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HBsAg Screening Reactivity among Blood Donors in a Resource-Constrained Blood Bank in Southern Senegal: Frequency and Associated Factors

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Abstract

Background: Hepatitis B virus remains an important transfusion-transmissible infection in sub-Saharan Africa. Operational data from blood banks with limited laboratory resources can help characterize routine screening results and identify priorities for improving blood safety. Objective: To estimate hepatitis B surface antigen screening reactivity among clinically selected blood donors in southern Senegal and assess associations with sex, age group and previous donation history. Methods: Routine records from 1 January to 31 May 2025 were analyzed for 1146 distinct donors aged 18 - 60 years. Screening used a rapid immunochromatographic assay without systematic confirmatory testing. Reactivity was estimated with a 95% confidence interval using the Wilson method. Chi-square tests and multivariable logistic regression assessed associations with donor characteristics. Results: Among 1146 donors, 839 (73.2%) were male and 96 had reactive results, giving an overall screening reactivity of 8.4% (95% confidence interval, 6.9% - 10.1%). Reactivity was 10.1% in males and 3.6% in females and reached 16.0% in donors aged 31 - 45 years. Male sex and the two age groups above 30 years were associated with reactivity in the adjusted analysis; first-time donor status was not. Conclusion: Hepatitis B surface antigen screening reactivity was 8.4% in this single-center donor population. The observed associations with sex and age warrant cautious interpretation. The results describe routine screening reactivity rather than confirmed

infection prevalence and provide a basis for local screening surveillance and donor counselling.

Keywords

Blood Donors, Hepatitis B, Screening Reactivity, Rapid Tests, Senegal

1. Introduction

Blood transfusion is an essential therapeutic intervention, but its benefit depends on a chain of safety measures that begins before blood collection and continues through laboratory qualification, component release and clinical use. International guidance emphasizes the need for organized blood systems and for screening donated blood for major transfusion-transmissible infections before transfusion [1]-[3]. In settings where hepatitis B virus (HBV) remains endemic, hepatitis B surface antigen (HBsAg) testing is therefore a core element of biological qualification of blood donations.

Hepatitis B virus (HBV) remains a major global health concern. The World Health Organization (WHO) estimated that 254 million people were living with chronic HBV infection in 2022, with approximately 1.1 million deaths attributable to hepatitis B, mainly from cirrhosis and hepatocellular carcinoma [4] [5]. In Senegal, infant vaccination has improved protection in younger birth cohorts, while adult screening and linkage to care remain important gaps [6] [7].

Several studies from Senegal and sub-Saharan Africa have documented HBV markers among blood donors [8] [9]. However, recent data describing routine HBsAg rapid screening in peripheral or resource-constrained blood bank services remain limited. This distinction is important because rapid immunochromatographic assays are operationally accessible and widely used, but they do not provide the same analytical performance as enzyme immunoassays, chemiluminescence or nucleic acid testing [10]-[12]. Local evidence generated under routine conditions can therefore help blood banks distinguish operational screening reactivity from confirmed virological prevalence, while still informing donor education, counselling and progressive quality improvement.

Rapid immunochromatographic tests offer short turnaround times and require little equipment. Laboratory immunoassays, including enzyme-linked immunosorbent assays (ELISA) and chemiluminescent assays, generally offer greater analytical sensitivity, while nucleic acid testing can detect HBV DNA during periods when HBsAg is not detectable. HBsAg screening alone cannot exclude occult HBV infection or infection during the early window period [10]-[12]. In the study blood bank, these higher-performance methods were unavailable on-site during the study period. The present analysis therefore describes routine screening reactivity, not assay accuracy or confirmed HBV infection prevalence.

2. Objectives

The primary objective was to estimate the proportion of HBsAg-reactive screening results among clinically selected blood donors at the Hôpital de la Paix de Ziguinchor from January to May 2025. The analytical objective was to assess associations with sex, age group and first-time or repeat-donor status. These were the explanatory variables collected for the analysis.

3. Materials and Methods

Study design and setting. This observational analysis used routine donor-selection and laboratory-screening records from a public hospital blood bank in southern Senegal between 1 January and 31 May 2025. The single-center setting and five-month period reflected the scope of the available service dataset. The purpose was to characterize the screening results of this blood bank, rather than to produce a nationally representative estimate or validate the rapid assay.

