NHS
Cheshire and Merseyside
Provider Collaborative

Streamlining Clinical Workflows in LIMS: High-Value Improvements to Authorisation and Decision Support

Sarah Curtis

Consultant Clinical Scientist, CSO

Liverpool Clinical Laboratories, Warrington & Halton Hospitals

Clinical Lead for Laboratory Informatics, Cheshire & Merseyside Pathology Network

sarah.curtis@liverpoolft.nhs.uk

Learning Outcomes

NHS
Cheshire and Merseyside
Provider Collaborative

- Build confidence to explore LIMS capabilities and drive curiosity-led, data-informed service improvement through understanding how LIMS features add value and support safe clinical reporting
- Optimising queues and rules to eliminate superfluous trapping, increasing focus of clinical review
- Leveraging evidence-based automated commenting to simultaneously elevate efficiency and clinical effectiveness
- Exploring new opportunities for embedding clinical decision support to support safe, consistent and efficient clinical decision-making
- Identifying triggers for process review and applying practical methods to evaluate current workflows and create targeted action plans

NHS
Cheshire and Merseyside
Provider Collaborative

Streamlined Authorisation Queues

Who is in the driving seat – you or your LIMS?

Efficiency And Effectiveness Require Intentionality Of Purpose and Processes

Could your Duty Biochemist day use a refresh?

Cheshire and Merseyside
Provider Collaborative

```
AIX Version 7
Copyright IBM Corporation, 1982, 2011.
login: TPATH
*******************************************************************************
*                                                                             *
*                                                                             *
*  Welcome to AIX Version 7.1!                                                *
*                                                                             *
*                                                                             *
*  Please see the README file in /usr/lpp/bos for information pertinent to    *
*  this release of the AIX Operating System.                                  *
*                                                                             *
*                                                                             *
*******************************************************************************
```

Why Do We Trap For Clinical Review?

NHS
Cheshire and Merseyside
Provider Collaborative

- To take an action
  - Abnormal result communication
  - Add a comment
  - Add a test ('reflective')
- Clinical quality review – something off in the 'wallpaper'?
  - Preanalytical issues
    - Contamination, 'wrong blood', etc.
  - Analytical issues
    - Analyser failure, missed dilution, etc.
- To learn?

Telephone queues ideally a separate entity

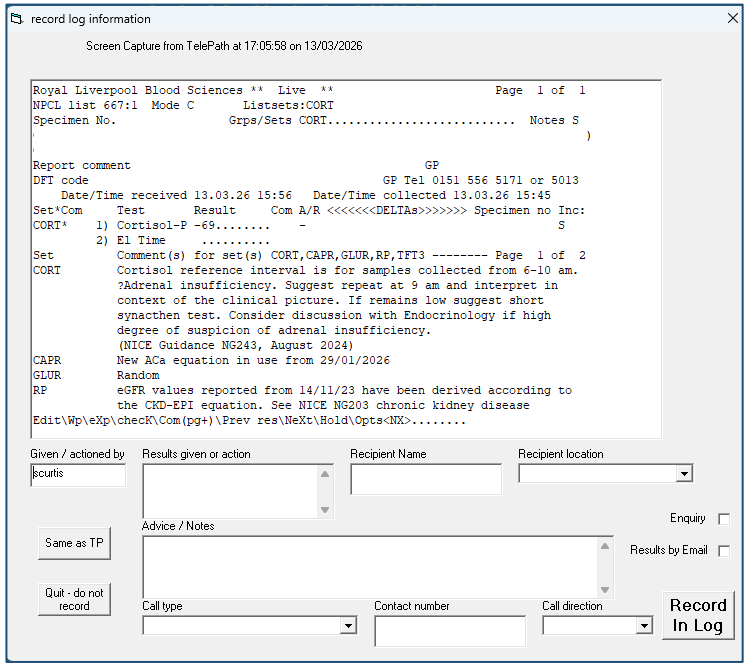
Automatable?

