SUSQI PROJECT REPORT

A sustainable clinical blood sample transport system

Start date of Project: 9th May 2025

Date of Report: 18th July 2025

Team Members:

- Laura Cook, Clinical Scientist, (laura.cook@nnuh.nhs.uk)
- Emma Miler, Clinical Scientist
- Bitzy Cave, Biomedical Scientist
- Emily Leach, Clinical Scientist
- George Bailey, Pre-Analytics Manager

Background:

Eastern Pathology Alliance (EPA) receives blood samples from over 100 GP surgeries across the Norfolk and Waveney region. This is a huge geographical area, covering over 1 million patients. Samples are transported in specialist medical courier vans with optimised routes to ensure samples are delivered efficiently. However, samples are packaged into single use plastic bags that are disposed of in clinical waste streams. This has a significant carbon footprint and to help the NHS reach net zero by 2040 *(1)*, a team within pathology began investigating more sustainable sample transport systems. Other laboratories have also been reviewing their processes, with a novel drone approach to sample delivery recently described by Guy's Hospital in London *(2).*

During the Winter of 2024/2025 five GP surgeries from the North Norfolk Coast complained about a large number of raised potassium results in their patients. This was thought to be due to the colder weather and the known phenomenon of potassium leaking out of red blood cells when exposed to colder temperatures *(3)*. This not only risks misdiagnosis, but often necessitates repeat testing (often in a hospital setting), resulting in delays to patient care and increased strain on NHS resources. A review was required to look at how samples were transported to the laboratory, and to see if this was a specific issue for those GP surgeries located furthest away from the laboratory.

The laboratory provider Abbott produces reusable sample transport bags called iLogger bags. These bags are a sustainable alternative to single use plastic transport bags. The reusable bags are also insulated with temperature mapping capability. The Abbott iLogger transport bags are specifically designed to maintain temperature stability during transit, reducing the risk of compromised test results. Although they require periodic battery replacements, they are durable and can be used repeatedly, significantly cutting down on waste and improving the reliability of sample transport. Switching to insulated, reusable transport bags represents an opportunity to enhance sustainable value from a clinical, environmental, financial and social perspective.

Specific Aims:

- To introduce a sustainable method of transporting blood samples from GP surgeries to the laboratory at the Norfolk and Norwich University Hospital.
- To reduce the number of falsely raised potassium results observed in the colder months by introducing temperature monitoring during transportation.

Methods:

Change 1: Introduction of iLogger bags

Progress so far

- In response to the GP complaints, the courier routes were adjusted, with the aim of reducing transit times.
- To further improve the sample transport the implementation of iLogger bags was considered.
- EPA have 40 iLogger bags that were given free of charge at the start of the laboratory contract. The iLogger bags will each require 3 type C batteries before they can be used to transport samples. Any replacement bags would be charged at £40/month per bag. Sixteen of these bags have been located in a store room at Queen Elizabeth Hospital. The others are yet to be located. Unfortunately, the iLogger bags were never used as they were not written into the transport tender.
- Discussions have taken place between EPA, Abbott, and the transport provider regarding the possibility of using Abbott iLogger bags to transport samples from GP surgeries to the laboratory. The courier company requested bag dimensions to ensure the bags could fit inside the vans without breaching the 'fill line'. Conversations are still ongoing to identify a solution that all stakeholders are happy with.

Next steps

- A trial will be undertaken using the Abbott iLogger bags for the GP surgeries furthest away from the laboratory e.g. those on the North Norfolk coast.
- If this trial is successful the bags could be rolled out permanently for all locations or a subset of surgeries furthest away.

Change 2: Software monitoring

A quote has been received from Abbott (£13,000 one off fee) to connect the iLogger bags to the laboratory computer system. This software would allow the transportation times and temperatures to be visible when authorising abnormal potassium results. Raised potassium results from samples that have been delayed in transit or exposed to severe temperatures could automatically be blocked from being reported. This would prevent falsely raised potassium results from being released and acted upon by the clinicians.

