Quality Improvement Project

Title: **Reducing Coagulation Testing in the Emergency Department**

Word Count: 4734

Submission Date: 12/12/2023

I confirm that this submission is my own work, is not copied from any other person's work (published or unpublished) and I have clearly referenced, in both the text and references, all sources used in the work. I authorise the use of this work as teaching material in the region if deemed appropriate by the QI Panel

Candidate Name & Signature: Dr James Tullie ST5

Supervisor Name & Signature: Dr Temem Hussan

Executive Summary

Introduction

This quality improvement project was undertaken in a district general hospital to reduce the number of coagulation samples being sent in the emergency department, hence trying to reduce waste and practice more sustainably

Scope of the problem and project aim

An audit was undertaken which showed that roughly 60% of patients who had bloods taken had a coagulation sample sent. Of these approximately 15% were clinically indicated.
Hence the aim was to reduce the proportion of patients having a coag sent from 60% to 10%

Interventions

3 PDSA cycles were undertaken.
The first cycle entailed changing the “bloods list” (the list of conditions at triage with suggested blood set request) to reduce the inclusion of coag testing. This was done with consultant team backing and highlighted to staff of all levels.
The second cycle consisted of a series of face to face education sessions aimed primarily at nursing staff, health care assistants and junior doctors.
The third cycle consisted of the addition of a laminate reminder in bloods trolleys over the section containing coag bottles.

Outcome

There was a steady reduction in the proportion of patients having a coag sent, dropping quite sharply after the bloods list was changed with a steadier decline thereafter. By the end of the project the proportion was regularly below 20%. This was short of the original aim but calculations estimated a saving of approximately £34000 over the five months of the project.

Why this Topic was Chosen

We do a lot of testing in modern medicine, some of it somewhat indiscriminate and could be avoided. Movements exist including “choosing wisely”[1] and “realistic medicine”[2] trying to look a bit more critically at what we do. Unnecessary testing has resource implications and the use of resources has a knock on impact on the climate crisis (however small the test may be - they all add up). A small example of this problem is the sending of coagulation samples in the emergency department, many of which are not clinically indicated and hence a waste of resources. This problem was what we set out to tackle in the emergency department at Darlington Memorial Hospital (a medium sized district general hospital with approximately 200 to 220 attendances per 24hrs) in 2023. Upon starting work in the department I felt proportionally more coagulation samples were being sent than in previous emergency departments I had worked in hence there was scope for improvement. The work took inspiration from the RCEM GreenED project.[3]

Analysis of the Problem

I undertook an audit to assess the problem in more detail and ascertain whether too many coag samples were being sent. 3 days worth of coag samples were audited from 5th-7th December 2022 as well as some additional basic data from 8th-11th Dec, with laboratory staff kindly supplying all the data in excel format. For these first three days the total number of “sets” of bloods sent in a 24hr period were compared against the number of coag samples to discover the percentage of patients who had bloods taken that included a coag. The number of “sets” of bloods included a small degree of estimation as the lab initially produced a unique number for haematology samples AND biochemistry samples. The vast majority of patients get both of these sent so the total number was divided by 2 to get the number of “sets” of bloods. Importantly the number of coag samples sent is exact. Each patient who had a coag done had their electronic case notes examined to determine the provisional triage diagnosis, the final ED diagnosis and then whether a coag was indicated and finally

did it alter management. The decision on whether a coag was indicated or not was decided by the author alone - the challenges of this approach will be covered in more detail in the reflection. Some additional notes were taken to try and look for themes to aid education. This data then allowed values to be derived for the percentage of coag samples that were indicated. For the following four days the number of coag samples sent as a percentage of blood sets was simply recorded to give a larger data sample but the appropriateness of these tests was not examined.

The results are shown here:

Date	Unique numbers	Blood "Sets"	Coag	%Coag	Number of indicated coags	%indicated coag
5/12/22	197	98.5	44	44.67	11	25
6/12/22	188	94	56	59.57	9	16.1
7/12/22	153	76.5	57	74.51	9	15.8
8/12/22	196	98	82	83.67		
9/12/22	213	106.5	69	64.79		
10/12/22	199	99.5	48	48.24		
11/12/22	200	100	57	57.00		

The initial audit confirmed a problem existed and based on this data we formed a **SMART** aim:

To reduce the proportion of patients having a coagulation sample done in ED from 60% to 10% by August 2023

Literature Review

Reducing coagulation sampling is not a new idea and is something that has been looked at many times previously. I was able to review a selection of papers and posters on the topic:

1. **REDucing Unnecessary Coagulation Testing in the Emergency Department (REDUCED)**[4]. This Canadian study involved uncoupling the PT/INR and APTT tests

at a laboratory level but this collaborative change had minimal effect on sample numbers but this was followed by changing the ED order panels which did have a good impact.

2. **A novel approach to improving coagulation sample ordering in an emergency department.**[2] This QI project from the Western Infirmary in Glasgow successfully reduced coag sampling with their key intervention being removing coagulation bottles from everywhere in the department other than resus.
3. **Reducing unnecessary blood-testing in the Emergency Department: the use of Quality Improvement science with laboratory data to address clinical problems.** This QI poster from Crosshouse Hospital Kilmarnock included interventions to reduce coag testing by agreeing clinical criteria and then repositioning coag sample bottles away from routine tubes.

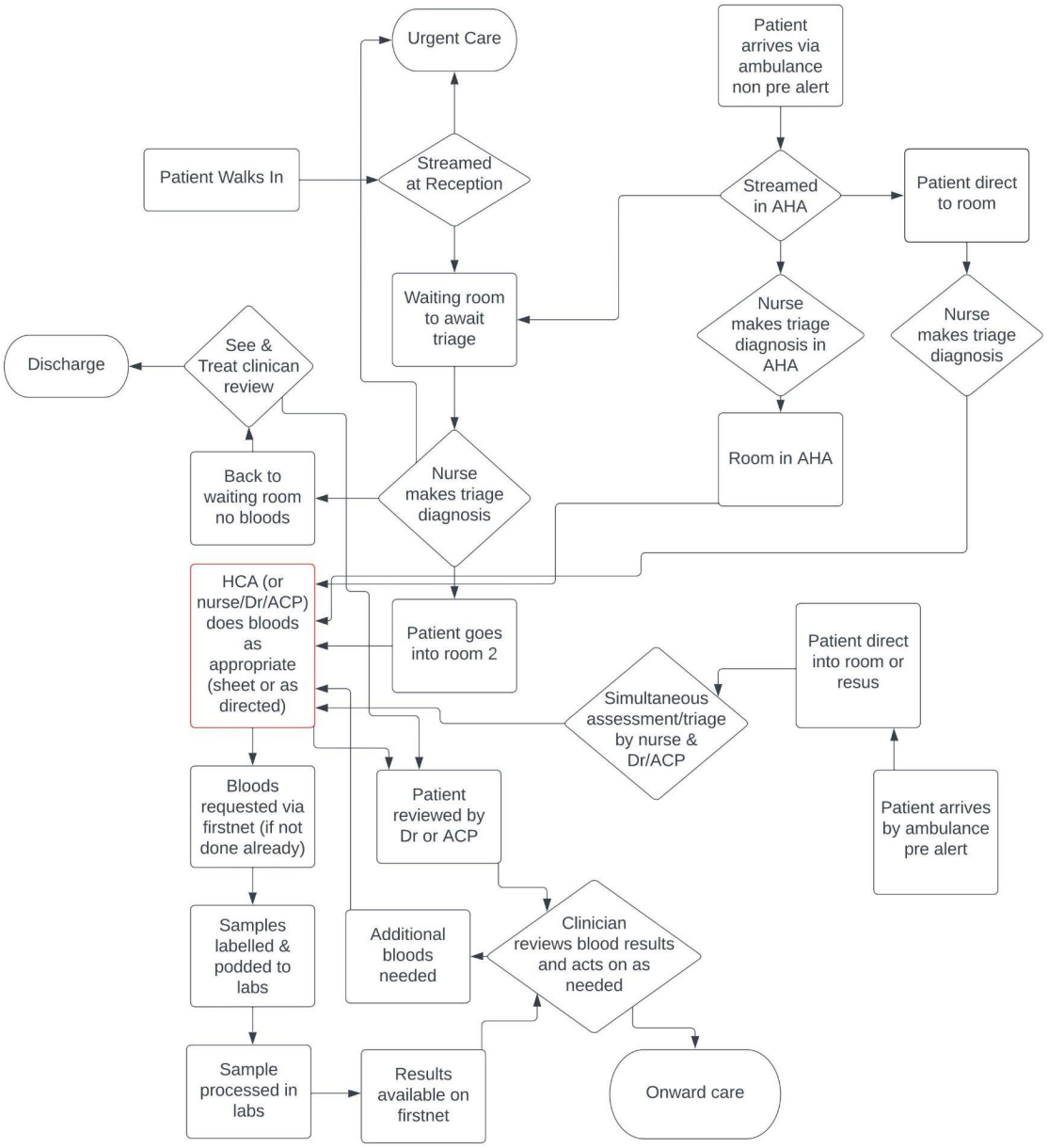
In addition to this one of the areas which was key to the audit period and the first PDSA cycle was deciding which patients did warrant a coag sample. To my knowledge there is no overarching guidance on this and contacting the haematology lead for laboratory sampling in the trust did not result in any guidance on this. While most cases seemed clinically straightforward I did some additional research into direct oral anticoagulants (whose use has increased significantly in recent years), specifically reversal of these agents in patients who are bleeding. My feeling was that coag samples were often sent inappropriately on patients who were on DOACs (where they are not routinely required) but equally didn't want to risk delaying reversal in a patient who may require it. Useful background reading was found via: **Comparing risk of major bleeding between users of different oral anticoagulants in patients with nonvalvular atrial fibrillation[7].** A large cohort study in Denmark and the UK found that overall DOACs had a lower risk of major bleeding than vitamin K antagonists but in the case of dabigatran and rivaroxaban the risk of GI bleeding was increased.

