Original Research Article **Medical Sciences**

Factors Influencing Donor Deferrals at King Abdullah Medical City (KAMC), Makkah: A Cross-Sectional Study on the Theoretical Role of Telemedicine in Enhancing Donor Retention

Sami Ahmed Alzahrani[1]*, Sultan Mohammed Almalki[1], Mohammed Ibraheem Alshaik[1], Mohammed Daifallah Alzahrani[1]

[1]King Abdullah Medical City, Makkah, Saudi Arabia

*Corresponding author: Sami Ahmed Alzahrani
King Abdullah Medical City, Makkah, Saudi Arabia

Abstract

The study aimed to evaluate donor deferrals among individuals presenting for whole blood or platelet apheresis donation at King Abdullah Medical City in Makkah, Blood Bank Department, and to classify deferrals by screening stage. Category 1 deferrals included interview-based reasons such as recent travel to malaria-endemic areas, current medication use, or behavioral risk disclosures. Category 2 deferrals included clinical assessment findings such as low hemoglobin, abnormal blood pressure, and high body temperature. The study also evaluated the theoretical potential of telemedicine to reduce Category 1 deferrals through pre-donation screening. A retrospective cross-sectional study was conducted at the Blood Bank Department of King Abdullah Medical City in Makkah between January 2023 and December 2024. From 3,029 recorded deferrals, a systematic random sample of 385 deferred donors was selected for analysis. Each deferral was classified according to the screening stage. Descriptive statistics and Chi-square tests were used. A total of 385 deferred donors were analyzed. Of these, 260 (67.5%) were classified as Category 2 and 125 (32.5%) as Category 1. Gender was significantly associated with deferral category (χ^2(1, N = 385) = 6.128, p = 0.013). Category 1 deferrals were more frequent among male donors (35.2%) than female donors (18.0%). Interview-based factors accounted for 32.5% of deferrals and could be identified in advance through structured remote screening methods such as tele-interviews, reducing the likelihood of unnecessary on-site visits. The study examined the theoretical role of telemedicine as a pre-donation triage tool, emphasizing its potential to decrease avoidable deferrals and strengthen donor retention through targeted early interventions.

Keywords: Blood Donation, Donor Deferral, Telemedicine, Donor Retention, Saudi Arabia, Screening, Eligibility.

INTRODUCTION

A reliable and sufficient blood supply is essential for efficient healthcare delivery, especially in Saudi Arabia, where demand keeps increasing because of trauma cases and the high incidence of chronic diseases [1, 2]. While blood donation campaigns are continuously organized, they still experience high deferral rates among donors, which are often associated with low hemoglobin levels, abnormal blood pressure, or medical histories that are risky for both donors and recipients [1-3]. Maintaining a stable donor pool is challenging, especially when donors have limited knowledge and hold misconceptions about the donation process or the medical criteria for eligibility [1-4].

Blood donation behavior in Saudi Arabia is strongly influenced by religious, altruistic, and social values that affect the blood supply [4-7]. Islamic teachings, such as the Quranic verse "Whoever saves one life, it is as if they have saved all of mankind" (Quran 5:32), are often cited as powerful motivators within blood campaigns and among blood bank centers. The family and community involvement further promotes positive attitudes toward blood donation, especially when reinforced by educational institutions and workplace campaigns. These measures have been demonstrated to increase participation in organized blood drives [9, 10].

Telemedicine represents a novel approach with potential to mitigate traditional barriers, significantly

enhancing donor retention and reducing avoidable deferrals [4-8]. Through telemedicine, remote consultation and eligibility evaluation can be conducted to avoid on-site deferral resulting from controllable reasons [8]. The potential application of telemedicine in this study is considered purely theoretical and is focused on Category 1 deferrals in the deferred donor records. This study evaluates the theoretical impact of pre-donation tele-screening on interview-based deferrals only, Category 1. The study aimed to evaluate donor deferrals among individuals presenting for whole blood or platelet apheresis donation at King Abdullah Medical City in Makkah, Blood Bank Department, and to classify deferrals by screening stage.

