PREDICTORS OF STI TEST KIT NON-RETURNS

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Contents

2018-2025

Understanding Predictors of STI Test Kit Non-Returns (2018–2025)

Executive Summary

This comprehensive analysis investigates declining return rates of STI self-test kits from 2018 to 2025, examining behavioural, demographic, and operational factors that influence service user return rates. Using advanced analytics on over one million service user orders, we identified critical patterns and developed evidence-based recommendations to enhance service performance and support our Pan London contract bid.

Key Findings

Performance Trends

- Steady decline in return rates from 2018 to present, with notable deterioration following COVID-19
- Seasonal variations show consistent annual patterns with peaks in January and mid-year (May-August)

Operational Insights

- Kit orders placed between 1:00-4:00 AM exhibit significantly lower return rates
- Sunday and Monday orders achieve highest return rates, while weekend orders (Friday-Saturday) show marked slight decline
- High-volume kit types demonstrate predictable patterns suitable for targeted interventions

Demographic Disparities

- Users aged 16-20 years show return rates 3-7% below average
- Service users in most deprived areas (IMD quintiles 1-3) exhibit slightly lower return rates
- MSM group demonstrate superior return rates for multiple sample kits such as blood,urine and double swabs (78%) compared to non-MSM groups (65%)
- Users aged 50+ maintain highest and most consistent return rates across all periods

Risk Indicators

- Service users reporting unprotected sexual activity and symptoms show elevated non-return likelihood
- Previous non-returners represent the strongest predictor of future non-compliance

Background & Objectives

Over the past three years, STI test kit return rates have shown persistent decline, with particularly notable deterioration following the COVID-19 pandemic. This trend undermines

service efficiency, impacts contractual performance indicators, and potentially compromises public health outcomes through reduced testing completion.

Objectives

- Identify primary drivers of non-return behaviour across demographic and operational dimensions
- Develop evidence-based intervention strategies to improve return rates for complete samples
- Strengthen competitive positioning for Pan London contract opportunities
- Establish baseline metrics for future performance monitoring

Key Performance Indicator

Return Rate = (Kits Returned ÷ Kits Sent) × 100

Partial returns is grouped as returned

Data & Methodology

Data Sources

Primary Dataset: Databricks STI kit order records (January 2018 – April 2025)
Brand Focus: ****** brand exclusively
Sample Size: Over 1 million service user orders

Scope Definition

Focus Kit Types**:** High-volume kits representing 93% of total volume

- Blood & swab combinations
- Blood & urine combinations
- Blood, urine & dual swab combinations
- Blood only
- Urine only
- Swab only

Exclusions

- Under-16 age group (volatile, non-representative trends)
- 75+ age bracket (consistently high return rates since 2022, limited variance)
- Low-volume kit types (2% of total, highly erratic patterns)
- Repeat dispatch kits (analyzed separately due to distinct behavioral patterns)

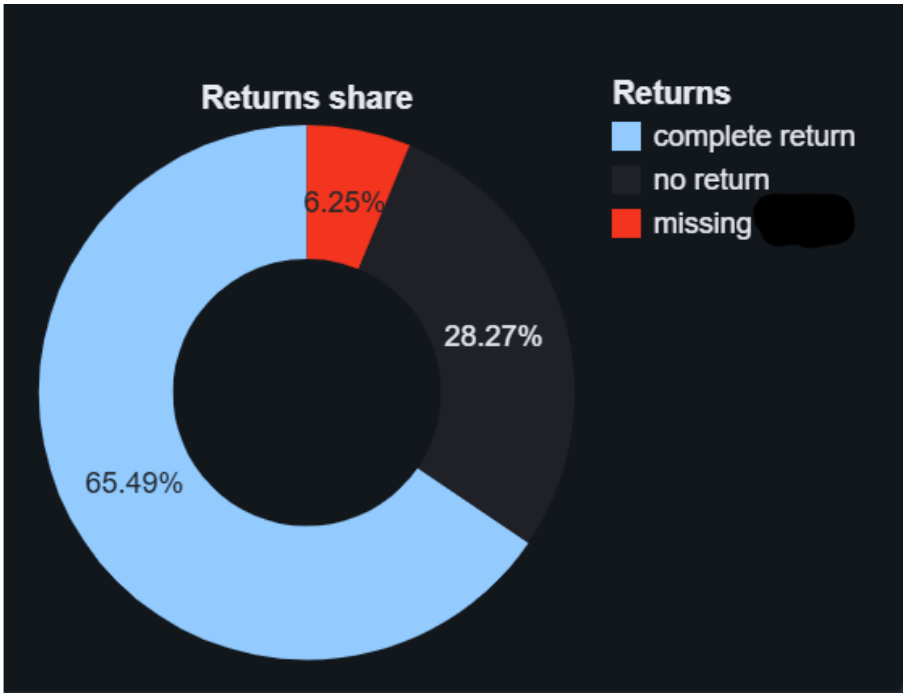
Analytical Methods

- Descriptive Statistics: Trend analysis and pattern identification
- Machine Learning: Random Forest classification modeling
- Model Interpretability: SHAP (SHapley Additive exPlanations) values for feature importance
- Temporal Analysis: Seasonal, weekly, and hourly pattern recognition