I then found some excellent guidance from Gloucestershire Hospitals both on which patients should have a coag sample done[8] (this was written as a trust protocol and samples sent without sufficient justification would simply be rejected). The list can be accessed via the

reference and has quite a limited list of indications and was a good reinforcement of my own understanding. They also had good guidance on management of bleeding in patients taking direct oral anticoagulants[9]. This guidance advised the checking of a coagulation sample hence informed the blood list used in PDSA cycle 1.

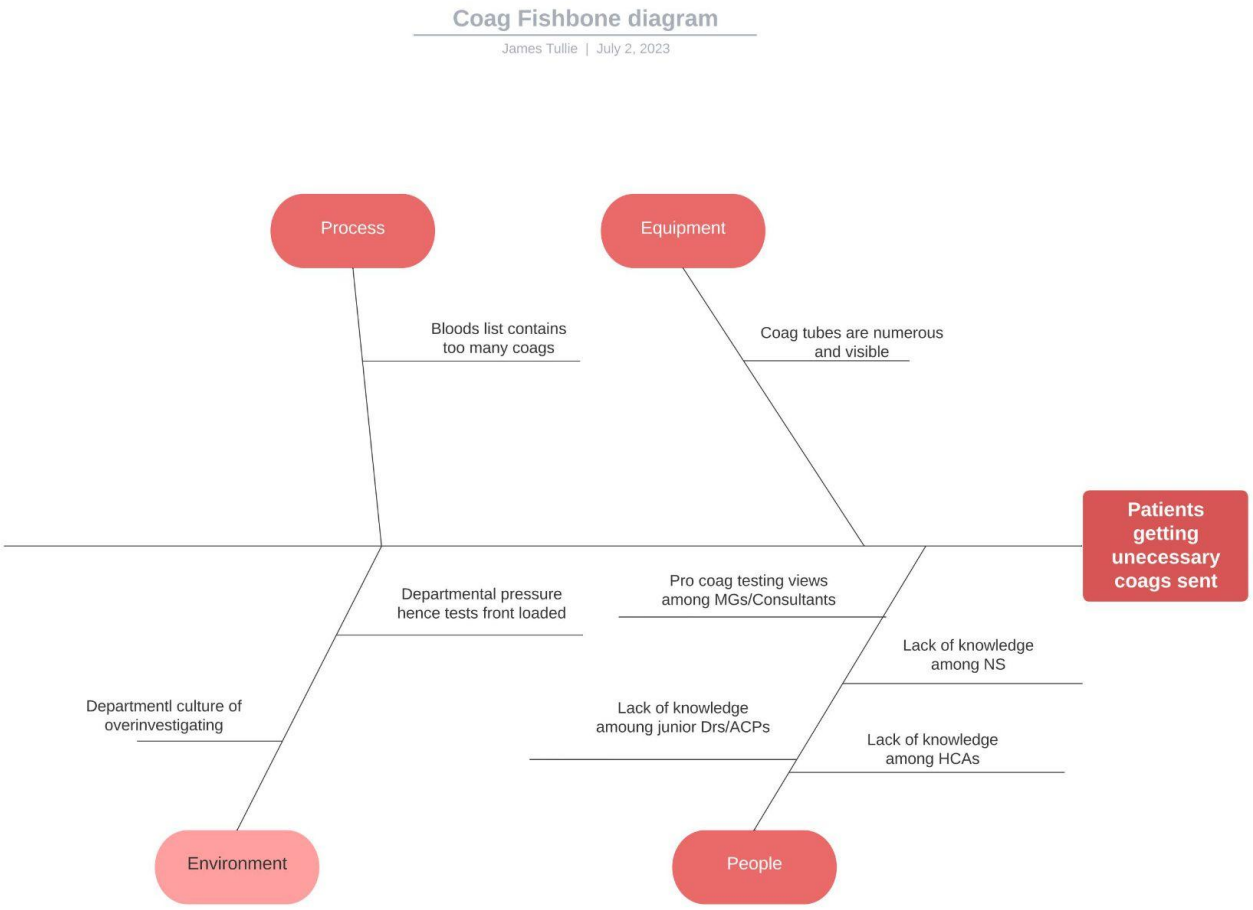
Analysis of the Issue & Intervention Choice

Several tools were used to try and analyse the issue further. A process map was developed to look in detail about when and where a coag sample was taken:



What was obvious from this process map was the majority of patients attend via the main reception waiting area and hence have bloods taken in the room next to triage and the second most numerous group come via ambulance handover area (AHA) and have bloods taken there. The majority of patients have their blood sample taken by a health care assistant or nurse and a smaller number by a doctor or ACP. Hence I was keen to focus interventions where they would have the biggest effect in terms of numbers so deliberately targeted these areas and staff groups. Other studies have described interventions at a lab level as mentioned above but I also made a conscious decision to keep interventions within the emergency department to try and keep the project to a feasible timescale.

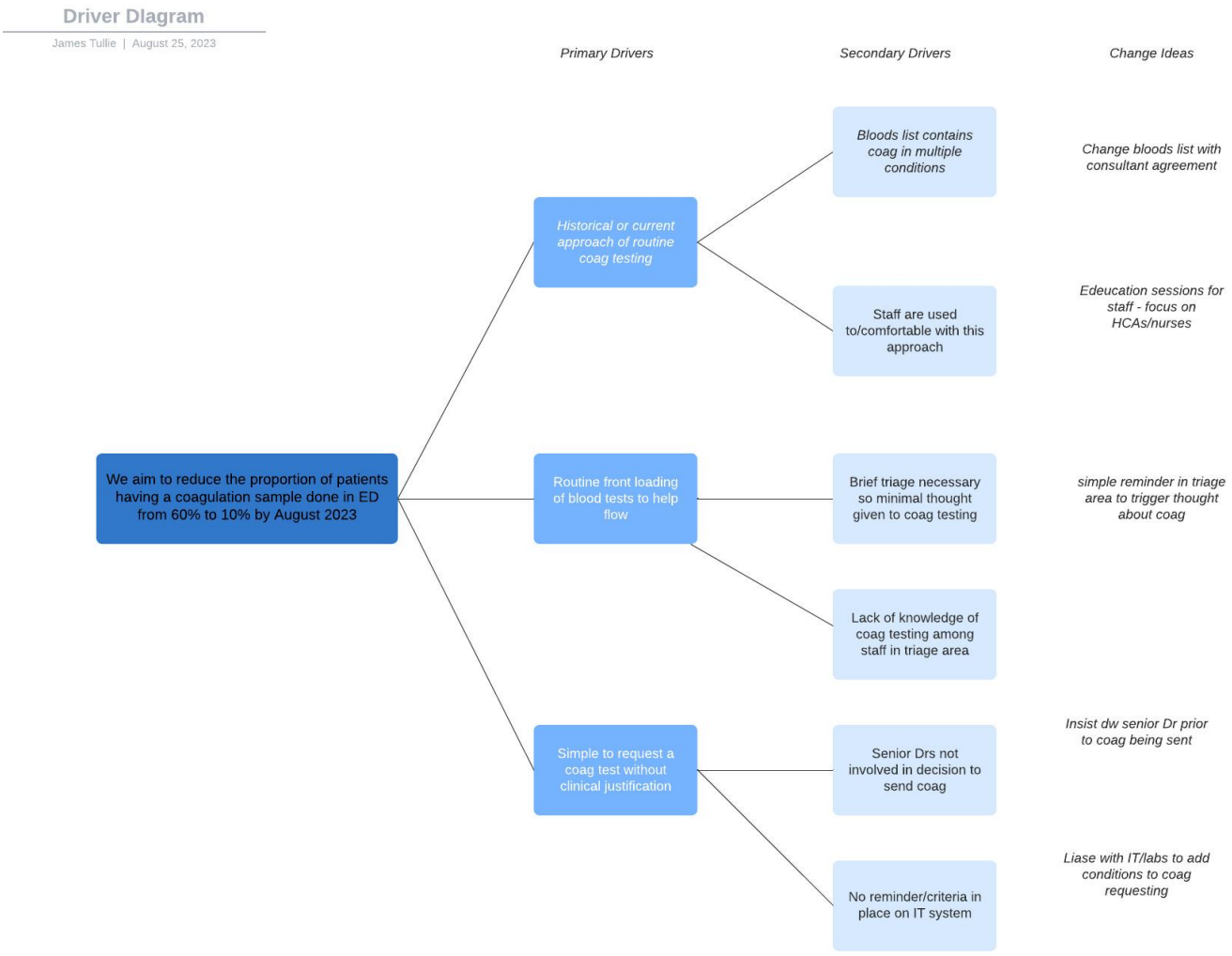
To supplement the process map a fishbone diagram was created which looked at what I perceived to be issues contributing to the sending of too many coag samples.



