



# Change proposal

## Iatrogenic anaemia caused by excess blood sampling in the critical care unit

Janice Windsor  
Senior Sister & Local Service Improvement Lead



# The problem



Anaemia remains a common comorbidity in critical care patients

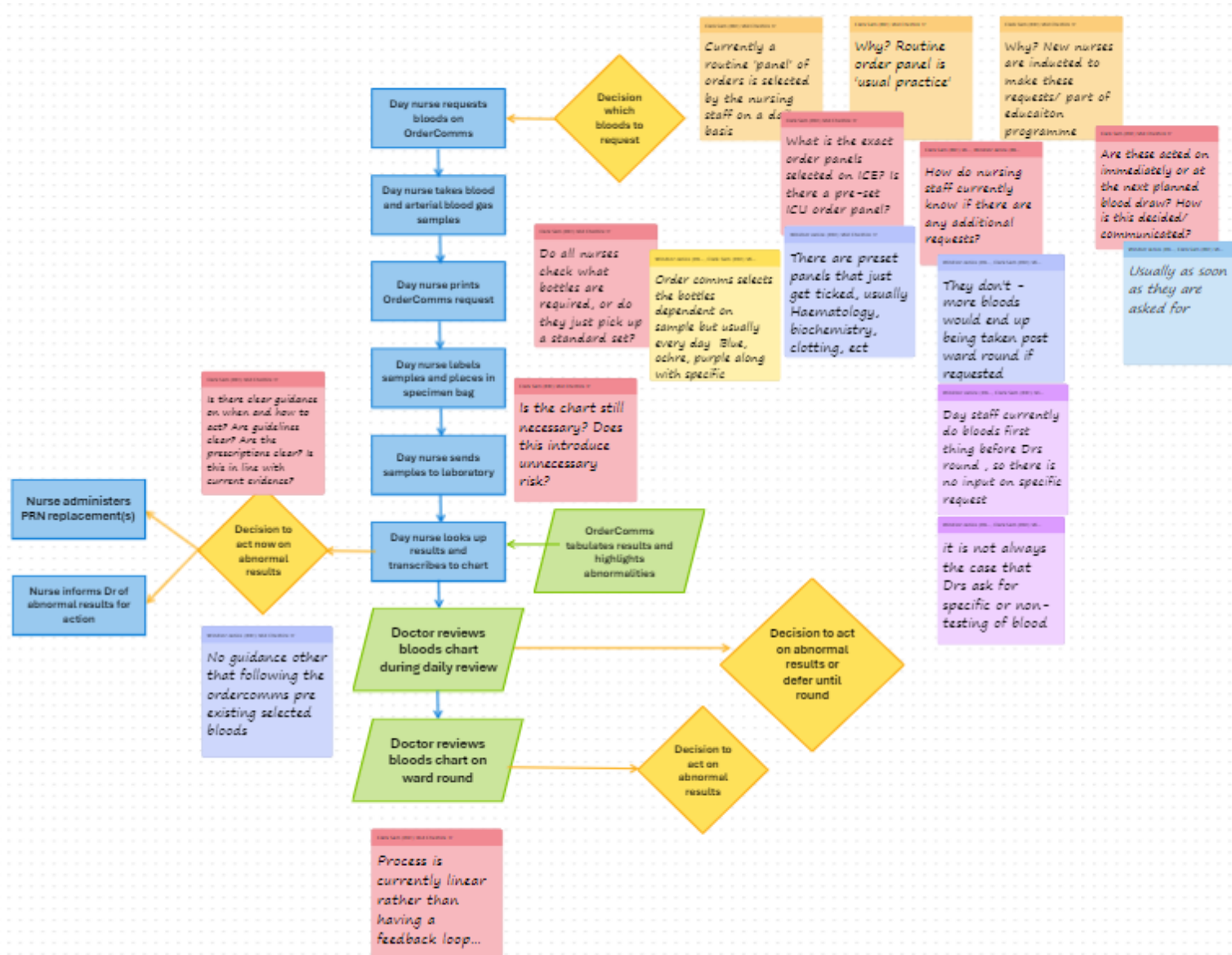
Although the cause can be multi-factorial, iatrogenic factors such as excess diagnostic phlebotomy is recognised in literature to contribute