MATERIALS AND METHODS
Study Design
This retrospective cross-sectional study analyzed donor deferral records from January 2023 to December 2024. Deferrals were classified according to the screening stage at which they occurred. Telemedicine was not implemented; it was assessed conceptually as a pre-donation triage approach to estimate its theoretical effect on Category 1 deferrals.

Study Setting
The study was conducted at the Blood Bank Department of KAMC in Makkah. This tertiary care facility serves a large and diverse donor population, including both Saudi and non-Saudi donors residing in the Makkah region.

Study Population
The study population included all individuals, whether Saudi or non-Saudi, who were deferred during the pre-donation screening process, either at the interview stage or during clinical assessment. In this study, the term "donor" refers to individuals who presented for either whole blood or platelet apheresis donation. The deferral records did not distinguish between these donor types.

Inclusion Criteria
- Deferrals based on interview screening, Category 1
- Deferrals based on clinical assessments, Category 2

Exclusion Criteria
- Accepted donors who completed the donation.
- Donors deferred during phlebotomy (e.g., poor veins, incomplete collection).
- Donors deferred due to positive results for infectious diseases post-donation.
- Donors outside the study period.

Study Procedures
A retrospective chart review was conducted to fulfill the study objectives by collecting data on the following variables:

- Donor code
- Deferral category: Category 1 or Category 2
- Preventability of deferral via telemedicine, defined theoretically by the screening stage
- Demographic information: age and gender

Category assignments used the recorded deferral factor in each case. Interview-based reasons, such as recent travel to malaria-endemic areas, current medication use, behavioral risk disclosure, or relevant medical history, were classified as Category 1; clinical assessments, such as low hemoglobin, abnormal blood pressure, or high body temperature, were classified as Category 2.

For this analysis, causes were mapped to one of two screening-stage categories using predefined operational definitions. No cause-level frequencies were analyzed independently.

The study was conducted in three stages: initial deferred donor records review in January 2025, data collection and analysis between February and April 2025, and final thesis completion in August 2025.

Data Collection and Management
Deferral records were retrieved from the _MAK system, a blood bank information system in the study setting, and then organized in Microsoft Excel for data analysis before being exported to SPSS for analysis. Relevant variables were extracted, and all personal identifiable information was removed to ensure confidentiality. A systematic random sample of 385 deferred donors was selected from a total of 3,029 deferrals. Each donor was assigned a unique study code linked to a secure master log stored separately.

Sample Size Determination
This study calculated the sample size using a conservative estimate of 50% population prevalence due to the absence of precise prior data.

The formula used for sample size calculation was:
$$n = \frac{(Z^2 \times p \times (1-p))}{d^2}$$
Where:
- n = required sample size
- $Z = 1.96$, corresponding to a 95% confidence interval
- $p = 0.50$, representing a conservative prevalence estimate
- $d = 0.05$, the margin of error

Substituting these values into the formula resulted in a minimum required sample size of 385 deferred donors for this study.

Statistical Analysis Plan
Descriptive Analysis
Continuous variables were summarized using means and standard deviations (SD), and categorical

variables such as deferral category and gender were expressed as frequencies and percentages.

Comparative Analysis

The association between gender and deferral category (Category 1 and Category 2) was assessed using the Chi-square ($\chi2$) test. A p-value of less than 0.05 was considered statistically significant. All statistical analyses were performed using SPSS software, version 21.

Ethical Approval and Confidentiality
Consenting Process

A waiver of informed consent was approved by the Institutional Review Board (IRB) of KAMC, as this retrospective observational study involved no more than minimal risk and relied exclusively on data previously collected for non-research purposes. The study protocol was approved under IRB number 24-1333, and research activities commenced only after final IRB clearance was granted.

Privacy and Data Security

All collected data were used only for the research objectives. Personal identifiers were removed at the time of data extraction, and each donor was given a unique study code. Identifying information was maintained separately in a secure log accessible only to the research team. Anonymized datasets were stored in encrypted files throughout all stages of analysis. Confidentiality standards were maintained in accordance with institutional data protection policies.