Some of these issues struck me as easier to target than others - in particular altering the bloods list and lack of knowledge amongst HCAs or nurses. Junior doctors could be trickier

as they are not permanent in the department and while I might change a senior colleague's view on coag testing - I felt this could be more challenging and less impactful. Over Investigating is also by no means a unique issue to this department rather something that is quite widespread. I hoped this project could help make people think about this important issue but targeting this broad complex issue as a whole I felt could be tricky.

A driver diagram was also created and change ideas lifted from this:



This shows a selection of the ideas that I came up with. While I could see that something like a change in the IT system to put conditions on coag requesting could work I felt that the logistics of making this happen in a sensible timeframe could be a barrier. Also having senior doctor involvement in the decision to send a coag sample could work (I was aware of another department where in order to send a coag sample you previously had to request a

bottle from the consultant in charge for instance). However I wasn't keen to do something that would add to delays in triage as this was frequently a very pressured area that already ran behind nor was I keen to burden the relatively small pool of senior medical staff. Changing the bloods list stood out as an obvious place to start and also meant getting senior staff buy in from the outset. Then I tried to pick measures that built on this change and complemented it while remaining achievable in the timescale. Removing coag tubes from main department areas had proved to be successful in aforementioned projects but given that coag testing remained on the bloods list in several areas this seemed impractical.

Stakeholder Analysis & QIP Team

The bulk of the work on this project including all the outcome measure analysis was undertaken by the author. The pros and cons of this will be discussed further in reflection. The second largest contributor in terms of time was Sami Ahmed, one of the clinical fellows working in the department who did the bulk of the audit work for the balancing measure. Temem Hussan is the departments lead consultant for QI work and rubber stamped the change to the blood list and gave feedback to this write up. Other key people in the team were Lesley Richards in the lab who provided the essential data on a monthly basis and lab manager Nicola McKeague who was supportive of the project and also provided information on costs. Kym Kavannagh the emergency department sister who assisted with communication with the nursing team.

The main stakeholders in the project were the emergency department staff. At the start the consultant group was key to the success of the QIP, then as it progressed the nursing staff and health care assistants were key and the next section will detail how we engaged with those groups. The project was deliberately focussed on coagulation testing in patients within the emergency department rather than on the wards but there was some informal discussion and also email correspondence with medical consultant staff involved in the running of the medical ambulatory care unit. Informal discussion within the department suggested they were very supportive of reducing coag testing hence it shouldn't produce a downstream

issue. I then had some informal feedback from a nurse practitioner working in the medical ambulatory care unit that they were seeing some delays due to patients coming from ED having had bloods done in ED which didn't include a coag sample, but they wished to do a d-dimer which entailed more blood taking rather than previously an add on. The lead consultant for the unit agreed with me that this was not a good reason for a coag sample and indeed felt d-dimer testing itself was overdone, so he was going to communicate this and was also happy that patients came to them without bloods taken in ED. There was also some useful input from a medical trainee who had done an audit and teaching presentation regarding coagulation testing in the trust a few years prior. Patients were not consulted directly regarding this project and I would hope they noticed little if any change in their care. I would like to think trying to be more environmentally friendly as well as saving the hospital money (while not harming patient care) is to the benefit of all patients who attend.

The Process

PDSA Cycle 1

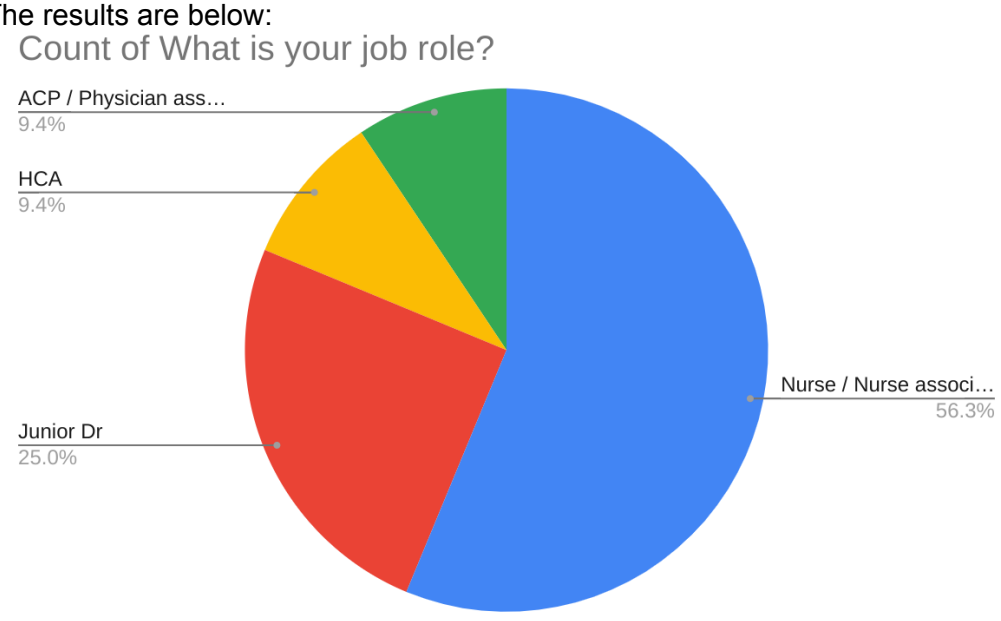
The first change I made was to alter the "bloods list" (the list of common presentations and the suggested blood set to be requested in triage for each condition). Before starting this project even after 5 months working in the department I was not actually aware of the existence of this list (which reflects the fact I don't work in the triage area but also perhaps the general awareness of it among staff in the wider department). The list contained coag sampling for multiple different conditions and several of these I felt were unnecessary. I drafted a suggested updated sheet after some thought and presented the idea of the project and the plan to change this list at the consultants meeting. The project was given approval from all and the decision for the finalised list was left to myself and TH. The original and updated lists are seen in appendix 1 and 2 respectively. Two conditions which had particular consideration were sepsis and head injury. Suspected sepsis originally contained a coag sample but NICE guidelines[10] list it only in sepsis with "high risk" features. I felt that the majority of patients coming through the waiting room or the AHA (who are not pre alerted)

were unlikely to have high risk features hence we would be over investigating in the majority. Alternatively those patients pre alerted (and hence more likely to have high risk features) and seen straight in resus or a monitoring room with early doctor involvement are then not in an area where the bloods list was routinely in use. Also head injury is a big group of patients and those patients on DOACs are quite numerous within that. Clearly most patients on a DOAC with a head injury do not have an intracranial bleed and of those that do it is rare they are time critical outside a resus setting. After reference to guidelines where a coag sample is advised if reversal is considered I stayed on the cautious side of the argument and left coag in if on an anticoagulant. Once the list was agreed an email was sent out to all clinical staff informing them of the project, the background to it and then the updated bloods list as well as a message on the department WhatsApp group. The list went live on 27/2/23 and this was accompanied by an announcement from the nurse in charge of the shift at the morning and evening nursing handover every day that week.

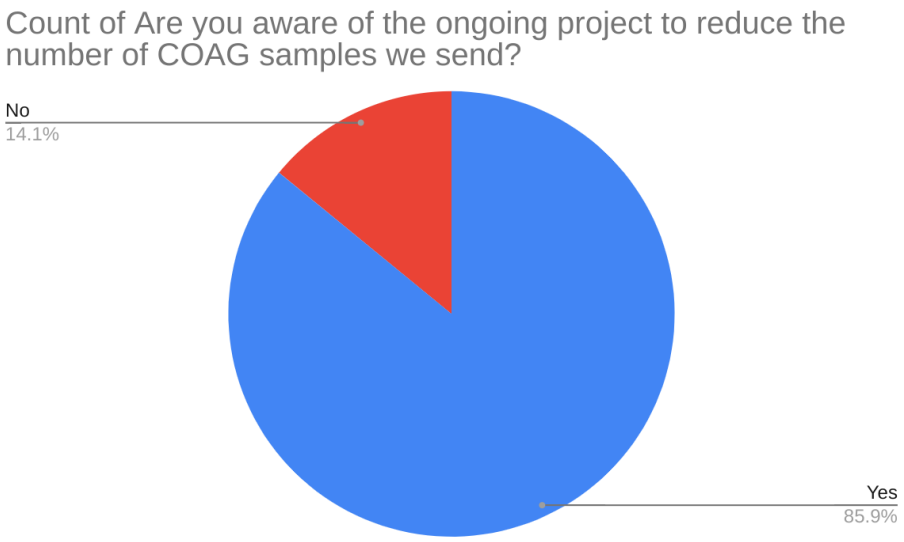
PDSA Cycle 2

As the results will show the first change actually resulted in quite a large and sustained reduction in the number of coags being sent (to an extent that surprised me) so rather than focussing solely on the bloods list again the second cycle consisted of some education sessions that highlighted it but also aimed to expand knowledge of coag testing. During the period of cycle 1 and prior to any education sessions in cycle 2 I used a quick questionnaire as a process measure to try and gauge knowledge of coag sampling. The questionnaire was done as a “google survey” and accessed via a QR code which I had on my phone and was done by people at the time. The results are below:

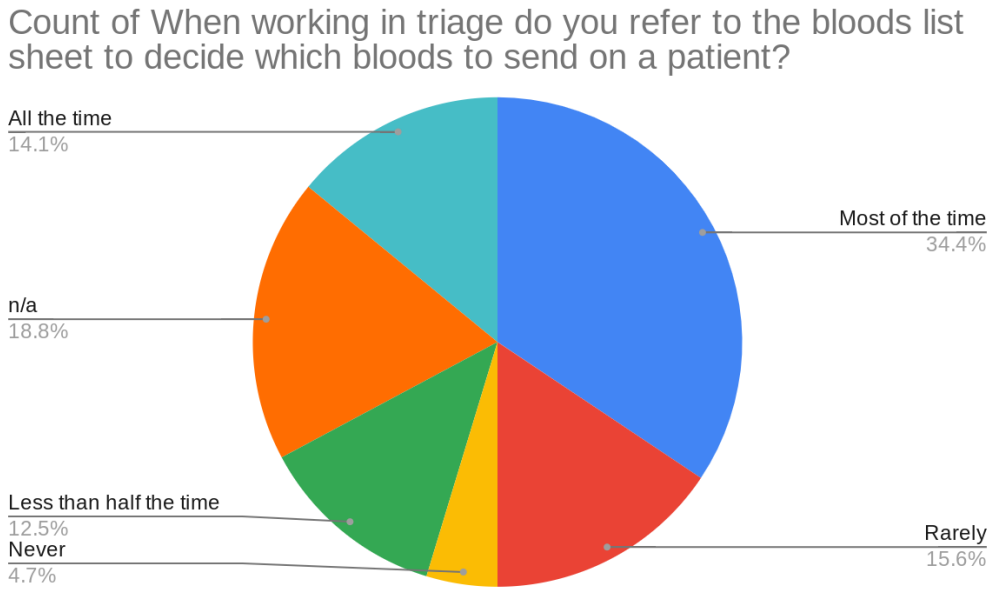
Staff breakdown (58 staff)-



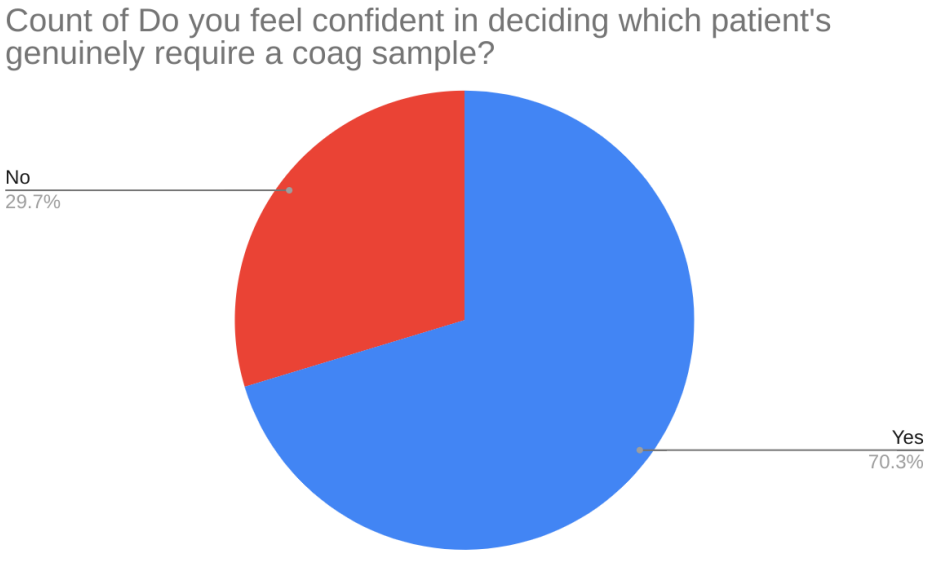
Awareness of coag project -



Adherence to Bloods list -



Coag Confidence -



The survey showed an encouraging percentage of staff were aware of the coag project suggesting to me communication by email and in the nursing handover had been successful to date. It also confirmed as I suspected that there was a variance in how often staff referred to the bloods list when working in triage hence this was something that could be improved but also some may continue not to use it and I wished to influence them in other ways. I was a bit surprised that the majority were confident which patients require a coag sample given the lack of overarching guidance there is on this. In retrospect a few clinical multiple choice questions may have been better utilised here.

I did 4 teaching sessions on the shop floor, two during night shifts and two during day shifts at “10@10” teaching. They were designed to be around 10 minutes long and primarily aimed at nursing staff, HCAs as well as ACPs and junior drs. I was keen that they were short enough to fit in to busy clinical shifts and mean that staff could feasibly leave their work and attend them and hence capture as many people as possible. A mixture of day and night sessions worked OK as some staff largely did night shifts and vice versa. The first session ran on 6/4/23 and the last on 1/6/23. At least 59 different staff attended these sessions, the majority being nurses or HCAs. It was a challenge fitting these in around a busy department and ensuring people could attend and also a challenge fitting these in around my work rota and other commitments. I had ideally hoped to have done more sessions and could have utilised a wider team to put on more - this will be touched on again in the reflection section. The presentation slides are in appendix 3. My focus was on the key patients that **do** require a coag - namely: Major bleeding, decompensated liver disease, paracetamol overdose (INR) and a reference to usefulness of INR checking in those on warfarin (something that used to be commonplace but has become less common with the advent of DOACs). It then included direction to the bloods list while also encouraging clinical judgement. It also covered some “common myths” that I had seen used as reasons for coag testing such as being on a DOAC (but no injury or bleeding) or undergoing surgery (not required in most cases[11]). I also touched on d-dimer testing as I had seen several cases of a coag being sent “in case they

need a d-dimer". I deliberately didn't include d-dimer specifically in the project as I felt it would overcomplicate things but touched on it here. The sessions were interactive and anecdotally well received.

PDSA Cycle 3

The 3rd PDSA cycle went live on 14/6/23 and was a simpler intervention consisting of a laminated reminder sheet which went over the compartment containing the coag tubes in all the blood trolleys in the department. The laminate is seen here:

This intervention was chosen for several reasons. Firstly, one of the consultants in the department had used this idea in a previous project she ran in another hospital to reduce coag sampling and it had been the most successful intervention in the project, hence I had high hopes it could help. It was also attractive in its simplicity as it was easy to implement and lastly I was hopeful it could target staff that may have missed the education or emails but also be an easy reminder for those that were aware of the project.

The Results

I'll firstly cover the balancing measure. Choosing a balancing measure was quite tricky as it had to be meaningful but workable. Various possibilities were considered. These included the example described in the REDUCED study[5] where they simply looked at the number of units of blood transfused (no increase) as a proxy measure for harm - I felt this was quite a crude measure. A fellow higher trainee directed me to a consultant at a neighbouring hospital who had run a similar project previously (without a balancing measure). He suggested measuring the number of patients who had to be re-bled to have a coag sample taken which ideally would have been done at the outset. I felt this was unworkable as this would entail auditing a vast number of patients which would be extremely time consuming and also differentiating those in whom it was indicated at the outset vs those in whom the clinical picture changed would be challenging. Also I am of the opinion that I was looking to reduce coag testing as a "front door" test. If at a later point in time a clinician has done a thorough review and deems additional testing is required which includes a coag sample then this is better than mass coag testing to encompass the few that are indicated. Hence I decided to focus on one high impact patient group - namely those with suspected upper GI bleeding. I pitched this idea at regional QI teaching and it was met with approval. We audited those who left the department with this as a provisional diagnosis (haemoptysis was also included) and audited whether they had a coag checked or not. The group I was specifically keen was not being missed were those with variceal bleeding (in whom coagulopathy is a real and relevant risk). Therefore we further examined a subset of patients who left the hospital (after inpatient admission) with a final diagnosis of upper GI bleed but DID NOT have a coag done in ED. Therefore effectively excluding those who didn't turn out to have a GI bleed at all (and whom I was less interested in). The audit ran from 14th Feb - 30th June. It was stopped at that point due to reassuring results, the project approaching conclusion as well as time pressures. The results are shown below:

Total patients: 136

Coag performed at triage? Yes: 86, No: 50

77 patients left hospital with a final diagnosis of UGIB (or haemoptysis). Note not all of these patients underwent an inpatient scope.

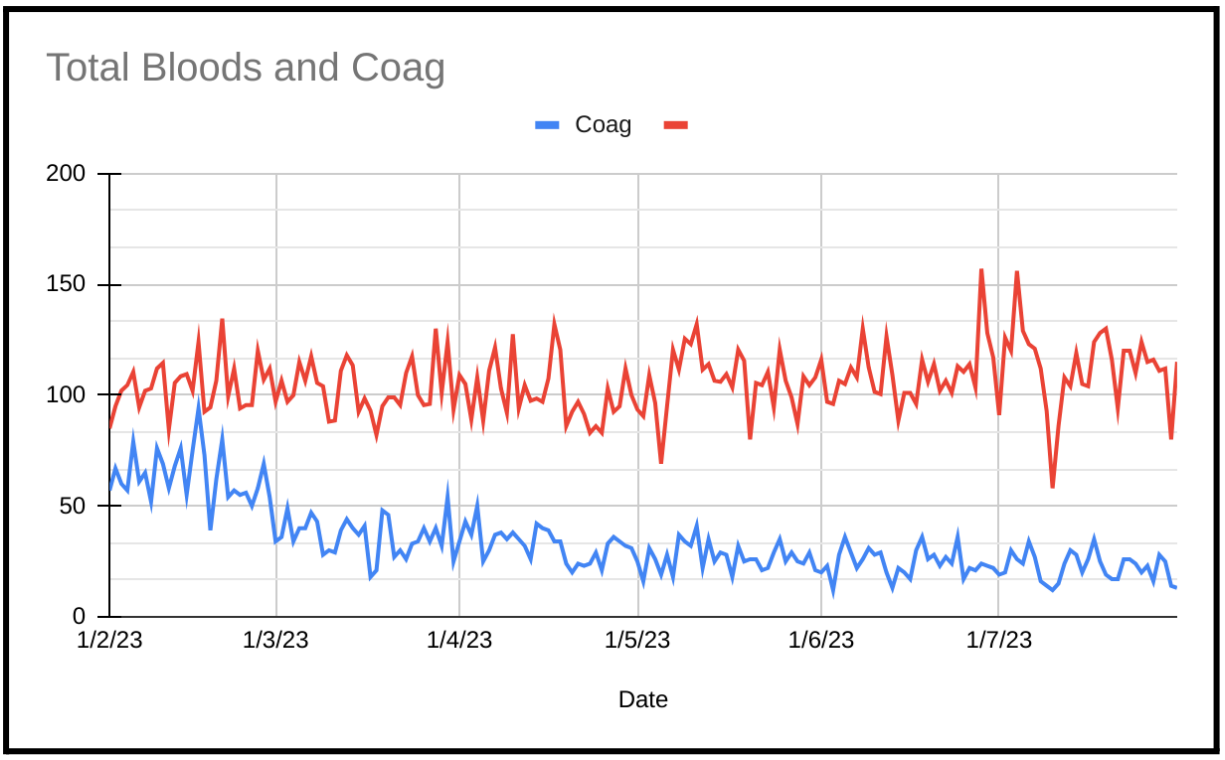
Of these 77 patients 25 **DID NOT** have a coag taken at triage.