Funding for the software to link the Abbott iLogger bags to the laboratory computer system (£13,000 one off fee) will be investigated.

Both changes would help with equity of care, ensuring fair and equal access to healthcare. Currently those patients living furthest away are more likely to require a repeat blood test in a hospital setting during the winter months, and are therefore disadvantaged for living further away from the laboratory.

Measurement:

Patient outcomes:

- Number of GP surgery complaints regarding raised potassium results.
- Number of patients attending A&E for repeat raised potassiums.

Environmental sustainability:
The GHG emissions associated with the single use plastic bags and ilogger 4 have been estimated using a bottom-up process based approach. Material and transport emission factors were sourced from the 2025 UK Government database and the ICE database.

For the single-use plastic bags, it was assumed they are made from LDPE, with each bag containing one absorbent pad made from polyacrylate. Disposal was assumed to be through domestic waste streams. Packaging and transport emissions were excluded from the calculation due to lack of available data. The total weight of a single-use bag, including one absorbent pad, is 34g. For the iLogger bags, weight and material composition data were provided by the manufacturer. The calculation includes three type C batteries, which need to be replaced once a year. The bags are produced in Porto and transported to the UK by land and freight train. Primary packaging (a cardboard box) is also included. The total weight of an iLogger 4, including the bag, box, absorbent pads, batteries, and cardboard packaging, is 2.6 kg. The iLogger bags are also fully repairable.

For the reduction in unnecessary A&E visits, the associated GHG emissions were estimated at 13.8 $kgCO_2e$ per visit, based on the Sustainable Healthcare Coalition's 2015 Emergency Department visit module.

Economic sustainability:

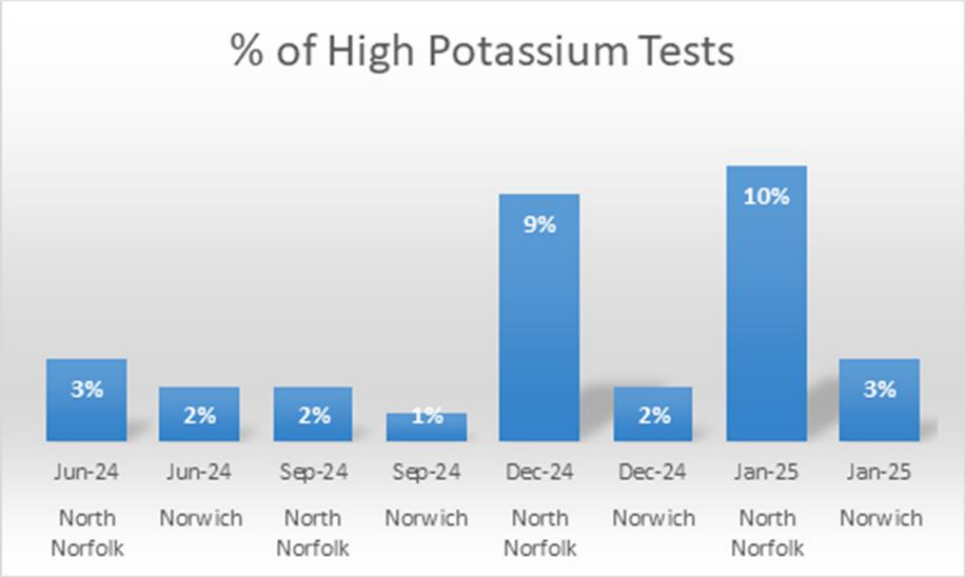
- Cost of single use plastic bags compared to implementing the Abbott iLogger bags.
- Cost of disposing of yellow clinical waste bags.
- Cost of unnecessary A&E admissions for repeat potassium results.
- Laboratory time spent booking in and processing unnecessary repeat potassium results.

Social sustainability:
We plan to collect qualitative feedback from staff and patients following the trial, with potential impacts outlined in the results section.

Results:

Patient outcomes:
An audit was performed to compare the number of raised potassium results reported to 10 GP surgeries (5 from North Norfolk and 5 from Norwich) during different months of the year.

