ORIGINAL ARTICLE

Prevalence of Transfusion-transmissible Infections in Blood Donors: A Private Hospital Experience

Henry Rantai Gudum[1], Chrisdyana Anjali Sirucoh[2], Nur Amirah Rukyno[2], Saruveish Mogan[2], Tay Siow Phing[1]

[1] Haematology Unit, Department of Pathology, Faculty of Medicine and Health Sciences, Universiti Malaysia Sarawak, 94300 Kota Samarahan, Sarawak, Malaysia
[2] Medical Student, Faculty of Medicine and Health Sciences, Universiti Malaysia Sarawak, 94300 Kota Samarahan, Sarawak, Malaysia

ABSTRACT

Introduction: Blood transfusion, a vital component of established medical protocols, has the potential to save lives and enhance well-being. Nonetheless, it carries inherent risks, with transfusion-transmissible infections (TTIs) remaining a global public health concern. Vigilant monitoring of TTI prevalence among blood donors and understanding of evolving patterns are crucial safety endeavours. The objective of this study was to assess the prevalence of TTIs and their patterns among blood donors within a private hospital's transfusion service. **Methods:** This retrospective study involved TTI testing results of blood donations at Normah Medical Specialist Centre (NMSC) in Kuching, Sarawak, spanning a decade from 2010 to 2019. **Results:** A total of 7329 blood donors contributed 16,085 blood units (2010 – 2019). Among them, 353 donors exhibited reactivity to TTIs, resulting in a prevalence of 4.81%. The majority of reactive donors were male (87.3%), of Malay ethnicity (62.6%), and first-time donors (73.9%). The prevalence rates were highest for HCV (2.69%), followed by HBV (1.41%), HIV (0.42%), and syphilis (0.39%). Both HBV and HCV demonstrated declining prevalence trends, while the prevalence of HIV and syphilis remained consistently low. The response to notification of positivity among reactive donors stood at a mere 4.0%, and the seroconversion rate among repeat donors reached 36.9%. No significant disparities in prevalence or response rates were observed between first-time and repeat donors. **Conclusions:** The prevalence of TTIs within NMSC's blood donor populace remains relatively low, though not negligible. The responsiveness of reactive donors to notifications displayed considerable deficiencies.
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Keywords: Transfusion-transmissible infections, blood donors, prevalence, seroconversion rate, response to notification of reactive TTI status

Corresponding Author:
Henry Rantai Gudum, PhD
Email: ghenry@unimas.my
Tel: +60 82 581000 Ext. 7686

INTRODUCTION

Blood transfusion is a cornerstone of modern medical practice, known for its potential to save lives and improve patient health. However, it is crucial to recognize that this life-saving procedure has inherent risks as blood transfusion can transmit infections. The prevalence of transfusion-transmissible infections (TTIs) among blood donors is influenced by the disease prevalence in the population from which donor selection is made, leading to geographical and regional variations (1).

According to WHO, low and middle-income countries often face higher TTI prevalence rates compared to high-income nations (1). These disparities can be attributed to challenges in healthcare services, varying hygiene standards, cultural factors, and differences in detection methodologies (1).

A population-based study among Malaysian adults revealed that the seroprevalence of hepatitis B surface antigen (HBsAg) was 4%, while the seroprevalence of hepatitis C virus antibody (anti-HCV) was 0.3% (2). HBsAg is the serological marker for hepatitis B virus (HBV) infection, and it appears in serum from one to ten weeks following acute infection. Chronic HBV infection is typically confirmed if HBsAg persists for more than six months. The diagnosis of chronic hepatitis C virus (HCV) infection usually requires both a reactive HCV antibody test and a positive molecular test detecting HCV RNA.

The Ministry of Health (MOH), Malaysia has reported an incidence rate of 15.71 per 100,000 for HBV and 10.55 per 100,000 for HCV within the Malaysian population (3). In terms of seroprevalence, HBV infections are low, while HCV infections fall into the intermediate range (2). Furthermore, according to the Malaysian AIDS Council

the notification rate for human immunodeficiency virus (HIV) in Malaysia dropped by 60% from 2002 to 2017 (4).

Although the risk of transfusion-transmitted viral infections is generally considered low, achieving a 'zero risk' scenario remains a significant challenge (5). Additionally, healthcare workers are also exposed to occupational risks associated with these pathogens. The World Health Organization (WHO) recommends mandatory screening for HIV, hepatitis B, hepatitis C, and syphilis in all blood donations, following established quality system requirements (1).

