

**Sero-predominance of Transfusion-Transmitted Infections Among Blood Donors at a Tertiary Care Teaching Hospital in North Bihar, India**

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**Abstract:**

**Background:** Blood transfusion is a critical therapeutic intervention that saves millions of lives worldwide. However, transfusion-transmitted infections (TTIs), such as Hepatitis B Virus (HBV), Hepatitis C Virus (HCV), Human Immunodeficiency Virus (HIV), and Syphilis, pose significant health risks to recipients. Despite advancements in screening and testing protocols, TTIs continue to be a public health concern, especially in resource-limited settings. Blood donation practices in regions like North Bihar still face challenges due to a higher proportion of replacement donors and insufficient screening methods.

**Aim:** This study aims to assess the sero-predominance of TTIs among blood donors at a tertiary care teaching hospital in North Bihar, India, and to identify the demographic and infection-related factors correlated with TTI positivity.

**Methods:** This retrospective study included 125 blood donors who donated blood at Madhubani Medical College and Hospital, Bihar, over a two-year period. Donor records were reviewed for demographic data and screening results for TTIs (HBV, HCV, HIV, Syphilis, and Malaria). The sero-predominance of TTIs was analyzed, and statistical tests (Chi-square) were applied to determine the association between donor demographics and infection status. Data analysis was performed using SPSS version 23.0.

**Results:** Out of 125 blood donors, 10 (8%) tested positive for TTIs. The most common infection was Hepatitis B (4%), followed by HIV (1.6%), HCV (1.6%), and Syphilis (0.8%). No cases of Malaria were detected. TTIs were more prevalent among male donors (9 out of 10 cases) and the 31-40 years age group (40%).

**Conclusion:** The sero-predominance of TTIs among blood donors in this region is notable, with Hepatitis B being the most prevalent infection. While the study found no significant association between gender and TTI positivity, it highlights the necessity for enhanced screening practices, especially for voluntary donors. Further, age-specific screening strategies may be useful in identifying high-risk groups.

**Recommendations:** It is recommended to strengthen voluntary blood donation programs, increase awareness regarding infection prevention, and implement nucleic acid testing (NAT) to improve blood safety. Regular health education for donors and healthcare workers is essential to mitigate the risks of TTIs.

**Keywords:** Sero-predominance, Transfusion-Transmitted Infections, Blood Donation, Hepatitis B, Blood Safety

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**Introduction**

Blood transfusion is a life-saving medical intervention widely used in surgical procedures, trauma care, anemia management, and hematological disorders. However, the safety of blood transfusion remains a major public health concern due to the risk of (TTIs), (HBV), (HCV), (HIV), Syphilis, and Malaria. These infections can be transmitted through blood or blood products when proper screening measures are not strictly followed. The (WHO) emphasizes stringent donor screening and advanced testing methods to minimize the risk of TTIs in transfusion practices [1].

The predominance of TTIs among blood donors varies across regions, depending on screening protocols, population risk factors, and healthcare infrastructure. Studies from India and other developing countries report a high burden of HBV and HCV, whereas developed nations have significantly reduced their TTI predominance due to nucleic acid testing (NAT) and strict donor eligibility criteria [2]. A recent systematic review (2021) on TTIs in India found that HBV remains the most prevalent infection among blood donors, followed by HCV and HIV, with sero-predominance rates ranging from 1% to 4% for HBV and 0.5% to 2% for HCV [3]. Despite the implementation of mandatory ELISA-based screening and pre-donation counseling, sporadic cases of TTI transmission still occur, highlighting gaps in surveillance and testing strategies [4].

In Bihar, one of India's most populous states, healthcare infrastructure and blood donation services are still developing, with many hospitals facing challenges in ensuring a 100% voluntary blood donor pool. Replacement donors (family/replacement donors) still contribute

significantly to blood donations, which can increase the risk of TTI transmission as they may conceal their medical history to meet urgent transfusion needs [5]. Studies suggest that voluntary donors have a lower TTI predominance compared to replacement donors, reinforcing the need to promote non-remunerated voluntary blood donation [6].

