# Colour-Change for Emergency Department Patient Care ; Implementing a Low-Technology, Low-Cost Solution to a Complex Issue

*Mr. P is a 43-year-old man who presented to the Emergency Department one Thursday evening with epigastric pain. He had a background of alcohol dependency and this was his second presentation in 2 days with worsening pain and nausea. His vital signs demonstrated mild tachycardia and his examination elicited some moderate tenderness in the epigastrium. It was deemed important to consider an episode of acute pancreatitis amongst his differential diagnosis and a serum lipase was sent to the lab as an urgent request. 90 minutes later the result wasn't available via the trust's computerised results service, and on enquiring of the lab it became apparent that the sample had been incorrectly sorted into a basket of routine samples, and had not been urgently processed as intended. It took a further hour to receive the result, which excluded pancreatitis for the treating clinician, and Mr. P was sent home with a working diagnosis of Gastro-Oesophageal Reflux. He had spent over 5 hours in the Emergency Department and had "breached" the Department of Health's 4-hour target. He was understandably annoyed that his management had been adversely affected by a simple human error and made a formal complaint 10 days later.*

## Introduction

The Royal Loamshire Hospital (RLH) is a medium-sized District General Hospital in England, seeing approximately 75,000 patients in its Emergency Department per annum with its team of 8 Emergency Medicine Consultants plus training and non-training grade junior doctors. It sees a varied caseload of predominantly 'medical' presentations, and being situated in a popular retirement town has a higher than average rate of complex elderly presentations. For the last three 'quarters' of the financial year it has failed to meet the DH 4 hour target overall with performance data submitted of 93.4%, 91.2% and 92.5% of patients being seen and discharged or admitted from the ED within 4 hours.

On arriving at the RLH on rotation from the region's teaching hospital/MTC hub it was striking that by comparison, the RLH had limited access to near-patient/ point-of-care testing (POCT). The department was equipped with a single blood gas analyser that was located in the resuscitation room, providing clinicians with a simple ABG/VBG capability augmented by serum Potassium, Sodium and Creatinine. Haematological investigations are sent to a central hospital laboratory, as are some of the more frequently used ED 'rule-out' tests, namely Troponin and D-Dimer. I became frustrated during the first few weeks of my placement at the RLH with this limited access to POCT and a sense that laboratory investigations seemed to frequently take a long time to be available electronically. Presentations that I had become accustomed to managing swiftly during my previous training placement with a barrage of POCT machines; 'rule-out PE', low risk ACS, suspected infections etc. were now taking considerably longer to adequately manage.

Monthly "middle-grade" (MG) teaching at the RLH has a forum for the MG doctors to discuss operational and management issues with one another as a group built into the agenda. I chose to raise an enquiry at the next such meeting I attended as to whether anyone else was frustrated by the access to POCT or had experienced difficulties with patient flow and disposition as a result of delay to getting blood results. The response was again striking – the entire MG tier of staff felt that patient care was often constrained by the speed of access to blood results, and all had many examples of anecdotal evidence of where a decision to admit or discharge had been delayed by late availability of blood results and examples of where diagnoses were changed on patients after several hours of treatment for one complaint when blood results had become available late on in their assessment. Mr. P was not an outlying example.

**Background – Analysis of the Problem and Stakeholder Engagement**

From discussion with the Clinical Lead it became apparent that the issue of delayed lab investigations/ delayed blood results had been raised by a number of the departmental Consultants and senior Nurses during the preceding 6 months and was on the Clinical Lead's "Risk Register". He himself shared anecdotal experience of cases that he felt had been managed sub-optimally and voiced frustration that the current model was frequently failing the department and it's patients. One of the Consultant body had been tasked with looking into the issue during their SPA time but had subsequently fallen ill and was off on long-term sick leave. The issue had therefore stagnated. I sought the Clinical Lead's permission to embark on a Service Improvement Project to address these shortcomings, and was granted his support. In terms of constraint, it was explained that any solutions would need to be low cost due to financial pressures on the directorate, and that due to long-standing political and cultural differences between the ED and the Pathology Department their was unlikely to be any support for solutions that involved investing in POCT equipment for the ED.

