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Aligning Blood Donation Policies with Public Health Goals: A Retrospective Study on Blood-Borne Infections among Donors in Tanzania

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Abstract

Background: Blood systems in many low- and middle-income countries depend on both voluntary non-remunerated and family/replacement donation. We compared transfusion-transmissible infection (TTI) screening reactivity between these donation categories and considered how blood services could simultaneously protect recipients, maintain availability, and improve donor linkage to prevention and care. Methods: We conducted a retrospective cross-sectional analysis of aggregate monthly blood-donation reports from Amana Regional Referral Hospital, Dar es Salaam, from January 2023 through December 2024. The unit of analysis was a screened donation event, not a verified unique donor. Monthly sex-specific component cells were used when workbook subtotals conflicted. Crude odds ratios (ORs) and 95% confidence intervals (CIs) were calculated, and grouped-binomial logistic regression adjusted for sex and calendar year. Results: The analysis included 14,222 screened donation events: 13,244 (93.1%) replacement and 978 (6.9%) voluntary. Replacement versus voluntary reactivity per 1000 events was 19.7 versus 7.2 for HIV, 43.0 versus 15.3 for hepatitis B virus (HBV), 11.6 versus 2.0 for hepatitis C virus (HCV), and 18.8 versus 8.2 for syphilis. Adjusted ORs were 2.42 (95%

CI 1.14 - 5.16) for HIV, 2.50 (1.49 - 4.20) for HBV, 4.32 (1.07 - 17.52) for HCV, and 2.05 (1.01 - 4.16) for syphilis. Conclusion: Replacement donation events had higher TTI screening reactivity, but replacement donors supplied most recorded blood in this shortage-prone setting. Regular voluntary donation should remain the preferred foundation, while medically eligible, non-remunerated replacement donors may supplement supply where shortages persist. Every unit requires identical quality-assured screening, and every reactive donor should receive confidential notification, diagnostic confirmation, counselling, and linkage to prevention, vaccination assessment, or treatment.

Keywords

Blood Donation, Replacement Donors, Voluntary Non-Remunerated Donors, Transfusion-Transmissible Infections, Tanzania

1. Introduction

Blood transfusion is essential for emergency, surgical, obstetric, paediatric, and medical care. Its benefits depend on an adequate supply and effective control of transfusion-transmissible infections. The World Health Organization (WHO) recommends universal screening of donated blood for HIV, HBV, HCV, and syphilis and identifies regular voluntary non-remunerated donors from low-risk populations as the preferred foundation of a safe blood supply [1] [2]. Family/replacement donors—relatives or acquaintances who donate in response to a patient's need—remain important where voluntary collections do not meet demand. Earlier Tanzanian studies reported substantial TTI reactivity and differences by donor category, although estimates varied by setting, donor selection, repeat-donor composition, and laboratory procedures [3]-[5]. Screening reactivity in a selected donor population is not equivalent to confirmed infection or population prevalence. This study compared HIV, HBV, HCV, and syphilis screening reactivity between replacement and voluntary donation events at Amana Regional Referral Hospital during 2023-2024 and examined whether donor-type associations persisted after adjustment for sex and year. It further considers a context-responsive policy in which recipient safety, blood availability, and donor health are measured together. The study was not designed to prove cost-effectiveness or measure post-screening linkage outcomes.

2. Methods

2.1. Study Design and Setting

This retrospective cross-sectional study used routine aggregate monthly blood-donation reports from Amana Regional Referral Hospital, an urban public referral hospital in Dar es Salaam, Tanzania. The reporting period was 1 January 2023 to 31 December 2024. Donation events were recorded at the hospital and during mobile collection activities in community settings.

2.2. Unit of Analysis and Repeat Donations

The totals represent screened donation events (units recorded in monthly reports), not verified unique persons. The source workbook contained no stable donor identifier; consequently, repeat donations by the same person could appear more than once and could not be linked or collapsed. Each recorded donation event was therefore treated as an observation. Potential within-person correlation is acknowledged as a limitation.

2.3. Record Selection and Data Reconciliation

All 24 monthly reporting blocks in the two-year period were reviewed. Because the source was an aggregate workbook rather than an individual-level database, an event-level count of exclusions for missing fields could not be reconstructed. When a displayed subtotal conflicted with its component cells, monthly male and female component cells were summed and used as the reproducible denominator. TTI counts were similarly reconstructed from the monthly sex-specific cells. No unobserved events were imputed (Table 1).