In Malaysia, blood donors are unpaid volunteers, with no allowance for replacement or directed donations. Potential donors are provided with educational information to ensure that individuals engaging in high-risk behaviours, such as unsafe sexual practices or intravenous drug use, refrain from donating. A comprehensive donor health questionnaire covering aspects of personal history, lifestyle, health conditions, medication, travel history, and surgical procedures is employed to guarantee donor safety and reduce the risk of transmitting infectious agents.

The routine serological screening carried out on blood donor samples in Malaysia include HIV-1, HIV-2, HBV, HCV, and syphilis. Nucleic Acid Testing (NAT), used for the detection of HIV, HCV, and HBV, has become a standard procedure in blood donor infectious screening in many developed and some developing countries. In Malaysia, NAT implementation began in November 2007, initially at the National Blood Centre. Since 2019, over 90% of blood donations in Malaysia have undergone NAT screening as a routine practice (6).

Nevertheless, NAT has not yet been introduced in the hospital at the time of this study. It is essential to recognize that the supply of safe blood is directly impacted by the incidence and prevalence rates of TTIs among blood donors. Continuous monitoring of infection rates and awareness of changing trends are vital safety measures. These TTI rates reflect the effectiveness of clinical and laboratory screening, as well as the demographic composition of the donor population (7). Understanding the trend of TTIs serves as a foundation for improving donor selection strategies and post-donation counselling services to minimize the transmission of infectious diseases.

Despite the acknowledged importance of understanding TTI epidemiology, there is a dearth of published data on TTI burdens across various regions in Malaysia. To date, no published information exists regarding the seroprevalence of TTIs among blood donors at private medical centres in Malaysia. Consequently, this study aimed to determine the prevalence of common TTIs among blood donors at a private medical centre in Kuching, Sarawak, Malaysia, over a ten-year period from January 2010 to December 2019. Furthermore, the study assessed trends in prevalence, response rates among donors notified of their reactive status, and the seroconversion rate among repeat donors.

MATERIALS AND METHODS

Study Design and Setting

This research employed a retrospective study design and the study was conducted at Normah Medical Specialist Centre (NMSC), a private medical centre located in Kuching, Sarawak, Malaysia. NMSC provides a range of inpatient and outpatient medical services, including general surgery, urology, orthopaedic surgery, obstetrics and gynaecology, internal medicine, nephrology, cardiology, paediatrics, and blood transfusion services, along with a blood donation program. This hospital's blood donors database is independent of and not linked to the Ministry of Health's donor database. Data collection spanned a 10-year period from January 2010 to December 2019.

Study Population

The inclusion criteria for the study included all blood donors who donated blood at NMSC between January 2010 and December 2019. Blood donors who were confirmed TTI positive were further analysed. The exclusion criteria was donors with incomplete blood bank or medical records were excluded from the analysis. Equivocal and false positive results were also excluded. The operational Definition of Blood Donor Categories and TTI positive donor include first-time donor: Individuals donating blood for the first time during the study period; repeat blood donor: Individuals who had donated blood on previous occasions before and during the study period, TTI positive donor: Donors who are screened reactive and confirmed positive by confirmatory testing; seroconverted donor: Donors who previously had nonreactive donations but later tested positive by screening and confirmatory tests in subsequent donations for the relevant marker(s) (HBV, HCV, HIV, syphilis).

Serological Testing Methods

The tests conducted include HBV screening: SD BIOLINE HBsAg test kit (Standard Diagnostics, Abbott); Confirmatory test for HBV: Neutralisation test (performed by a referral laboratory, Innoquest Pathology Sdn. Bhd.); HCV screening: SD BIOLINE HCV test kit (Standard Diagnostics, Abbott); Confirmatory test for HCV: LIA (performed by a referral laboratory, Innoquest Pathology Sdn. Bhd.); HIV screening: SD BIOLINE HIV 1/2 3.0 kit (Standard Diagnostics, Abbott); confirmatory test for HIV: Western Blot (performed by a referral laboratory, Innoquest Pathology Sdn. Bhd.); Syphilis testing: SD BIOLINE Syphilis 3.0 test kit (Standard Diagnostics, Abbott); confirmatory test for syphilis: T. pallidum hemagglutination assay (TPHA), done in

NMSC laboratory. All serological tests were conducted following the manufacturer's instructions.

