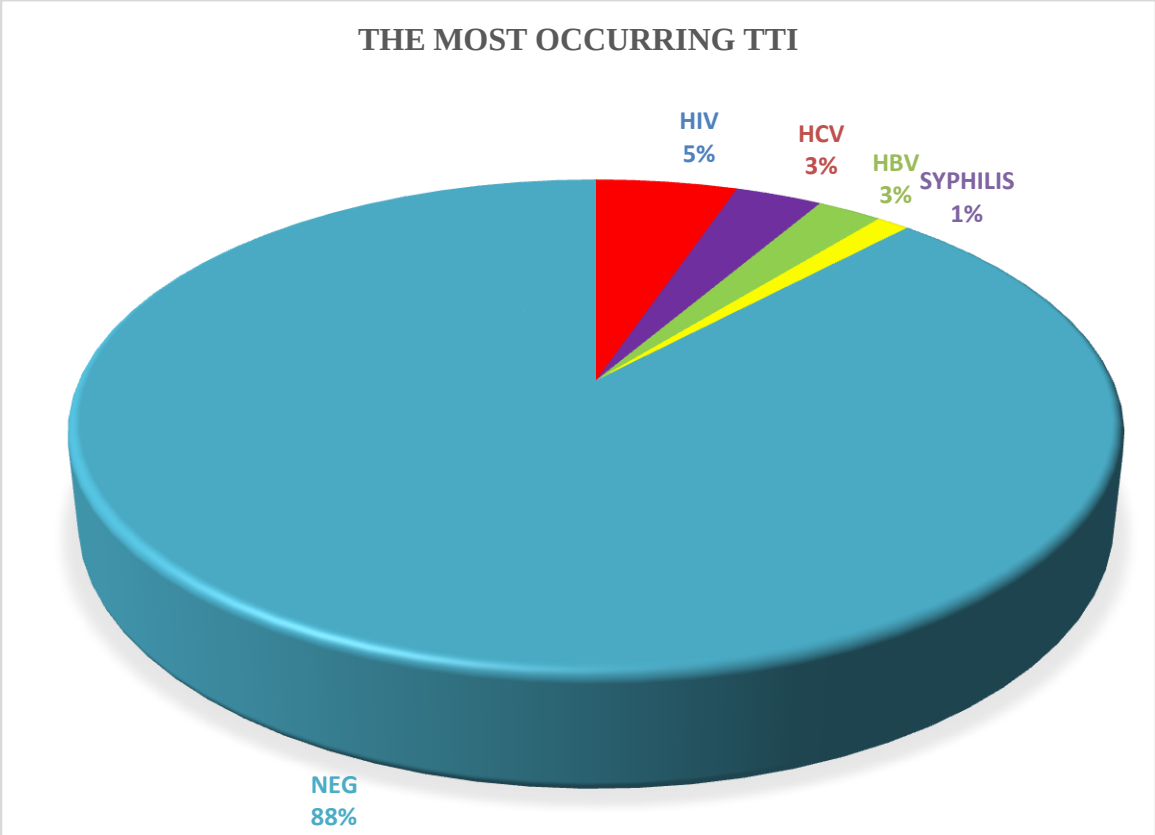

Figure 2 most occurring transfusion transmissible infection

Each donor donates 1 pint. From the figure 2, out of the 250 donated pints, 30 pints were discarded because they had confirmed transfusion transmissible infections.

IX. DISCUSSION, CONCLUSION AND RECOMMENDATION

Discussion of the findings

Transfusion of blood and blood products is a life saving measure and helps innumerable people worldwide. At the same time however, blood transfusion is an important mode of transmission of infection to the recipients. In developing countries the prevalence of TTI is much higher and quite far from attaining a zero risk level at the present moment. In developed countries, the blood supply is safe due to a combination of donor education, donor screening, willingness to donate, and strict laboratory testing procedures. Therefore, the risk of transfusion-transmitted infections is extremely low in these countries.

This study shows a high prevalence of transfusion transmissible infectious agents (HIV 5.2%, HCV 3.2%, HBV 2.4% and Syphilis 1.2%). These findings partly agree with those by Chukwurah and Nneli in Enugu, who reported prevalences of 5.3% for HIV and 1.7% for syphilis, but differ with regards to HBV and HCV for which lower prevalences were observed in this study as compared to their report. The 5.2% seroprevalence of HIV found in this study is higher than the 0.02% prevalence of HIV in blood donation previously reported by a study carried in China.

It was observed in this study that 1.2% of the prospective blood donors had syphilis infection. This 1.2% seroprevalence of syphilis in the study is lower than the 3.6% sero-reactivity reported in Maiduguri, the 7.5% seroprevalence reported in Ghana but is higher than the 0.1% reported by Ejele *et al* in Port Harcourt.

