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ORIGINAL RESEARCH

SEROREACTIVITY FOR TRANSFUSION-TRANSMISSIBLE INFECTIONS AMONG BLOOD DONATIONS: A 5.5-YEAR RETROSPECTIVE STUDY AT A TERTIARY CARE TEACHING HOSPITAL IN NORTHERN TELANGANA

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ABSTRACT

Background: Transfusion-transmissible infections (TTIs) remain an important preventable hazard of blood transfusion. Local audits of screening-marker reactivity are needed to evaluate donor selection and laboratory screening practices.

Objective: To estimate the seroreactivity of mandatory TTI screening markers and describe the donor pool at a government medical college blood centre in northern Telangana over 5.5 years.

Methods: A retrospective record-based cross-sectional study included all 6083 whole-blood donations collected from January 2020 through May 2025. Donations were screened for HIV, hepatitis B surface antigen (HBsAg), anti-HCV, syphilis, and malaria according to the centre's routine protocol. Marker-specific and overall seroreactivity were reported with Wilson 95% confidence intervals (CIs). Annual variation was assessed using Pearson's chi-square test and temporal trend using the Cochran–Armitage test.

Results: Of 6083 donations, 4380 (72.0%) were voluntary and 1703 (28.0%) were replacement donations; 6039 (99.3%) were from male donors. Thirty-eight donations were reactive for at least one marker (0.62%; 95% CI 0.46%–0.86%). Syphilis-screening reactivity was most frequent (24; 0.39%; 95% CI 0.27%–0.59%), followed by HBsAg (10; 0.16%; 95% CI 0.09%–0.30%) and HIV (4; 0.07%; 95% CI 0.03%–0.17%). No anti-HCV- or malaria-reactive donation was recorded. Annual overall seroreactivity ranged from 0.33% to 0.92%, without a significant temporal trend (p=0.691) or between-year heterogeneity (p=0.627).

Conclusion: Overall TTI screening-marker reactivity was low in this selected donor population. Syphilis-screening reactivity accounted for most reactive donations, but interpretation depends on confirmation of the exact assay and testing algorithm. Continued voluntary-donor recruitment, rigorous quality assurance, donor counselling, and consideration of nucleic acid testing may further improve blood safety.

Keywords: Blood donors; Transfusion-transmissible infections; Seroreactivity; HIV; Hepatitis B; Syphilis; Telangana

INTRODUCTION

Blood transfusion is an essential component of modern health care, but donated blood may transmit infectious agents when donor selection and laboratory screening fail to identify an infected donation. Screening programmes therefore focus on infections of major relevance to transfusion safety, including human immunodeficiency virus (HIV), hepatitis B virus (HBV), hepatitis C virus (HCV), Treponema pallidum, and malaria in endemic settings [1–3].

The frequency of reactive screening markers varies by geography, donor characteristics, assay sensitivity, donor-selection practice, and the balance between voluntary and replacement donation. Blood donors are a highly selected population, and donor seroreactivity should not be interpreted as community prevalence. Nevertheless, periodic blood-centre audits provide useful quality indicators and can identify changes that warrant investigation [1,4].

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Government Medical College, Ramagundam serves an industrial and migrant population in northern Telangana. Published donor-screening data from this area are limited. This study therefore estimated the frequency of mandatory TTI screening-marker reactivity and described the composition of the donor pool during the first 5.5 years of the centre's operation.

MATERIALS AND METHODS

Study design and setting

This retrospective, record-based cross-sectional study was conducted at the blood centre of Government Medical College, Ramagundam, Peddapalli district, Telangana, India. Reporting was guided by the STROBE statement for observational studies [5].

Study period and population

All whole-blood donations collected from 1 January 2020 through 30 May 2025 were included. Donations were collected at the hospital and at institution-organized outreach camps. The unit of analysis was a donation; the available records did not identify repeat donors.

Donor selection

Prospective donors underwent medical-history assessment, risk screening, and physical examination in accordance with applicable national requirements and WHO donor-selection guidance [1,6]. Accepted donors were aged 18–60 years in the observed dataset, weighed more than 45 kg, and had haemoglobin above 12.5 g/dL

Laboratory screening

Pilot samples collected at donation were screened for HIV-1 p24 antigen and antibodies to HIV-1/2, HBsAg, anti-HCV, syphilis, and malaria. HIV screening used a fourth-generation antigen/antibody ELISA.

Handling of reactive donations

Initially reactive samples were retested according to the centre's routine procedure, and repeatedly reactive units were removed from inventory and discarded in accordance with biomedical-waste requirements.

Statistical analysis

Categorical variables were summarized as counts and percentages. Seroreactivity was calculated using total donations screened as the denominator. Wilson score 95% CIs were calculated for marker-specific and overall proportions [7]. Annual variation was assessed with Pearson's chi-square test, and ordered temporal trend with the Cochran–Armitage test. Donor-type composition was analysed similarly. Two-sided $p<0.05$ was considered statistically significant.