Data Collection and Statistical Analysis

Data were obtained from the Blood Bank Information System (BBIS) at NMSC, which contained the following information: Sociodemographic data (age, gender, ethnic group, occupation), blood donation information (donation date, donation frequency, donor status), results of infectious disease screening (HIV, HBV, HCV, syphilis). For infectious disease-positive donors, dates of notification and response obtained from medical records.

Data were systematically entered into a pre-designed data collection form. IBM SPSS (version 22.0) was used for statistical analysis. Descriptive statistics were employed, and graphs were generated using Microsoft Excel. Continuous data and categorical variables were presented as numbers and percentages (%). Chi-square (χ^2) or Fisher's Exact tests were utilized for the comparison of categorical data. The significance level was set at $p \leq 0.05$.

Ethical Considerations

Ethical clearance was obtained from the Medical Ethics Committee of the Faculty of Medicine and Health Science, University Malaysia Sarawak, and the Medical Ethics Committee of NMSC. Permission to conduct the study was obtained from the Medical Director of NMSC. All data collected were kept confidential and anonymized to protect the privacy of study participants. Informed consent was not sought from study participants since this research used secondary data and did not involve direct contact with donors.

RESULTS

Demographic Characteristics of Blood Donors

A total of 16,085 blood units were collected from 7,329 blood donors during the 10-year period from 2010 to 2019. Male donors contributed the majority (77.7%) of the blood, while female donors contributed 22.3%. The ethnic distribution of donors was as follows: Malay (53.3%), Chinese (19.6%), Bidayuh (12.0%), Iban (9.4%), Melanau (1.3%), and other ethnic groups (4.4%). Most donors were civilians (98.8%), with smaller contributions from police (0.7%) and armed forces (0.5%). First-time donors accounted for 72.5% (n=5,314) of the total number of donors, while repeat donors accounted for the remaining 27.5% (n=2,015).

Characteristics of confirmed TTI positive Blood Donors

Out of 7,329 donors, 353 (4.81%) were confirmed positive for at least one TTI (HBV, HCV, HIV, or syphilis) out of 407 who were initially reactive on screening tests. Of these TTI positive donors, 87.3% were male, 12.7% were female, 73.9% were first-time donors, and 62.6% were Malay (Table I). Almost all confirmed TTI positive donors (99.4%) belonged to the civilian category. The mean age of the TTI positive donors was 32.3 years, with an age range of 18 to 68 years .

Table I: Characteristics of TTI positive blood donors at NMSC (2010-2019)

Description	n (%)
Gender	
Male	308 (87.3%)
Female	45 (12.7%)
Ethnic Group	
Malay	221 (62.6%)
Bidayuh	45 (12.8%)
Chinese	35 (9.9%)
Iban	30 (8.5%)
Melanau	5 (1.4%)
Others	17 (4.8%)
Occupation	
Civilian	351 (99.4%)
Army Forces	2 (0.6%)
Donor Status	
First Time Donor	261 (73.9%)
Repeat Donor	92 (26.1%)

Prevalence of TTIs among Blood Donors

Over the 10-year period (2010-2019), the overall seroprevalence of TTIs was 4.81%. HCV had the highest prevalence (2.69%), followed by HBV (1.41%), HIV (0.42%), and syphilis (0.39%) (Table II). Co-infections were detected in 1.98% of positive donors, primarily involving HBV and HCV.

Trends in prevalence of TTIs

Figure 1 illustrates the trends in prevalence of TTI positive blood donors from 2010 to 2019. The prevalence of HBV and HCV showed a decreasing trend, while HIV

Table II: Prevalence of TTIs among the positive blood donors (2010-2019)

TTIs	n	Seroprevalence (%)
HCV	197	2.69
HBV	103	1.41
HIV	31	0.42
Syphilis	29	0.39

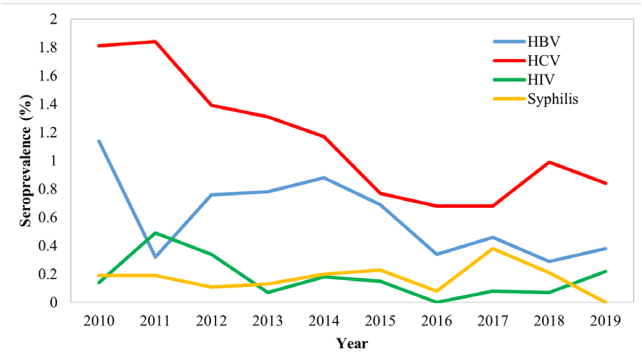

Figure 1: Trends in seroprevalence of TTIs (2010-2019).

and syphilis remained relatively stable with minimal annual variation.

