BMC Infectious Diseases

RESEARCH

Open Access

Prevalence trends of transfusion-transmitted infections at a tertiary private hospital blood bank in Uganda: a retrospective 6-year review (2017–2022)

Andrew Marvin Kanyike[1*], Frank Kakuba[1], Posiano Mayambala[1], Racheal Nalunkuma[1], Rachael Mukisa Nakandi[1], Yusuf Mulumba[2], Edith Namulema[1], Simon Peter Nsingo[1] and Robinson Ssebuufu[1]

Abstract

Background Blood transfusion is a life-saving medical intervention that can transmit transfusion-transmitted infections (TTIs). In Uganda, prevalent infections in the general population may increase the risk of TTIs. This study determined the trends in seroprevalence of TTIs, including the Human Immunodeficiency Virus (HIV), Hepatitis B Virus (HBV), Hepatitis C Virus (HCV), and syphilis among blood donations over a 6-year period at a tertiary hospital blood bank in Uganda.

Methods This was a retrospective cross-sectional study utilizing data from Mengo Hospital Rotary Blood Bank in central Uganda. Data was accessed through the central electronic system of Uganda Blood Transfusion Services for January 2017 to December 2022. Data was analyzed using STATA version 16.0. Descriptive statistics and time trend analysis were performed. A p-value < 0.05 was considered statistically significant.

Results We analyzed 24,547 blood donations, the majority of which were male donors (18,525, 75.5%) within the age group of 25–40 years (9737, 39.7%) and of Blood group O (12,509, 51.0%). The overall prevalence of TTIs was 8.7% (2,142) and significantly higher among males (8.9%, $p < 0.001$) and those over 40 years (10.7%, $p < 0.01$). Syphilis had the highest prevalence at 3.0%, followed by HBV (2.8%), HCV (1.7%), and HIV (1.3%). Co-infections were observed in 0.6% (136) of the donors, with the most common being HBV and syphilis (33, 0.1%). The prevalence trends of TTIs analysed among new donations decreased from 13.7% in 2017 to 8.9% in 2022 ($p = 0.124$). Only HCV showed a statistically significant variation, decreasing from 5.2% in 2017 to 1.7% in 2022 ($p = 0.009$).

Conclusion There is a decreasing trend of TTIs among blood donors in Central Uganda, although the prevalence of HBV and Syphilis remains high. Additional public health interventions to decrease TTI rates in the general population may increase the safety of blood transfusions.

Keywords Transfusion transmitted infections, HIV, Hepatitis B, Hepatitis C, Syphilis, Blood donation

*Correspondence:
Andrew Marvin Kanyike
andrewmarvinkanyike@gmail.com
[1]Mengo Hospital, Kampala, Uganda
[2]Uganda Cancer Institute, Kampala, Uganda

Background

Blood transfusion is a life-saving treatment for critical conditions involving significant blood loss, such as hemophilia, hemolytic anemia, major trauma, and various surgeries [1, 2, 3]. Globally, approximately 118.2 million donations are made yearly, with the greatest percentage coming from developing countries [4]. Although much needed, blood transfusion is a potential route for various transfusion-transmitted infections (TTIs) of public health concern [3, 5]. The WHO recommends mandatory screening of donor blood for four major TTIs including the Human Immunodeficiency Virus (HIV), Hepatitis B Virus (HBV), Hepatitis C Virus (HCV), and syphilis [3, 4].

Several measures, including stringent donor selection, clinical exams, history taking, standardized testing, safe disposal of infected blood, and advanced procedures like pathogen inactivation, have been implemented to ensure blood transfusion safety [5, 6, 7]. However, eliminating risk remains challenging, with studies showing a 1% risk of transfusion-related adverse reactions, including TTIs, in developing countries [2, 8]. This is compounded by untested pathogens, testing errors, and false negatives due to immunological windows or incubation periods that current serological tests cannot detect [2, 9]. A recent study found an 84% false discovery rate in the Architect anti-HCV screening test in Uganda, suggesting the need for confirmatory testing using an algorithm based on signal-to-cut-off ratios to reduce false positives [10].