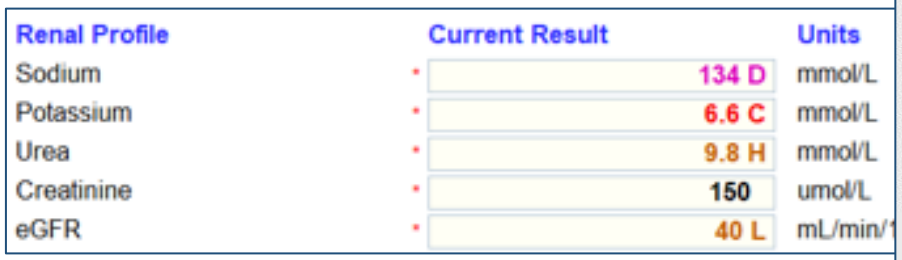
A necessary safety net for technical validation or redundancy of function?

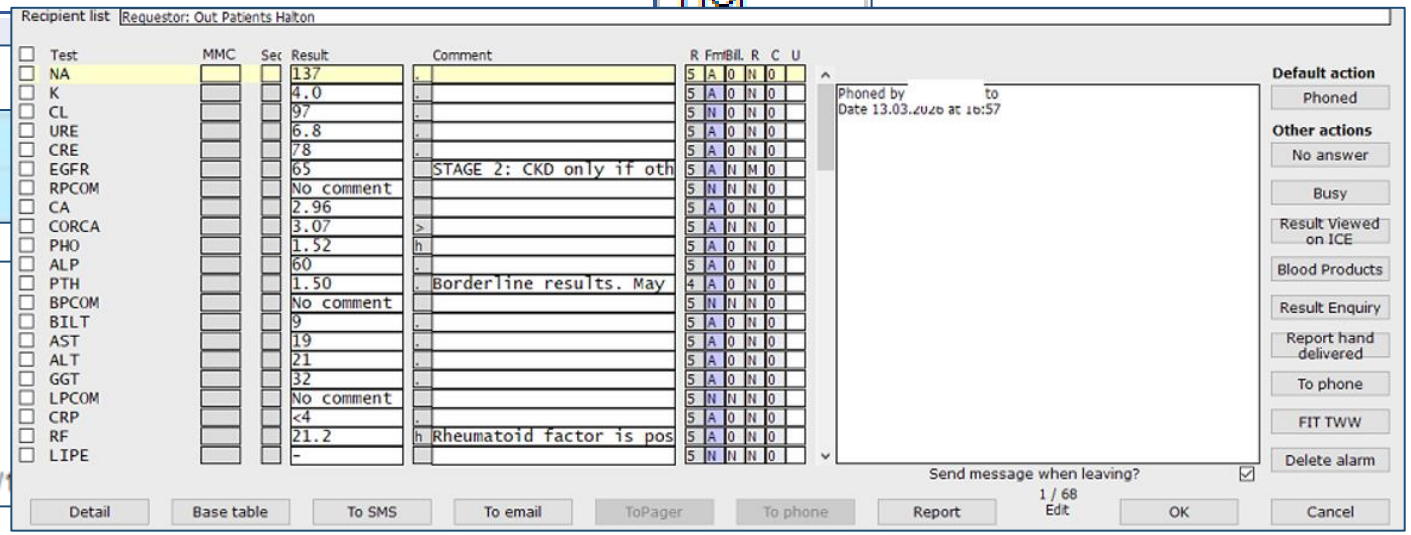
A 'rite of passage' and necessary for maintaining competency or baked-in redundancy of purpose for experienced staff?

Telephone Queues

- Results breaching critical limits automatically added
- Other results forwarded ad-hoc
- Easier to share phoning between roles (CS, BMS, admin)
- Call flagging – signalled via colours, flags, icons?
- Call logging – specify minimum information for audit and business intelligence?