Excess diagnostic phlebotomy, and anaemia contributed by this, can result in:

- Increased ICU stay and mortality
- Increased hospital stay following ICU discharge
- Increased need for transfusion, and risk of complications associated with this
- Increased consumable use associated with both phlebotomy and transfusion
- Increased financial cost associated with both phlebotomy and transfusion



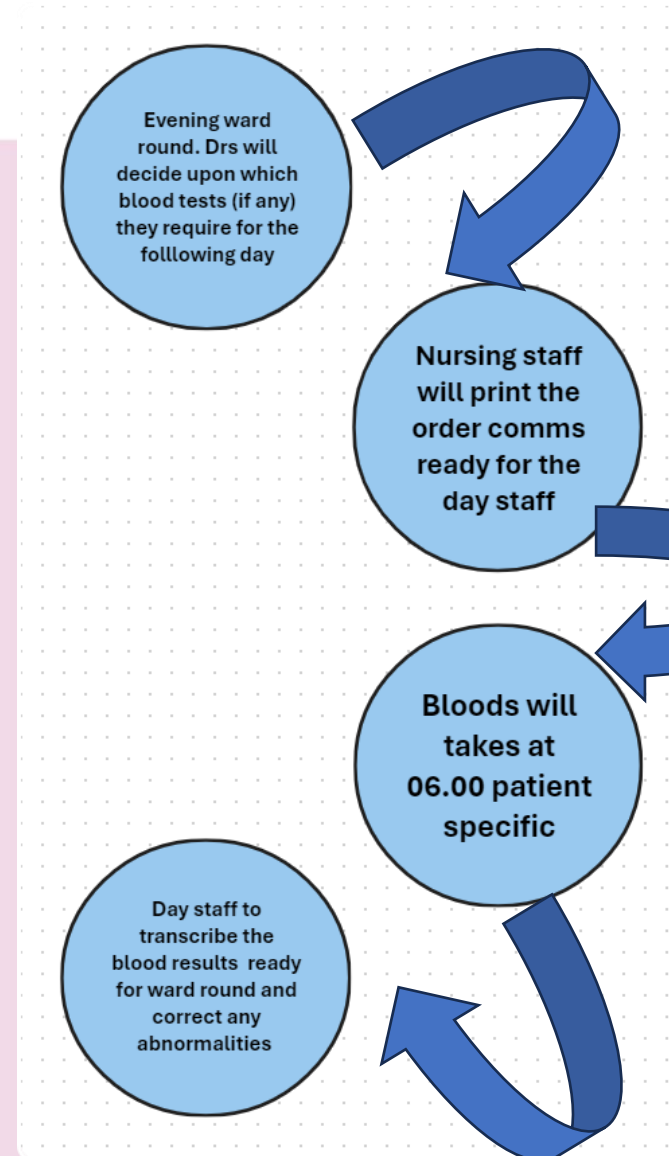
# Diagnosing the problem





## Designing a solution

- We've already changed the timing of blood tests to ensure results are available for ward round – this followed examining and questioning the current process
- Currently looking at further changes to be tested with PDSA cycles:





# Plans for change



Prioritisation Matrix - PICK Chart		
High impact/benefit	IMPLEMENT (quick wins)	
	CHALLENGING (start planning with others)	
Low impact/benefit	<p>Bloods to be taken at 06.00 to ensure the results are back for 10.00 --&gt; Removes waste (time) from process</p> <p>Patient specific tests requested on PM WR for next day - Sticker on daily review vs alteration to daily review with check boxes</p>	<p>Re-organise the order comms/ new order sets for DCS - Structure to make individual choices and not groups of samples daily - Remove unnecessary tests from groups</p> <p>Use of a closed circuit (Edwards) to return blood to the patient --&gt; reducing infection and waste</p> <p>Teaching/education defined for new started Guidelines/ quick access guidelines</p>
	<p>Discontinue paper blood results chart --&gt; Removes unnecessary step (waste), reduces nursing time, removes risk of transcription errors</p>	<p>Use paediatric blood bottles - Lower volume required, initially looked viable but would need to go through ethics. Therefore this process would prove longer and complicated to achieve, can implement closed circuit systems instead.</p>
POSSIBLE plan for later)		
Easy		
Hard		