Study population and record verification. All 1146 distinct donors who underwent blood donation during the study period were included. Each donation corresponded to a different donor, and each donor contributed one observation. Data were verified against both blood bank registers and individual donor records before analysis. All 1146 records were retained; none were excluded during data cleaning. Candidates deemed ineligible at pre-donation assessment did not proceed to blood collection and were outside the analyzed donor population. Their number was not available in the analytical dataset.

Donor selection and blood collection. Before donation, candidates underwent a medical assessment, received routine counselling and completed the routine donor questionnaire. Blood was collected only from candidates judged eligible who provided informed consent for donation and routine screening. Repeat-donor status indicated a history of donation before the donation included in this dataset; it did not indicate repeated observations during the study. Donor status was recorded as first-time or repeat donor. The questionnaire did not distinguish voluntary donations from family/replacement donations.

HBsAg screening and quality assurance. A plasma or serum sample obtained from the donation tubing was centrifuged at approximately 4000 rpm for 10 - 15 minutes and screened using the Determine™ HBsAg rapid immunochromatographic assay (Abbott), following the manufacturer's instructions. Kits were stored at 2˚C - 8˚C. Lot references were recorded for traceability, and positive and negative control samples were tested whenever a new assay lot was opened. Tests were performed by qualified and authorized senior laboratory technicians and laboratory engineers. Results were read within the prescribed time window. Absence of the procedural control line rendered a test invalid and required repetition on a new device. Valid results were recorded as reactive or non-reactive. Reactive donations were excluded from the transfusion circuit. Because systematic confirmatory testing was unavailable on-site, the outcome was HBsAg screening reactivity rather than confirmed HBV infection.

Post-donation counselling and referral. Donors with reactive results received counselling and were referred to CARES II, implemented by ENDA Santé, for clinical assessment before a decision on enrolment and care [13]. Enrolment depended on clinical eligibility and willingness to participate. Donors who declined participation were referred to the hepatogastroenterology service. Donors with non-reactive screening results, particularly first-time donors, were encouraged to become regular donors. Subsequent programme enrolment, clinical outcomes and return donation were not outcomes measured in this study.

Variables and outcomes. The primary outcome was HBsAg screening reactivity. The explanatory variables were recorded biological sex, age group (18 - 30, 31 - 45 and 46 - 60 years), and first-time or repeat-donor status. These were the only explanatory variables collected for the analysis. Vaccination status, education, occupation, residence, donation category and behavioral risk factors were not collected; their omission was due to data availability rather than statistical variable selection.

Statistical analysis. Data were analyzed using Excel and R. Overall screening reactivity was expressed as a percentage with a 95% Wilson score confidence interval. Group comparisons used Pearson's chi-square tests, with Yates' continuity correction for the two-by-two sex and donor-status tables. All expected cell counts in the reported contingency tables exceeded five. Sex, age group and donor status were included together in the multivariable logistic regression. The reported contrasts used female sex, age 18 - 30 years and repeat-donor status as reference categories. Adjusted odds ratios (ORs) and 95% confidence intervals (CIs) were reported, with $p < 0.05$ as the significance threshold. Sparse-cell and model-fit diagnostics for the multivariable regression were not documented in the original analysis; adjusted associations were therefore interpreted cautiously.

Ethical considerations. The study used anonymized routine blood donation and laboratory screening data only, with no additional sampling, intervention or direct contact with donors for research purposes. It was conducted in accordance with institutional procedures for the use of anonymized routine service data and with the principles of the Declaration of Helsinki. The retrospective analysis was authorized by the institutional authorities responsible for the blood bank; no separate ethics approval number was issued under the local procedure for anonymized routine data. Donor privacy was protected throughout the analysis. Before blood collection, each donor had undergone a medical consultation, completed the medical eligibility and informed-consent questionnaire, and consented to blood donation and routine screening for transfusion-transmissible infections.

4. Results

All 1146 donor records assessed for analysis were included, with no records excluded during data cleaning. The sample comprised 839 male donors (73.2%) and 307 female donors (26.8%). Overall, 96 donors had reactive HBsAg results, corresponding to screening reactivity of 8.4% (95% Wilson CI, 6.9% - 10.1%).