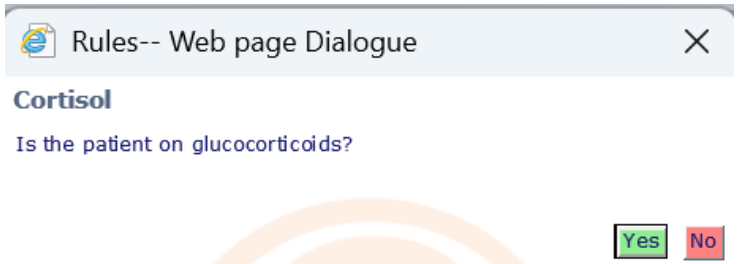


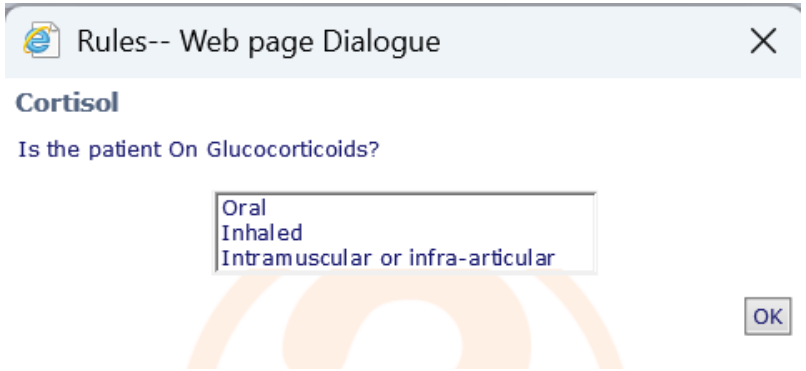


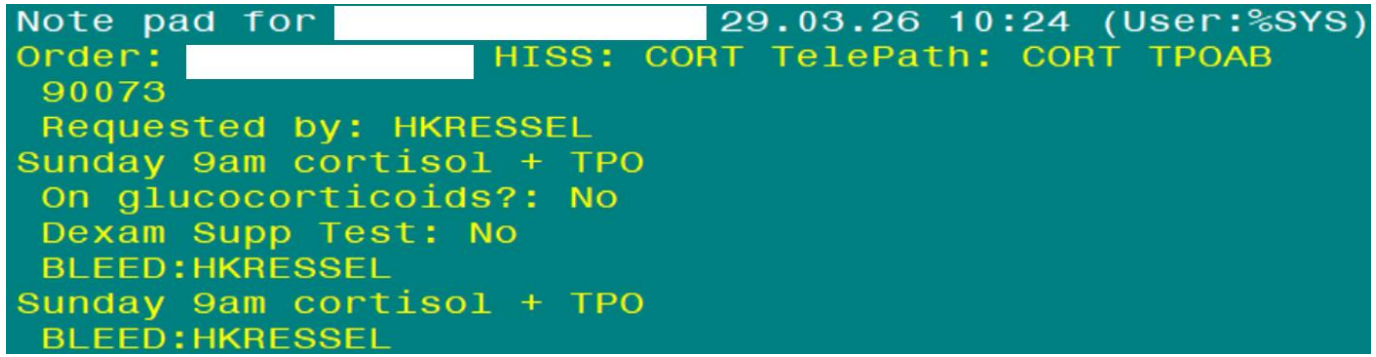
Order Questions For Safe Result Management

Low cortisol - critical abnormality?