# Which tests do we really need daily?



## Most critical care patients Most days

Full blood count

Urea and electrolytes

## Some critical care patients Some days

Liver function test

ALT  
*(Requested separately)*

Coagulation screen

Bone profile  
*(Includes calcium and phosphate; iCa available on ABG)*

Magnesium

## Certain critical care patients Certain days



Amylase

C-Reactive Protein

## Rare critical care patients Certain days



Glucose  
*(Available via capillary or ABG)*

Figure 2. Guideline for ordering coagulation tests

Trigger	Action
On ICU admission	→ Order screening coagulation profile if not done that day
Arising during ICU stay:	
• Significant bleeding	→ Order coagulation profile as required
• Before significant procedure: - New thrombocytopenia < 50 - Liver failure - DIC	→ Order coagulation profile once and then daily if abnormal*
• Warfarin therapy Isolated high INR (> 1.3)	→ INR only, daily or less when patient improving
• Heparin therapy Isolated high aPTT (> 42)	→ aPTT only, as per heparin protocol, or daily or less if patient improving
• Coagulation profile abnormal* but none of the above	→ Consider ordering coagulation profile second daily or less if patient improving

ICU = intensive care unit. DIC = disseminated intravascular coagulation. INR = international normalised ratio. aPTT = activated partial thromboplastin time. \* INR > 1.3; aPTT > 42 s; fibrinogen excluded.





Critical Care Unit Blood Results		
<u>Routine critical care admission bloods</u>		
Full blood count	<input type="checkbox"/>	£3.64
Coagulation screen	<input type="checkbox"/> *INR and aPTT ratio	£5.54
Liver profile	<input type="checkbox"/> *Bilirubin and ALT	£4.51
Renal profile	<input type="checkbox"/> *Urea, sodium, potassium, and creatinine	£4.62
Bone profile	<input type="checkbox"/> Albumin, ALP, calcium, adjusted calcium, and phosphate	£4.52
Magnesium	<input type="checkbox"/>	£1.30

Except for when included in 'Routine critical care admission bloods', we remind colleagues that the following tests should not be ordered routinely:

Glucose	X	Glucose is available through point of care testing (measured by capillary glucose or blood gas).	£2.71
Calcium & albumin	X	Ionised calcium (measured on blood gas) is a reliable marker of the amount of 'available' calcium in the blood.	£0.78
Bone profile	X	Order the components of a bone profile separately, as required (i.e., request 'Phosphate').	£4.52
C-reactive protein	X	C-Reactive protein is non-specific, and it can take up to 48 hours for levels to rise after a trigger.	£2.89
Amylase	X	Amylase is a marker of disease of the pancreas and should only be ordered to confirm clinical findings.	£2.78

### Coagulation testing quick reference guide.

Trigger	Order	
On critical care admission		
Significant bleeding		
Before significant procedure	Coagulation screen	£5.54
Liver failure		
Disseminated intravascular coagulation		
Warfarin therapy	INR only	
Unfractionated heparin therapy	aPTT only	

### Liver function testing quick reference guide.

Trigger	Order	
Suspect hepatocellular damage	ALT AST	£2.72
Suspect cholestasis or impaired conjugation	Bilirubin	£2.72
Suspect cholestasis or infiltrative disease	ALP	
Suspect cholestasis	GGT	£2.73
Suspect synthetic dysfunction	Coagulation screen Albumin	£5.54