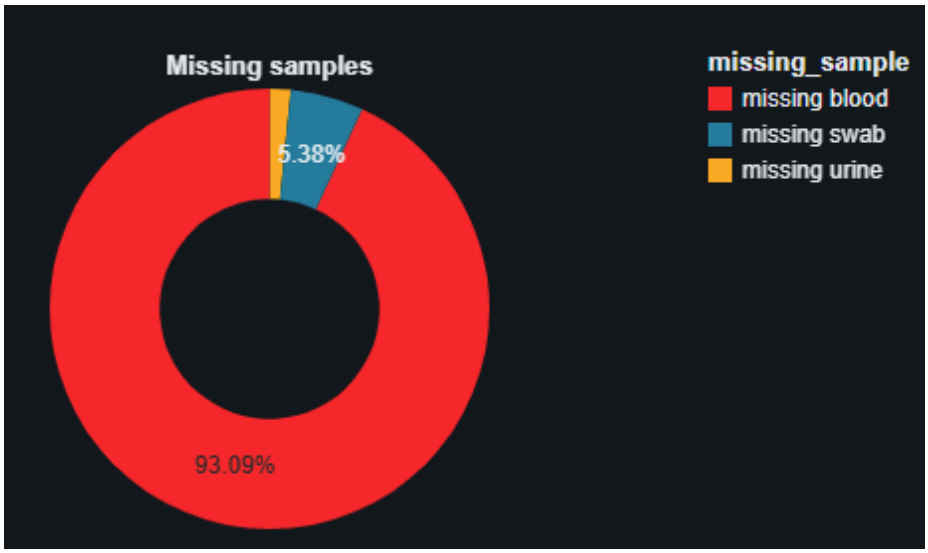
Key Findings & Insights

1. Return rate

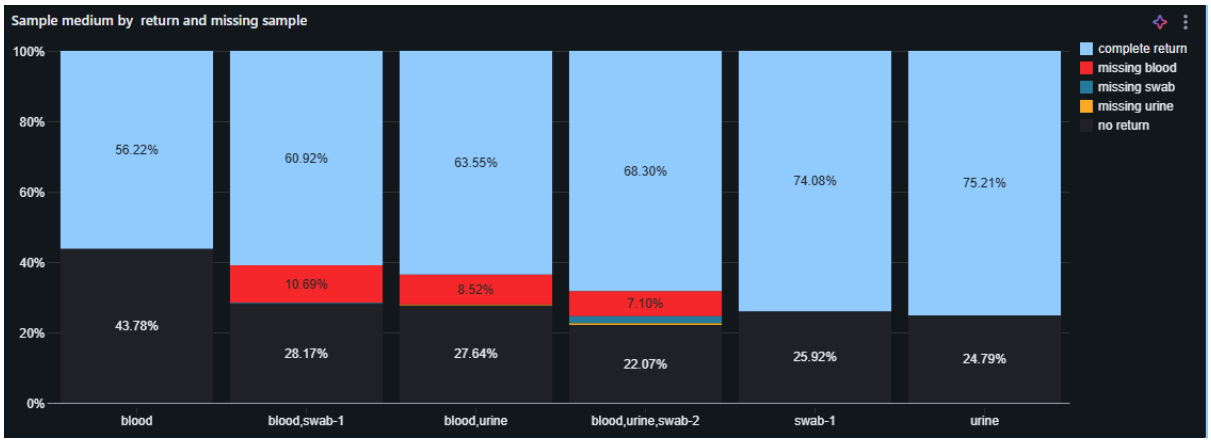
Overall, we have a 65% complete return and 6.3% partial or missing sample returns



Missing sample: 93% of all incomplete or missing returns is blood sample.



Sample medium: There are 6 top kit types and sample mediums which accounts for 93% of all volume. Blood only medium has the lowest returns of 44%. While swab or urine only is 74%



2. Predictive Model Insights

The Random Forest classifier is machine learning model used to identify key predictive features for non-return behaviour, ranked by importance through SHAP analysis.