The risk and prevalence of TTIs are highest in Low- and Middle-income countries (LMICs) due to the high prevalence of both TTIs in the general population and conditions that are transfusion dependent, like thalassemia, sickle cell disease, and significant injuries. This attracts high donation demand, hence possibly recruiting risky donors [11, 12]. This is further compounded by using serological tests that have limited sensitivity [3]. The WHO recommends using nucleic acid amplification tests (NAATs) to reduce the risk of missed opportunities during widow periods of infections. NAATs have significantly reduced the transmissions of TTIs in developing countries [13]. However, they are unsustainable due to high costs, lack of infrastructure, and lack of necessary expertise in these settings [9].

The importance of screening donated blood is multipronged; besides eliminating the risk of TTIs, it provides a continuous surveillance platform for the specific tested TTIs in the general population [14, 15]. Therefore, the trends and changing epidemiology of TTIs can be tracked, acting as an indicator upon which tenable strategies to ensure their control could be hinged [14]. Additionally, several public health interventions like vaccination programs for some TTIs, such as HBV, have been widely implemented; the routine screening is an avenue to monitor their impact and effectiveness and guiding efforts of the health authorities. Thus, it's imperative to assess and report up-to-date prevalence and incidence of TTIs among donated blood, especially in LMICs with the highest risk.

Despite the benefits, the endemicity of routinely tested TTIs globally and within the sub-Saharan region has not been extensively documented [16]. In Uganda, data on TTI seroprevalence among blood donors is limited. Cwinyaai et al. reported a TTI prevalence rate of 13.8% from a random sample of 1370 blood donors at a regional blood bank in Northern Uganda [17]. This relatively high prevalence in a presumably healthy population warrants more studies to determine the burden of TTIs in Uganda's general population. The currently limited information hinders our ability to monitor the evolving epidemiology of these infections, particularly considering changing public health dynamics such as the Coronavirus disease 2019 (COVID-19) pandemic, which may have influenced their patterns through altered healthcare access, vaccination coverage, and social behaviors. Therefore, this study determined the trends in the seroprevalence of TTIs, including HIV, HBV, HCV and syphilis, at a tertiary private hospital blood bank in Uganda over six years from 2017 to 2022.

Methodology

Study design

This was a retrospective cross-sectional study utilizing data from Mengo Hospital Rotary Blood Bank (MHRB) from January 2017 to December 2022.

Study setting

The Mengo Hospital Rotary Blood Bank (MHRB) was established in 2017 in Kampala, Uganda's capital city. It is the second-largest blood bank in the country and is regulated by the Uganda Blood Transfusion Services (UBTS) in Nakasero. The UBTS is a centrally coordinated department at the Ministry of Health with a network of 8 regional blood banks and six blood collection centers distributed across the country's cities and regions. MHRB provides free blood and blood products to all hospitals nationwide and is open 24 h daily to hospitals with transfusion licenses. The primary sources of blood collection are communities such as schools and churches and donors who visit the blood bank at Mengo Hospital. The majority of the blood donations come from students. The blood bank collects and dispatches approximately 1500 units of blood components each month, majorly around the central Uganda region. All donors at MHRB are Voluntary Non-Remunerated Blood Donors (VNRBD). They are categorized into new donors, donating for the first time, repeat donors who have donated more than

once and regular donors who donate every three months throughout the year.

Sample size

The available data determined the sample size. The study analyzed the records of all blood donations at MHRB over a six-year period, using data from the UBTS electronic records. Uganda has approximately 80,000–90,000 registered blood donors, most donating twice a year [18].

Study population

The study included blood donations made at Mengo Hospital from eligible blood donors per the UBTS criteria: aged ≥ 16 to 70 years, > 45 kg, Hemoglobin levels ≥ 12.5 g/dL, no chronic conditions such as diabetes, asthma, etc., no respiratory infection within 14 days, no skin lesions, no known TTIs, females shouldn't have been menstruating, pregnant or breastfeeding, and one must have completed malaria treatment more than two weeks before the donation [19]. We excluded records whose data on the outcomes of the TTI test results was missing.

Laboratory testing procedures

The collected blood units are screened routinely for HIV, HBV, HCV, and Syphilis. The MHRB uses multiple test system starting with the Architect i2000-system (Abbott Core Laboratories, USA) and follows testing algorithms approved by the quality department [19]. Chemiluminescent microparticle immunoassay (Abbott Core Laboratories, USA) is used for the qualitative detection of HIV p24 antigen and antibodies to HIV 1 & 2, hepatitis B surface antigen, and antibodies to the Hepatitis C virus. Syphilis is detected using the Treponema pallidum hemagglutination Assay (TPHA) (Abbott Core Laboratories, USA). Positive samples are repeatedly tested in duplicate for reproducibility and confirmed with ELISA techniques [19]. Test results obtained from the screening and all donor demographics are fed routinely into the electronic UBTS system, a central system used by all blood banks in Uganda.