## Side A



### Critical Care Unit Blood Results

*Affix patient addressograph here*

7 days

## Reduced number of 'most routine' tests

## Space to document ionised calcium

[illegible]



# Change proposal

## Side A



1. Review today's results in context of clinical picture

2. Tick tests required tomorrow

3. Write any additional tests here

Requests for tomorrow								
Full blood count	£3.64	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Coagulation screen*	£5.54	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Renal profile*	£4.62	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Magnesium	£1.30	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Phosphate		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Liver profile*	£4.51	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other (See medical notes)		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		HbA1c TSH						

Blood tests should be requested based on clinical need, rather than as 'routine'.  
Unnecessary phlebotomy leads to excess blood loss and increases potential need for transfusion.

September 2024



Routine critical care admission bloods

Full blood count	<input type="checkbox"/>		£3.64
Coagulation screen	<input type="checkbox"/>	*INR and aPTT ratio	£5.54
Liver profile	<input type="checkbox"/>	*Bilirubin and ALT	£4.51
Renal profile	<input type="checkbox"/>	*Urea, sodium, potassium, and creatinine	£4.62
Bone profile	<input type="checkbox"/>	Albumin, ALP, calcium, adjusted calcium, and phosphate	£4.52
Magnesium	<input type="checkbox"/>		£1.30

**Note:** Future plans to amend order set, and to include screening swabs



Except for when included in 'Routine critical care admission bloods', we remind colleagues that the following tests should not be ordered routinely:

Glucose	X	Glucose is available through point of care testing (measured by capillary glucose or blood gas).	£2.71
Calcium & albumin	X	Ionised calcium (measured on blood gas) is a reliable marker of the amount of 'available' calcium in the blood.	£0.78
Bone profile	X	Order the components of a bone profile separately, as required (i.e., request 'Phosphate').	£4.52
C-reactive protein	X	C-Reactive protein is non-specific, and it can take up to 48 hours for levels to rise after a trigger.	£2.89
Amylase	X	Amylase is a marker of disease of the pancreas and should only be ordered to confirm clinical findings.	£2.78



## Quick reference guides as to which tests to request when

### Coagulation testing quick reference guide.

Trigger	Order	
On critical care admission	Coagulation screen	£5.54
Significant bleeding		
Before significant procedure		
Liver failure		
Disseminated intravascular coagulation	INR only	
Warfarin therapy		
Unfractionated heparin therapy	aPTT only	

### Liver function testing quick reference guide.

Trigger	Order	
Suspect hepatocellular damage	ALT	£2.72
	AST	£2.72
Suspect cholestasis or impaired conjugation	Bilirubin	
Suspect cholestasis or infiltrative disease	ALP	
Suspect cholestasis	GGT	£2.73
Suspect synthetic dysfunction	Coagulation screen	£5.54
	Albumin	

National recommendations for minimum re-testing intervals in pathology



Further information here

Because you  Matter



## Run Chart 2

### Cost



	Apr	May	Jun
<b>CRITICAL CARE BED DAYS</b>	<b>191</b>	<b>207</b>	<b>179</b>
Amylase	£428.12	£544.88↑	£364.18↓
Bone Profile	£759.36	£949.20↑	£637.32↓
C-Reactive Protein (CRP)	£485.52	£604.01↑	£407.49↓
Full blood count	£611.52	£844.48↑	£564.20↓
Glucose	£433.60	£544.71↑	£384.82↓
Liver Function Tests	£775.72	£942.59↑	£640.42↓
Magnesium	£219.70	£270.40↑	£183.30↓
Proteins (T.Prot/Albumin/Glob)	£95.70	£117.16↑	£81.78↓
Urea & Electrolytes	£803.88	£1,016.40↑	£669.90↓
<b>Total Cost</b>	<b>£4613.12</b>	<b>£5833.83↑</b>	<b>£3933.41↓</b>
<b>Cost Per Bed Day</b>	<b>£24.15</b>	<b>£28.18↑</b>	<b>£21.97↓</b>