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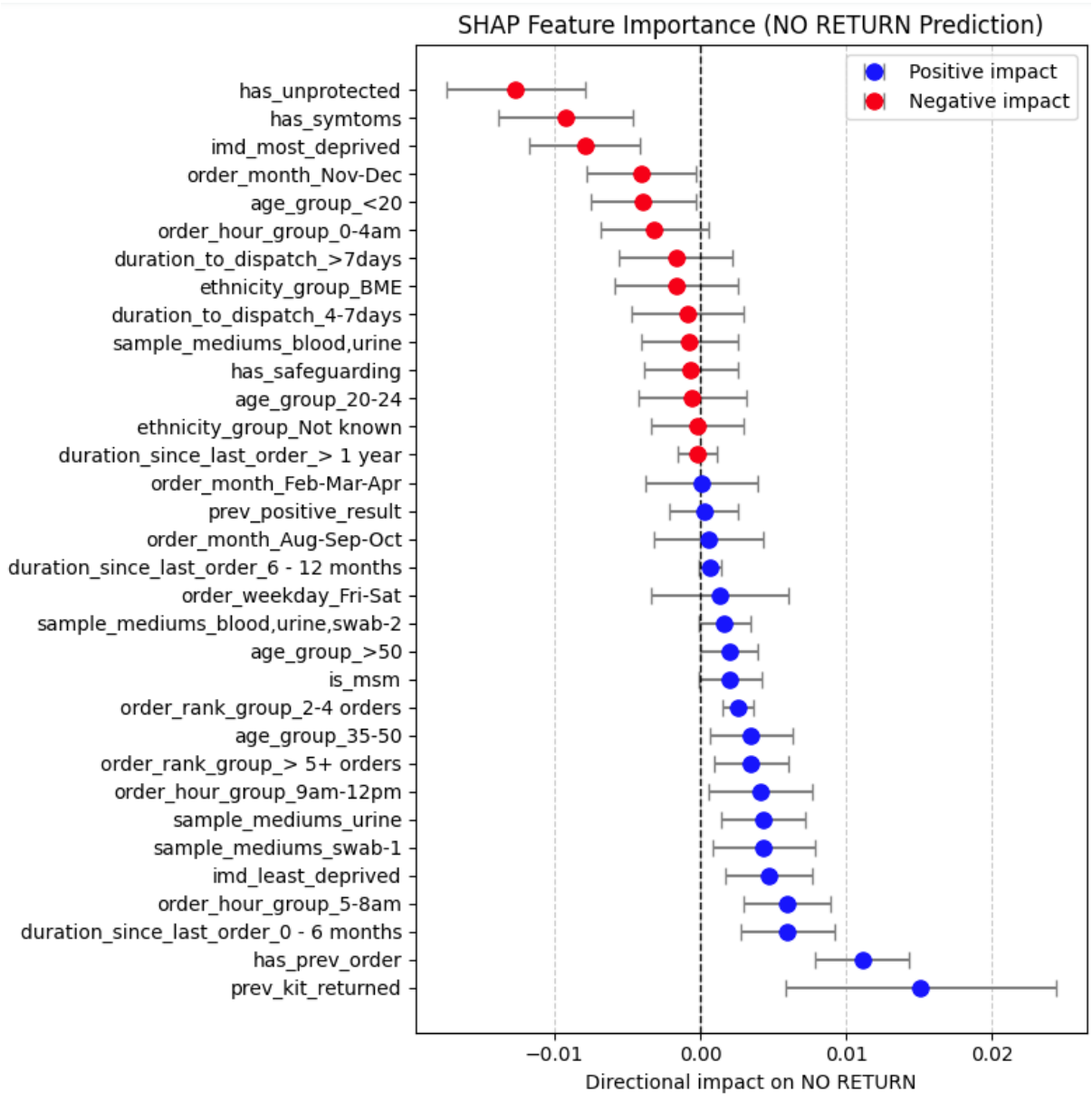


This chart explains how certain features of the user kit orders contribute to non returns.

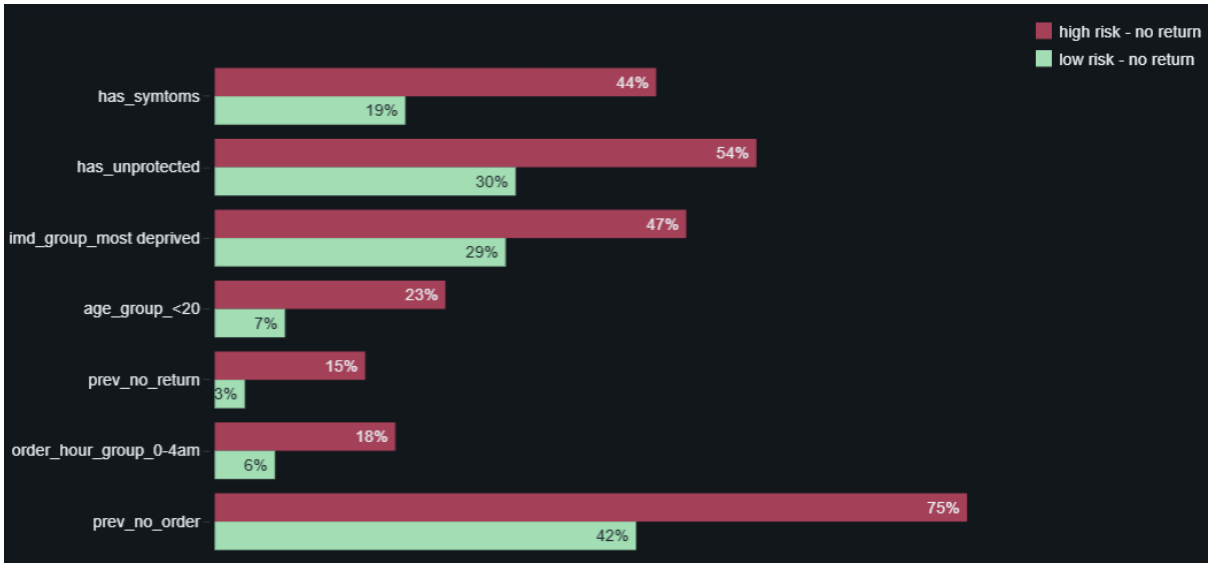
The colour of the dot represent:

🔴 Red = High negative impact on no return (negative x-axis values)

🔵 Blue = less negative impact on no return (positive x-axis values)

If the red is more to the left side of the x-axis that means that feature has higher influence to cause no returns.

Key Features of Non-Return: Percentage of High Risk vs Low Risk Users



This chart shows the percentage distribution of key features that drive non-return, comparing high-risk and low-risk users based on the predictive model. For example, **44%** of high-risk users reported symptoms, compared to only 19% of low-risk users.