Table 1. Analytic donation-event denominators after reconciliation of monthly component cells.

Year	Replacement events	Voluntary events	Total events	Voluntary share
2023	5877	616	6493	9.5%
2024	7367	362	7729	4.7%
Total	13,244	978	14,222	6.9%

2.4. Variables and Laboratory Screening

Available variables were calendar month, year, sex, donation type (replacement or voluntary), and reactive screening counts for HIV, HBV, HCV, and syphilis. According to written clarification from the National Blood Transfusion Service (NBTS), donated blood was screened using Abbott ARCHITECT and Abbott Alinity analyser platforms with infection-specific assays for HIV, hepatitis B virus (HBV), hepatitis C virus (HCV), and syphilis. The ARCHITECT platform used ARCHITECT HIV Ag/Ab Combo Assay, ARCHITECT HBsAg Qualitative Assay, ARCHITECT Anti-HCV Assay, and ARCHITECT Syphilis TP Assay. The Alinity platform used Alinity s HIV Ag/Ab Combo Assay, Alinity s HBsAg Assay, Alinity s Anti-HCV Assay, and Alinity s Syphilis Assay. The HIV antigen/antibody combination assays were described by NBTS as fourth-generation assays. All initially reactive samples were retested in duplicate and subsequently evaluated using infection-specific supplementary tests: Enzygnost HIV Integral 4 ELISA Test for HIV, Enzygnost HBsAg 6.0 ELISA Test for hepatitis B surface antigen, Monolisa HCV Ag/Ab Ultra ELISA Test for HCV, and Serodia TPPA Qualitative Test for syphilis. Reactive units were excluded from transfusion. Screening and supplementary reactivity were used for blood-unit safety and were not interpreted as a confirmed clinical diagnosis in an

individual donor. Individual-level diagnostic confirmation, notification, counselling, and linkage outcomes were not available in the aggregate dataset.

2.5. Statistical Analysis

Counts and reactivity rates per 1000 donation events were calculated for each donor category. Crude ORs and Wald 95% CIs were derived from 2 × 2 tables, and two-sided Fisher exact tests were used because voluntary-donor reactive counts were small. Separate grouped-binomial logistic regression models were fitted for HIV, HBV, HCV, and syphilis. Each model included donor type as the exposure and sex and calendar year as prespecified covariates. Adjusted ORs (aORs), 95% Wald CIs, and two-sided p-values are reported. Age was not included because TTI outcomes were not jointly cross-tabulated by age, donor type, sex, and year. Statistical significance was defined as $p < 0.05$.

2.6. Ethical Considerations

The analysis used anonymized aggregate routine-service data and retained no personal identifiers. Ethical approval was granted by Kibong'oto Infectious Disease Hospital, Nelson Mandela Africa Institute of Science and Technology-Centre for Education Development in Health, Arusha (KIDH-NM-AIST-CEDHA)-KNCHREC, clearance number KNCHREC00072/12/2026.

3. Results

3.1. Donation-Event Profile

The analysis included 14,222 screened donation events, of which 13,244 (93.1%) were replacement donations and 978 (6.9%) were voluntary donations (Table 1). The voluntary share declined from 9.5% in 2023 to 4.7% in 2024. Male donation events predominated in both categories: 10,744/13,244 (81.1%) replacement and 822/978 (84.0%) voluntary events. These percentages describe donation events rather than unique donors.

3.2. TTI Screening Reactivity by Donor Type

Table 2. Reactive TTI screening results by donation type, 2023-2024.

Outcome	Replacement n/N (per 1000)	Voluntary n/N (per 1000)	Crude OR (95% CI)	Fisher p	Adjusted OR* (95% CI)	Adjusted p
HIV	261/13,244 (19.7)	7/978 (7.2)	2.79 (1.31 - 5.92)	0.003	2.42 (1.14 - 5.16)	0.022
HBV	570/13,244 (43.0)	15/978 (15.3)	2.89 (1.72 - 4.84)	<0.001	2.50 (1.49 - 4.20)	<0.001
HCV	153/13,244 (11.6)	2/978 (2.0)	5.70 (1.41 - 23.05)	0.002	4.32 (1.07 - 17.52)	0.040
Syphilis	249/13,244 (18.8)	8/978 (8.2)	2.32 (1.15 - 4.71)	0.012	2.05 (1.01 - 4.16)	0.048

*Adjusted separately for sex and calendar year using grouped-binomial logistic regression. OR = odds ratio; CI = confidence interval.