Comparison of TTIs prevalence between First-Time and Repeat Donors

Table III compares the prevalence of each TTI between first-time and repeat donors. Although first-time donors had higher TTI prevalence, the difference was not statistically significant.

Response Rate of TTI positive Blood Donors to Notification

The overall response rate to notification of TTI positivity was poor. Only 4.0% (14 out of 353) of confirmed positive donors returned for follow-up counselling. Donors positive for HIV and HBV had better response rates to hospital notifications, while none of the syphilis-positive donors attended counselling (Table IV). Repeat donors showed better response rate (26%) compared to first time donors (11.5%), however, the difference was not statistically significant (Table V).

Table III: Comparison of TTI positive first time and repeat donors

TTIs	Reactive Cases [n (%)]		*p* value*
	First Time Donor	Repeat Donor	
HCV	141 (54.0)	56 (61.5)	0.223
HBV	82 (31.4)	21 (22.8)	0.142
HIV	22 (8.4)	9 (9.8)	0.673
Syphilis	23 (8.8)	6 (6.5)	0.659

* Data were compared by Chi-square test (χ^2) with statistical significance level at $p \leq 0.05$.

Table IV: Response rate for different TTI

TTIs	Response Rate (%)
HCV	3.0
HBV	5.8
HIV	6.5
Syphilis	0

Table V: Response rate of first time and repeat donors

TTI	Response Rate (%)		*p* value
	First Time Donor	Repeat Donor	
HCV	2.1	5.4	0.355
HBV	4.9	9.5	0.599
HIV	4.5	11.1	0.503
Syphilis	0	0	-

Data were compared by Fisher's Exact test with statistical significance level at $p \leq 0.05$.

Seroconversion Rate for Repeat Donors

Out of 2,015 repeat donors, 92 (4.6%) experienced seroconversion. The majority of seroconversions were related to HCV (60.9%), followed by HBV (22.8%), HIV (9.8%), and syphilis (6.5%).

DISCUSSION

This study examined the prevalence of TTIs, prevalence trends, responses to positive status notifications, and seroconversion rates among blood donors at NMSC, a private hospital in Kuching, Sarawak, from January 2010 to December 2019.

In terms of demographics, a significant majority of blood donors were male (77.7%), consistent with findings in Kelantan, Malaysia (8), and findings in other countries, including India (9), Turkey (10), Eritrea (11), Nigeria (12), Ghana (13), Paraguay (14), and Brazil (15). Over 50% of blood units were contributed by Malay donors, similar to findings in Kelantan (8), despite the general ethnic composition in Kuching being different (Chinese 36.7%, Malays 35.7%, Bidayuh 12.4%, Iban 10.9%, Melanau 0.6%) (16). This may be due to the hospital's proximity to Malay-populated areas. Civilian donors dominated (98.8%), consistent with findings in Ethiopia (17). Most donors were first-time donors (72.5%), similar to studies in China (18) and Pakistan (19), contrasting with a study in Malawi (20) where 56.0% were repeat donors. The high proportion of first time donors and the lower proportion of repeat donors in this study could be attributed to differences in donor databases and incentives. This hospital maintains a blood donors database that is independent of and not linked to the Ministry of Health's donor database. Donors who might have donated elsewhere but donated in this hospital for the first time, would be recorded as first time donors, if they fail to produce the blood donor card. Also, there is a tendency for donors to "migrate" to the MOH as there are better incentives for donation at MOH facilities, including free treatment and entitlement for admission to second class and first class wards after specified number of donations.