Top Risk Factors (Increase Non-Return Likelihood):

I. Has Symptoms
II. Unprotected Sexual Activity
III. Previous no return behaviour
IV. IMD Most deprived (quintiles 1-3)
V. Late-Night Ordering: 1:00-4:00 AM

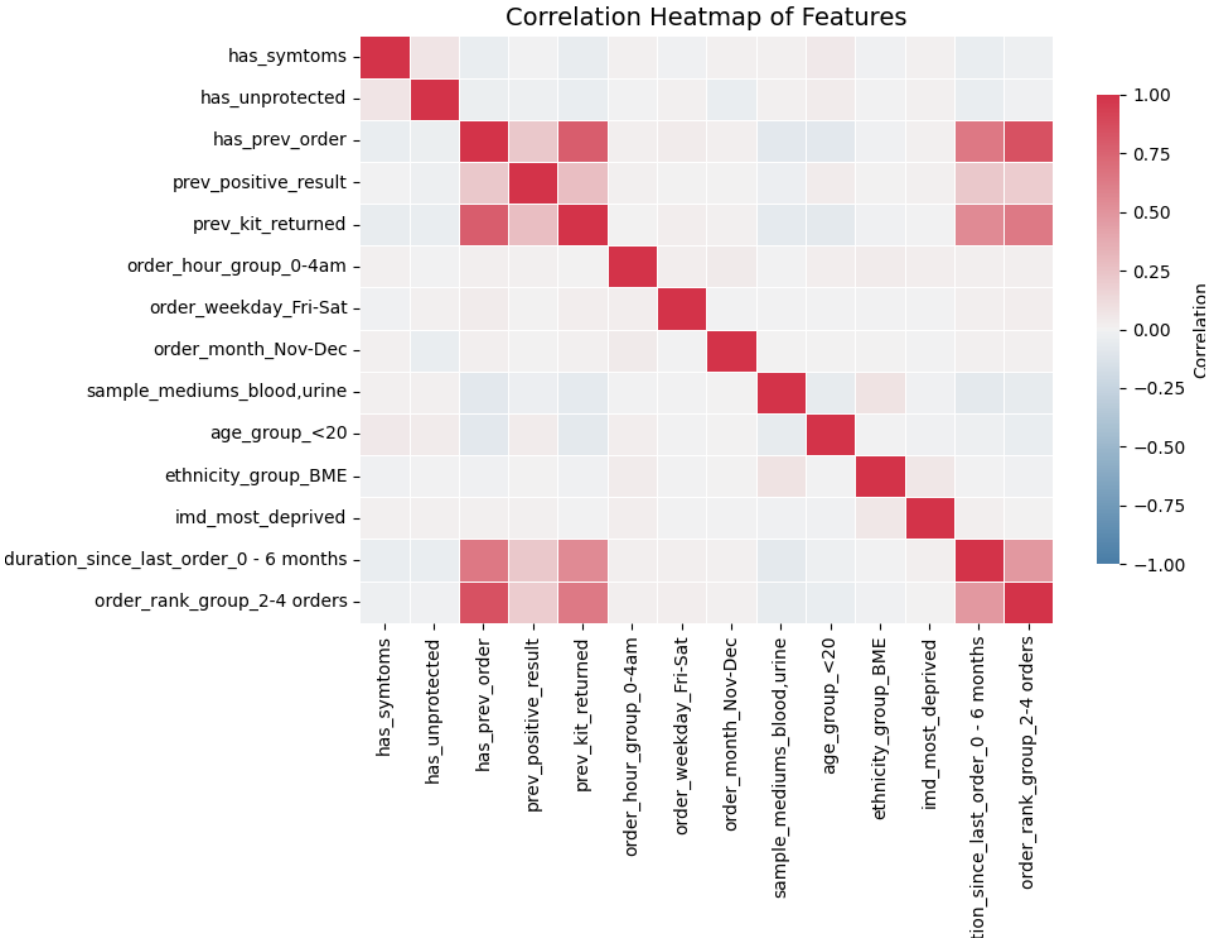
2. Kit Performance Patterns

I. High-Volume Kit Reliability: High-volume kits using standard sample mediums demonstrate consistent return rate patterns, making them suitable for predictive modeling and targeted interventions. These kits represent the core service offering and provide stable baselines for performance measurement.
II. Low-Volume Kit Volatility**:** Low-volume specialty kits exhibit unpredictable fluctuations (ranging from 55% to 90% monthly return rate), introducing statistical noise that compromises model accuracy. These variations reflect small sample size and specialised use cases rather than systematic behavioural patterns.

3. Correlations between features

Overall, correlations between features are weak, indicating that most variables influencing non-return behaviour act independently. This improves the model's ability to capture unique effects from each feature.

A notable exception is the positive correlation between users in the prior orders group (order rank group 2–4) and those whose most recent order occurred within the last 0–6 months. This may suggest that frequent ordering is likely common among users who place new orders within 6 months after their previous one.



4. Temporal Patterns

I. **Seasonal Variations**

Overall there has been a 10% decline in return rate from 2018 to 2025 this might be caused by three factors or combination; increasing testing population, digital uptake surge, change in service delivery.