Location Type	Month	Total Number of Potassium Tests	Total Number of High Potassium Tests	% of High Potassium Tests (>5.4 mmol/L)	Total Number of Potassium Tests >=6.5 mmol/L
North Norfolk	June 24	3025	81	3%	3
North Norfolk	Sept 24	2947	66	2%	0
North Norfolk	Dec 24	3051	273	9%	9
North Norfolk	Jan 25	3910	400	10%	13
Norwich	June 24	2332	37	2%	0
Norwich	Sept 24	2214	26	1%	0
Norwich	Dec 24	2080	47	2%	0
Norwich	Jan 25	2632	71	3%	0



The results show an average 2-3% of potassium results are flagged as elevated (> 5.4 mmol/L). However, during December 2024 and January 2025 the rate of elevated potassium results for the 5 North Norfolk GPs audited was 9 - 10%. This increase in raised potassium results is likely due to the cold weather experienced during December 2024 and January 2025, and the significant distance the samples travel from North Norfolk to the laboratory at NNUH.

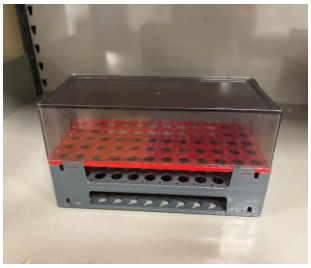
This increase in potassium results will result in patients requiring repeat blood samples and for those potassium results of 6.5 mmol/L or above, a trip to A&E for an ECG investigation. For the 5 North Norfolk GP surgeries audited, this would have been 9 - 13 patients a month during the winter months. The numbers would be higher if a lower cut off was used by the clinician.

It is also a known issue that during the summer months potassium results can be spuriously reduced if prolonged exposure to heat. This was not investigated in this study, however, by implementing the iLogger temperature mapped bags the impact of falsely reduced potassium results will be reduced. This would result in fewer repeat samples being required with more timely and efficient care for patients.

Environmental sustainability:

a) 

b) 

c) 

- Image a: Single use plastic bag (this includes 1 absorbent pad per bag) = 0.065 kgCO2e per bag
    - 300,000 bags per year: 300,000 * 0.065 kgCO2e = 19,524 kgCO2e per year
- Image b and c: ilogger 4 = 12.44 kgCO2e per bag
    - Assume the bags last 5 years and 40 bags are used = 99.52 kgCO2e per year
    - There is also carbon associated with the requirement to change the 3 batteries per bag an additional once a year = 37.2 kgCO2e per year

Replacing 300,000 single-use plastic bags each year with 40 reusable iLogger 4 bags is a reduction of approximately 19,387 $kgCO_2e$ per year, equivalent to driving 57,037 miles in an average car. This is the same distance as driving a car twice around the Earth every year.

There would also be carbon savings from

- unnecessary A&E visits (13.8 kg CO2e per visit) ~ 386 kg CO2e per year
- Reduced repeat blood samples (0.3 kgCO2e per sample) ~ 164 kgCO2e per year
- disposal of yellow clinical waste bags containing the single use plastic bags which was not calculated as part of the project.

Total projected annual savings are **19,937 kgCO2e**, equivalent to driving 58,655 miles.

Change 2:
The impact of use of the software was not estimated as part of this project.

Economic sustainability:
Change 1:
Switch to reusable bags

- The single use plastic bags cost pathology £20,000 a year (300,000 bags).
- There is no cost for the iLogger bags as pathology already owns 40 bags. However, each bag will require 3 type C batteries (to be purchased from the pathology budget - minimal expense - £73.20 per year).
- New bags (e.g. for wear and tear, loss etc) can be purchased from Abbott for £40 per month per bag.

Use of the reusable bags will save pathology £19,926.8 per year.

Reduced A&E admissions
Using the insulated temperature mapped bags will significantly reduce the number of spurious elevated potassium results that require repeating in a hospital setting. For the 10 GP surgeries audited there is a potential saving of £2,548 from 28+ patients attending A&E at £91/visit (cost of a low level investigation A&E attendance provided by trust sustainability team). There will also be a reduction in the number of repeat blood samples received, but the cost of this (£1.90) can be incorporated in the A&E visit. Note there will also be laboratory savings in terms of reduced staff time spent booking in and processing repeat potassium.