Although all the blood donors were apparently healthy, the 2.4% seroprevalence of HBsAg found in this study indicates that some donors may go on to develop chronic hepatitis, cirrhosis, and some may even progress to develop hepatocellular carcinoma, given the reports that HBV causes acute and chronic hepatitis with a high tendency to progression to cirrhosis and hepatocellular carcinoma. Early treatment of these apparently healthy seropositive individuals is, therefore, encouraged.

The finding of a high prevalence of anti-HCV antibodies among apparently healthy blood donors in the study further confirms the presence of hepatitis C infection and highlights the necessity to adopt measures that will ensure safe blood transfusion.

In this study the highest rates of seroprevalence were found among the 16–35 year-old age group. This finding is in agreement with previous results reported by Baba *et al* and Ejele *et al* in which higher prevalences were

observed among youths. This observation is worrisome since the most productive and economically viable age group of the population is the worst hit. There is the urgent need for renewed intensification of prevention programmes aimed at changing high-risk behaviours.

X. CONCLUSION

The threat of infectious agents entering the blood supply is not static and may evolve as new pathogens emerge or as old ones change their epidemiological pattern. Nevertheless, the goal of a safe and affordable blood supply that can meet the growing global demands may be reached by the coordinated optimization of each step in the transfusion chain, including the careful consideration of donor eligibility criteria, adherence to rigorous rules during donation, processing and storage, the optimal implementation of available screening tests, the use of suitable pathogen inactivation methods and finally the vigilance of prudent physicians, who evaluate the necessity of each transfusion.

Efforts invested in providing lowest possible risk blood products need to be matched by the diligence of physicians administering the transfusions who need to report adverse consequences of blood transfusions. Hence, national haemovigilance systems linked to an international network are becoming indispensable elements of blood product safety and quality. Combined with the development and implementation of sensitive and affordable detection and inactivation approaches, these measures can make blood transfusion a safer form of therapy.

XI. RECOMMENDATIONS

According to the study findings the following steps were recommended:-

I. Transmission of TTIs during serologically negative window period still poses a threat to blood donor safety. Therefore strict selection of blood donors and comprehensive screening of donor's blood using standard methods are highly recommended to ensure the safety of blood for recipient.

II. Emphasis must be laid on voluntary risk reduction, which will require increased awareness and change in the attitude of people. Voluntary blood donation has to be made a part of healthy lifestyle, enlightening the public about the benefits of voluntary blood donations.

III. A significant proportion of donated blood remains unsafe as it is either not screened for all major TTIs or not in a quality controlled manner. Therefore effective laboratory screening using Enzyme immunoassays (EAI) which is more sensitive or Nucleic acid testing (NAT) which reduces the window period is highly recommended.

IV. Recipients of blood and blood products should be well monitored for any complication or infections which may arise due to transfusion.

XII. SUGGESTION FOR FURTHER STUDIES

It is recommended that the following areas which are outside the scope of this study and therefore not covered in this study be looked into:-

i. The prevalence of parasitic infections in blood transfusion

ii. The survival rate of transfusion transmissible infection agents in the refrigeration temperatures of 2 – 6 degree Celsius.

iii. The prevalence of fungal infections in blood transfusion

REFERENCES

[1]. Bihl F., Castelli D., Marincola F., Dodd R. Y. & Brandes C (2007). *Transfusion transmitted infections.* J Transl Med.

[2]. Biswas R., Tabor E., Hsia C. C., Wright D. J., Laycock M. E., Feibig E. W., Peddada L., Smith R., Schreiber G. B., Epstein J. S., Nemo G. J. & Busch M. P (2003). *Comparative sensitivity of HBV NAT and HBs Ag assays for detection of acute HBV infection*

[3]. Blajchman MA, Goldman M, Baeza F: *Improving the bacteriological safety of platelet transfusions.* Transfus Med Rev 2004, 18(1):11-24

[4]. Colin JF, Cazals-Hatem D, Loriot MA, Martinot-Peignoux M, Pham BN, Auperin A, Degott C, Benhamou JP, Erlinger S, Valla D, Marcellin P, (1999). *Influence of human immunodeficiency virus infection on chronic hepatitis B in homosexual men*.

[5]. Diarra A, Kouriba B, Baby M, Murphy E, Lefrere JJ (2009). *HIV, HCV, HBV and syphilis rate of positive donations among blood donations in Mali*: *lower rates among volunteer blood donors.* Transfus Clin Biol 2009, 16:444-447. Pre-publication history.