Cheshire and Merseyside Provider Collaborative





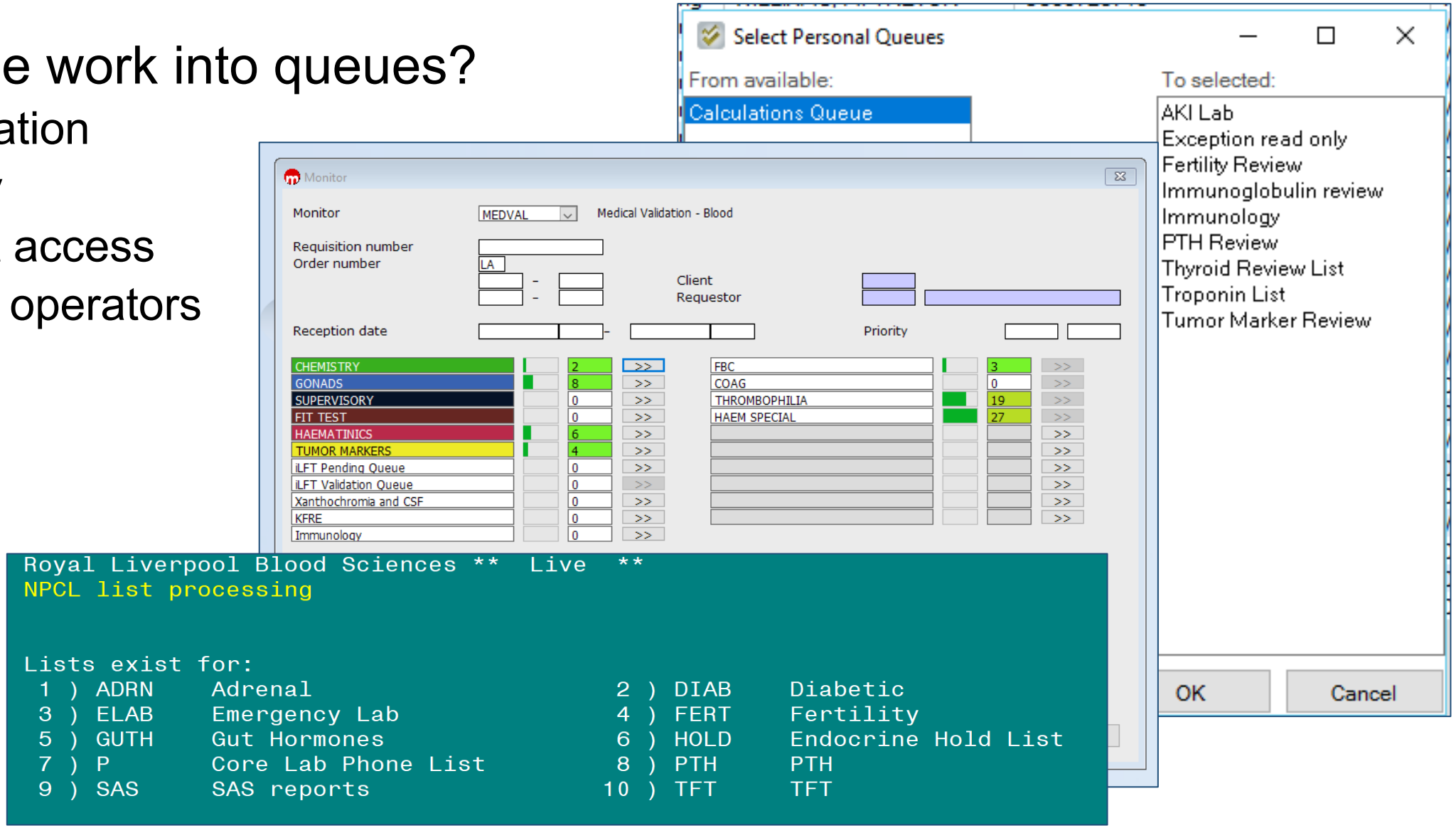


LIMS opportunity to selectively add to telephone queue based on responses

Your Queue or Mine?

NHS
Cheshire and Merseyside
Provider Collaborative

- Why divide work into queues?
  - Prioritisation
  - Visibility
  - Efficient access
  - Multiple operators



Intentionality – Efficiency and Effectiveness (2)
What fields are configured in your system?

