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Potential cost savings by minimisation of blood sample delays on care decision making in urgent care services

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HIGHLIGHTS

Conclusion

- Blood sample rejection rate in a single large NHS Foundation Trust is high.
- The highest rate of blood sample rejection is in the Accident and Emergency department.
- Blood sample rejection is associated with increased in-hospital stay.
- Blood sampling technique impacts on rejection rates.
- Reduction in sample rejection rates in emergency care areas in acute hospitals has the potential to impact on patient flow and cost.

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ABSTRACT

Background: Timely availability of blood sample results for interpretation affects planning and delivery of patient care from initial assessment in Accident and Emergency (A&E) departments.
Materials and methods: Rates of, and reasons for, rejected blood samples submitted from all clinical areas over one month were evaluated. Haemoglobin (Hb) represented haematology and potassium (K^+), biochemistry. A prospective observational study evaluated the methodology of sample collection and impact on utility.
Results: 16,061 haematology and 16,209 biochemistry samples were evaluated; 1.4% (n = 229, range 0.5–7.3%) and 4.7% (n = 762, range 0.9–14%) respectively were rejected, with 14% (n = 248/1808) K^+ rejection rate in A&E. Patients with rejected K^+ and Hb had a longer median in-hospital stay of 9 and 76 h respectively and additional stay fixed costs of £26,824.74 excluding treatment. The rejection rate with Vacutainer and butterfly (4.0%) was lower than Vacutainer and cannula (28%).
Conclusion: Sample rejection rate is high and is associated with increased in-hospital stay and cost. Blood sampling technique impacts on rejection rates. Reduction in sample rejection rates in emergency care areas in acute hospitals has the potential to impact on patient flow and reduce cost.

1. Introduction

Over the last ten years Accident & Emergency (A&E) attendances in England have increased to 16 million per year with a 31% increase in emergency admissions and is projected to increase further as the population ages and expands [1]. Managing the throughput of A&E requires minimisation of delays in care provision. The timely availability of blood results is a core component of patient assessment and decision-making. Almost all patients being admitted through A&E have haematology and biochemistry blood samples taken. Early diagnosis allows swift intervention, preventing patient deterioration [2]. Many risk scoring systems rely on blood test results as one or more of their components to help identify patients requiring urgent surgery or intensive care

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admissions [3]. The number of research studies in this area is limited. Previous studies have shown that not all blood samples are clinically indicated, nor will influence management [2,4,5]. A recent publication suggest that overdue blood tests may be an important source of variation in spending by acute hospitals and a substantial potential cost saving [4]. Here, we evaluated the extent and reasons for blood sample rejection, impact on acute decision-making and use of hospital resources.

2. Materials and methods

All Trust staff undertaking phlebotomy attend mandatory training; the standard approach is the Vacutainer® system attached directly to a needle or via butterfly tube (BD Medical, Oxford, UK). All samples are processed in the hospital laboratory. A prospective audit was performed over a one-month period to identify the number of rejected blood samples using the Telepath Systems Ltd electronic laboratory system using predefined criteria. The definition of a rejected sample was one that had reached the laboratory, which could not be processed.

A rejected haemoglobin (Hb) and potassium (K^+) level were chosen to represent haematology and biochemistry respectively. The origin of samples and the reason for rejection was collected. External samples were excluded. The number of samples repeated within 24 h, time from notification of initial rejection to the repeat's sample laboratory receipt, and length of stay of admitted patients were collected. Fixed costs for additional length of stay for patients with rejected samples were calculated using standard tariffs (£7.01/hour or £168.17 a day) excluding investigative and treatment costs.

Additionally, a prospective cohort study was performed to evaluate sampling approaches as a cause of rejection. Blood sampling technique was observed in the Accident and Emergency (A&E) department by senior nurses over a two-week period. The identity of the blood taker, technique, cannula diameter, and any difficulties encountered were documented and correlated with the phlebotomist's sample rejection rates. The Clinical Audit Committee of University Hospitals Birmingham (UHB) approved this study.

3. Statistical analysis

Blood sample rejection rates by clinical area were analysed with a Chi^2 analysis and funnel plots to identify areas with differing test rejection rates of two or more standard deviations. Time delays were reported as medians and ranges, and analysed with Mann-Whitney tests. Statistical analyses were performed using IBM SPSS 19 (IBM SPSS Inc.) and funnel plots produced using the Analytical Tools for Public Health template [6].