Confirmed positive donors were mostly male (87.3%),

with no statistically significant gender-based prevalence difference, aligning with Nigerian (12) and Indian (21) studies. In contrast, a study in Qatar (22) showed less gender disparity. First-time donors were more likely to be reactive (73.9%), akin to findings in China (18), Pakistan (19), and Malawi (20). Malays and civilians constituted most reactive donors, reflecting the ethnic composition of the blood donors. Notably, the prevalence of TTIs differed among ethnic groups, being significantly higher for HBV among Bumiputera Sarawak and for HCV among Malays. The mean age of reactive donors was 32.3 years, with a range from 18 to 68 years, similar to studies in Nigeria (23), Bangladesh (24), and Eastern Ethiopia (25). Younger donors were more likely to be seropositive, indicating higher risk behaviours.

Over the 10-year period, the overall prevalence of TTIs was 4.81%, varying by country. It was higher than in Brunei Darussalam (1.49%) (26) and Eritrea (3.80%) (27) but lower than in Nigeria (19.3%) (28). HCV had the highest prevalence (2.69%), followed by HBV (1.41%), HIV (0.42%), and syphilis (0.39%). Notably, our study showed higher seroprevalence for HBV, HCV, and HIV than a study in Kelantan from 2017-2018 (29). Our study also showed higher prevalence for HCV than that of two other previous Malaysian studies (30, 31). The differences might be due to regional variations in infection rates.

HBV and HCV seroprevalence decreased over the 10-year period, while HIV and syphilis remained low. These trends mirrored the general population trends in Sarawak, Malaysia, from 2011 to 2018 (32) and were similar to Brunei (26) and Eritrea (27). The prevalence among first-time donors reflected population prevalence. In our study the prevalence of TTIs in first time donors were not statistically significant from repeat donors. This may result from a lack of awareness among blood donors about TTI risks and their current lifestyle practices, which could contribute to seropositivity.

Only 4% of confirmed positive donors sought follow-up counselling after notification, much lower than India (33, 34) and European countries (35). Previous studies showed significant variation in the response rate among blood transfusion centres globally, with figures ranging from 21.6% (36) to as high as 98.2% (37). Our study revealed that donors positive for HIV had the highest response rate (6.5%), followed by HBV (5.8%), HCV (3%), and syphilis (0%). These findings were different from a study in University Sains Malaysia hospital where positive donors with HCV had the highest response rate (70.7%), followed by HBV (58.9%), HIV (54%) and syphilis (32.9%) (38). The overall response rate for repeat donors is higher (26%) than first time donor (11.5%), which was similar with a study done in India (39). This poor response may be attributed to low health knowledge, TTIs stigma, and misunderstanding of screening outcomes (33). Achieving the ideal 100% response rate may require behavioural and psychological intervention among the blood donors.

In general, the safest donors are repeat and unpaid voluntary donors. The overall seroconversion rate was 4.6% in our study, with HCV being the most common (60.9%), followed by HBV (22.8%), HIV (9.8%), and syphilis (6.5%). This differed from a Kuala Lumpur study (40) where HBV had the highest seroconversion rate, followed by syphilis, HCV, and HIV. The seroconversion rate among repeat donors reflects the extent to which donors are informed and aware of high-risk factors (activities and behaviours) (40). Factors contributing to seroconversion among repeat donors included concealing high-risk activities during pre-donation interviews and donating during the window period (41,42). NAT testing can reduce the residual risk of HIV, HBV and HCV transmission. It shortens the window period resulting in better detection (43-45).

Local data on TTIs transmission rates is scarce. Ministry of Health, Malaysia Haemovigilance reports from 2016-2019 identified 254 seroconverted donors. A look back investigations done on all blood components from those donations did not reveal any reactive recipient during window periods (7).

CONCLUSION

In our study, we found that the overall prevalence of TTIs among blood donors was relatively low, offering a level of confidence in the safety of our blood donation program in our local setting. Among the TTIs, HCV exhibited the highest overall prevalence, followed by HBV. It is noteworthy that the prevalence of both HBV and HCV showed a decreasing trend over the years, which is a positive indication of the impact of the existing preventive strategies. Furthermore, our findings indicated that the prevalence of HIV and syphilis remained consistently low over the study period. However, it is crucial to emphasize the importance of maintaining vigilance and continuous improvement in our donor selection process. A more meticulous and thorough background check during pre-donation counselling is recommended to further reduce the incidence and prevalence of TTIs in our local setting. This proactive approach can contribute to the ongoing decline in HBV and HCV prevalence and help us continue to keep HIV and syphilis rates low. The response rate of positive donors upon notification of their TTIs positivity is poor. This could be improved by enhancing the donor education program and pre-donation counselling sessions.

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