In his internationally renowned work on Transformation, "Leading Change", John Kotter [1] proposes an 8-stage process of creating sustained major change. The first two stages are to i) establish a sense of urgency and ii) create the "guiding coalition". My interpretation of the situation following my meeting with the Clinical Lead was that there was a groundswell of frustration with the current state, it had clearly been raised as an issue at Senior Nurse, Consultant and MG level and was the major issue in at least one complaint. I prioritised collecting data to accurately measure the situation to support the growing "sense of urgency" amongst the clinical body. In terms of a "guiding coalition" I had the support and hence potentially the leverage of the Clinical Lead and had received the tacit authority of my MG peers to engage with this issue at the original MG meeting, but I felt that a Project Team was the correct way to proceed. Meredith Belbin [2] talks of a need for a number of "roles" to be filled by the members of a team to increase the chances of success, and reflecting upon my own leadership styles and preferences I considered it important to recruit individuals who would fulfill the "Monitor-Evaluator" and "Completer-Finisher" roles in particular to complement my own "Plant" and "Chairperson" tendencies. It was

also important that the project team had sufficient capacity to work quickly to make best use of the "sense of urgency" already generated and that they shared a motivation in addressing this issue. I approached the ED Matron for suggestions of appropriate individuals from within the nursing team, wanting the project team to have a strong nursing presence to maximise nursing "buy-in" and an individual was suggested who had just been promoted to Sister. The team was further augmented by a MG colleague who had previously worked in a biochemistry laboratory and a Foundation Doctor who had been the author of a number of Datix incident reports about delayed laboratory investigations. The Clinical Lead granted the team protected time with the departmental IT manager who leads on data collection and analysis via the Symphony IT system.

Analysis of Symphony system data revealed that 3.8% of 'breaches' of the 4 hour target during the preceding 12 months had been attributed to "delay in results" during formal breach coding as required by trust processes. As a separate code was used for "radiology delay" it was assumed that the large majority of this was due to Pathology results.
The trust database of Datix incident forms was interrogated and 23 incident forms had been submitted in the year that were related to delayed blood results in the ED. A member of the team was tasked with reviewing these forms to identify any prevailing themes, in particular if there were specific investigations that were more or less likely to be delayed, and identified that over 70% of the incident forms cited Biochemistry in particular as the results that were delayed.
Finally, the ED Safety Lead at the RLH compiles a database of complaint "themes" to inform departmental Safety Days, and on enquiry revealed that the department in the previous year had received 4 complaints where an excessive wait for blood results had been raised by the complainant as a factor in their complaint. Reviewing the notes of these 4 cases, in 3 it was a wait specifically for Biochemistry that prompted the delay, with the fourth delay being due to an inadequately labeled coagulation specimen in a patient awaiting an INR result.
These findings correlated well with informal focus groups chaired by the team members with Junior and Middle Grade doctor cohorts and an ED nursing group who reported that it was predominantly Biochemistry results that were felt to be an issue by end-users.

It was decided that in order to keep the project objectives 'SMART' (Specific, Measurable, Achievable, Realistic and Timely [3] Biochemistry investigations ONLY would be the focus of the QIP, limiting the number of other departments in the hospital that we needed to engage with to one. It was decided that in terms of formal "Change Methodology" a PDSA Cycle (Plan, Do, Study, Act) as described by the NHS Institute [4] would underpin the project, remaining conscious of Kotter's guidance on successful change implementation.
At an early project meeting following the collection of the incident/complaints data and the decision to focus on Biochemistry it was suggested that we did not have sufficient understanding of what happens to Biochemistry blood samples after the process of Phlebotomy and how the results are generated that we rely upon. A proposal was therefore generated to submit to the Clinical Leads of both EM and Pathology/Biochemistry to undertake a 'process mapping' exercise

following a number of dummy biochemistry samples through the system end-to-end, which was supported by both departments.

Engaging with the Laboratory staff to discuss access to the lab to follow samples an additional facet to the problem was discovered. Laboratory staff had through their channels complained for some time of the interruption to their processes incurred by having to field telephone requests from ED clinical staff enquiring after blood results and had highlighted this themselves as a problem requiring solution. It was agreed at this stage that a member of the laboratory staff would join the project team and that a collaborative solution that would seek to minimise the adverse effect on lab working of ED staff chasing delayed results would be sought to break what appeared to be a vicious cycle of delay-enquiry-delay. Reflecting at this stage the ED project team were all conscious of the initial flaw in not seeking the involvement of a member of the laboratory team at an early stage in the planning process considering what a significant stakeholder the laboratory is in the system. The involvement of the Senior Laboratory Technician delivered fresh impetus to the project and 'opened doors' to the process mapping exercise that were previously slow to open, most likely to due to suspicion and cynicism of an externally led project affecting Lab working practices.
The information collected from engaging with Lab staff enabled some interim improvements pending the completion of the project; Lab staff reported that one of their busiest times each day was early evening as community blood tests usually arrived en masse in the late afternoon, unfortunately coinciding with a peak of telephone calls from the ED chasing results on patients who had arrived during the afternoon peak. Even before the main project had completed it's analysis of the problem a positive intervention was possible in asking ED staff to limit calls to the labs during this period. As project lead I decided that a secondary objective of the project would be to try and build mutual understanding between the ED and the Laboratory to reduce what at times had become an unprofessional and antagonistic culture which was counter to the shared objective of quality patient care.