Screening reactivity differed by sex (Table 1): 10.1% of male donors and 3.6% of female donors had reactive results ($p = 0.0006$).

Table 1. HBsAg screening reactivity by sex.

Sex	Reactive, n	Non-reactive, n	Total, n	Reactivity, %	*p*-value
Male	85	754	839	10.1	0.0006
Female	11	296	307	3.6	

Screening reactivity varied by age group (Table 2), with the highest proportion among donors aged 31 - 45 years (16.0%), followed by those aged 46 - 60 years (10.7%) and 18 - 30 years (5.2%) ($p < 0.0001$).

Table 2. HBsAg screening reactivity by age group.

Age, years	Reactive, n	Non-reactive, n	Total, n	Reactivity, %	*p*-value
18 - 30	39	716	755	5.2	<0.0001
31 - 45	46	242	288	16.0	
46 - 60	11	92	103	10.7	

First-time and repeat donors had similar screening reactivity (Table 3): 8.5% and 8.2%, respectively ($p = 0.959$).

Table 3. HBsAg screening reactivity by donor status.

Donor status	Reactive, n	Non-reactive, n	Total, n	Reactivity, %	*p*-value
Repeat	45	501	546	8.2	0.959
First-time	51	549	600	8.5	

In the reported multivariable analysis (Table 4), male sex (adjusted OR, 2.82; 95% CI, 1.47 - 5.41), age 31 - 45 years (adjusted OR, 3.47; 95% CI, 2.19 - 5.51) and age 46 - 60 years (adjusted OR, 2.21; 95% CI, 1.08 - 4.51) were associated with screening reactivity. First-time donor status was not statistically associated after adjustment (adjusted OR, 1.44; 95% CI, 0.93 - 2.23).

Table 4. Reported multivariable logistic regression for HBsAg screening reactivity.

Factor or contrast	Adjusted OR	95% CI	*p*-value
Female sex	1.00 (reference)	—	—
Male sex	2.82	1.47 - 5.41	0.0019
Age 18 - 30 years	1.00 (reference)	—	—
Age 31 - 45 years	3.47	2.19 - 5.51	<0.0001
Age 46 - 60 years	2.21	1.08 - 4.51	0.0296
Repeat donor	1.00 (reference)	—	—
First-time donor	1.44	0.93 - 2.23	0.1047

OR, odds ratio; CI, confidence interval. The model included sex, age group and donor status together. Model-fit and sparse-cell diagnostics were not documented in the original analysis.

5. Discussion

Among 1146 clinically selected donors, 96 had reactive HBsAg screening results, giving a reactivity of 8.4%. The study describes results generated during routine blood-bank activity in a setting with limited laboratory resources. It does not estimate confirmed HBV infection prevalence, measure diagnostic sensitivity or specificity, or quantify residual transfusion-transmission risk.

The lack of systematic confirmatory testing is central to interpretation. Rapid testing was the available routine method during the study period, and reactive donations were excluded from transfusion. This operational role does not establish that a rapid assay has sufficient sensitivity to identify every infectious donation. HBsAg-negative window-period and occult infections remain possible, and false-reactive results cannot be excluded without confirmation [10]-[12]. The findings support documenting screening activity and strengthening access to reference testing, rather than claiming validation of the assay.

African transfusion literature describes HBV screening within a broader context of donor recruitment, clinical selection, laboratory capacity and quality systems [14]-[18]. Donor studies in Ghana, Tanzania, Cameroon, Burkina Faso and Nigeria also document substantial variation in HBV-marker frequencies [19]-[26]. Differences in assays, confirmation procedures, donor populations and study periods limit direct numerical comparisons. Experience with rapid-test screening in resource-poor settings further emphasizes the importance of interpreting results within the actual screening pathway [27]. In Ziguinchor, the earlier study by Manga and colleagues reported HBsAg carriage of 12.1% among donors screened in 2013 [9]. The difference from the present 8.4% cannot establish a temporal trend because the services, donor categories and testing procedures are not identical.

WHO population-level classifications describe low HBsAg endemicity as <2%, intermediate endemicity as 2% to <8%, and high endemicity as ≥8% [28]. Although the numerical screening reactivity observed here exceeds 8%, these categories concern population HBsAg seroprevalence. They cannot be used to classify southern Senegal from a clinically selected, single-center donor sample tested without systematic confirmation.