4. Results

There was a statistically significant difference in Hb (Chi^2 $p = 0.006$) and K^+ (Chi^2 $p = 0.001$) rejection rates across clinical areas (Fig. 1, Table 1). Rejection rates were highest for Hb and K^+ from A&E at 1.7% and 13.7% respectively (Table 1, Fig. 1).

The main cause for Hb rejection was failure of sample to reach the laboratory in 83 (36%) (Table 2) where an empty packet without a sample was sent to the lab. Eight of 30 (27%) initial Hb samples taken in A&E were not repeated. The main cause for K^+ rejection was haemolysis in 678/762 (89%) (Table 2). Of 248 A&E rejected K^+ samples, 99 (40%) were not repeated.

After the initial A&E sample was rejected, the time for a second, repeat sample to reach the laboratory after the first was processed was 7 h (range 1–81) for Hb and 9 h (range 0–276) for K^+ samples. In-hospital stay was increased by a median of 9 h for rejected K^+ and 76 h for rejected Hb samples respectively (Table 3).

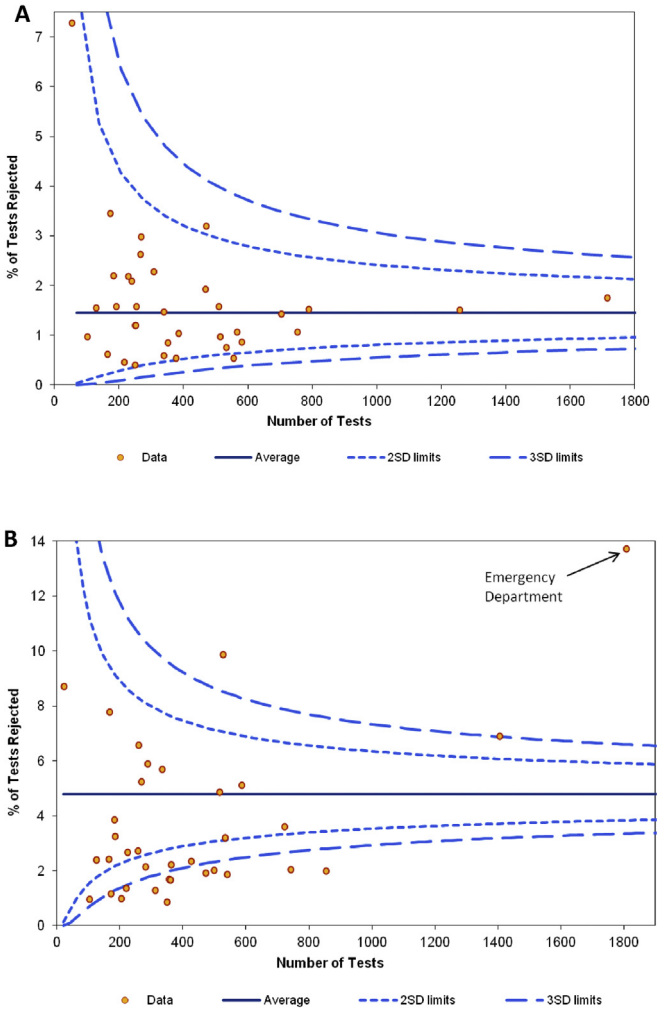

Fig. 1. A: A funnel plot of haemoglobin rejection rate by clinical area. B: A funnel plot of potassium rejection rate by clinical area.

A review of A&E records for rejected Hb samples confirmed delays in antibiotic treatment in three patients, surgery in one, and pulmonary embolus treatment in one. The additional cost for increased length of stay due to rejected blood test from A&E was calculated as £16,286.20 and £10,538.54 for repeat K^+ and Hb sampling respectively.

In the prospective part of the study, blood sampling methodology in A&E was observed in 163 patients. 27 (18%) of 155 K^+ samples were rejected. 7 of 23 patients who met the criteria of 'difficult to bleed' had rejected samples. The nursing staff bled the majority (91/155, 59%) and a variety of methodologies were observed (Tables 4 and 5).

The rejection rate with Vacutainer and butterfly (4.0%) was lower than Vacutainer and cannula (28%) ($p = 0.001$) (Table 5). There was no difference in rejection rates between A&E (4.0%) and combined ward areas (3.5%) ($p = 0.693$) for Vacutainer and needle or butterfly tube (Table 5).

5. Discussion

This study confirms blood sample rejection rate variation across clinical areas with the highest in A&E. Sample rejection is often related to problems arising prior to analysis and laboratory errors are rare [7,8]. In this study there was no evidence of transportation