: Donor Return Behavior in South Africa and the US: A Comparison between Mobile and Fixed Site Blood Drives.

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# Abstract

**Background:** A

**Methods:** A

**Results:** A

**Conclusions:** A

# Introduction

Citation [1]. See [Figure 1](#fig-sample), [Table S 1](#cor-sample), [Table 1](#thm-sample), and [Figure S 1](#lem-sample). Blood collection sites often issue a haemoglobin deferral to donors when tested for low haemoglobin levels. Making an informed decision about potential changes to such deferrals and their eligibility criteria requires understanding how haemoglobin deferral policies may impact long-term donor return behaviour. Most medical care depends on a steady blood supply to meet urgent care needs in healthcare facilities. By modelling the donor return dynamics, we can estimate the impact of having different inter-donation interval policies. This will help blood collection sites tailor donor deferral policies to manage the risk of iron deficiency in donors while avoiding blood shortages.

It is shown that additional deferral decreases the donor’s likelihood to return for a donation (Clement et al., 2021). This suggests the importance of blood banks evaluating their deferral policies and understanding the significance of encouraging donors to return promptly once eligible. Further research also shows that besides individual factors, collection site characteristics are essential in predicting the differences in donor return behaviour. A multilevel model was used to show that return varied across collection sites, and fixed sites were associated with higher donor satisfaction and the likelihood of donor return (Merz et al.,2017) . The return has been associated with factors such as repeat donor status, older age, higher educational attainment, being born in the United States and donation at fixed sites (Custer et al., 2011). A 2012 study investigated the effects of fixed or mobile donation with differing sponsor types on donation return time and found the lowest return time among fixed-site donors and those alternating between fixed and mobile sites (Carey et al., 2012). However, mobile collection sites represent a large share of blood collection in many countries and as blood centres around the world consider changes to donor deferral criteria, understanding the impact on donor return behaviour, particularly mobile donors, is critical to make certain policy changes will not threaten the fragile blood supply.

In this study, we use blood donor data from the US (Vitalant) and South Africa (SANBS) to improve understanding of donor return dynamics at mobile and fixed collection sites to inform blood donor management policy. We use a Kaplan Meier model to evaluate the time to return of the donor to fixed versus mobile collection sites, and a LASSO penalized cox proportional hazard model to anlyse the association between time to return and predictor variables such as age, sex, education level, donor history and so on.

# Methods

## Data

Data from South African National Blood Service from the year 2017 to 2022 were included in this analysis. Demographic information (age, sex, education, race/ethnicity), donation environment (fixed and mobile), and other characteristics (blood type, donation date, donation procedure, and donation outcome) were extracted. Data from the year 2015 to 2017 was used to create donor history variables such as red blood cells loss in the last 12 months, red blood cells lost in the last 24 months, days since last red blood cell loss, and days since last double red blood cell loss.

Outcome type was generated for each visit based on the deferral code and status of donation as either completed donation, hemoglobin deferral or other deferral. Time until return was calculated from the day the donor was eligible to donate again (56 days inter donation interval after a completed whole blood or red blood apheresis donation or as determined by the collection site for deferrals). The data was right-censored due to the end of data collection period or no return.. Additionally, a ‘fixed-mobile pattern’ variable was defined for each visit as: (1) returning to a fixed site after donation at a fixed site (FF), (2) returning to a mobile drive after donation at a fixed site (FM), (3) returning to a fixed site after donation at a mobile drive (MF), and (4) returning to a mobile drive after donation at a mobile drive (MM).

Only donors who donated or intended to donate a whole blood product or a red blood cell apheresis product were included in the analysis. Furthermore, donors who received permanent deferrals were excluded entirely. Observations with negative return times (returning before the eligible date) were excluded for the analysis (<1%). Deferred observations with a missing donation product were imputed as “Whole Blood (WB),” if previous or next donation was ‘WB’ or if the donor has only donated a whole blood product.

* WB imputation for SANBS detailed - add in appendix
* Vitalant data

## Kaplan Meier Analysis

An analysis of donor return times stratified by outcome type (compeleted donation, hemoglobin deferral, and other deferral) was conducted using Kaplan Meier analysis. It compared the median return times between different outcomes, while controlling for censoring. Separate models were developed for different donation environments i.e. fixed collection site and mobile drive, and for first time and repeat donors, to more accurately estimate median return time.

## Lasso Penalised Cox Proportional Hazards Analysis

A lasso penalized Cox Proportional Hazards model was implemented to determine factors influencing donor return time. Predictor in the analysis included donation environment (fixed or mobile), outcome type, race, sex, age at the time of the visit, donation product, first time donor status and donor history measures. Interaction terms between first time donors, fixed collection site and hemoglobin deferral were also included. All data analyses were conducted using Python programming language (Version 3.11.3).

# Results

In total, the population consisted of 3,658,560 successful donations and 439,099 deferrals of which 53% were hemoglobin deferrals

Out of 4,286,365 visits made by 596,176 donors, 48% were at fixed sites, and 13% resulted in a deferral. Haemoglobin deferrals occurred at 4% of visits to a fixed site and 6% of visits to a mobile drive. After a completed donation, the median time to return from when a donor is eligible was 70 days at fixed sites and 106 days at mobile drives. After a haemoglobin deferral, the median return time was longer: 138 days at fixed sites and 190 days at mobile drives. The lasso-penalised Cox proportional hazards model had an average cross-validated concordance index of 0.67. Male donors (hazard ratio [HR] of 1.21), black South African donors (HR of 1.02) and donating at a fixed site (HR of 1.03) were associated with a shorter time to return. Female donors (HR of 0.97), first-time donors (hazard ratio of 0.84) and haemoglobin deferrals (HR of 0.9) were associated with longer return times. Interaction terms indicated that first-time donors returned later at fixed sites vs mobile (HR of 0.96), and haemoglobin deferred donors returned earlier at fixed sites vs mobile (HR of 1.04).

# Discussion

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# Declarations

**Funding:** A

**Conflicts:** A

**Ethics/Consent:** A

**Data and materials:** A

**Code availability:** A

**Authors’ contributions: A**

# References

1. Langham S, Wright A, Kenworthy J, Grieve R, Dunlop WCN. Cost-effectiveness of take-home naloxone for the prevention of overdose fatalities among heroin users in the United Kingdom. *Value in Health*. 2018;21(4):407-415. doi:[10.1016/j.jval.2017.07.014](https://doi.org/10.1016/j.jval.2017.07.014)

# Tables

**Table 1** Table caption here.

| **col1** | **col2** | **Source** |
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| **A** | | |
| 1 | Yes^[Footnote 2] | [@Langham2018a]^[Footnote 1] |
| 2 | Yes | [@Keane2018] |
| **B** | | |
| 1 | No |  |
| 2 | No |  |

# Figures

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| **Figure** 1: Figure caption here. |

# Supplemental materials

# A. Supplement section

# Supplemental tables

**Table S 1** Table caption here.

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| **A** | | |
| 1 | Yes^[Footnote 2] | [@Langham2018a]^[Footnote 1] |
| 2 | Yes | [@Keane2018] |
| **B** | | |
| 1 | No |  |
| 2 | No |  |

# Supplemental figures

**Figure S 1** Figure caption here.