Total projected annual savings from reduction in bag purchase and reduced A&E admissions is **£22,474.80.**

Change 2:
To connect the iLogger bags to the laboratory computer system would require a one off £13,000 fee. This would allow transport data to be visible whilst authorising potassium results in the lab. It could also automatically block results where the samples had been delayed in transit or exposed to prolonged temperature extremes.

Social sustainability:

Patients

By implementing the Abbott iLogger bags, a number of patients will not receive elevated potassium results that need repeating in a hospital setting. There have been a number of complaints from patients woken by 111 overnight, only to have a normal potassium result when repeated in a hospital setting. There is also an issue with some patients being unable to travel to A&E independently and requiring an ambulance or family members to help out.

Staff

Staff will benefit from using the Abbott iLogger bags in terms of reduced plastic waste, with increased job satisfaction (aligns with trust sustainability values). A number of laboratory reception staff have previously voiced concerns about the large number of single use plastic disposed of in yellow clinical waste bins. It is also quite time consuming to open the huge amount of plastic bags received.

Staff will also benefit from the reduced time spent booking in the repeat blood tests, phoning out spurious results (this can be extremely time consuming overnight),

Discussion:

This project looked at sustainable blood sample transport bags to reduce the amount of single use plastic waste disposed of in the laboratory, and shows there is a significant cost and carbon saving with the iLogger bags.

The bags have the additional benefit of being temperature mapped. This could reduce the number of raised potassium results reported inappropriately in the colder months to GP surgeries located furthest away from the laboratory. This would help with equity of care, ensuring fair and equal access to healthcare. Currently those patients living furthest away are more likely to require a repeat blood test in a hospital setting during the winter months. Patients are disadvantaged for living further away from the laboratory.

Conclusions:

This project has shown the benefits for patients, staff and the Trust of implementing reusable temperature mapped sample transport bags. Further work will be required to ensure the transport provider can begin to use the Abbott iLogger bags. This is especially important for the GP surgeries located the greatest distance from the NNUH laboratory. The iLogger bags can have huge sustainable, financial, clinical and social advantages and work should continue to ensure they are implemented efficiently.

References

(1) Greener NHS, Delivering a net zero NHS (https://www.england.nhs.uk/greenernhs/a-net-zero-nhs/)

(2) NHS delivery drones take flight offering faster and greener patient care | Guy's and St Thomas' NHS Foundation Trust

(3) Sinclair D., Briston P., Young R., et al. (2003) Seasonal pseudohyperkalaemia. J. Clin. Pathol. 56, 385-388

Critical success factors

Please select one or two of the below factors that you believe were most essential to ensure the success of your project changes.

People	Process	Resources	Context
☐ Patient involvement and/or appropriate information for patients - to raise awareness and understanding of intervention X **Staff engagement** X **MDT / Cross-department communication** ☐ Skills and capability of staff ☐ Team/service agreement that there is a problem and changes are suitable to trial (Knowledge and understanding of the issue) ☐ Support from senior organisational or system leaders	☐ clear guidance / evidence / policy to support the intervention. ☐ Incentivisation of the strategy – e.g., QOF in general practice ☐ systematic and coordinated approach ☐ clear, measurable targets ☐ long-term strategy for sustaining and embedding change developed in planning phase ☐ integrating the intervention into the natural workflow, team functions, technology systems, and incentive structures of the team/service/organisation	☐ Dedicated time ☐ QI training / information resources and organisation process / support ☐ Infrastructure capable of providing teams with information, data and equipment needed ☐ Research / evidence of change successfully implemented elsewhere ☐ Financial investment	☐ aims aligned with wider service, organisational or system goals. ☐ Links to patient benefits / clinical outcomes ☐ Links to staff benefits ☐ 'Permission' given through the organisational context, capacity and positive change culture.