Optimising inpatient blood testing using a novel clinical decision support system: Protocol for a feasibility randomised controlled trial

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Background: Inappropriate blood testing in NHS hospitals, encompassing both overtesting and undertesting, poses a significant patient safety risk. Overtesting can lead to iatrogenic anaemia, unnecessary discomfort, sleep disruption, while undertesting can result in missed or delayed diagnoses. The Carter Review, a Department of Health commissioned review of UK pathology services estimated 25% of pathology tests were unnecessary, indicating a clear need for practice improvement. This research addresses the challenge of ensuring the right test is performed at the right time for every patient.

Objectives: This project aims to develop and evaluate the feasibility of a clinical decision support (CDS) system designed to optimise blood testing of hospital inpatients. The primary objectives are to assess the system's usability and usefulness among junior doctors and to refine its features ahead of a larger effectiveness trial.

Methods: This study is a feasibility randomised controlled trial conducted at University College London Hospitals Foundation Trust. Junior doctors on inpatient wards will be randomised to either have access to the CDS system or continue with standard practice. The system is built using open protocols (SMART on FHIR, CDS Hooks) to ensure future interoperability with other electronic health record systems. It is also designed to be compliant with regulatory requirements to ensure patient safety. It will provide real-time advice at the point of ordering by integrating national guidelines, predictive analytics, and a novel measure of information entropy to signal a test's potential usefulness. The trial will initially run in a shadow mode, where clinicians evaluate the tool's recommendations on patients they do not directly care for. An initial audit on testing variation across protected characteristics has informed the development to mitigate algorithmic bias. Clinicians will be actively involved in the iterative design of the user interface.

Results: This study is a feasibility randomised controlled trial conducted at University College London Hospitals Foundation Trust. Junior doctors on inpatient wards will be randomised to either have access to the CDS system or continue with standard practice. The system is built using open protocols (SMART on FHIR, CDS Hooks) to ensure future interoperability with other electronic health record systems. It is also designed to be compliant with regulatory requirements to ensure patient safety. It will provide real-time advice at the point of ordering by integrating national guidelines, predictive analytics, and a novel measure of information entropy to signal a test's potential usefulness. The trial will initially run in a shadow mode, where clinicians evaluate the tool's recommendations on patients they do not directly care for. An initial audit on testing variation across protected characteristics has informed the development to mitigate algorithmic bias. Clinicians will be actively involved in the iterative design of the user interface.

Conclusion: By providing targeted, data-driven information directly within the clinician's workflow, this CDS system has the potential to significantly reduce low-value blood tests while prompting for necessary but forgotten ones. This research will provide evidence on the feasibility of using an interoperable, entropy-based system to improve the appropriateness of inpatient diagnostics, directly enhancing patient safety and care quality.

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Introduction

Inappropriate blood testing in NHS hospitals poses a significant risk to patient safety. Over testing can lead to iatrogenic anaemia and patient distress, while undertesting can result in missed or delayed diagnoses.

Highlighting the scale of this issue, the national Carter Review estimated that 25% of all pathology tests are unnecessary[1]. To address this, our research aims to help clinicians order the right blood tests at the right time.

Aim & Objectives

The aim is to develop and evaluate the feasibility of a novel clinical decision support (CDS) system for inpatient blood testing. The primary objectives are to:

- Assess usability and workflow integration among resident doctors.
- Evaluate perceived usefulness and clinical acceptability.
- Identify refinements to inform a large-scale trial.

Proposed Methods

The personalised utility of each blood test will be evaluated using entropy-based metrics generated by multimodal models.

Phase 1:	Silent evaluation
Clinicians evaluate the tool's clinical decision support on patients they do not directly care for using retrospective and then live data.	

Phase 2:	Randomised controlled trial
Acute medicine resident doctors at UCLH will be randomised to either the intervention group, with access to the CDS system, or a control group that will continue with standard practice.	

Outcome Measures

- Feasibility & usability (e.g., System Usability Scale, user engagement logs).
- Test ordering patterns (e.g., number of tests per patient per-day).
- Adverse events (e.g., unplanned escalation in care).

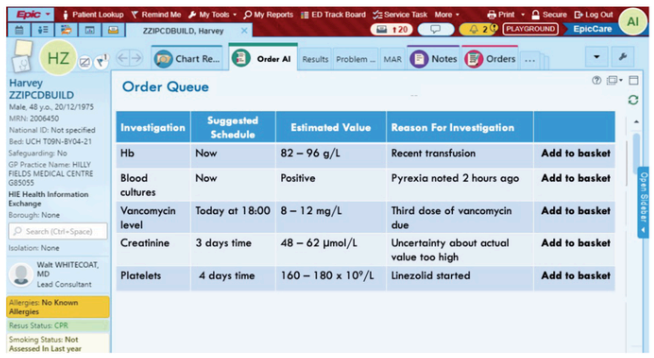

Figure 1: A prototype of the ordering clinical decision support tool embedded within UCLH's EHRS testing environment.

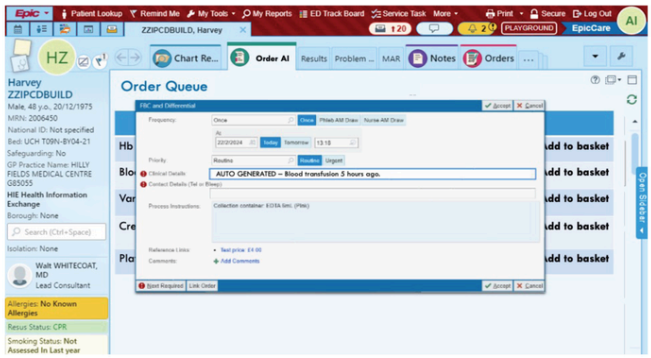

Figure 2: A prototype of the clinical decision support tool could assist in completing a blood test order form to make its use more compelling.

Conclusion

This study will provide crucial evidence on the feasibility of using an interoperable, entropy-based CDS to improve diagnostic decision-making.

Findings will directly inform the design of a future large-scale effectiveness trial aimed at enhancing patient safety and care quality.

References

1. Department of Health. Review of NHS Pathology Services in England: Report of the Second Phase of the Independent Review of NHS Pathology Services. Independent Review Report. Department of Health and Social Care, 2008.

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