All four reactive screening outcomes were more frequent among replacement donation events (Table 2). HBV had the highest reactivity in both groups. The rela-

tive difference was largest for HCV, although the confidence interval was wide because only two voluntary donation events were reactive.

4. Discussion

Replacement donation events constituted more than 93% of the analytic sample and had significantly higher screening reactivity for HIV, HBV, HCV, and syphilis than voluntary events. Adjustment for sex and calendar year did not remove these associations. HBV was the most frequently reactive marker, while HCV showed the largest relative difference and the greatest statistical uncertainty. The findings are consistent with Tanzanian studies reporting higher TTI burdens among replacement donors [3]-[5]. Direct numerical comparison requires caution because donor recruitment, eligibility screening, proportions of first-time and repeat donors, assays, confirmatory procedures, and study periods differ. Test-seeking behaviour and pressure to replace blood for a relative may also affect disclosure during predonation assessment. The estimates therefore describe screening reactivity among selected donation events and should not be generalized as population prevalence or interpreted causally. WHO promotes blood systems based on regular voluntary non-remunerated donation because such donors generally have lower TTI prevalence [1] [2]. This remains an appropriate long-term foundation. Nevertheless, policy must also address availability. In settings where voluntary collections remain insufficient, abruptly removing medically eligible replacement donors may delay transfusion for obstetric haemorrhage, trauma, severe childhood anaemia, emergency surgery, and other time-critical conditions. Higher reactivity among replacement donors is therefore a reason for stronger donor selection, quality management, and follow-up—not a reason to weaken testing or to ignore the contribution of eligible, non-remunerated replacement donors to emergency supply. We propose separating the decision about the unit from the duty owed to the donor. Every donation, regardless of category, must undergo the same validated, quality-assured screening and must not be released when reactive. The donor should then receive confidential notification, diagnostic confirmation, counselling, and linkage to appropriate HIV, hepatitis, or syphilis services [5] [6]. For HBV, people confirmed not to be infected should be assessed for vaccination eligibility under national guidance, while those with confirmed infection should receive clinical evaluation, prevention counselling, and treatment when indicated. Donation must never become a substitute for accessible voluntary diagnostic testing, and replacement donation must be protected from coercion: inability or unwillingness of a relative to donate should not delay or deny a patient's treatment. Because mandatory unit screening is already required for recipient safety, adding effective notification, reflex confirmation, vaccination assessment, and linkage may generate additional public-health benefit at a comparatively low incremental cost. The present study did not measure costs or linkage outcomes; cost-effectiveness is therefore a hypothesis requiring prospective evaluation. Future studies should estimate the incremental cost per confirmed new diagnosis, successfully

linked donor, HBV-susceptible person vaccinated, treatment initiation, viral suppression, safe unit released, and emergency transfusion delay avoided. Laboratory capacity should be evaluated as a complete quality system rather than by the presence of an analyser alone. Validated assays and algorithms, competent staff, internal quality control, external quality assessment, uninterrupted reagents, maintenance, traceability, haemovigilance, confirmatory testing, and referral pathways are all required. Nucleic acid testing can reduce window-period risk, but implementation should be evaluated for feasibility, throughput, quality assurance, and cost-effectiveness [7].

4.1. Policy Implications

National and international programmes should measure more than the proportion of voluntary donations. A context-responsive framework should monitor: (1) Adequacy and timeliness of safe blood; (2) Voluntary, informed, non-remunerated and non-coercive donor recruitment; (3) Identical screening and release standards for every unit; (4) Confidential notification and diagnostic confirmation of reactive results; (5) Successful linkage to prevention, vaccination assessment, or treatment; (6) Conversion of eligible replacement donors into regular voluntary donors. Regular voluntary donation remains the preferred foundation, while ethically recruited replacement donors can serve as a supplementary source where documented shortages persist.