The process mapping exercise generated a flow diagram of a blood sample's "journey" from patient to result that can be seen at Appendix 1. Key issues that were felt to be contributing to the adverse delays were subsequently deduced from that and are summarised here;

- Samples designated as ED origin by manually marking sample container and labeling transport bag with sticker
- ED samples arrived at single central specimen reception point via vacuum transfer pod – no separate hopper/basket depending on original location
- Manual sorting at specimen reception was by specimen type and final destination (biochemistry/haematology/microbiology)
- Biochemistry samples sorted into rack and only transferred to lab once sufficient samples collected
- Biochemistry lab staff notified of samples to be processed by bell.
- At this stage, no designation of samples as ED origin/urgent request.

With sufficient understanding of the problem the project team were then directed to spend a week considering practical low cost solutions to the problem, working on the assumption that lack of overt 'visibility' of ED samples was the major contributory factor in those samples frequently not being processed as urgently as the end-users might have expected. It was intended that at the next planning meeting a shortlist of 3 potential solutions would be debated from which the planned intervention would be decided.

One member of the project team was asked to conduct a search of online databases of published articles to ascertain if any organization had written-up a solution to this problem. I personally contacted a sample of 6 NHS trusts at the ED/Pathology Lab level to ask how they handled ED blood samples, and from these enquiries subsequently visited a neighbouring trust with a potentially workable solution. To complete the 'external research' component of the evaluation a third member of the team was asked to look for solutions outside of hospitals/healthcare, and directed towards industry and retail for how large businesses rapidly sort resources. This exploratory phase learnt that;

- A number of hospitals had invested in digital barcode reading technology that allowed ED samples to be isolated from those more routine samples from elsewhere in the hospital
- One of the hospitals surveyed had ED samples arriving by Vacuum Chute at a separate location within the laboratory from where samples are loaded on to analysers as a priority
- One hospital made use of a different (red) coloured vacuum pods to highlight ED samples
- No published literature exists specifically relating to the issue of laboratory prioritisation of ED blood samples and delays (see Appendix 3 for search strategy)
- A number of brief online reports published by Service/Quality Improvement organisations (BMJ Quality Improvement etc.) describe simple solutions to similar challenges. In one, ED radiology requests were printed on coloured paper to facilitate their identification and prioritisation, whilst in another Medical Assessment unit TTOs were printed on coloured paper to allow their prioritisation by pharmacists at one trust.
- The industrial sector enquiry was of little assistance as the organisations surveyed had advanced electronic sorting systems.

Despite the intention being to select a model from a shortlist of 3 only one proposal was tabled at the planning meeting.

**Concept/Plan**

Electronically generated labels from Emergency Department patients were to be printed on coloured sticky labels, which would facilitate a simple visual sort at pathology reception. The biochemistry laboratory agreed to process these samples as a priority. By this simple cost effective measure the project team aimed to reduce delayed and lost samples, and generate an enhancement in the average processing time for urgent ED biochemistry samples.

In order to implement this concept, one project team member was delegated the task of procurement of labels and another tasked with liaison with the trusts IT department to ensure compatibility of labels with all ED printers and to check that coloured labels could be read by the laboratory scanners. A relatively short deadline for implementation of a pilot study period was set in order to maintain the momentum of the project and to guide the team member in charge of procurement with a timeline for receipt of sample labels. As project team lead I made a short presentation on the concept to both a routine Consultant meeting and a Band 6/7 Senior Nursing meeting and was reassured that there was no objection from this senior tier.

One significant advantage of this concept in terms of Quality Improvement is that there was little requirement to engage with and seek the support of all ED staff, as by replacing printer paper with coloured paper there would be no positive action required of the majority of staff; that is we would not need medical and nursing staff to *choose* coloured paper over white as no alternative would be offered. Nevertheless all ED and laboratory staff were sent an email detailing the project pilot and a short piece was included in the departmental newsletter to alert staff to the change and the start date. All ED clerical staff were briefed individually face-to-face as it was felt that this section of the ED staff were those most likely to have responsibility for loading the printer cartridges and so their "championing" of the project was considered critical.