Given these concerns, this study aims to determine the sero-predominance of TTIs among blood donors at a tertiary care teaching hospital in North Bihar. By analyzing retrospective blood donor records, this research provides valuable epidemiological insights into the burden of TTIs in the region and highlights the importance of robust screening measures. The findings will contribute to strengthening blood safety protocols and guiding future policies to reduce transfusion-related risks. This study aims to assess the sero-predominance of TTIs among blood donors at a tertiary care teaching hospital in North Bihar, India, and to identify the demographic and infection-related factors correlated with TTI positivity.

**Methodology****Study Design**

This retrospective study was conducted.

**Study Setting**

The study was carried out at Madhubani Medical College and Hospital, Madhubani, Bihar, which serves as a major healthcare center in the region. The hospital has a well-established blood bank that follows standard donor screening and testing protocols. The study involved a review of blood donor records over a period of two years.

## Participants

A total of 125 blood donors were included in the study. Data were collected from blood donor records maintained in the hospital's transfusion unit. The study focused on voluntary and replacement blood donors who donated blood during the study period.

## Inclusion and Exclusion Criteria

The study included all individuals who donated blood at the hospital's blood bank and underwent mandatory screening for TTIs. Donors with incomplete records, repeat donors within the study period, and individuals found medically unfit for blood donation were excluded.

## Bias

To minimize selection bias, only first-time donors with complete records were considered. Additionally, laboratory personnel conducting TTI screening were blinded to donor demographic details to prevent observer bias.

## Data Collection

Data were extracted from hospital records, including donor demographics, screening results for TTIs (HIV, Hepatitis B, Hepatitis C, Syphilis, and Malaria), and other relevant medical details. The

collected data were anonymized before analysis to ensure confidentiality.

## Procedure

All blood donors underwent routine screening as per hospital and national blood transfusion guidelines. Donor blood samples were tested for TTIs using enzyme-linked immunosorbent assay (ELISA) and rapid diagnostic tests as per standard protocols. Positive cases were confirmed using additional testing procedures before final diagnosis.

## Statistical Analysis

The collected data were analyzed using SPSS version 23.0. Descriptive statistics such as frequency and percentage were used to determine the predominance of TTIs among blood donors. Chi-square tests were applied to assess associations between demographic variables and TTI positivity. A p-value of <0.05 was considered statistically significant.

## Results

A total of 125 blood donors were included in the study. The majority were males (110; 88%), while females accounted for 15 (12%). The mean age of the donors was  $32.5 \pm 8.6$  years, with an age range of 18–60 years. Most donors belonged to the age group of 31–40 years (40; 32%), followed by 21–30 years (35; 28%).

**Table 1: Demographic Characteristics of Blood Donors**

Characteristic	Number (n=125)	Percentage (%)
<b>Gender</b>		
Male	110	88%
Female	15	12%
<b>Age Group (Years)</b>		
18–20	10	8%
21–30	35	28%
31–40	40	32%
41–50	25	20%
51–60	15	12%

## Predominance of Transfusion-Transmitted Infections (TTIs)

Out of 125 donors, 10 (8%) tested positive for at least one TTI. Hepatitis B Virus (HBV) was the most common infection,

found in 5 donors (4%), followed by Hepatitis C Virus (HCV) in 2 donors (1.6%), HIV in 2 donors (1.6%), and

Syphilis in 1 donor (0.8%). No cases of Malaria were detected.

**Table 2: Predominance of Transfusion-Transmitted Infections (TTIs) Among Blood Donors**

Infection	Number of Cases (n=125)	Percentage (%)
HIV	2	1.6%
Hepatitis B Virus (HBV)	5	4%
Hepatitis C Virus (HCV)	2	1.6%
Syphilis	1	0.8%
Malaria	0	0%
Total TTI Cases	10	8%

### Association Between TTIs and Donor Demographics

The predominance of TTIs was higher in male donors (9 out of 10 cases, 90%)

compared to female donors (1 out of 10 cases, 10%). The highest predominance was observed in the 31–40 years age group (4 cases, 40%), followed by the 21–30 years group (3 cases, 30%).