Participant Safety and Ethical Compliance

This study adhered to the principles of ethical research involving human subjects, including respect for participant privacy and fairness. Although the study involved no direct contact with participants, all procedures were designed to minimize risk and ensure regulatory compliance. Oversight was conducted in accordance with the standards of the KAMC Human Research Protection Program.

RESULTS
Descriptive Statistics

During the study period, 3,029 donor deferrals were recorded at KAMC. A systematic random sample of 385 deferred donors met the inclusion, exclusion criteria and formed the analytic dataset.

Table 1: Age and Gender Distribution of Deferred Donors (n = 385)

Variable	Value
Age (years)	
Mean	35.4
Median	35.0
Standard Deviation	10.1
Minimum	18
Maximum	61
Gender	
Male	324 (84.2%)
Female	61 (15.8%)

Note: Age is summarized by mean, median, standard deviation, and range. Gender is presented as counts and percentages of the total deferred sample.

Age ranged from 18 to 61 years, with a mean of 35.4 years, a median of 35.0 years, and a standard deviation of 10.1 years. Males accounted for 324 of 385 deferred donors (84.2%), while females accounted for 61 of 385 deferred donors (15.8%). The predominance of male donors is consistent with regional donation patterns reported in Saudi Arabia.

Table 2: Distribution of Deferral Categories among Deferred Donors (n = 385)

Deferral Category	Counts	Percentage (%)	Preventable via Telemedicine?
Category 1	125	32.5%	Yes
Category 2	260	67.5%	No

Note: Category 1 denotes interview-based deferrals; Category 2 denotes clinical assessment deferrals. "Preventable via telemedicine" is a theoretical designation based on screening stage and was not operationally tested.

Category 1 accounted for 125 out of 385 deferrals (32.5%) and Category 2 accounted for 260 out of 385 deferrals (67.5%). Category 2 deferrals occurred at just over twice the frequency of Category 1. Only Category 1 deferrals were considered theoretically preventable via telemedicine, forming the basis for the potential impact calculations presented in the Discussion.

Comparative Analysis

Table 3: Association between Gender and Deferral Categories (n = 385)

Gender	Category 1	Category 2	Total
Male	114 (35.2%)	210 (64.8%)	324
Female	11 (18.0%)	50 (82.0%)	61
Total	125	260	385

Note: Percentages indicate the proportion of each gender deferred in Category 1 and Category 2.

Cross-tabulation of deferral category by gender is shown in Table 3. In males, 114 out of 324 (35.2%) were deferred in Category 1, and 210 out of 324 (64.8%) were deferred in Category 2. In females, 11 out of 61 (18.0%) were deferred in Category 1, and 50 out of 61 (82.0%) were deferred in Category 2. Category 1 deferrals were 17.2% higher in males than in females. The association between gender and deferral category was statistically significant, $\chi2(1, N=385) = 6.128, p=0.013$

DISCUSSION

This study evaluated donor deferrals at KAMC in Makkah using a screening-stage classification model designed to distinguish between interview-based and clinical-assessment ineligibility. From a total of 3,029 recorded deferrals between January 2023 and December 2024, 385 cases were selected through systematic random sampling to ensure representativeness. Deferred donors were predominantly male and in early to mid-adulthood, a pattern consistent with national trends in Saudi Arabia and comparable to reports from other regional centers [10]. Male donors represented 84.2% of all deferrals, while females accounted for 15.8%, reflecting gender differences in donation participation patterns as shown in Table 1 [1-3].