Slight peaks in January and mid-year periods (June-August), followed by decline in November-December (holiday season). This pattern has remained stable since 2018, suggesting systematic seasonal behavioural influences.

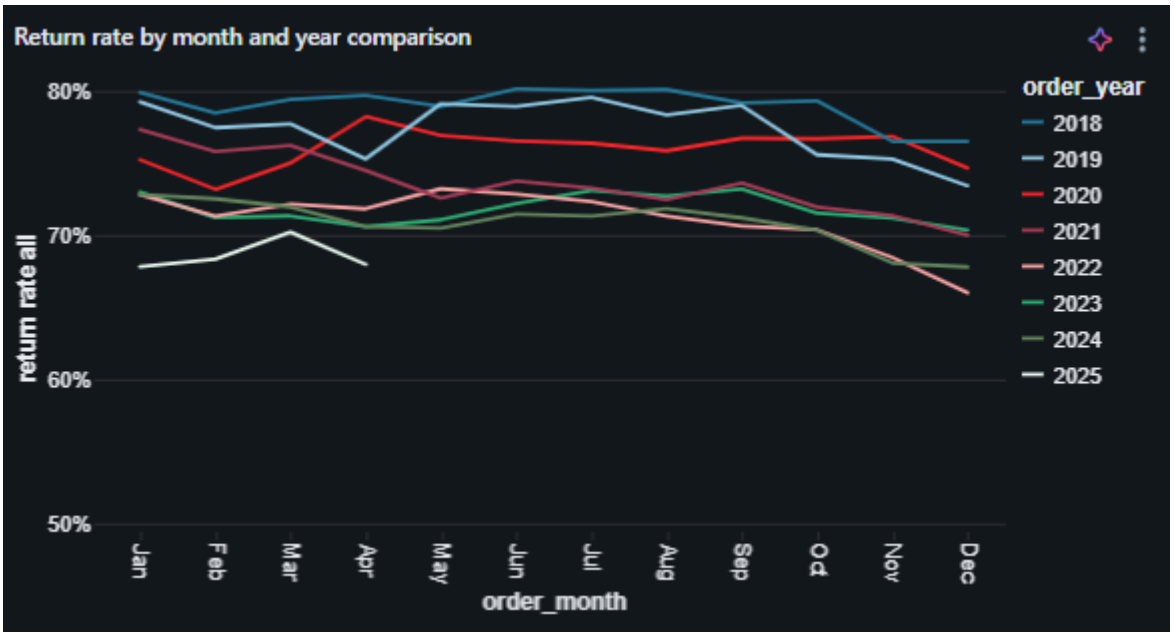


Chart: Monthly Return Rate Trends 2018 - 2025

II. Weekly/ hourly Distribution

- Friday and Saturday orders shows slightly lower returns
- 5:00-8:00 AM orders achieve highest return rates
- Risk Period: 1:00-4:00 AM orders show significantly reduced returns
- Implication: Late-night ordering may indicate impulsive behaviour or compromised decision-making

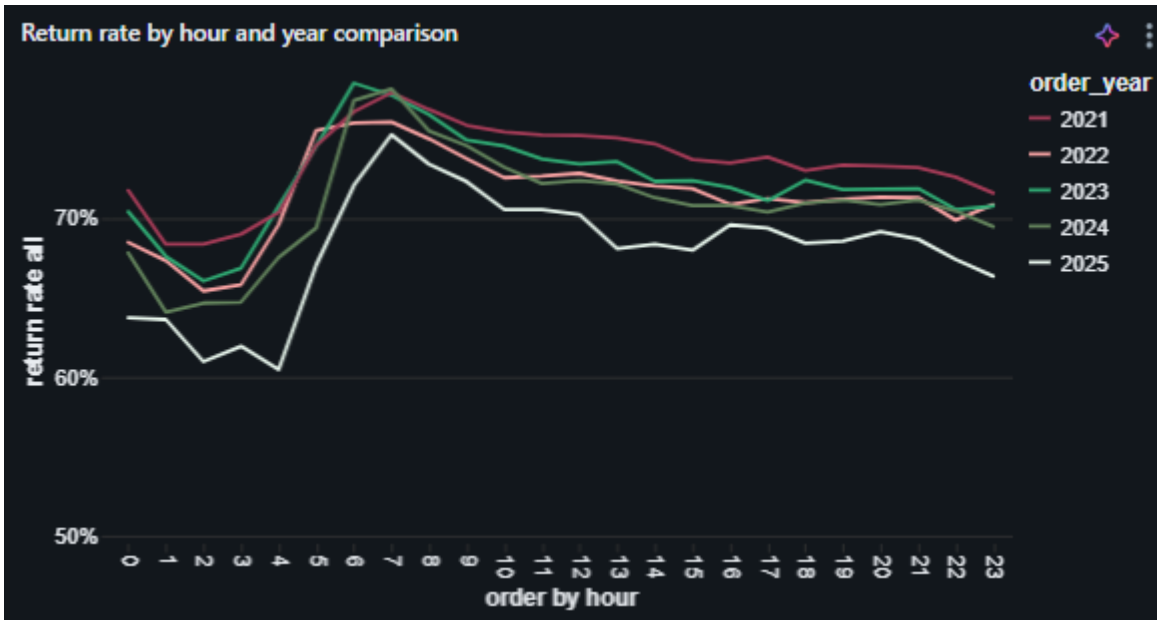


Chart: Return Rate by Order Hour

1- 4 am shows lowest dip while 6 -8am peak, this may highlight impact of service capped areas which resets by midnight.