**Table 3: Association of TTIs with Donor Demographics**

Variable	TTI Positive (n=10)	TTI Negative (n=115)	p-value
<b>Gender</b>			
Male	9 (90%)	101 (87.8%)	0.82 (NS)
Female	1 (10%)	14 (12.2%)	
<b>Age Group (Years)</b>			
18–20	1 (10%)	9 (7.8%)	0.76 (NS)
21–30	3 (30%)	32 (27.8%)	
31–40	4 (40%)	36 (31.3%)	
41–50	1 (10%)	24 (20.9%)	
51–60	1 (10%)	14 (12.2%)	

(NS = Not Significant;  $p > 0.05$  indicates no significant association)

### Discussion

This retrospective study analyzed 125 blood donors. The donor pool was predominantly male (88%), with most donors belonging to the 31–40 years' age group (32%). The overall predominance of TTIs was 8%, indicating a continued risk of infectious disease transmission through blood transfusion.

Among the identified infections, (HBV) was the most common (4%), followed by (HCV) (1.6%), HIV (1.6%), and Syphilis (0.8%). Notably, no cases of malaria were detected. The higher predominance of HBV aligns with global trends, where HBV

remains a major transfusion-related concern in low- and middle-income settings. The presence of HIV and HCV highlights the importance of stringent donor screening protocols to prevent transmission.

An analysis of demographic factors revealed that TTIs were more frequent in male donors (9 out of 10 cases, 90%). However, statistical analysis showed no significant association between gender and TTI predominance ( $p=0.82$ ). In terms of age distribution, the highest predominance was noted in the 31–40 years' group (40%), followed by the 21–30 years' group (30%), suggesting that middle-aged individuals

might have higher exposure risks to blood borne infections.

These findings emphasize the critical need for continued vigilance in blood donation screening. The absence of malaria cases suggests effective donor deferral strategies for febrile illnesses, but the presence of viral infections indicates a need for improved public health education, vaccination programs (especially for HBV), and enhanced (NAT) methods. While the study sample is limited, the results align with national and regional patterns of TTIs in blood donors.

Overall, this study highlights that despite screening measures, a notable proportion of donors still test positive for TTIs, posing potential risks to blood safety. Strengthening screening guidelines, public awareness programs, and advanced testing methodologies can significantly reduce the burden of transfusion-transmitted infections. Future research with larger sample sizes and longitudinal follow-up is recommended to explore trends over time and evaluate the effectiveness of preventive measures.

(TTIs) remain a significant concern in blood donation safety. A study by Yadav et al. examined the seroprevalence of TTIs among blood donors, identifying a notable presence of infections such as HIV, Hepatitis B and C, and syphilis. The research highlighted the critical need for enhanced screening protocols to minimize transmission risks and protect recipients from potential infections [7]. Further analysis by Saha et al. focused on trends in TTIs over time. Their findings indicated that improved donor selection, increased awareness, and the adoption of advanced testing methodologies have contributed to a decline in the prevalence of TTIs among blood donors. However, despite these improvements, sporadic cases of infections still occur, emphasizing the importance of continuous monitoring and policy adjustments [8]. A study by Dwivedi et al. specifically explored the prevalence of

Hepatitis B and C among blood donors in India. The researchers found that these infections remain among the most common TTIs detected, with Hepatitis B exhibiting a higher seroprevalence than Hepatitis C. The study reinforced the importance of implementing (NAT) as a standard screening method to enhance early detection and reduce transmission risk [9].

Collectively, these studies underscore the persistent challenge of TTIs in blood donation services. While significant progress has been made through improved screening methods and public health interventions, ongoing surveillance and advancements in testing technology are crucial to further reducing the burden of transfusion-transmitted infections.

## Conclusion

This study highlights the ongoing risk of transfusion-transmitted infections among blood donors, emphasizing the need for strict donor screening, advanced testing methodologies, and awareness programs to enhance blood safety. Further large-scale studies are recommended to validate these findings.

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