The PDSA cycle for the project is detailed below. In terms of measurement it was felt that the most appropriate metrics to be used were some of the factors that constituted the evidence for change initially; datix incident forms about delayed blood samples and clinical breach codes reporting 4 hr breaches due to waiting for blood results. These outcomes were chosen over a physical "time to results" metric as establishing a baseline for the existing time taken for a sample to be processed and blood result available was deemed complicated and these practical outcomes were a measure of what was important to the ED "end-user". A team consensus was reached on running a pilot of 2 months in the expectation that this would generate sufficient evidence in the "do" phase of the PDSA cycle to inform long term change.

What are we trying to achieve?

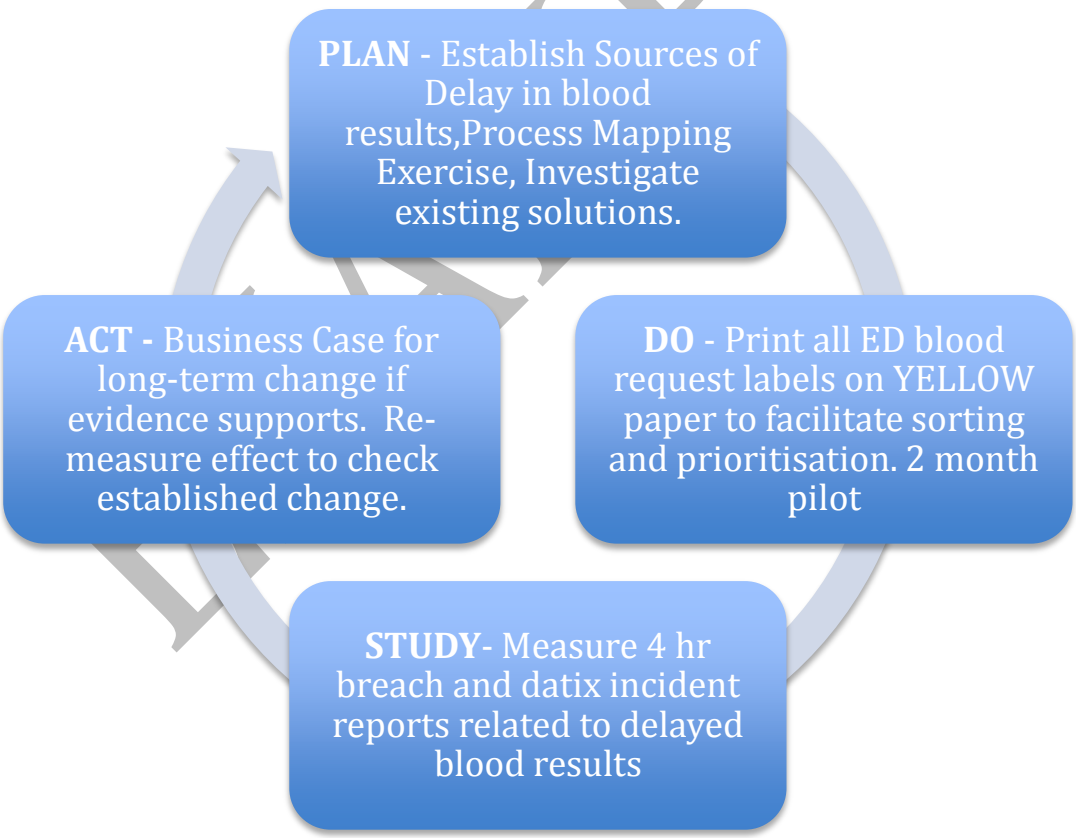
**Eliminate delays in ED urgent blood testing.**

How will we know if a change is an improvement?

**Clinical incidents, complaints and 4 hr breaches due to delays in blood results decreased.**

What changes can we make that will result in improvement?

**Support identification and prioritisation of ED blood samples.**



**Change Implementation**

Having widely advertised the planned change and communicated the project to all potentially involved or affected staff members, in line with Kotter's 4th stage (communicate your change vision) a significant setback befell the project when the first batch of coloured labels were loaded into a departmental printer only to discover that the printer ink was not compatible with the label purchased. Labels were badly 'smudged' and unreadable by either human eye or laboratory machine. This unforeseen complication delayed a successful start to the project by 2 weeks as alternative labels were identified that successfully retained ink and were readable by the laboratory machines.

Once "up and running" there were very few issues with implementation – all stock of the original white labels were removed from the department and the ED stationary store was only stocked with coloured labels. In the laboratory, support for the initiative was good, possibly as a result of goodwill generated by the efforts to reduce unnecessary telephone enquiries from the ED as a source of interruption, and aided by the presence of a project team member in the biochemistry laboratory itself. There were reports of occasional episodes of (part-time) laboratory staff being unaware of the need to process the yellow-labeled ED samples preferentially but this did not constitute a trend and only occurred on a small number of occasions.