5. Demographic Analysis

Age-Related Patterns

- **16-20 Years:** 3-7% below average return rates, suggesting need for age-appropriate engagement strategies

- **50+ Years:** Consistently highest returns across all periods, indicating established health-seeking behaviors

Sexual Health Demographics

- **MSM group:** High return rates for complex kits, with 80% full return rate
- **Non-MSM:** Lower performance (65%) for equivalent complex kit type

Socioeconomic Factors

- **Most deprived areas:** Users from most deprived areas (IMD quintiles 1-3) show lower return rates, highlighting the need for tailored support strategies.

Key Questions & Answers

- How do return rates differ between first-time users and repeat users?

  Repeat users are generally more likely to return their kits than a first timer—unless they have a history of non-return. In such cases, they tend to repeat the same behaviour. This pattern is supported by SHAP values for the features has_previous_order and prev_kit_returned, where non-return history (blue shading) strongly correlates with future non-returns.

- Are users who test more frequently over a year more likely to return their kits?

  Yes. Users who place a new order within 0–6 months of their previous test are more likely to return their kit compared to those who test less frequently or after a longer gap.

- Are users with a recent STI result more likely to return their kit?

  The feature prev_positive_result shows a neutral impact on return likelihood. Although the SHAP value appears in blue, its position near the zero line indicates no strong directional effect on behaviour.

- Do users who previously failed to return continue to not return?

  Yes. The model shows a strong signal that users with a history of non-return are significantly more likely to not return again.

- How does blood kit return behaviour compare to other kit types?

  Blood-only kits were excluded from this analysis due to limited sample size (under 3%). However, kits containing a blood sample (e.g., blood & swab, blood & urine) show lower return rates compared to urine-only or swab-only kits.

- Are users in more deprived (lower IMD) areas less likely to return kits?

  Yes. The model indicates that users from lower IMD quintiles (more deprived areas) are more likely to not return their kits, suggesting that socioeconomic factors may influence engagement with postal testing services.

- What was the effect of the SMS messaging experiment on return rates?

  The data was not sufficient to draw conclusive results. While a slight increase in return rates was observed, the difference was not statistically significant, and may be explained by seasonal variation or other concurrent factors. Further controlled testing (e.g., A/B experiments) is recommended.

Recommendations

1. Historical Practice Review

Identify successful pre-2020 operational practices that may have been discontinued as service volume increased.

Implementation:

- Conduct comprehensive audit of 2018-2019 operational procedures
- Interview long-term staff members about previous or discontinued practices
- Analyse correlation between specific practices and return rate performance

2. Temporal Intervention Strategies

Late-Night order management
For capped regions, implement intelligent order scheduling:

- Redirect Strategy: Automatically defer 1:00-4:00 AM orders to optimal 5:00-8:00 AM window
- Example: "Our data shows kits ordered between 1:00-4:00 AM are less likely to be returned. We recommend placing your order after 5:00 AM for best results."

3. Dynamic Order Journey Customisation

Implement intelligent messaging based on user responses on the order journey:

- High-Risk Indicators: Custom messaging for users reporting symptoms + unprotected activity
- Alternative Pathway Suggestions: Clinic referrals for urgent cases
- Completion Support: Enhanced follow-up for identified risk categories

4. Evidence-Based Testing Framework

A/B Testing Protocol
Implement rigorous testing for all new interventions:

- Randomised Control Groups: Ensure statistical validity
- Measurement Frameworks: Establish clear success metrics
- Iterative Improvement: Continuous refinement based on results

SMS/Email Optimisation
Test multiple message variations across demographic segments:

- Content variations: Urgency-focused vs. educational vs. motivational
- Timing Optimisation: Test different reminder schedules
- Personalisation Levels: Generic vs. demographic-specific

5. Demographic-Targeted Interventions

Age-Specific Communication Protocols
Develop differentiated messaging strategies:

- 16-20 Age Group: Youth-focused language, social media integration, peer influence messaging
- Middle Age Groups: Health consequence focus, family responsibility messaging

Socioeconomic Support Enhancement

- Barrier Reduction: Multiple return options, proactive follow-up
- Community Partnerships: Collaborate with local organisations serving deprived communities

Limitations & Considerations

- Age Exclusions: Under-16 and 75+ groups excluded due to specialized patterns
- Kit Type Limitations: Low-volume kits excluded to maintain statistical reliability
- Return Classification: Partial returns grouped with complete returns, potentially masking return quality issues
- Repeat Dispatch**:** 5% of orders involving multiple kits require separate analysis
- Volume Scaling: Operational changes accompanying growth may confound historical comparisons
- External Factors: Broader healthcare system changes may influence user behavior patterns

Future Work Priorities

1. Repeat Dispatch Analysis

Understand the 50% non-return rate among users receiving repeat kits.

- Behavioural Patterns: Identify reasons for repeat kit requests
- Return Rate Factors: Determine what drives low returns in repeat kit
- Service Optimisation: Develop strategies for improving repeat user outcomes

2. Partial Return Investigation

Explore incomplete kit return patterns, particularly for blood-based kits.