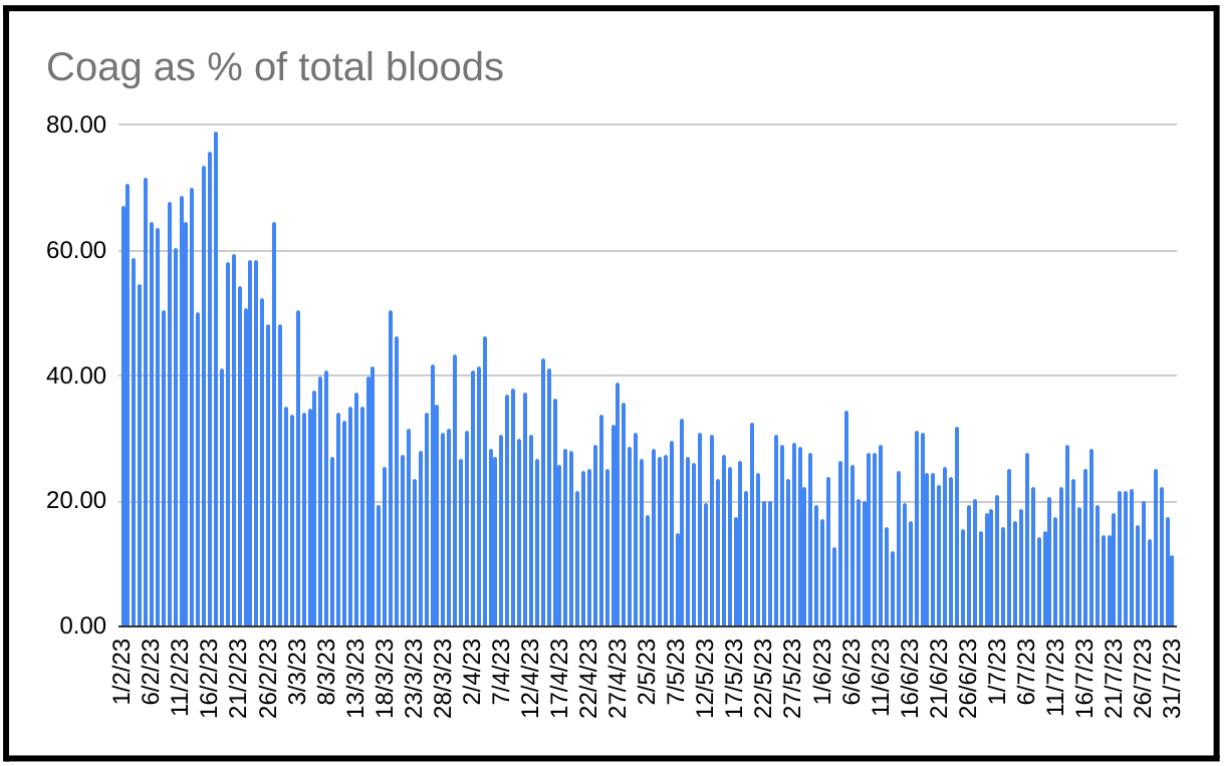
Of these 25 patients 17 had a coag checked later in the admission. Only 2 of these coag tests were abnormal

None of these 25 patients had any FFP transfused at any time during admission (8 had red cells transfused)

The conclusion from this data was that there was no convincing evidence of any harm being done due to reducing coag testing in ED

The outcome measure was the number of daily coag samples sent from A&E. I compared this against the daily number of blood sets sent (with use of a multiplication factor as mentioned previously. Note on 28th June (unbeknown to me until it happened) the lab made a change to the electronic requesting of samples so that biochemistry and haematology samples could be requested under one unique accession number (up to 10 tests) hence from that date onwards there is no halving of the total number. The day of the 28th itself may be a rogue value as I am unsure the exact time the change took place. Importantly the number of coag samples was an exact number all the way through. The results:





The full data can be seen in appendix 4.

The data demonstrate a successful and steady reduction in the number of coag samples sent. There is a sharp drop when the bloods list is changed then a slower decline thereafter.

We did not quite reach the 10% aim but were regularly under the 20% mark which is satisfying. This will be discussed further in the reflection section.

In addition to the numbers I calculated the cost saving. The lab confirmed that a single coag sample cost £7.02 at their end (excluding the bottle) and procurement team confirmed the bottles cost £0.10 each, hence £7.12 per coag sample. During the December audit period and February the average % of blood sets to include a coag sample was 61.38 hence I multiplied the daily number of blood sets by a factor of 0.61 to derive a predicted number of coag samples had changes not been made. The actual number of coags sent was subtracted from this number and the result multiplied by 7.12 to produce a daily saving. This data can be seen in appendix 4. Over the 5 months the total estimated saving was:

£34,095.76

Reflection

In addition to the reflection within the body of the write up, further thoughts follow here.

When the initial audit was done one of the challenges was actually deciding whether a coag sample was indicated in each case. It became clear that there is no universal guidance in relation to this in an undifferentiated ED setting. Hence the decision was made in each case by the author. Clearly having an interest in reducing tests and driving this project I could be prone to bias in this area and having either another individual look at this or better still a panel of people may have been better. For practical and timing reasons it was simpler to do this myself. In looking at each case if there was a weak argument for a coag being done I erred on the side of it being indicated rather than not indicated though clearly this is a subjective thing. If someone were to look at the data I would argue that it's quite clear that the majority of the coag samples sent had no good clinical indication at all and I suspect even the most risk averse clinicians would agree with this. My feeling is many of them were simply being done without any thought as a matter of course rather than for a clinical indication or after referral to a condition list.

A key strength of this project was the data. Being a numerous test the numbers were fairly large and analysing the data was an important task which I elected to take on myself rather than try and recruit someone to do this. I did this because I felt it was key to the project and it meant I was fully invested in tracking the progress. It was unfortunate that the electronic requesting changed part way through as this affected the data slightly. There are a small subset of patients who have a single haematology or biochemistry test sent while in ED rather than both (these are often repeat samples if a prior one has haemolysed for example). Hence the number of blood sets from 28th June and beyond is likely to be very slightly higher hence the proportion of coags may appear very slightly better than previously. I don't think this is a huge issue (the absolute number of coag samples fall throughout) but cannot be realistically measured. The project team was small and the majority of the work was done by myself with Sami Ahmed's balancing measure audit also being quite a large piece of work. Clearly a larger team could have spread the load more and may have been particularly helpful in certain areas such as delivering more education and may also have broadened the ideas from the outset. I was worried a larger team could have introduced delays in what was already a relatively tight timescale and I was also quite keen to deliver the education myself.
Why did we not reach the target 10%? I am unsure - perhaps it was too ambitious at the outset. Perhaps changing the bloods set to its current form was never destined to reach this percentage in terms of the frequency of coag samples it would advise (after all better use of it may also have resulted in some patients getting coags sent that might not have had previously)? Or perhaps the education drive and other measures simply weren't enough or other approaches should have been chosen. I was conscious more staff could have been interviewed or opinions sought or different angles taken but overall I think the approach taken was reasonable and I think the sustained improvement would support this.
In terms of the interventions I was actually quite surprised how big and immediate impact the changing of the bloods list made as I thought the message might take longer to get out and also people were perhaps not referring to the list anyway (I suspect the change meant more people did). In contrast to this the last intervention of the reminder laminate made a much

smaller difference - perhaps this was because the biggest gain had already been made. I think there is potential scope to improve things further in DMH in relation to coag sampling but at this juncture I'd want further analysis to guide it. This could potentially mean auditing all patients seen and comparing their triage diagnosis vs the bloods they had sent and calculating compliance against the bloods list. This would allow the number of coags that "should" be sent each day as per the bloods list. If this number is around the current level (~20%) then pushing for further reduction without revisiting the list would be foolish in my opinion. To get enough data this would be quite a time consuming piece of work and wasn't possible during the period of this project.