Data collection tool and procedures

We extracted data from the UBTS donor electronic records with the help of the blood bank data clerk at MHRB. The data was then exported into a Microsoft Excel sheet and cleaned. Information extracted included demographics (age, sex, and address), laboratory test results for HIV, HCV, HBV, and syphilis, and details regarding previous donations (dates, test results, impediments).

Measures of study outcomes

Prevalence of TTIs

The prevalence of each specific TTI was calculated and expressed as a percentage:

$$\frac{Number\ of\ donations\ with\ a\ confirmed\ \ TTI}{The\ total\ number\ of\ donations} x100$$

Data management and analysis

Data was automatically extracted from the UBTS electronic system, then converted to a Microsoft Excel spreadsheet, cleaned, and exported for analysis into STATA version 16.0 (StataCorp, College Station, Texas, USA). Descriptive statistics were performed to describe the characteristics of the study population and the distribution of the different TTIs. The chi-square test for trends was used to test the significance of annual changes in seroprevalence rates of TTIs over 6 years among new blood donors. Chi-square and/or Fischer's exact tests were also conducted to examine the relationships between the seroprevalence rates of TTIs and the independent variables. A p-value < 0.05 was considered statistically significant.

Results

Participant socio-demographics and blood donation characteristics

The analysis included 24,547 blood donations, the majority of which are males (18,525, 75.5%) and those aged 25–40 years (9737, 39.7%). Donors were predominantly from blood group O (12,509, 51.0%) and the largest group of donors were new (15,745, 64.1%) and repeat donors (8,618, 35.1%) (Table 1).

Prevalence rates and demographic distribution of transfusion-transmitted infections among blood donations

The overall prevalence of transfusion-transmitted infections was 8.7% (n = 2,142). Syphilis was the most prevalent infection at 3.0%, whilst HIV was the least (1.3%). The highest prevalence rates were observed among males (8.9%, $p < 0.001$), individuals aged over 40 years (10.7%, $p < 0.01$), donors with blood group B (8.6%, $p < 0.01$), and new donors (10.0%, $p < 0.01$) (Table 1).

Syphilis prevalence was highest among donors aged over 40 years (5.3%, $p < 0.001$), whereas HIV (1.7%, $p < 0.001$), HCV (1.8%, $p = 0.008$), and HBV (3.1%, $p = 0.002$) were most prevalent among those aged 25–40 years. Male donors had significantly higher rates of HBV (3.1%, $p < 0.001$) and HCV (1.9%, $p < 0.001$) compared to female donors. Blood group A donors exhibited the highest prevalence of HCV (2.1%, $p < 0.01$), while blood group B donors showed the highest prevalence of HIV (1.5%, $p = 0.02$). New donors consistently demonstrated significantly higher prevalence rates across all TTIs compared

Table 1 Prevalence rates of transfusion-transmitted infections across various sociodemographic characteristics of blood donations at Mengo hospital blood bank from 2017–2022