**Outcomes**

At the 2-month point, data analysis demonstrated that clinical incident forms regarding lost or delayed biochemistry samples had been markedly reduced, with only 1 such form having been submitted during the pilot study period. There were no 4-hour breaches coded as being due to delayed blood results.

| Outcome Measure | Oct – Dec 2013 (Year Total) | Oct – Dec 2014 |
|---|---|---|
| Datix Incidents | 4 (23) | 1 |
| 4hr Breach Attribution | 37 (228) | 0 |

Alongside this data, "end-user" /stakeholder satisfaction as measured in a series of informal feedback discussions and conversations with senior ED medical and nursing staff and senior Laboratory staff was interpreted as being unanimously supportive of the change. Laboratory staff welcomed the simplicity with which they were able to identify ED samples and prioritise them. They commented upon the marked improvement in working life quality in the laboratory during the early evening period when telephone enquiries chasing delayed blood results had been almost entirely eliminated. ED staff remarked upon how they had begun to have faith in the system generating blood results reliably in time for them to make decisions on their patients in an appropriate time frame. Whether as a direct result of the yellow-label project or simply due to enhanced communication and empathy of one another's working environments and

challenges, the professional relationship between the ED and the Biochemistry Laboratory was greatly improved with a more collaborative and collegiate attitude being felt to prevail.

At the end of the 2-month pilot the project team were asked to submit a business case with financial estimates to make the change permanent and this is attached at Appendix 4. In summary, coloured labels were projected to cost less than £1000 per annum more than the plain white labels that were the original stock. Direction was received from the ED Clinical Lead and Matron to place a recurring order and a permanent transition to coloured labels was affected.

**Reflections**

This was a straightforward concept that was implemented well to achieve a simple yet important objective. As a Quality Improvement Project it was concise and uncomplicated with easily measured criteria to monitor successful change. Patient care has been improved within my host department whilst a number of lessons have been learnt regarding change, both personally and with respect to the institution.

It was telling that at the inception of the project, having identified an issue with delayed blood results, my initial instinct was to seek a solution involving investment in POCT. This is almost certainly 'framed' by having recently rotated from a department with substantial investment in near-patient testing to the extent that there was almost a 'mini-laboratory' in the ED, but it represents a cognitive bias at work and some evidence of closed thinking. Reflecting upon this I would note that perhaps the most important lesson learnt during this process is the importance of truly understanding the issue at hand before trying to implement a change or solution. I have referred throughout to Kotter's work on Change Management, but it could be argued that there is a critical 9$^{th}$ stage that precedes the published 8 stages of successful change, namely to understand the problem. It was taking the time to process map the 'journey' of a blood sample and discuss the issue with the laboratory staff that permitted the development of a simple concept that could be implemented at low cost.

The recruitment of a capable an enthused team was almost certainly pivotal to the success of the project, in particular it was the co-opting of a member of the Biochemistry Laboratory staff to the project team that really enabled the QIP to "gain traction" and momentum, and most importantly it was his involvement that facilitated all of the very positive advances in ED/Lab collaborative working and understanding that has underpinned the practical changes made. The lesson to reflect upon then is that a team best effects change such as this with representation from all stakeholder departments. Had the team remained one with solely ED membership, the solutions and implementation are likely to have taken far longer to achieve.

This last reflection has institutional applicability – too often in Healthcare single departments or organisations set out to seek their own solutions to complex multidisciplinary problems and as such they don't give themselves the

opportunity to understand problems in depth or remove the natural inter-departmental hurdles that exist. The lesson to extract for the organisation is the importance of stakeholder engagement, even when the issue being addressed appears a relatively small one.

One final reflection concerns the temporary delay caused by ink: printer incompatibility, the lesson here being to adequately test any change that involves technology before announcing the start date for a project.

**Summary**

A focused Quality Improvement project was undertaken to address the negative effect on ED patient care being caused by inefficiencies and delays in the processing of ED blood samples. A significant proportion of the project time was spent in analysing the problem, including the completion of a process mapping exercise to explore how blood samples were handled at the RLH. A multi-disciplinary team worked together to investigate potential solutions to the issues identified and a low-technology change was proposed. Coloured printer labels were used for ED samples to allow easier sorting at the laboratory level, facilitating faster processing of these urgent requests. Simple metrics were measured to demonstrate the effectiveness of the change, which had a significant positive impact. Improved relations between the ED and laboratory were an important by-product of the project. As this report is written, 9 months from the outset, coloured labels are still in use and have generated sustained improvement in incident, complaint and 4 hr. breach data, important surrogates for improved patient care.