Table 2 shows that Category 1 interview-based deferrals accounted for 32.5% of all deferrals, while Category 2 clinical-assessment deferrals represented 67.5%. Category 1 deferrals were attributable to history-based findings such as recent travel to malaria-endemic areas, current medication use, behavioral risk disclosures, or relevant medical history that could be disclosed without physical examination. Category 2 deferrals were associated with measurable physiological findings such as low hemoglobin, abnormal blood pressure, or elevated body temperature, which require the actual presence of the donors and cannot be detected remotely, underscoring the limitations of remote screening for certain medical criteria. The predominance of Category 2 is consistent with previous Saudi studies that reported anemia and hypertension as leading causes of donor ineligibility. Reducing these deferrals would require targeted health measures, including nutritional optimization, iron supplementation programs, and regular hematological monitoring for repeat donors, particularly those in high-risk groups [1-3]. Based on our dataset, if tele-screening intercepted 25%, 50%, and 75% of Category 1 deferrals before arrival, the total number of on-site deferrals would decrease by approximately 8.1%, 16.3%, and 24.4%, respectively. These calculations assume accurate self-reporting and full compliance with remote screening protocols, which in practice would likely yield lower but still meaningful reductions.

In practice, this could be implemented as a pre-donation telephone or video interview conducted 24–48 hours before the appointment, using the same eligibility questionnaire applied on-site. Integration with *Wateen* would allow automatic flagging of ineligible donors, reducing wasted appointment slots.

There was a statistically significant association between gender and deferral category, $\chi2(1, N=385)=6.128, p=0.013$, as shown in Table 3. Males were more often deferred for interview-based reasons, such as medication use or behavioral risk disclosures, while females were more often deferred for clinical findings, such as low hemoglobin. This finding is consistent with national data that report a higher prevalence of iron deficiency among females. These differences are influenced by physiological factors such as iron deficiency and by cultural factors, including concerns about the donation process, varying health awareness, and limited familiarity with eligibility requirements [4-6]. Addressing these differences may require remote eligibility screening and detailed history review for males, as well as nutritional support, anemia prevention initiatives, and targeted donor education for females to improve long-term eligibility [8-11].

The results indicate that incorporating structured tele-screening into existing donor management platforms, such as *Wateen* or *Sehhaty* could reduce Category 1 deferrals by identifying ineligible donors before they travel to the donation site [8-11]. This would improve scheduling efficiency, optimize staff workload, prevent ineligible donors from attending on-site sessions, and enhance donor retention through a more streamlined process [2-5]. Although the impact for female donors may be smaller because of the predominance of clinical deferrals, the classification model offers a structured framework for integrating telemedicine into donor selection protocols. It also provides a basis for evaluating electronic triage tools that identify common causes of deferral before donation, supporting both donor convenience and more efficient use of blood bank resources [8-11].

Strengths and Limitations

This study has several strengths. It applied a defined screening-stage classification model, enabling direct linkage of deferral determinants to targeted interventions. The use of systematic random sampling from a large deferred-donor dataset enhanced representativeness, and the identification of a statistically significant association between gender and deferral category adds analytic value. Consistency with published Saudi deferral data supports contextual external validity [1-11].

However, the study also has limitations. Its single-center retrospective design restricts generalizability. Telemedicine was evaluated conceptually rather than operationally tested, limiting the practical applicability of the findings. Cause-level frequency data were not analyzed, as specific deferral causes were grouped under two broad categories. In addition, missing donor level variables such as education, donation history, and socioeconomic profile reduced the depth of contextual interpretation.

Recommendations

This study recommends implementing structured pre-donation tele-screening for Category 1 factors through tele-interview before donation day and integrating it into existing national platforms such as *Wateen* or *Sehhaty*. Gender-specific approaches should be adopted, with remote history review prioritized for males and targeted nutritional or iron supplementation programs for females.

CONCLUSION

This study identified clinical-assessment deferrals as the primary cause of ineligibility, with interview-based deferrals forming a significant secondary category that could be addressed through theoretical pre-donation tele-screening. A statistically significant gender difference was observed, with males more frequently deferred for interview-based reasons and females more often deferred for clinical findings, reflecting both physiological and cultural influences on donor eligibility. These patterns suggest that targeted strategies, such as remote eligibility screening for males and nutritional or iron supplementation programs for females, could enhance donor retention and reduce preventable deferrals.