Variable	Total *n* (%)	Total TTIs *n* (%)	HBV *n* (%)	HCV *n* (%)	HIV *n* (%)	Syphilis *n* (%)
Sample Size	24,547 (100)	2142 (8.7)	682 (2.8)	419 (1.7)	316 (1.3)	725 (3.0)
Sex						
Male	18,525 (75.5)	1644 (8.9)	576 (3.1)	356 (1.9)	246 (1.3)	569 (3.1)
Female	6022 (24.5)	371 (6.2)	106 (1.8)	63 (1.0)	70 (1.2)	156 (2.6)
P-Value		**< 0.001**	**< 0.001**	**< 0.001**	0.322	0.055
Age group in years						
16–24	9628 (39.2)	651 (6.8)	256 (2.7)	172 (1.7)	87 (0.9)	174 (1.8)
25–40	9737 (39.7)	956 (9.8)	305 (3.1)	180 (1.8)	168 (1.7)	377 (3.9)
> 40	2482 (10.1)	266 (10.7)	66 (2.6)	42 (1.7)	37 (1.5)	132 (5.3)
Unknown*	2700 (10.9)	142 (5.3)	55 (2.0)	25 (0.9)	24 (0.8)	42 (1.6)
P-Value		**< 0.001**	**0.002**	**0.008**	**< 0.001**	**< 0.001**
Blood group						
A	5822 (23.7)	500 (8.5)	166 (2.9)	120 (2.1)	78 (1.3)	167 (2.9)
AB	1019 (4.2)	84 (8.2)	32 (3.1)	15 (1.5)	12 (1.2)	31 (3.0)
B	5102 (20.8)	441 (8.6)	142 (2.8)	96 (1.9)	79 (1.5)	148 (2.9)
O	12,509 (51.0)	969 (7.7)	337 (2.7)	182 (1.4)	142 (1.1)	372 (2.9)
Unknown*	95 (0.4)	21 (1.0)	5 (5.2)	6 (6.3)	5 (5.3)	7 (7.4)
P-Value		**< 0.001**	0.540	**< 0.001**	**0.002**	0.152
Type of donation						
New	15,745 (64.1)	1575 (10.0)	557 (3.5)	327 (2.1)	245 (1.6)	549 (3.5)
Repeat	8618 (35.1)	435 (5.0)	123 (1.4)	92 (1.1)	70 (0.8)	174 (2.0)
Regular	166 (0.7)	5 (3.0)	2 (1.2)	0 (0.0)	1 (0.6)	2 (1.2)
Unknown*	18 (0.1)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
P-Value		**< 0.001**	**< 0.001**	**< 0.001**	**< 0.001**	**< 0.001**

*Missing demographic data

Table 2 Trends of prevalence of transfusion-transmitted infections among new blood donations at Mengo hospital blood bank from 2017–2022

Variable	Frequency of TTIs *N* (%)							
Year	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**Total***	***P*-value**
Number of Donors	232 (1.5)	2149 (13.6)	4713 (29.9)	1234 (7.8)	4109 (26.1)	3305 (20.9)	15,742 (100)	
HBV	12 (5.2)	94 (4.3)	145 (3.1)	45 (3.6)	137 (3.3)	124 (3.8)	557 (3.5)	0.553
HCV	12 (5.2)	60 (2.8)	90 (1.9)	20 (1.6)	90 (2.2)	55 (1.7)	327 (2.1)	**0.009**
HIV	4 (1.7)	38 (1.8)	71 (1.5)	18 (1.4)	68 (1.7)	46 (1.4)	245 (1.6)	0.509
Syphilis	4 (1.7)	81 (3.8)	142 (3.0)	40 (3.2)	210 (5.1)	72 (2.2)	549 (3.4)	0.935
Total	32 (13.7)	273 (12.7)	448 (9.5)	123 (9.9)	505 (12.3)	297 (8.9)	1678 (10.6)	0.124

*Three of the new donors were missing a year of donation

to repeat or regular donors, including HBV (3.5%), HCV (2.1%), HIV (1.6%), and syphilis (3.5%; all $p < 0.001$), Table 1.

Trends of transfusion-transmitted infections among new blood donations

This analysis examined the prevalence trends of TTIs among new donors. The prevalence of TTIs among new donors decreased from 13.7% in 2017 to 8.9% in 2022 ($p = 0.124$). Only HCV showed a statistically significant variation in prevalence over the years, decreasing from 5.2% in 2017 to 1.7% in 2022 ($p = 0.009$). The prevalence of HBV was highest in 2017 at 5.2% and gradually reduced to 3.5% in 2022, with the lowest prevalence observed in 2019 at 3.1% ($p = 0.553$). HIV prevalence decreased steadily from 1.7% in 2017 to 1.4% in 2022 ($p = 0.509$). Unlike the other TTIs, the prevalence of syphilis generally increased from 1.7% in 2017 to 5.1% in 2021, then dropped to 2.2% in 2022 ($p = 0.935$) (Table 2; Fig. 1).

Prevalence of co-transfusion transmitted infections among blood donations

Approximately 136 donors (0.55%) experienced co-infections. Syphilis and HBV were the most common co-infections, whilst HIV-Syphilis co-infections were the least (26, 0.11%). Two participants (0.01%) were identified with multiple co-infections involving HBV, HIV, and Syphilis (Table 3).