[6]. Dodd RY (2007). *Current risk for transfusion transmitted infections*. Curr Opin Hematol 2007, 14:671-676.

[7]. Dzieczkowski J. S. & Anderson K. C (2008). *Transfusion Biology and Therapy* In: McGraw Hill: Harrison's Principles of Internal Medicine, pp 707-713.

[8]. El Ekiaby M, Lelie N, Allain JP (2010). *Nucleic acid testing (NAT) in high prevalence-low resource settings*. Biologicals 2010, 38:59-64.

[9]. Gibson RJ, Hawkins AE, Beecham MR, Ross E, Waite J, Briggs M, (1997). *Interaction between HIV and hepatitis B virus in homosexual men*; effects on the natural history of infection. AIDS, 11:597-606. Lule GN, 1997. Hepatitis: An update gastroenterology.

[10]. Jayaraman S, Chalabi Z, Perel P, Guerriero C, Roberts I (2010). *The risk of transfusion- transmitted infections in sub-Saharan Africa*. Transfusion. 50:433-442.

[11]. Kinde G, Oke J, Gnahoui I, Massougbodji A (2000). *The risk of malaria transmission by blood transfusion at Cotonou, Benin*. Sante 2000, 10(6):389-392

[12]. Kitchen AD, Chiodini PL (2006). *Malaria and blood transfusion*. *Vox Sang* 90(2):77-84.

[13]. Kuhnl P, Seidl S, Holzberger G (1985). *HLA DR4 Antibodies Cause Positive HTLV-III Antibody ELISA Results*. The Lancet 1985;1222-3

[14]. Laperche S, Boukatou G, Kouegnigan L, Nebie Y, Boulahi MO, Tagny CT, Yahaya R, Tapko JB, Murphy E, Lefrere JJ (2009). *Transfusion safety on the African continent*: an international quality control of virus testing in blood banks. Transfusion 2009, 49:1600- 1608.

[15]. Matee MI, Magesa PM, Lyamuya EF (2006). *Seroprevalence of human immunodeficiency virus, hepatitis B and C viruses and syphilis infections among blood donors at the Muhimbili National Hospital in Dar es Salaam, Tanzania.* BMC Public Health 2006, 6:21.

[16]. McDonald CP, Roy A, Lowe P, Robbins S, Hartley S, Barbara JA (2001). *Evaluation of the BacT/Alert automated blood culture system for detecting bacteria and measuring their growth kinetics in leucodepleted and non-leucodepleted platelet concentrates.*

[17]. Ministry of Health of Mozambique (2007). *HIV and syphilis epidemiological data surveillance*. Ronda Epidemiologica.

[18]. Moor A. C. E., Dubbelman T. M. A. R., VanSteveninck J. & Brank A (1999). *Transfusion transmitted diseases*: risks, prevention and perspectives. Eu J Haematol 1999; 62: 1-18.

[19]. Okonko IO, Okerentugba PO, Akinpelu AO, 2012. *Prevalence of HBs AG among attendees of ARFH centre in Ibadan, South-western Nigeria*. Am-Eurasian J Sci Res

[20]. Pathak S. & Chandrashekhar M. (2010). *Nucleic acid testing: Redefining security in blood screening*. Available: http://www.maxhealthcare.in/ max-medical-journal/september2010/nuclearacid_testing.html.

[21]. Peeling RW, Ye H (2004). *Diagnostic tools for preventing and managing maternal and congenital syphilis*: An overview. Bull World Health Organ 2004, 82:439-446.

[22]. Public Health Agency of Canada (2003). *Transfusion transmitted diseases/infections*. Modified on 2003-05-12.

[23]. *Transfusion transmitted diseases*. – Blood Book, Blood information for life (2011).

[24]. Umolu PI, Okoror LE, Orhue P, 2005. *Human immunodeficiency virus (HIV) seropositivity and hepatitis B surface antigenemia (HBsAG) among blood donors in Benin City, Edo State, Nigeria*. Afr Health Sci, 5(1): 55-58.

[25]. Wagner SJ (2004). *Transfusion-transmitted bacterial infection: risks, sources and interventions.* Vox *Sang* 2004, 86(3):157-163

[26]. World Health Organization (2002). *Aide-mémoire: Blood safety*. World Health Organization, Geneva.

[27]. World Health Organization (2004): *Hepatitis B Assays: Operational Characteristics*. World Health Organization Report 1 & 2 2004.

[28]. World Health Organization (2008). *Universal access to safe blood transfusion*. World Health Organization, Geneva.

[29]. World Health Organization (2009). *HIV Rapid Assays: Operational Characteristics*. World Health Organization Report 16.