- Technical Barriers: Identify collection difficulties
- User Experience: Understand abandonment points
- Support Interventions: Develop targeted assistance strategies

3. AI Agents for Personalised User Experience

Innovation Opportunity**:** Develop intelligent AI agents for order journey customisation.

- Real-Time Adaptation: Dynamic content based on user responses using AI agents
- Predictive Intervention: Proactive support for high-risk users through AI-powered personalisation
- Outcome Optimisation: Continuous learning from user interactions via AI agents

4. Comparative Brand Analysis

Extend analysis to other kit brands such as Fettle and service providers.

- Best Practice Identification: Learn from high-performing alternatives
- Service Enhancement: Adopt successful strategies from other providers

Conclusion

This analysis reveals significant opportunities to improve STI test kit return rates through targeted, evidence-based interventions. The combination of demographic understanding, temporal optimisation, and behavioural insights provides a comprehensive foundation for enhancing service performance and supporting strategic objectives.

The recommended interventions focus on high-impact, implementable strategies that address identified risk factors while building on existing strengths. Success will require coordinated implementation, rigorous testing, and continuous refinement based on performance data.

By addressing the key drivers of non-return behaviour and implementing intelligent intervention strategies, we can significantly improve service outcomes while strengthening our competitive position for future contract opportunities.

2018 vs 2024

STI Test Kit Non-Returns 2018 vs 2024

Executive Summary

This report outlines insights from a predictive model designed to identify key drivers of non-return behaviour for STI test kits, with a focus on informing practical interventions. We also assess return trends across two key time points (2018 vs 2024) and quantify the impact of switching from blood-based to swab-based HIV/syphilis testing on return rates.

1. Predictive Model Insights

Despite substantial overlap in return and non-return user profiles—making broad prediction difficult—the model identifies a **high-confidence group (15–20%)** of users where the likelihood of non-return can be predicted with **79% accuracy**. These users represent a clear target for interventions.

- **Current overall return rate:** 72%
- **Model-informed return rate:** 77%
- **Potential uplift:** +4.5% points
- **Model used:** Random Forest (best performing after iterations)
- **Precision on high-confidence predictions:** 79%

➞ Recommendation**:** Focus behavioural or service design interventions on the **15–20% of users** where the model is most certain of risk.

2. Comparison of Key Predictors: 2018 vs 2024

Across both years, seven core features consistently drive non-return behavior, though their relative influence has shifted. Notably:

Rank	2018 Top Predictors	2024 Top Predictors
1	has_symptoms	previous_kit_returned
2	previous_kit_returned	has_symptoms
3	is_weekday	has_unprotected
4	ethnicity_group_BME	is_weekday
5	has_unprotected	ethnicity_group_BME
6	age_group_<20	order_hour_0-4am
7	imd_group_most_deprived	order_month_nov_dec

Chart 1: Feature Importance Comparison 2024

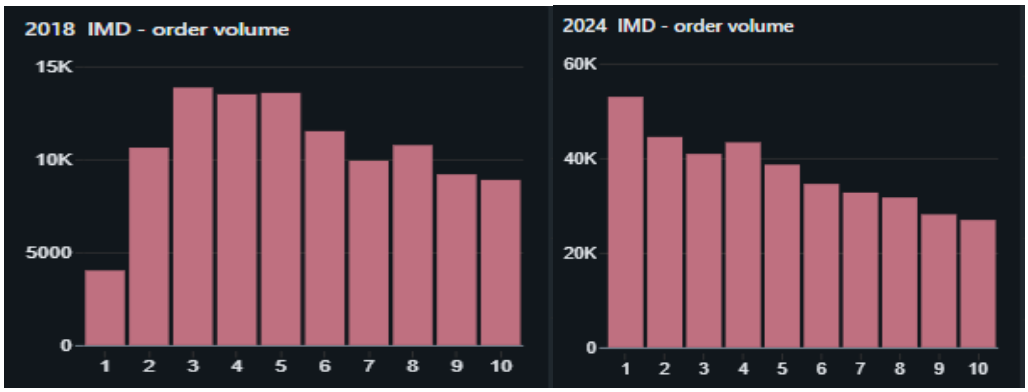
➞ **Insight:** Behavioural signals like symptoms, prior return history, and unprotected sex are stable predictors. However, time-of-order patterns and deprivation indicators have gained relevance in 2024.

3. IMD Trends and Returns

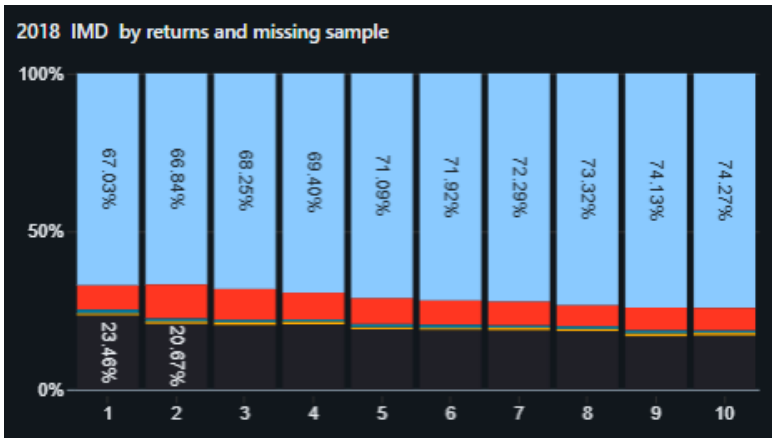
Service expansion between 2018 and 2024 significantly improved coverage in highly deprived communities (IMD score 1):