4.2. Strengths and Limitations

This study covers two consecutive years and reports both crude and adjusted donor-type associations. Its principal limitations are the retrospective single-centre design and aggregate source data. Unique donors and repeat donations could not be identified, individual-level exclusions and missingness could not be reconstructed, and independence may be overstated. Eligibility information may be affected by recall, social-desirability, coercion, or test-seeking bias. Although NBTS verified the assay platforms and supplementary-testing algorithm, individual-level supplementary results were not available in the aggregate reports. Age adjustment was not possible, multiple TTIs in one event could not be identified, and notification, confirmation, vaccination, linkage, treatment, viral suppression, and cost outcomes were unavailable. The proposed policy model was not tested by this dataset and requires prospective multicentre evaluation of safety, equity, acceptability, availability, and cost-effectiveness.

5. Conclusion

Replacement donation events at Amana Regional Referral Hospital had higher reactive screening rates for HIV, HBV, HCV, and syphilis than voluntary events during 2023-2024, including after adjustment for sex and year. These findings support stronger risk management but should not be used in isolation to remove a major source of blood where shortages threaten timely transfusion. Regular vol-

untary non-remunerated donation should remain the preferred foundation, while ethically recruited, medically eligible replacement donors may supplement supply where shortages persist. Every unit must undergo identical quality-assured screening. When a result is reactive, the unsafe unit must be excluded—but the donor must not be discarded. Confidential notification, confirmation, counselling, vaccination assessment where appropriate, and linkage to prevention or treatment should become measurable blood-system outcomes.

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Data Availability

The aggregate data supporting the findings are held by Amana Regional Referral Hospital and the National Blood Transfusion Service and may be available from the corresponding author subject to institutional authorization and applicable confidentiality requirements.

Author Contributions

Conception and original draft preparation: Bryceson Loti Kiwelu and Daud Dunstan Peter; Design: Lilian Lipanga Minzi; Supervision: Daud Dunstan Peter; Fundings: Bryceson Loti Kiwelu; Materials: Amina Abillah and Salome Kiampa; Data Collection and/or Processing: Lilian Lipanga Minzi; Analysis and/or Interpretation: Lilian Lipanga Minzi; Literature Review: Jamila Makame and Pendael Joseph; Writer: Daud Dunstan Peter and Lilian Lipanga,Minzi; Critical Review: Sokoine Lesrikali Kivuyo, Rayi Ekwabi, Salome Kiamba, and Daud Dunstan Peter.

Conflicts of Interest

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

References

[1] World Health Organization (2026) Testing of Donated Blood. WHO. https://www.who.int/teams/health-product-policy-and-standards/standards-and-specifications/blood-and-products-of-human-origin/quality-and-safety/donation-testing

[2] World Health Organization and International Federation of Red Cross and Red Crescent Societies (2010) Towards 100% Voluntary Blood Donation: A Global Framework for Action. WHO.

[3] Mremi, A., Yahaya, J.J., Nyindo, M. and Mollel, E. (2021) 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*, **16**, e0249061. https://doi.org/10.1371/journal.pone.0249061

[4] Matee, M.I.N., Magesa, P.M. and Lyamuya, E.F. (2006) Seroprevalence of Human

Immunodeficiency Virus, Hepatitis B and C Viruses and Syphilis Infections among Blood Donors at the Muhimbili National Hospital in Dar Es Salaam, Tanzania. *BMC Public Health*, **6**, Article No. 21. https://doi.org/10.1186/1471-2458-6-21

[5] Mohamed, Z., Kim, J.U., Magesa, A., Kasubi, M., Feldman, S.F., Chevaliez, S., *et al*. (2019) High Prevalence and Poor Linkage to Care of Transfusion-Transmitted Infections among Blood Donors in Dar-Es-Salaam, Tanzania. *Journal of Viral Hepatitis*, **26**, 750-756. https://doi.org/10.1111/jvh.13073

[6] World Health Organization (2014) Blood Donor Counselling: Implementation Guidelines. WHO.

[7] World Health Organization (2017) Guidelines on Estimation of Residual Risk of HIV, HBV or HCV Infections via Cellular Blood Components and Plasma. WHO Technical Report Series No. 1004, Annex 4. WHO.