Integrating telemedicine into donor management platforms such as *Wateen* or *Sehhaty* could reduce Category 1 deferrals by identifying ineligible donors before arrival, improving scheduling efficiency, optimizing resource allocation, and enhancing donor retention. Tailoring such systems to gender-specific patterns, including remote eligibility screening for males and targeted nutritional or iron supplementation programs for females, could further improve outcomes, especially if services are extended beyond standard working hours. However, the single-center retrospective design, absence of operational telemedicine testing, and

lack of cause-level frequency data limit the generalizability of these findings. Future multicenter prospective research is recommended to validate the classification model, assess the feasibility and cost-effectiveness of telemedicine in donor screening, and develop targeted interventions to reduce preventable deferrals while ensuring a safe and adequate blood supply.

REFERENCES

1. Elsafi SH. (2020). Demographical pattern of blood donors and pre-donation deferral causes in Dhahran, Saudi Arabia. *Journal of Blood Medicine, 11*, 243-249.
2. Kabrah SM., Abuzerr S., Almaghrabi RO., Alserihi R., Felimban RI., Mujalli A., et al. (2023). The Quality of Blood Donation Services and Its Association with Blood Donors' Trust and Loyalty at Makkah Blood Donation Centers in Saudi Arabia: A Cross-Sectional Study. *Healthcare, 11*(15), 2115.
3. AlNouri AK., Maghrabi LA., Hamdi SS., Abd El-Ghany SM., & AlNouri KA. (2019). Analysis of the most common causes of blood donor deferral in northern Jeddah: a single-center study. *Journal of Blood Medicine, 10*, 47-51.
4. Alanazi AE., Almulla BRF., Alanazi SMS., Alshammari SKM., Aldossary AAA., Alanazi SGM., et al. (2023). Knowledge and Barriers About Blood Donation and Associated Factors in Saudi Arabia: A Systematic Review. *Cureus*.
5. Alanzi T., Alanzi N., Alsleman N., Bu-Sarair Danah., Almaqabel Abdulrahman Abdulaziz A., Alharbi R., et al. (2023). The Impact of Social Media Applications on Donor Engagement and Retention in the Saudi Arabian Blood Donation System. *Cureus*.
6. Alkalash SH., Alturki OA., Alzubaidi WS., Sabi NM., Almarhabi NA., Alnashri MH., et al. (2024). Knowledge, Attitude, Motivators, and Barriers to Blood Donation Among Adults in Al-Qunfudah

Governorate, Saudi Arabia: A Cross-Sectional Study. *Cureus*.

7. Saleh RA., Khalil H., Alsaleh M., Almeharish A., Mohammed V., Alhumaidan H., et al. (2021). Voluntary and non-voluntary blood donations among doctors. *Health Science Reports, 4*(3).

8. Alessa T. (2022). Evaluation of the Wateen App in the Blood-Donation Process in Saudi Arabia. *Journal of Blood Medicine, 13*, 181-190.

9. Al-Hajri QR., Alfayez A., Alsalman D., Alanezi F., Alhodaib H., Al-Rayes SA., et al. (2021). The Impact of WhatsApp on the Blood Donation Process in Saudi Arabia. *Journal of Blood Medicine, 12*, 1003-1010.

10. Alsughayyir J., Almalki Y., Alalshaik M., Aljoni I., Kandel M., Alfhili MA., et al. (2022). Demography and blood donation trends in Saudi Arabia: A nationwide retrospective, cross-sectional study. *Saudi Journal of Biological Sciences, 29*(4), 103450.

11. AlOtaibi N., Alsleebi S., Alanezi F., Alhodaib H., AlThani B., Aljabri D., et al. (2021). Usage and Acceptability of the Wateen Application Among the Population of Saudi Arabia. *Journal of Blood Medicine, 12*, 863-873.

12. Halawani AJ. (2022). The impact of blood campaigns using mobile blood collection drives on blood supply management during the COVID-19 pandemic. *Transfusion and Apheresis Science, 61*(3), 103354.