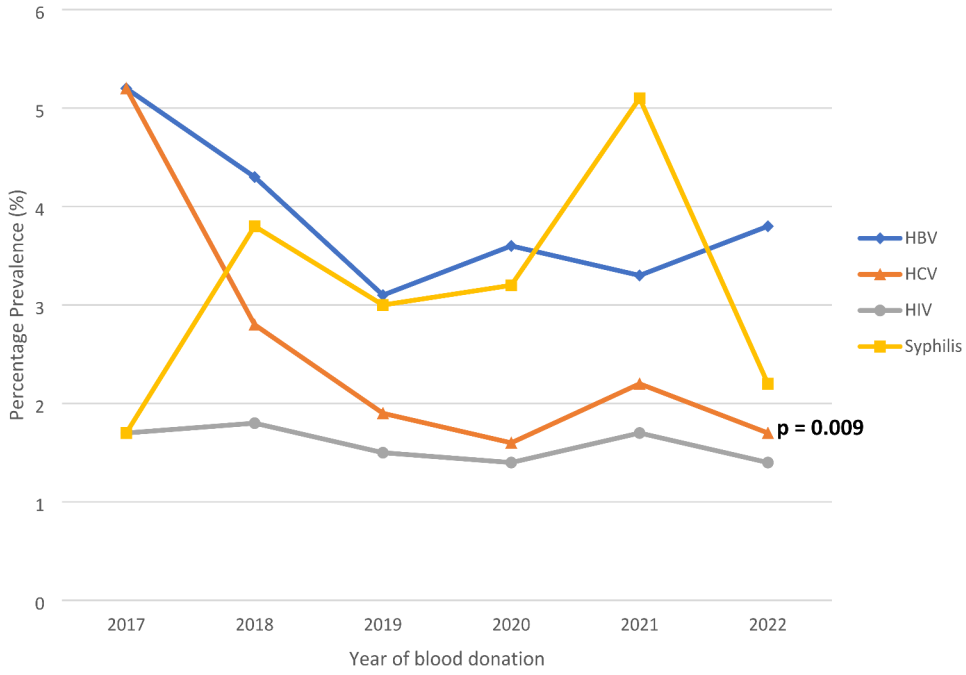

Fig. 1 Graphical presentations of trends of TTI over the years among new blood donors at Mengo Hospital blood bank, Uganda 2017–2022

Table 3 Prevalence of co-infections of HIV, HBV, HCV, and syphilis among blood donors

Co-infection	Frequency	Percentage
HBV- syphilis	33	0.13
HIV- syphilis	26	0.11
HBV-HIV	26	0.11
HBV-HCV	25	0.10
HCV- syphilis	15	0.06
HCV-HIV	8	0.03
HBV-HIV-Syphilis	2	0.01
HCV-HIV-Syphilis	1	0.00
Total	136	0.55

Discussion

Blood transfusion services are critical for a high-quality healthcare system. However, contaminated blood products can lead to transfusion-transmissible infections (TTIs), which can be fatal [4]. Initially, syphilis was the only known TTI in the 1930s, but with research advancements, several other pathogens have been discovered [20]. This study examined 24,547 blood donations for the prevalence of four TTIs: HIV, HBV, HCV, and syphilis, which the WHO recommends for testing in donated blood.

The overall prevalence of transfusion-transmitted infections (TTIs) among all donors was 8.7% and higher (10.6%) when considering only new donors. It's worth noting that repeat donors consistently exhibited lower infection rates compared to new donors. Thus, prioritizing repeat and regular donors could serve as a key strategy to enhance blood safety by minimizing the risk of TTIs. Also, encouraging the general population to become regular blood donors could potentially foster greater health consciousness and reduce engagement in high-risk behaviors that may lead to acquiring TTIs.

Irrespective of the donation type, however, the TTI trend showed a general decline over the six-year period. This could be attributed to public health interventions such as HBV vaccinations, test-and-treat policies, and heightened awareness messages to protect against HIV. The prevalence rate of TTI in this study among donors from central Uganda is lower than the recently reported rate of 13.8% from a regional blood bank in Northern Uganda [17]. This difference reflects geographical variations in the prevalence of infectious diseases in the general population within Uganda, warranting targeted resource allocation and strategies for addressing these health concerns. Furthermore, the overall prevalence in this study is lower than reported in Kenya (14.1%) [21] and Tanzania (10.1%) [22]. The Kenyan and Tanzanian studies collected data from various regions, possibly explaining the lower prevalence.