References

1. About Choosing Wisely UK [Internet]. Choosing Wisely UK. Available from: https://choosingwisely.co.uk/about-choosing-wisely-uk/
2. Realistic Medicine – Shared decision making, reducing harm, waste and tackling unwarranted variation [Internet]. Available from: https://www.realisticmedicine.scot/
4. Home [Internet]. greened.rcem.ac.uk. [cited 2023 Aug 3]. Available from: https://greened.rcem.ac.uk/
5. Fralick M, Hicks LK, Chaudhry H, Goldberg N, Ackery A, Nisenbaum R, et al. REDucing Unnecessary Coagulation Testing in the Emergency Department (REDUCED). BMJ Quality Improvement Reports. 2017;6(1):u221651.w8161.
6. Murphy E, MacGlone S, McGroarty C. A novel approach to improving coagulation sample ordering in an emergency department. BMJ Quality Improvement Reports. 2015;4(1):u204785.w2857.
7. Souverein PC, Ham HA, Huerta C, Merino EM, Montero D, León‐Muñoz LM, et al. Comparing risk of major bleeding between users of different oral anticoagulants in patients with nonvalvular atrial fibrillation. British Journal of Clinical Pharmacology. 2020 Jul 13;87(3):988–1000.
8. Coagulation [Internet]. Gloucestershire Hospitals NHS Foundation Trust. [cited 2023 Aug 3]. Available from: https://www.gloshospitals.nhs.uk/our-services/services-we-offer/pathology/haematology/coagulation/#:~:text=Blood%20samples%20should%20preferably%20reach
9. Management of Bleeding in Patients Taking Oral Anticoagulants Vitamin K antagonists [Internet]. Available from: https://www.gloshospitals.nhs.uk/media/documents/Oral_anticoagulants_bleeding_guide.pdf
10. NICE. Recommendations | sepsis: Recognition, diagnosis and early management | guidance | NICE [Internet]. Nice.org.uk. NICE; 2016. Available from: https://www.nice.org.uk/guidance/ng51/chapter/Recommendations#managing-and-treating-suspected-sepsis-in-acute-hospital-settings
11. van Veen JJ, Spahn DR, Makris M. Routine preoperative coagulation tests: an outdated practice? British Journal of Anaesthesia. 2011 Jan;106(1):1–3.

Appendix 1

COAG + NO TROP PLS.

Complaint	Bloods	ECG	Urine
Chest pain	Trop (only if cardiac CP), U&E, CRP. FBC.	Y	
Palpitations	U&E, CRP. FBC. Cl, Mg, Calcium	Y- show to Dr before bloods	
SOB	U&E, CRP. FBC.	Y	
Cough	U&E, CRP. FBC.		
Abdo pain	U&E, LFT, Amylase, CRP. FBC. VBG.	Y	Y +/- PT
Constipation	U&E, LFT, CRP. FBC.		Y
Diarrhoea	U&E, LFT, Bone, Mg2+, CRP. FBC.		Y
Vomiting	U&E, LFT, Bone, Mg2+, CRP. FBC.		Y +/-PT
Nausea	U&E, LFT, CRP. FBC.		Y +/- PT
Dizziness	U&E, LFT, CRP. FBC.		
Head injury	U&E. FBC. Coag.	Y	
Arm/limb weakness/stroke/TIA	U&E, LFT, Bone, Mg2+, CRP. FBC. Coag. VBG.	Y	Y
Headache	U&E, CRP. FBC.		
Pain on PU/increased frequency/unable to PU	U&E, CRP. FBC.		Y
Fever	U&E, LFT, CRP. FBC. VBG. Cultures (if able)	Y	Y
Confusion	U&E, LFT, Bone, Mg2+, CRP, TFT. FBC. VBG.	Y	Y
?#NOF	U&E, LFT, Bone, Mg2+, CRP. FBC. Coag. G+S.	Y	Y
Simple/mechanical fall			
Trauma	U&E, LFT, amylase, CRP. FBC. Coag. G+S/Xmatch. VBG	Y	Y
?DKA	U&E, LFT, CRP. FBC. Glu. VBG. Ketones.	Y	Y
Seizure	U&E, LFT, CRP. FBC. VBG.	Y	
Haematemesis (vomiting blood)/malaena	U&E, LFT, CRP. FBC. Coag. G+S/Xmatch.		
Haemoptysis (coughing up blood)	U&E, LFT, CRP. FBC. Coag. G+S/Xmatch.		
Haematuria	U&E, CRP. FBC. Coag. G+S/Xmatch.		Y
PV Bleeding	U&E, beta HCG. FBC. Coag. G+S/Xmatch.		Y + PT
Overdose	U&E, LFT, CRP, CK, Paracetamol. FBC. Coag. Ethanol. VBG.	Y	
Collapse	U&E, LFT, Bone, Mg2+, CRP, CK. FBC. Coag. VBG.	Y	Y
Sepsis	U&E, LFT, CRP. FBC. Coag. Cultures (if able). VBG.	Y	Y
Hyperglycaemia	U&E, LFT, CRP. FBC. Lac, glu. Ketones.		Y
Hypoglcaemia	U&E, LFT, CRP. FBC. Lac, glu.		
Rash	U&E. FBC.		
Leg pain/swelling	U&E, CRP. FBC. Coag. D-Dimer only after discussion with doctor	Y	
Back pain	Discuss with Dr.		Y +/- PT
Swollen joint	U&E, serum urate, CRP. FBC.		
Needlestick	X 2 serum for storage (micro form)		
Human bite	X 2 serum for storage (micro form)		
Dog/animal bite			
Electrocution	Discuss with Dr.	Y	

Appendix 2

Complaint	Bloods	ECG	Urine
Chest pain	Trop (only if cardiac CP), U&E, CRP. FBC.	Y	
Palpitations	U&E, CRP. FBC.	Y- show to Dr before bloods	
SOB	U&E, CRP. FBC.	Y	
Cough	U&E, CRP. FBC.		
Abdo pain	U&E, LFT, Amylase, CRP. FBC. VBG.	Y	Y +/- PT
Constipation	U&E, LFT, CRP. FBC.		Y
Diarrhoea	U&E, LFT, Bone, Mg2+, CRP. FBC.		Y
Vomiting	U&E, LFT, Bone, Mg2+, CRP. FBC.		Y +/-PT
Nausea	U&E, LFT, CRP. FBC.		Y +/- PT
Dizziness	U&E, LFT, CRP. FBC.		
Head injury	U&E. FBC. Coag (only if on anticoagulant. INR if warfarin).	Y	
Arm/limb weakness/stroke/TIA	U&E, LFT, Bone, Mg2+, CRP. FBC. Coag (INR if warfarin) VBG.	Y	Y
Headache	U&E, CRP. FBC.		
Pain on PU/increased frequency/unable to PU	U&E, CRP. FBC.		Y
Fever	U&E, LFT, CRP. FBC. VBG. Cultures (if able)	Y	Y
Confusion	U&E, LFT, Bone, Mg2+, CRP, TFT. FBC. VBG.	Y	Y
?#NOF	U&E, LFT, Bone, Mg2+, CRP. FBC. INR if on warfarin. G+S.	Y	Y
Simple/mechanical fall			
Trauma	U&E, LFT, amylase, CRP. FBC. Coag (If on anticoagulant or MAJOR bleeding) G+S/Xmatch. VBG	Y	Y
?DKA	U&E, LFT, CRP. FBC. Glu. VBG. Ketones.	Y	Y
Seizure	U&E, LFT, CRP, Mg, bone. FBC. VBG.	Y	
Haematemesis (vomiting blood)/malaena	U&E, LFT, CRP. FBC. Coag. G+S/Xmatch.		
Haemoptysis (coughing up blood)	U&E, LFT, CRP. FBC. Coag. G+S/Xmatch.		
Haematuria	U&E, LFT, CRP. FBC. Coag (only if on anticoagulant. INR if warfarin). G+S/Xmatch.		Y
PV Bleeding	U&E, beta HCG. FBC. Coag (only if on anticoagulant. INR if warfarin). G+S/Xmatch.		Y + PT
Overdose	U&E, LFT, CRP, CK, Paracetamol. FBC. INR . Ethanol. VBG.	Y	
Collapse	U&E, LFT, Bone, Mg2+, CRP, CK. FBC. VBG.	Y	Y
Sepsis	U&E, LFT, CRP. FBC. Cultures (if able). VBG.	Y	Y
Hyperglycaemia	U&E, LFT, CRP. FBC. Lac, glu. Ketones.		Y
Hypoglcaemia	U&E, LFT, CRP. FBC. Lac, glu.		
Rash	U&E. FBC.		
Leg pain/swelling	U&E, CRP. FBC. D-Dimer only after dw senior doctor	Y	
Back pain	Discuss with senior Dr.		Y +/- PT
Swollen joint	U&E, serum urate, CRP. FBC.		
Needlestick	X 2 serum for storage (micro form)		
Human bite	X 2 serum for storage (micro form)		
Dog/animal bite			
Electrocution	Discuss with senior Dr.	Y	

Appendix 3

Coagulation Testing in ED

James Tullie ST4

Why?