RESULTS

Donation volume and donor type

A total of 6083 donations were recorded. Voluntary donations accounted for 4380 (72.0%) and replacement donations for 1703 (28.0%). The annual donor-type distribution varied significantly ($\chi^2=81.08$, df=5, $p<0.001$), and the replacement share showed an overall increasing trend across the ordered study years (χ^2 for trend=35.28, $p<0.001$), although it declined in the first half of 2025.

Table 1. Annual distribution of voluntary and replacement donations

Year	Voluntary, n (%)	Replacement, n (%)	Total
2020	720 (82.6)	152 (17.4)	872
2021	843 (73.9)	298 (26.1)	1141
2022	840 (69.2)	374 (30.8)	1214

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Year	Voluntary, n (%)	Replacement, n (%)	Total
2023	709 (70.1)	302 (29.9)	1011
2024	711 (65.4)	376 (34.6)	1087
2025*	557 (73.5)	201 (26.5)	758
Total	4380 (72.0)	1703 (28.0)	6083

*January–May2025 only.

Sex distribution

Overall, 6039 donations (99.3%) were from male donors and 44 (0.7%) from female donors.

Table 2. Annual distribution of donations by donor sex

Year	Male, n	Female, n	Total
2020	868	4	872
2021	1131	10	1141
2022	1208	6	1214
2023	999	12	1011
2024	1084	3	1087
2025*	749†	9	758
Total	6039	44	6083

Distribution of reactive donations by age

Of the 38 reactive donations, 29 (76.3%) occurred among donors aged 21–40 years

Table 3. Age distribution of reactive donations by screening marker

Marker	18–20	21–30	31–40	41–50	51–60	Total
HIV	0	2	1	1	0	4
HBsAg	0	3	5	2	0	10
Anti-HCV	0	0	0	0	0	0
Syphilis screening	0	8	10	4	2	24
Malaria	0	0	0	0	0	0

TTI screening-marker seroreactivity

Thirty-eight donations were reactive for at least one screening marker, corresponding to 0.62% (95% CI 0.46%–0.86%).

Table 4. Seroreactivity for transfusion-transmissible infection screening markers

Marker	Reactive, n	Seroreactivity, %	Wilson 95% CI, %
HIV	4	0.07	0.03–0.17
HBsAg	10	0.16	0.09–0.30
Anti-HCV	0	0.00	0.00–0.06
Syphilis screening	24	0.39	0.27–0.59
Malaria antigen	0	0.00	0.00–0.06
Any marker	38	0.62	0.46–0.86

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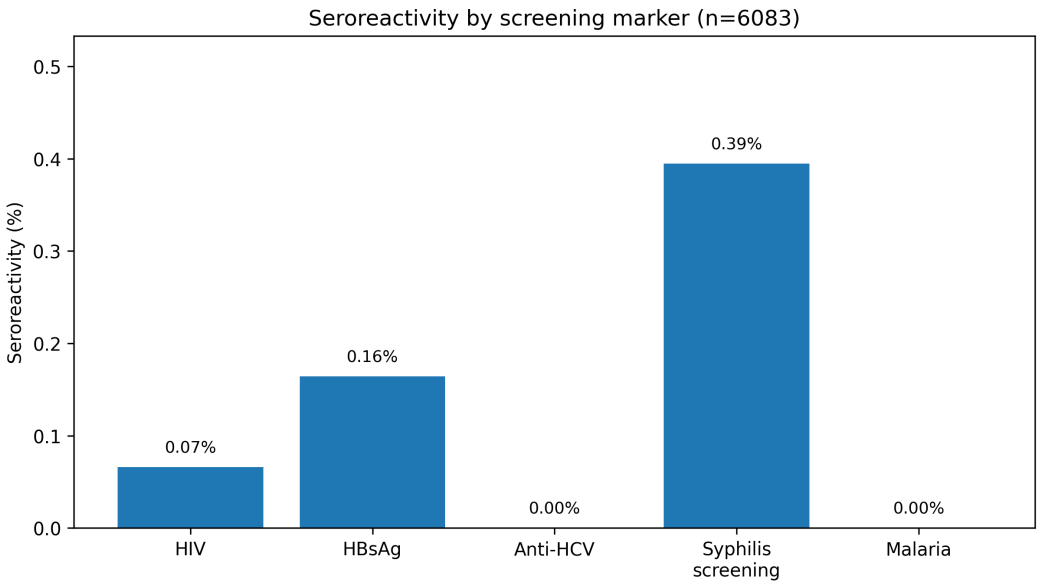

Figure 1. *Seroreactivity by screening marker among 6083 donations.*

Annual trend

Annual seroreactivity ranged from 0.33% in 2022 to 0.92% in 2024. There was no significant linear trend (Cochran–Armitage χ^2=0.16, p=0.691) and no significant heterogeneity between years (Pearson χ^2=3.48, df=5, p=0.627).

The 2025 observation covers January–May only.