In this study, syphilis exhibited the highest overall prevalence rate at 3%. The rate was significantly higher in individuals over 40 years (5.3%, $p < 0.001$). Among new donors, the prevalence was even higher at 3.4%, showing a generally increasing trend, although this increase was not statistically significant. Interestingly, previous studies have reported considerably lower rates of syphilis, including 1.2% in Kenya [21], 0.7% in India [23], and 1.2% in Nigeria [24]. These differences may reflect temporal changes in disease patterns or variations in study

populations. However, we acknowledge that TPHA was used as a confirmatory test without further validation, which may have led to an overestimation of syphilis prevalence in case of cross-reactivity.

Hepatitis B virus (HBV) also had a high overall prevalence rate of 2.8% and the highest rate among new donors at 3.5%. This trend remained almost constant over the six years. Similarly, HBV was reported as the commonest TTI in several studies, with comparatively higher rates of 4.1% in Northern Uganda [17], 4.5% in India [2], 13.4% in Burkina Faso [7], and 5.2% in Tanzania [22]. This is because HBV is likely to have a high prevalence in the general population due to its highly contagious nature. It can be easily transmitted from one infected individual to another through various routes, as it is present in all body fluids and secretions, including blood, saliva, semen, sweat, breast milk, tears, and urine [25]. The comparatively lower prevalence from Ugandan studies can be attributed to the national HBV program initiated in 2015 with WHO support. This program has screened over 4 million people of all age groups, and more than 30% of those infected with hepatitis B are aware of their status and can access comprehensive treatment services [26]. However, sustainable efforts and complementary programs are needed because Uganda still bears one of the highest burdens of hepatitis B worldwide, with 6% of the population chronically infected [26, 27].

This study showed a relatively low overall prevalence of HCV (1.7%) and 2.1% among new donors, with a significant downward trend observed over the years ($p = 0.009$). In contrast, HCV was the most prevalent TTI in Northern Uganda (6.6%) in a similar study [17]. This also aligns with a recent report showing a high prevalence of active HCV (7.8%) among the general Ugandan population [28]. The higher HCV prevalence in Northern Uganda is largely due to unsafe injection practices linked to the region's history of conflict and displacement in camps, compounded by limited awareness of HCV transmission and inadequate healthcare infrastructure [28]. The prevalence of specific infections among blood donors likely reflects the broader disease burden in the general population [21]. Therefore, targeted interventions are needed to address these regional differences in prevalent infectious diseases in Uganda.

HIV had the lowest overall prevalence rate at 1.3% and among new donors at 1.6% compared to all the TTIs. Uganda has made significant strides in the fight against HIV, achieving the second target of the Joint United Nations Program on HIV/AIDS (UNAIDS)'s "95-95-95" targets [29], with 96.1% of HIV-positive adults receiving Antiretroviral Therapy (ART) [30]. Progress is also being made toward the third target, with 92.2% of those on ART being virally suppressed [30]. This high rate of viral suppression means that individuals on ART are less likely to transmit the virus, contributing to the low rates of HIV in the population.

Strengths and limitations

This study utilized a large sample size from a comprehensive Uganda Blood Transfusion Services dataset. The study's retrospective design also enabled the assessment of long-term trends and the identification of changes in TTI prevalence over time. Despite its strengths, the study has several limitations. First, as a retrospective study, it is liable to inherent inaccuracies, inconsistencies, or missing information. Second, the study is limited to a single blood bank in Uganda that largely collects blood within the central region, which may not represent other regions. In addition, comparing results with other studies is challenging, as many African studies do not include confirmed results through alternative assays or molecular methods. This includes the lack of confirmation for syphilis assays in this study, which may impact the interpretation of the findings.

Conclusions

This study presents the current prevalence of TTIs among blood donors in Central Uganda. The findings indicate that syphilis and HBV are commonly prevalent TTIs in this region. The high prevalence of syphilis and HBV raises significant public health concerns due to their potential for severe complications. The treatment for these diseases is cheap and available; therefore, interventions should focus on heightening awareness and encouraging prevention, testing and early treatment among the general population. The study also noted a significant decrease in blood donors in 2020, likely due to COVID-19 pandemic restrictions, demonstrating the impact of global health crises on blood donation rates. Additionally, the observed prevalence of co-infections, especially HBV and syphilis, necessitate comprehensive screening and targeted interventions to prevent multiple infections. Further research is warranted to investigate the factors contributing to the high prevalence of HBV and syphilis and to develop targeted interventions.