- We send lots of coag samples. Most are inappropriate
- My audit estimates at least 80% are not indicated
- Unnecessary testing has a cost - 1 coag test is roughly £6 not forgetting the plastic waste
- All tests should have an indication (we do a lot! - 260 sets of bloods some days, rejected G&S)

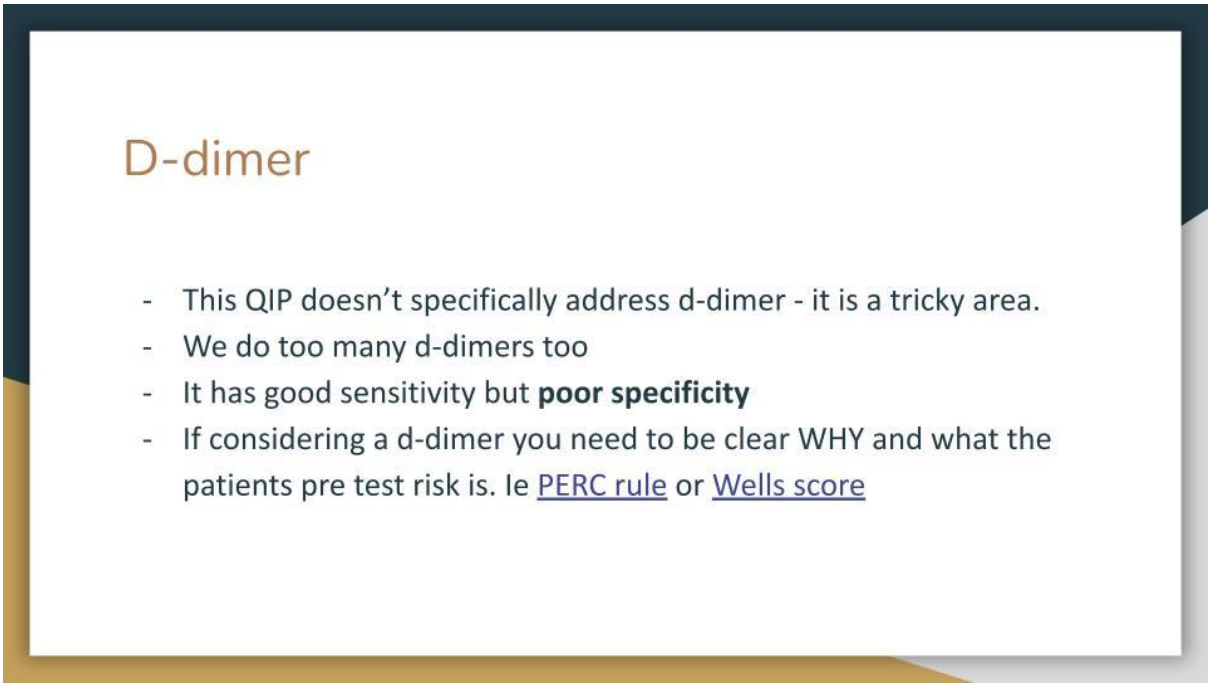
Green ED

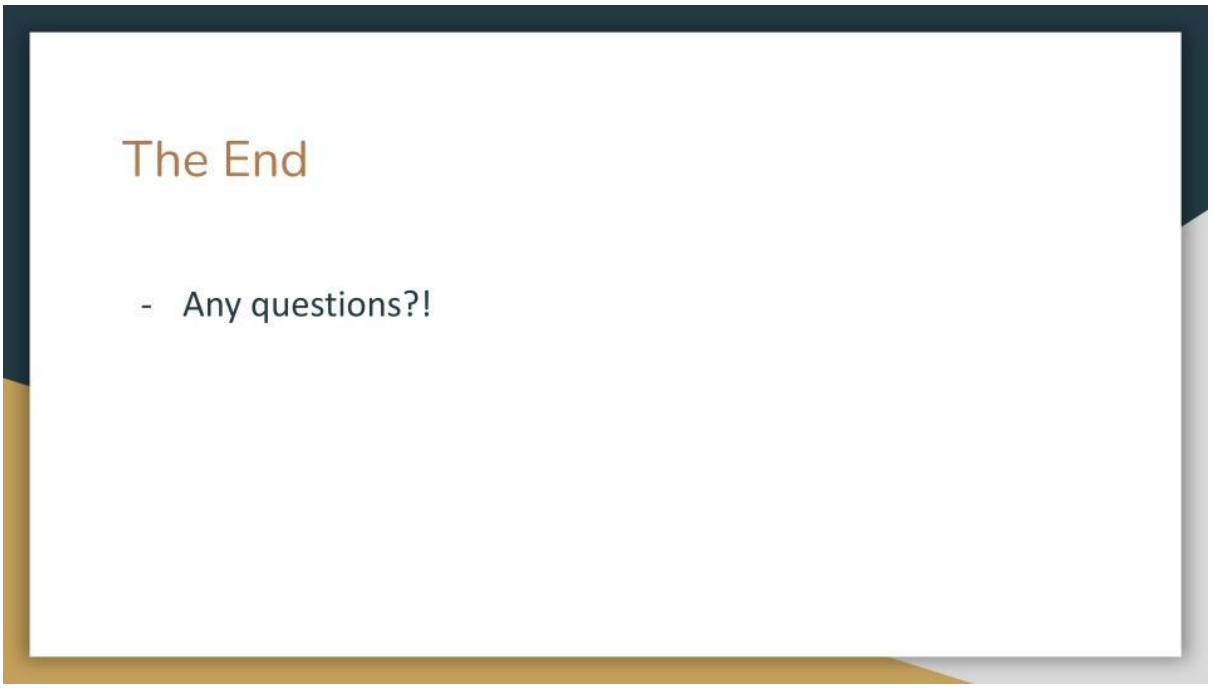
Which Patients Actually Need a Coag?!

- Not many!!
- **Major** bleeding (esp upper GI)
- Decompensated liver disease
- Paracetamol OD (INR)
- Check the bloods list if unsure. ie suspected stroke/TIA is an indication - though probably no benefit for majority
- Note patients on **warfarin** generally require an INR

Common myths

- All patients on DOACs need a Coag - No!
- All patients for possible surgery need a Coag - No! (as per NICE guidance)
- They might need a d-dimer…..I'll do a coag just in case….Don't get me started on this one!! - No!





Appendix 4

Date	Total Bloods		Coag	%				
1/2/23	170	85	57	67.06				
2/2/23	190	95	67	70.53				
3/2/23	204	102	60	58.82				

4/2/23	209	104.5	57	54.55				
5/2/23	221	110.5	79	71.49				
6/2/23	189	94.5	61	64.55				
7/2/23	204	102	65	63.73				
8/2/23	206	103	52	50.49				
9/2/23	224	112	76	67.86				
10/2/23	229	114.5	69	60.26				
11/2/23	169	84.5	58	68.64				
12/2/23	211	105.5	68	64.45				
13/2/23	217	108.5	76	70.05				
14/2/23	219	109.5	55	50.23				
15/2/23	204	102	75	73.53				
16/2/23	248	124	94	75.81				
17/2/23	185	92.5	73	78.92				
18/2/23	189	94.5	39	41.27				
19/2/23	213	106.5	62	58.22				
20/2/23	269	134.5	80	59.48				
21/2/23	199	99.5	54	54.27				
22/2/23	224	112	57	50.89				
23/2/23	188	94	55	58.51				
24/2/23	191	95.5	56	58.64				
25/2/23	191	95.5	50	52.36				
26/2/23	240	120	58	48.33				
27/2/23	214	107	69	64.49	65.27	-3.73	-£26.56	
28/2/23	224	112	54	48.21	68.32	14.32	£101.96	
1/3/23	194	97	34	35.05	59.17	25.17	£179.21	
2/3/23	213	106.5	36	33.80	64.965	28.97	£206.23	
3/3/23	194	97	49	50.52	59.17	10.17	£72.41	
4/3/23	200	100	34	34.00	61	27.00	£192.24	
5/3/23	230	115	40	34.78	70.15	30.15	£214.67	
6/3/23	213	106.5	40	37.56	64.965	24.97	£177.75	
7/3/23	235	117.5	47	40.00	71.675	24.68	£175.69	
8/3/23	211	105.5	43	40.76	64.355	21.36	£152.05	
9/3/23	208	104	28	26.92	63.44	35.44	£252.33	
10/3/23	176	88	30	34.09	53.68	23.68	£168.60	
11/3/23	177	88.5	29	32.77	53.985	24.99	£177.89	
12/3/23	222	111	39	35.14	67.71	28.71	£204.42	
13/3/23	236	118	44	37.29	71.98	27.98	£199.22	
14/3/23	227	113.5	40	35.24	69.235	29.24	£208.15	
15/3/23	185	92.5	37	40.00	56.425	19.43	£138.31	
16/3/23	197	98.5	41	41.62	60.085	19.09	£135.89	
17/3/23	186	93	18	19.35	56.73	38.73	£275.76	