## Run Chart 3 Blood Products

Quarter 2 – Month:	Apr	May	Jun	Total
5% Albumin		5↑		5
20% Albumin	10	17↑	2↓	28
Cryoprecipitate	-	7↑	↓	7
Fresh Frozen Plasma	8	9↑	↓	17
Prothrombin Complex Concentrate		↔	↔	0
Platelets		17↑	↓	17
Whole Bag Blood	10	53↑	6↓	69
<b>Grand Total</b>	<b>28</b>	<b>108</b>	<b>14</b>	<b>267</b>



## 2023 Data Highlights



### Data for:

Amylase  
Bone profile  
CRP  
FBC  
Glucose  
LFT  
Magnesium  
Proteins  
U+E

**19, 678 tests ordered  
at a cost of £60, 514.88**



Project No & Title:	Iatrogenic impacts of over blood testing	Strategic Alignment:	Sustainability and Quality	Start Date:	16/3/24	End Date:	31/3/25
Project Lead:	Sr Janice Windsor	Project Sponsor:	Dr Sam Clark	Department:	Critical Care Unit		

## Step 1. Describe

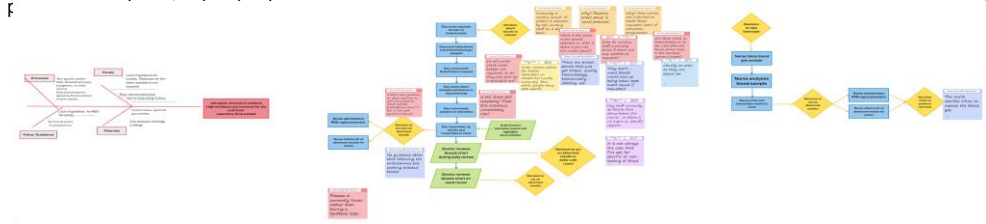
There is un-necessary 'routine' blood testing of critically ill adult patients within Critical Care at MCHT. Frequent blood drawing on this patient cohort can result in Iatrogenic anaemia, increased incidence of transfusion, and potential for longer length of stay, which all could have detrimental effects on patients. It also results in a cost implication for the Trust, i.e. increased consumables, laboratory testing, transfusions and Critical care.

**Project Team:** SSR Jan Windsor and Dr Sam Clarke Stakeholder analysis

## Step 2. Diagnose

**Current process(es):**  
Bloods are taken daily in the morning prior to ward rounds. These are decided by the nurse in the bed space and what is presented in the preset choices available on ICE. Waste is therefore an issue within the process including in terms of : patient's blood not being required daily or at least less volume; consumable waste; motion waste ;time for the clinical staff to take the bloods; time for lab technicians to test; and the subsequent costs incurred.

The below Fishbone Diagram identifies the root causes to the issue and the below Process Map shows the



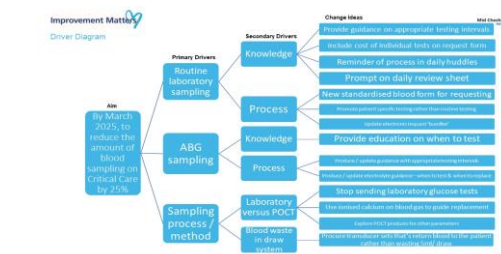
Themes arising from the fishbone include the reliance on non-specific blood requests resulting in all of them being selected for most of the time; Lack of confidence in rationalising the need to not repeat a blood gas so often was also identified and a lack of awareness as to the impacts of unnecessary routine blood testing and blood gases on patients and the organisation.

Audit was used to examine the bloods ordered in terms of the volumes taken and the frequency, as well as the amount of blood test taken with no change to treatment, costs of tests and consumable's, volumes of blood taken and amount of blood transfused.



## Step 3. Design

To reduce the amount of 'unnecessary' blood sampling on Critical Care by 25% by March 2025.