Cheshire and Merseyside Provider Collaborative

Trapping rules: basic

- By test/profile – ‘exists’
- Test limit breaches
  - Reference limits
  - Critical/abnormal/phone limits
  - Delta changes (% and/or absolute)
- By consultant
- By location

```
Royal Liverpool Biochemistry TRAINING System
Authorization Intervention - Definition - Set

Authorisation list code TFT

'Set` codes to be included on Authorization list:-

    1) FREET4 Free T4                    2) FT3... Free T3
    3) TSH2.. TSH                        4) TFTFT. TFT check
    5) THYG.. Thyroglobulin II           6) TGAB.. Thyroglobulin ab
    7) TFT3.. TFTs                       8) ......
```

```
Royal Liverpool Blood Sciences **  Live  **
Authorization Intervention - Definition

 Authorisation list code ELAB   Emergency Lab

 1) Result Type(s):-
                    .              .
                    .              .
                    .              .

 2) Range check failures - (R)eference\(A)bnormal\(N)either [D:A]  A
 3) Delta check failures (numeric+derived) Y
 4) Ignore range failure if delta applied and passed N
 5) Routine for special processing         ........
 6) Processing mode at NPCL A) all sets B) user specify C) all groups/sets C
  Further screens: (enter field identifier)
        'SET' for sets to be intercepted
        'CC'  for consultants to be intercepted
        'SI'  for special interest codes to be intercepted
        'LOC' for locations to be intercepted
     Enter '??' for a full list, '^L' to list those already entered.
 7) List Order - Patient\Specimen\Original .
 Accept \ Reject \ Change \ Delete <A> .....
```

Intentionality – Efficiency and Effectiveness (2)
What fields are configured in your system?

NHS Cheshire and Merseyside Provider Collaborative

Trapping rules: more advanced

- By coded result/comment
- By clinical details
- By DOB/Age
- By specimen
- By medical specialty
- …?

```
Royal Liverpool Biochemistry TRAINING System
Code directory for Patient record field
Code                    Expansion

 1) ABNRES              Failed abnormal range
 2) AC                  Analytical category
 3) AD                  Admission diagnosis
 4) ADG                 Diagnosis Group
 5) AGE                 Age
 6) AGEAR               Age (range check)
 7) AKI2                AKI by v2
 8) AKI3                AKI by v3
 9) AKID                AKI diff by v2/3
10) ALC                 Authorisation list code
11) ALTSNM              Alternative Surname
12) AMBUL               Ambulance required
13) ASRP                All sample rack pos
14) BA                  Booking in area
15) BEGTR               Start of treatment
16) BG                  Blood group
17) BLEED               Specimen taken by

Select one\Next page\ESCape to quit <N> .
```

```
Royal Liverpool Biochemistry TRAINING System
Code directory for Interception criteria used
Code

 1) RCE                 Coded report comment
 2) SET                 Set
```

```
Royal Liverpool Biochemistry TRAINING System
Authorization Intervention - Definition - Coded report comment

Authorisation list code Emergency Lab

'Coded report comment` codes to be included on Authorization list:-

    1) ADD... Could this be Addison's?      2) GPGLU. ! High Glucose on FASTING
    3) HIGLU. ! High Glucose                4) LGLU.. !Low glucose
    5) GPAKTP ! Phone this AKI alert to     6) ICTCRE !!Duty Biochemist MUST ovr
    7) PHEAD5 !DB enter specimen in DERE    8) PHEAD3 'Sheiner-Tozer' adjusted n
    9) OLDTRP !There is an OLD or Query    10) LDHH1. !Duty Biochemist please ow
   11) HIBIL6 Abnormal liver profile wit   12) A1AT2. ! Click SAS button and fii
```

Intentionality – Efficiency and Effectiveness (3)
What fields are configured in your system?