18/3/23	164	82	21	25.61	50.02	29.02	£206.62	
19/3/23	190	95	48	50.53	57.95	9.95	£70.84	
20/3/23	198	99	46	46.46	60.39	14.39	£102.46	
21/3/23	198	99	27	27.27	60.39	33.39	£237.74	
22/3/23	191	95.5	30	31.41	58.255	28.26	£201.18	
23/3/23	220	110	26	23.64	67.1	41.10	£292.63	
24/3/23	235	117.5	33	28.09	71.675	38.68	£275.37	
25/3/23	200	100	34	34.00	61	27.00	£192.24	
26/3/23	191	95.5	40	41.88	58.255	18.26	£129.98	
27/3/23	192	96	34	35.42	58.56	24.56	£174.87	
28/3/23	260	130	40	30.77	79.3	39.30	£279.82	
29/3/23	202	101	32	31.68	61.61	29.61	£210.82	
30/3/23	248	124	54	43.55	75.64	21.64	£154.08	
31/3/23	187	93.5	25	26.74	57.035	32.04	£228.09	
1/4/23	218	109	34	31.19	66.49	32.49	£231.33	
2/4/23	210	105	43	40.95	64.05	21.05	£149.88	
3/4/23	178	89	37	41.57	54.29	17.29	£123.10	
4/4/23	216	108	50	46.30	65.88	15.88	£113.07	
5/4/23	177	88.5	25	28.25	53.985	28.99	£206.37	
6/4/23	222	111	30	27.03	67.71	37.71	£268.50	
7/4/23	243	121.5	37	30.45	74.115	37.12	£264.26	
8/4/23	206	103	38	36.89	62.83	24.83	£176.79	
9/4/23	184	92	35	38.04	56.12	21.12	£150.37	
10/4/23	255	127.5	38	29.80	77.775	39.78	£283.20	
11/4/23	188	94	35	37.23	57.34	22.34	£159.06	
12/4/23	209	104.5	32	30.62	63.745	31.75	£226.02	
13/4/23	195	97.5	26	26.67	59.475	33.48	£238.34	
14/4/23	197	98.5	42	42.64	60.085	18.09	£128.77	
15/4/23	194	97	40	41.24	59.17	19.17	£136.49	
16/4/23	215	107.5	39	36.28	65.575	26.58	£189.21	
17/4/23	264	132	34	25.76	80.52	46.52	£331.22	
18/4/23	241	120.5	34	28.22	73.505	39.51	£281.28	
19/4/23	172	86	24	27.91	52.46	28.46	£202.64	
20/4/23	185	92.5	20	21.62	56.425	36.43	£259.35	
21/4/23	194	97	24	24.74	59.17	35.17	£250.41	
22/4/23	183	91.5	23	25.14	55.815	32.82	£233.64	
23/4/23	166	83	24	28.92	50.63	26.63	£189.61	
24/4/23	172	86	29	33.72	52.46	23.46	£167.04	
25/4/23	166	83	21	25.30	50.63	29.63	£210.97	
26/4/23	206	103	33	32.04	62.83	29.83	£212.39	
27/4/23	185	92.5	36	38.92	56.425	20.43	£145.43	
28/4/23	190	95	34	35.79	57.95	23.95	£170.52	

29/4/23	224	112	32	28.57	68.32	36.32	£258.60	
30/4/23	200	100	31	31.00	61	30.00	£213.60	
1/5/23	187	93.5	25	26.74	57.035	32.04	£228.09	
2/5/23	181	90.5	16	17.68	55.205	39.21	£279.14	
3/5/23	218	109	31	28.44	66.49	35.49	£252.69	
4/5/23	193	96.5	26	26.94	58.865	32.87	£234.00	
5/5/23	138	69	19	27.54	42.09	23.09	£164.40	
6/5/23	190	95	28	29.47	57.95	29.95	£213.24	
7/5/23	241	120.5	18	14.94	73.505	55.51	£395.20	
8/5/23	223	111.5	37	33.18	68.015	31.02	£220.83	
9/5/23	251	125.5	34	27.09	76.555	42.56	£302.99	
10/5/23	246	123	32	26.02	75.03	43.03	£306.37	
11/5/23	264	132	41	31.06	80.52	39.52	£281.38	
12/5/23	223	111.5	22	19.73	68.015	46.02	£327.63	
13/5/23	228	114	35	30.70	69.54	34.54	£245.92	
14/5/23	213	106.5	25	23.47	64.965	39.97	£284.55	
15/5/23	212	106	29	27.36	64.66	35.66	£253.90	
16/5/23	219	109.5	28	25.57	66.795	38.80	£276.22	
17/5/23	207	103.5	18	17.39	63.135	45.14	£321.36	
18/5/23	241	120.5	32	26.56	73.505	41.51	£295.52	
19/5/23	231	115.5	25	21.65	70.455	45.46	£323.64	
20/5/23	160	80	26	32.50	48.8	22.80	£162.34	
21/5/23	211	105.5	26	24.64	64.355	38.36	£273.09	
22/5/23	209	104.5	21	20.10	63.745	42.75	£304.34	
23/5/23	221	110.5	22	19.91	67.405	45.41	£323.28	
24/5/23	189	94.5	29	30.69	57.645	28.65	£203.95	
25/5/23	241	120.5	35	29.05	73.505	38.51	£274.16	
26/5/23	213	106.5	25	23.47	64.965	39.97	£284.55	
27/5/23	198	99	29	29.29	60.39	31.39	£223.50	
28/5/23	174	87	25	28.74	53.07	28.07	£199.86	
29/5/23	217	108.5	24	22.12	66.185	42.19	£300.36	
30/5/23	209	104.5	29	27.75	63.745	34.75	£247.38	
31/5/23	216	108	21	19.44	65.88	44.88	£319.55	£20,457.79
1/6/23	232	116	20	17.24	70.76	50.76	£361.41	
2/6/23	194	97	23	23.71	59.17	36.17	£257.53	
3/6/23	192	96	12	12.50	58.56	46.56	£331.51	
4/6/23	213	106.5	28	26.29	64.965	36.97	£263.19	
5/6/23	210	105	36	34.29	64.05	28.05	£199.72	
6/6/23	225	112.5	29	25.78	68.625	39.63	£282.13	
7/6/23	216	108	22	20.37	65.88	43.88	£312.43	
8/6/23	260	130	26	20.00	79.3	53.30	£379.50	
9/6/23	225	112.5	31	27.56	68.625	37.63	£267.89	

10/6/23	203	101.5	28	27.59	61.915	33.92	£241.47	
11/6/23	201	100.5	29	28.86	61.305	32.31	£230.01	
12/6/23	253	126.5	20	15.81	77.165	57.17	£407.01	
13/6/23	218	109	13	11.93	66.49	53.49	£380.85	
14/6/23	177	88.5	22	24.86	53.985	31.99	£227.73	
15/6/23	202	101	20	19.80	61.61	41.61	£296.26	
16/6/23	202	101	17	16.83	61.61	44.61	£317.62	
17/6/23	192	96	30	31.25	58.56	28.56	£203.35	
18/6/23	232	116	36	31.03	70.76	34.76	£247.49	
19/6/23	212	106	26	24.53	64.66	38.66	£275.26	
20/6/23	228	114	28	24.56	69.54	41.54	£295.76	
21/6/23	204	102	23	22.55	62.22	39.22	£279.25	
22/6/23	213	106.5	27	25.35	64.965	37.97	£270.31	
23/6/23	202	101	24	23.76	61.61	37.61	£267.78	
24/6/23	226	113	36	31.86	68.93	32.93	£234.46	
25/6/23	221	110.5	17	15.38	67.405	50.41	£358.88	
26/6/23	228	114	22	19.30	69.54	47.54	£338.48	
27/6/23	207	103.5	21	20.29	63.135	42.14	£300.00	
28/6/23		157	24	15.29	95.77	71.77	£511.00	
29/6/23		128	23	17.97	78.08	55.08	£392.17	
30/6/23		117	22	18.80	71.37	49.37	£351.51	£29,539.78
1/7/23		91	19	20.88	55.51	36.51	£259.95	£29,826.29
2/7/23		126	20	15.87	76.86	56.86	£404.84	£30,129.17
3/7/23		120	30	25.00	73.2	43.20	£307.58	£30,257.54
4/7/23		156	26	16.67	95.16	69.16	£492.42	£30,543.73
5/7/23		129	24	18.60	78.69	54.69	£389.39	£30,860.71
6/7/23		123	34	27.64	75.03	41.03	£292.13	£30,960.61
7/7/23		121	27	22.31	73.81	46.81	£333.29	£31,079.23
8/7/23		112	16	14.29	68.32	52.32	£372.52	£31,273.99
9/7/23		93	14	15.05	56.73	42.73	£304.24	£31,402.55
10/7/23		58	12	20.69	35.38	23.38	£166.47	£31,416.96
11/7/23		86	15	17.44	52.46	37.46	£266.72	£31,431.35
12/7/23		108	24	22.22	65.88	41.88	£298.19	£31,560.93
13/7/23		104	30	28.85	63.44	33.44	£238.09	£31,621.13
14/7/23		119	28	23.53	72.59	44.59	£317.48	£31,734.20
15/7/23		105	20	19.05	64.05	44.05	£313.64	£31,848.61
16/7/23		104	26	25.00	63.44	37.44	£266.57	£31,907.03
17/7/23		124	35	28.23	75.64	40.64	£289.36	£32,058.08
18/7/23		128	25	19.53	78.08	53.08	£377.93	£32,300.13
19/7/23		130	19	14.62	79.3	60.30	£429.34	£32,453.71
20/7/23		116	17	14.66	70.76	53.76	£382.77	£32,629.86
21/7/23		94	17	18.09	57.34	40.34	£287.22	£32,846.23

22/7/23		120	26	21.67	73.2	47.20	£336.06	£33,079.84
23/7/23		120	26	21.67	73.2	47.20	£336.06	£33,178.17
24/7/23		110	24	21.82	67.1	43.10	£306.87	£33,283.86
25/7/23		124	20	16.13	75.64	55.64	£396.16	£33,387.39
26/7/23		115	23	20.00	70.15	47.15	£335.71	£33,447.73
27/7/23		116	16	13.79	70.76	54.76	£389.89	£33,645.38
28/7/23		111	28	25.23	67.71	39.71	£282.74	£33,798.14
29/7/23		112	25	22.32	68.32	43.32	£308.44	£33,931.71
30/7/23		80	14	17.50	48.8	34.80	£247.78	£33,899.67
31/7/23		115	13	11.30	70.15	57.15	£406.91	£34,095.76