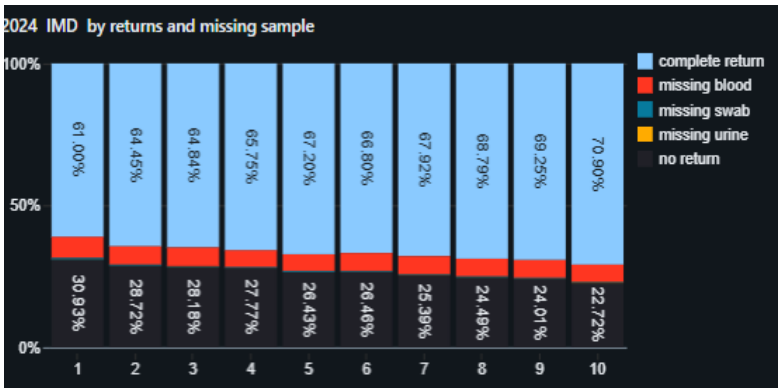
- Volume increase **2018 to 2024 (IMD 1):** 4,000 → 50,000 (+1000%)
- Yet, IMD most deprived areas return rates **is ~7 percent** lower than least deprived areas

Chart 2: IMD Group Trend – 2018 vs 2024



Our services have tripled over the past seven years, but one of the most notable achievements is our impact on reducing health inequalities. Between 2018 and 2024, service expansion significantly improved access in the most deprived communities (IMD score 1), with orders from these areas increasing from 4,000 to 50,000—a remarkable 1000% growth.





However, there has been a drop in return rate by 6% for IMD 1 and 4% drop for IMD score 10 from 2018 to 2024

➞ **Insight:** Growth in coverage is commendable, but structural issues—such as delivery reliability—likely suppress return rates in deprived areas. These external factors are not captured in our data and merit further investigation.

4. Blood Kit Return Rates: Impact of Swab Substitution (using 2024 data)

Blood-related kits account for a significant share of non-returns, with blood samples making up over 90% of missing items.

Current Blood Kit Performance:

Kit Type	Volume	Complete Return Rate
Blood-only	20,000	59%
All blood-related	283,000	62%

Model 1a: Replacing Missing Blood Samples with Swab

If 90% of missing blood samples in mixed kits are HIV/Syphilis and were replaced by swabs:

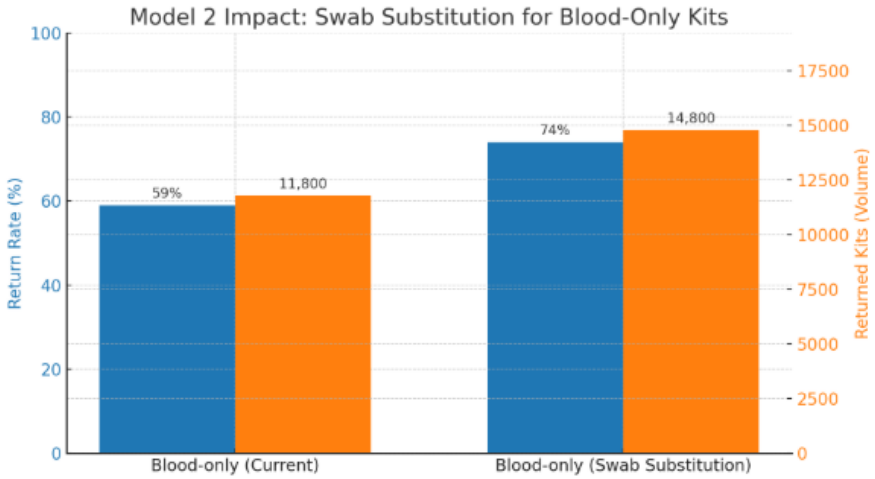
- **Blood kit return rate improves from 62% → 70%**
- **Estimated uplift:** +18,200 complete returns

Model 1b: Increasing Blood-Only Kit Return to Match Swab Kits

If offering swab options improves blood-only kit return rate from 59% to 74% (the current swab kit rate):

- Blood-only kit return rate from 59% → **74%**
- **Estimated uplift:** +3,000 additional complete returns

Chart 5:



Overall Impact of Swab Substitution

- Net increase in blood kit complete return rate**: 62% → 71%**
- **Return rate improvement :** approx. +9.5% points

Insight: This is a low-friction, high-impact change targeting the most common failure point—blood samples—and is especially valuable for underserved users.

Recommendations

- **Prioritise high-confidence predictions:** Target interventions on the 15–20% of users with the highest prediction accuracy to achieve a meaningful 4.5% improvement.
- **Swab substitution should be piloted:** Starting with blood-only kits and expanding to mixed kits where HIV/Syphilis testing is required.
- **Address external barriers:** Survey findings highlighted delivery issues. This issue should be investigated further, especially to understand whether it contributes to lower returns in the most deprived areas.
- **Continue monitoring behaviour shifts over time:** Particularly the growing influence of ordering time, age, and IMD in 2024.