Table 5. Annual seroreactivity for any TTI screening marker

Year	Reactive, n	Donations, n	Seroreactivity, %	Wilson 95% CI, %
2020	6	872	0.69	0.32–1.49
2021	7	1141	0.61	0.30–1.26
2022	4	1214	0.33	0.13–0.84
2023	7	1011	0.69	0.34–1.42
2024	10	1087	0.92	0.50–1.69
2025*	4	758	0.53	0.21–1.35

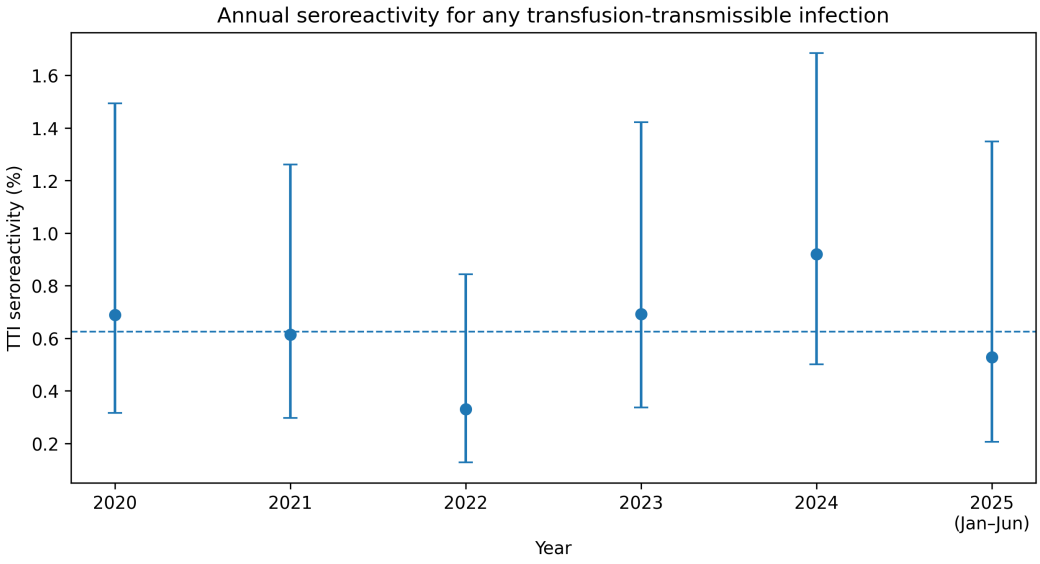

Figure 2. *Annual seroreactivity for any TTI marker with Wilson 95% confidence intervals.*

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DISCUSSION

This 5.5-year audit found overall TTI screening-marker reactivity of 0.62% among 6083 donations. Syphilis-screening reactivity accounted for 24 of the 38 reactive donations, followed by HBsAg and HIV. No anti-HCV- or malaria-reactive donation was recorded. Annual fluctuation was not statistically significant.

The observed HIV and HBsAg proportions are within the lower range of several Indian hospital-based donor series [8–14]. Such comparisons require caution because centres differ in donor selection, voluntary-donor recruitment, test platforms, confirmatory algorithms, and calendar period. Confidence intervals are particularly important when event counts are small; for example, the HIV estimate is based on only four reactive donations.

The apparent predominance of syphilis-screening reactivity is the most unusual finding. Its interpretation cannot be separated from the test method. Non-treponemal tests identify reagin and may produce biological false-positive results, whereas treponemal tests identify specific antibodies and may remain reactive after treated infection. The contradictory assay descriptions in the source records prevent a firm conclusion about active syphilis burden. A clearly documented two-test algorithm is essential before this pattern is presented as a regional epidemiological feature.

Voluntary donations represented 72.0% of the total. WHO promotes voluntary non-remunerated donation as a central component of safe and sustainable blood supply [1,15]. However, the present dataset did not link donor type to marker reactivity, so it cannot directly compare voluntary and replacement donations.

Women contributed less than 1% of donations. This marked imbalance limits the representativeness of the donor pool and prevents meaningful sex-specific analysis. Similarly, the concentration of reactive donations among people aged 21–40 years cannot be interpreted without age-specific denominators.

No anti-HCV or malaria reactivity was observed. With 6083 donations, zero events still permit an upper 95% confidence limit of approximately 0.06%. Continued internal and external quality assurance is therefore important, especially when a marker remains consistently non-reactive over several years.

Serological screening cannot eliminate window-period risk. Nucleic acid testing shortens the detection window for HIV, HBV, and HCV, although implementation depends on resources, infrastructure, and national policy [16–18].

Strengths and Limitations

Complete enumeration of all recorded donations over 5.5 years. Independent recalculation of proportions, Wilson confidence intervals, and annual trend statistics. Unresolved identity of the syphilis assay and incomplete confirmatory-testing information.

CONCLUSION

TTI screening-marker reactivity was low among donations collected at this northern Telangana blood centre. Syphilis-screening reactivity was the most frequent finding, followed by HBsAg and HIV, while no anti-HCV- or malaria-reactive donation was recorded. No significant temporal trend was demonstrated. The main finding regarding syphilis should remain provisional until the assay and confirmation algorithm are verified. Strengthening data quality, quality assurance, donor counselling, voluntary-donor recruitment, and access to nucleic acid testing may further improve transfusion safety.

Declarations

Ethics approval and consent waiver: The study was approved by institutional ethics committee

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Funding: Nil

Competing interests: Nil

Data availability: De-identified aggregate data may be made available by the corresponding author subject to institutional approval.

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