Abbreviations

COVID-19	Coronavirus-2019
HBV	Hepatitis B Virus
HCV	Hepatitis C Virus
HIV	Human Immunodeficiency Virus
HTLV	Human T-Lymphotropic Virus
IDIs	Inter-donation intervals
IRB	Institution Review Board
LMICs	Low- and Middle-income countries
NATs	Nucleic acid amplification tests
STS	Serologic tests for syphilis
TTI	Transfusion -Transmitted Infections
UBTS	Uganda Blood Transfusion services
VNRBDs	Voluntary nonremunerated blood donors
WHO	World Health Organization

Acknowledgements
We appreciate Ms. Justin Nalwanga, the data clerk at MHRB, who helped extract blood donation records from the UBTS electronic system.

Author contributions
AMK, FK, and PM conceptualized and formulated the research protocol. PM participated in extracting the data. YM, EN and AMK participated in data cleaning, analysis and interpretation. AMK, RN, RMN and EN wrote the initial draft of the manuscript. RS, SPN and EN critically reviewed and revised the manuscript. All authors read and approved the final manuscript.

Funding
No funding was received to conduct this study.

Data availability
The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate
The Mengo Hospital Research Ethics Committee (MHREC) approved the study under approval number MH-2023-26. Because it was a retrospective study, no informed consent was obtained from study participants; however, a waiver of consent was issued from the MHREC to use the data. The study protocol and conduct adhered to the principles in the Declaration of Helsinki and good clinical practice (GCP).

Consent for publication
Not applicable.

Clinical trial number
Not applicable.

Competing interests
The authors declare no competing interests.

Received: 20 November 2024 / Accepted: 1 April 2025
Published online: 07 May 2025