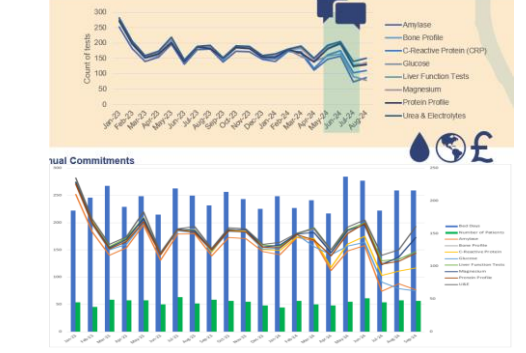


Key tests of change from Driver Diagram:

- Consultant to review blood results on the evening ward round and request which they would like for the next day
- New blood request form to breakdown bloods and cost
- Daily huddle reminder of new process
- The ABG being taken should be relevant and justified:
  - Is there a change in FIO2 needed?
- Education and staff support
- New transducer sets that return blood to the patient thus saving 5mls per draw

## Step 4. Data

Data shows that by initiating discussion about routine blood testing we reduced the number of requests (April-July 2024). Following this we changed practice with an updated results sheet and continue to see reductions. We will continue with the tests of change to make continuous improvements.



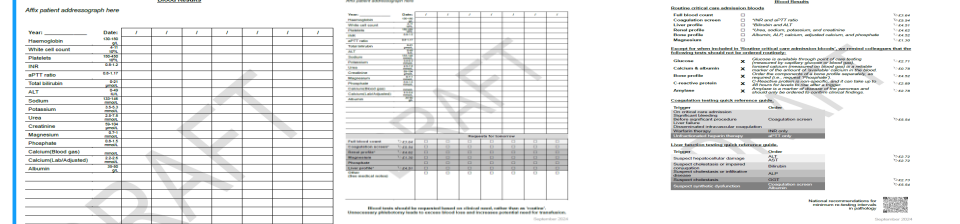
Since the beginning of the project there has been a reduction in the number of the 'common' tests sent, with these improvements equating to a saving of **£15,857.90** from Jan 2023-Dec 2024.

## Step 5. Implement

I trialled many of the changes from the driver diagram and tested them on Critical Care. I worked through the PICK chart



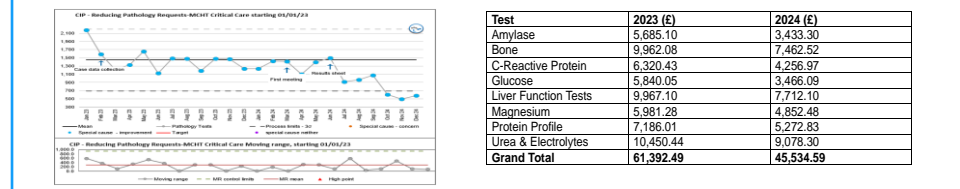
A scoping exercise on 1 specific patient's phlebotomy history confirmed that we repeated bloods daily without considering clinical need. This audit of 43 days was presented with run charts of patients' results and number of blood transfusions the patient had received. Gemba walks involved engaging staff on current practice and discussing how we could improve



Above provides examples of the blood forms developed with a reduced number of 'most routine' tests and costs indicated. The forms and routines were shared with staff and reinforced in Safety Huddles. This is reducing the burden of nursing staff transcribing results from an electronic system

## Step 6. Develop

The improvement aim was met with a reduction in the amount of unnecessary blood sampling on Critical Care by 42.59 % in the last 6 months since introducing the change.



Although improvement has been made, there are indications of reverting to previous practices. This is a good indicator for further teaching, reinforcing the change and continued data collection. With the DCS, there is an opportunity to change the requesting process, and we will liaise with the development team. There is also potential to abolish laboratory glucose testing, saving a further **£466.09** annually. The improvement work is already being shared with other areas, as there has been an interest from other Consultants around how they can apply these change ideas to reduce unnecessary blood sampling in their areas to similar effects, improving patient outcomes and achieving cost