Male donors were more numerous than female donors and had higher screening reactivity. The reported adjusted association is consistent with sex differences observed in regional donor studies [9] [14]. Possible differences in exposures, health-service use and donor recruitment may contribute, but these factors were not measured. Women represented 26.8% of the sample, so some combinations of sex, age and donor status may have limited numbers. The sex association should be interpreted cautiously and should not be used to stigmatize donors or restrict

recruitment on the basis of sex.

Donors aged 31 - 45 years had the highest reactivity, while those aged 46 - 60 years also had higher adjusted odds than the 18 - 30-year reference group. This pattern may reflect differences in exposure history or birth cohorts, but it is not evidence of a steadily increasing rate with age. Senegalese population research documents vaccination gains in children alongside persistent infection in adults [7]. Because vaccination status and age at infection were unavailable, vaccination cannot be identified as the explanation for the age association in this study.

The absence of a statistically significant association with previous donation history does not establish equivalent safety between first-time and repeat donors. Donation history and donation category are different dimensions: both groups may include voluntary and family/replacement donors. In African settings, family mobilization around a patient's need can coexist with voluntary recruitment, as discussed by Tagny and colleagues [14] [15]. Because the routine questionnaire did not record donation category, this study cannot determine its contribution to the observed results. Previous donation also does not necessarily imply sustained regular donation. Encouraging donors with non-reactive results to return was a routine practice, but donor retention was not measured.

Quality assurance remains essential for any screening method. During the study period, kit lot references were recorded, kits were stored at 2˚C - 8˚C, positive and negative controls were used at each new lot opening, and testing was performed by authorized laboratory professionals. These procedures support routine test execution but do not replace confirmation of individual reactive results or establish field diagnostic accuracy. African external quality-control studies show why laboratory performance requires continued attention [29]. Improved access to laboratory immunoassays and, where feasible, nucleic acid testing remains a priority [3] [8] [11].

The counselling and referral pathway connects blood safety with access to care. Donors with reactive screening results were referred to CARES II for evaluation before a decision on programme enrolment [13]. Donors declining participation were referred to hepatogastroenterology. This pathway should be distinguished from confirmed programme enrolment or treatment initiation, which were not measured. Referral also avoids interpreting a screening result as a complete clinical diagnosis.

The study was restricted to one blood bank and five months, limiting generalizability and assessment of longer-term variation. Screening reactivity may differ from confirmed infection prevalence because confirmatory assays and HBV DNA testing were not systematically available. Vaccination status, education, occupation, residence, donation category and behavioral exposures were not collected, leaving potential unmeasured confounding. Sparse-cell and model-fit diagnostics were not documented in the original regression analysis; the adjusted associations should therefore be considered exploratory. Future multicenter studies over longer periods should include confirmatory testing, broader donor information, docu-

mented model diagnostics and follow-up of referral and donor retention.

6. Conclusion

HBsAg screening reactivity was 8.4% among 1146 distinct donors in this resource-constrained blood bank in southern Senegal. Male sex and the age groups above 30 years were associated with reactivity in the reported adjusted analysis, whereas first-time donor status was not; these associations require cautious interpretation. The results describe routine screening reactivity rather than confirmed HBV infection prevalence. In this setting, reactive donations were excluded from transfusion and donors with reactive results were counselled and referred for further assessment. Continued screening surveillance, quality assurance and improved access to confirmatory and higher-performance testing can support donor management and transfusion safety.

Data Availability

The data supporting the findings of this study are available from the corresponding author upon reasonable request, subject to institutional authorization and confidentiality requirements.

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Author Contributions

Mame Ngoné COLY: Conceptualization, supervision, methodology, validation, writing—review and editing, corresponding author. Cheikh Mohamed Fadel SIBY: Data collection, data curation, preliminary analysis, original draft preparation. Habibou SARR: Methodology, supervision, validation, writing—review and editing. Demba MAKALOU: Data verification, local coordination, writing—review and editing. Mamadou Wagué GUEYE: Data verification, transfusion practice input, writing—review and editing. Macoura GADJI: Methodological guidance, transfusion medicine expertise, validation, writing—review and editing.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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