References

1. Pallavi P, Ganesh CK, Jayashree K, Manjunath GV. Seroprevalence and trends in transfusion transmitted infections among blood donors in a university hospital blood bank: A 5 year study. Indian J Hematol Blood Transfus. 2011;27(1):1–6.
2. Priya T, Sumathi V. Seroprevalence of transfusion transmitted infections in blood Donors-A 6 year experience in tertiary care hospital. Int J Pharm Clin Res. 2022;14(10):652–9.
3. Madhavi P, Anuradha P, Rajani Kumari K, Swaroop P. A study on prevalence of transfusion related infections amongst voluntary blood donors in a tertiary health care centre. Int J Toxicol Pharmacol Res. 2022;12(8):248–56.
4. World Health Organization. Blood safety and availability fact sheet. [Internet]. 2020 [cited 2023 Jan 16]. Available from: https://www.who.int/newsroom/factsheets/detail/blood-safetyand-availability
5. Ghazanfar S, Hassan S, Shahid Z, Khan MS, Malik AR, Bhutta HS, et al. Frequency of transfusion transmissible infections among blood donors of Rawalpindi district, Pakistan. Afr Health Sci. 2022;22(3):590–8.
6. Germain M, Goldman M. Blood donor selection and screening: strategies to reduce recipient risk. Am J Ther. 2002;9(5):406–10.
7. Wongjarupong N, Oli S, Sanou M, Djigma F, Koumare AK, Yonli AT, et al. Distribution and incidence of blood-borne infection among blood donors from regional transfusion centers in Burkina Faso: A comprehensive study. Am J Trop Med Hyg. 2021;104(4):1577–81.
8. Niazkar HR, Dorgalaleh A, Rad F. First-time blood donors are double-edged swords for blood transfusion centers: A retrospective study in Southwest Iran. Turkish J Hematol. 2020;37(1):30–5.
9. Kupek E, Petry A. Changes in the prevalence, incidence and residual risk for HIV and hepatitis C virus in Southern Brazilian blood donors since the implementation of NAT screening. Rev Soc Bras Med Trop. 2014;47(4):418–25.
10. Lucey O, Acana S, Olupot-Olupot P, Muhindo R, Ayikobua R, Uyoga S, et al. High false discovery rate of the architect anti-HCV screening test in blood donors in Uganda and evaluation of an algorithm for confirmatory testing. Vox Sang. 2022;117(12):1360–7.
11. Ware AD, Jacquot C, Tobian AAR, Gehrie EA, Ness PM, Bloch EM. Pathogen reduction and blood transfusion safety in Africa: strengths, limitations and challenges of implementation in low-resource settings. Volume 113. Vox Sanguinis: Blackwell Publishing Ltd; 2018. pp. 3–12.
12. Nagalo BM, Bisseye C, Sanou M, Kienou K, Nebié YK, Kiba A, et al. Seroprevalence and incidence of transfusion-transmitted infectious diseases among blood donors from regional blood transfusion centres in Burkina Faso, West Africa. Tropical Med Int Health. 2012;17(2):247–53.
13. Slot E, Janssen MP, Marijt-van der Kreek T, Zaaijer HL, van de Laar TJ. Two decades of risk factors and transfusion-transmissible infections in Dutch blood donors. Transfus (Paris). 2016;56(1):203–14.
14. Calba C, Goutard FL, Hoinville L, Hendrikx P, Lindberg A, Saegerman C, et al. Surveillance systems evaluation: a systematic review of the existing approaches. BMC Public Health. 2015;15(1):448.
15. O'Brien SF, Zou S, Laperche S, Brant LJ, Seed CR, Kleinman SH. Surveillance of Transfusion-Transmissible infections. Transfus Med Rev. 2012;26(1):38–57.
16. Abdella S, Moshago Berheto T, Tolera G, Belete W, Deressa T, Feleke A et al. Sero-prevalence of transfusion transmittable infections: HIV, Hepatitis B, C and Treponema pallidum and associated factors among blood donors in Ethiopia: A retrospective study. Nasrallah GK, editor. PLoS One. 2020;15(10):e0241086.
17. Cwinyaai N, Opio D, Kajumbula H, Zalwango JF, Akunzirwe R, Okello T, et al. Prevalence and factors associated with transfusion-transmissible infections among blood donors in Arua regional blood bank, Uganda. BMC Infect Dis. 2024;24(1):926.
18. Checkley L, Motwani G, Wange IC, Nwanna-Nzewunwa O, Kirya F, Ajiko MM et al. Assessment of blood donation and transfusion in Eastern Uganda: A Mixed-Methods study. Ann Glob Health. 2019;85(1).
19. Uganda Blood Transfusion Services (UBTS). Quality and monitoring [Internet]. 2020 [cited 2023 Jan 16]. Available from: https://ubts.go.ug/quality-and-monitoring.html
20. Kakkar N, Kaur R, Dhanoa J. Voluntary donors-need for a second look. Indian J Pathol Microbiol. 2004;47(3):381–3.
21. Bartonjo G, Oundo J, Ng'ang'a Z. Prevalence and associated risk factors of transfusion transmissible infections among blood donors at regional blood transfusion center Nakuru and Tenwek mission hospital, Kenya. Pan Afr Med J. 2019;34:31.
22. Mremi A, Yahaya JJ, Nyindo M, Mollel E. Transfusion-Transmitted infections and associated risk factors at the Northern zone blood transfusion center in Tanzania: A study of blood donors between 2017 and 2019. PLoS ONE. 2021;16(3):e0249061.
23. Bhattacharya P, Chandra PK, Datta S, Banerjee A, Chakraborty S, Rajendran K, et al. Significant increase in HBV, HCV, HIV and syphilis infections among blood donors in West Bengal, Eastern India 2004–2005: exploratory screening reveals high frequency of occult HBV infection. World J Gastroenterol. 2007;13(27):3730–3.
24. Olokoba AB, Olokoba LB, Salawu FK, Danburam A, Desalu OO, Badung LH, et al. Syphilis in voluntary blood donors in North-eastern, Nigeria. Eur J Sci Res. 2009;31(3):335–40.
25. di Filippo Villa D, Navas MC. Vertical transmission of hepatitis B Virus—An update. Microorganisms. 2023;11(5):1140.
26. Meenakshi Dalal (WHO Africa region). Uganda elevates health for all with free hepatitis testing, treatment and vaccines. 2023.
27. Ministry of Health U. World Hepatitis Day. 2018: Press statement on the progress of implementation of Hepatitis B vaccination program in Uganda. Ministry of Health. 2018;(July):1–7.
28. Nankya-Mutyoba J, Apica BS, Otekat G, Kyeyune DB, Nakyagaba L, Nabunje J, et al. Hepatitis C in Uganda: identification of infected blood donors for micro-elimination. J Virus Erad. 2021;7(2):100041.
29. United Nations Programme on HIV/aids (UNAIDS). UNAIDS. Global HIV & AIDS statistics_2024 fact sheet. 2024;4–38.
30. Uganda Ministry of Health. Population-based HIV Impact Assessment. 2022.

Publisher's note