Cheshire and Merseyside Provider Collaborative

Trapping rules: custom filters

- Rule-outs
  - ‘Not’ a location
  - ‘Not’ a consultant
  - ‘Not’ a comment (autocomment)
- Result </> value
- Combinations – ‘all’ (and) / ‘any’ (or)
- – be creative!

```
Royal Liverpool Biochemistry TRAINING System
Authorisation group rule definition for Group CC unit 6


     /---------------------- 1 Set = PTH,FPTH
    |----------------------- 2 Location Group '= REN (Renal Wards)
-all|     /----------------- 3 Location '= 9Y,9YPO,BAC,AC9ECC,REMTHR,AWTHB,AWT...
 10|     |------------------ 4 Location '= CCHEM,DCC,XVIR,LABEQA,DIAB,REDIA,RE...
    \all|------------------- 5 Consultant '= C3137073,RQMPRO,RQ6SLS,C6029632,A...
      9 |------------------- 6 Consultant '= C4539432,TAND,RESATA,C6129837,ROL...
        |------------------- 7 Consultant '= REIAAA,RQMIKH,EMCM,TSPU,MLPH,GOLD...
         \------------------- 8 Medical speciality '= NEPY,REMNEPY,NEPH
```

```
Royal Liverpool Biochemistry TRAINING System
Authorisation group rule definition for Group CC unit 4


     /---------------------- 1 Set = TFTHAB,TFTFT
    |-all /----------------- 2 Set = FT3 (Free T3)
    |  6  \any /------------ 3 Not Location = CGON,NMED,REMMAD,RENCHM,RENDW,RE...
    |       5  \------------ 4 FREET3 (or eq) > 6.9
    |-all /----------------- 7 Set = THYG (Thyroglobulin II)
    |  11 \any /------------ 8 THYG (or eq) > 0.9
    |       10 \------------ 9 Not TGAB (or eq) < 25
-any|-all /-----------------12 Set = TGAB (Thyroglobulin ab)
 26|  14 \-----------------13 TGAB (or eq) > 24
    |     /-----------------15 Set = TFT3,FREET4
    |-all|-----------------16 Not Set TFT3 comment = EU,TSHAR,TFTBOR,TSHN,TFTBO3
    |  19|-----------------17 Not Set FREET4 comment = TSHAR,TFTBOR,TSHN,TFTB...
    |     \-----------------18 Not Location = NMED,TRIALS,LABEQA,CRFA,RCNMED
    |     /-----------------20 Set = TSH2 (TSH)
     \all|-any /-----------21 TSH2 (or eq) > 49
      25|  23 \-----------22 Not Set TSH2 comment = EU,TSHAR,FT4,TFTBOR,TSHN...
        \-----------------24 Not Location = NMED,TRIALS,LABEQA,CRFA,RCNMED
```

```
Royal Liverpool Biochemistry TRAINING System
Authorisation group rule definition for Group CC unit 1


        /----------------- 1 Set = IVFE2,KETONE,LIPID,BLIPID,DIALIP,APRI,AAP...
       |     /any /------ 2 Management Stats Group '= IP,A/E,EIP,EIC
       |-all|  4  \------ 3 Lab Statistics Group = AH (ALDER HEY CHILDRENS)
       |  8  \any /------ 5 Set = PAR,SALIC,HSTROP
    /any|      7  \------ 6 AKI (or eq) > 0
    |  16|-all /---------- 9 Strip report number = 61,62,63
    |    |  11 \----------10 Set '= HSTROP,SIROL,IFIX,U5HIAA,FE,FERRIT,HAPTO...
-all|    |-----------------12 CA (or eq) < 0.60
 18|     \all /----------13 HSTROP (or eq) > 49
    |      15 \----------14 Management Stats Group = A/E (Accident & Emerge...
     \---------------------17 Location(H) '= LAB,LABEQA,ZTRAIN,LABAKI
```

NHS
Cheshire and Merseyside
Provider Collaborative

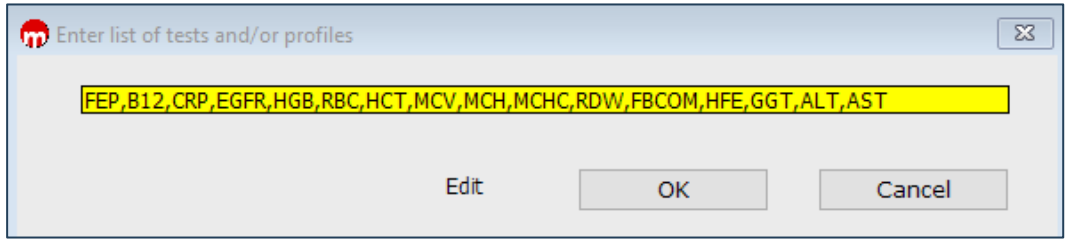
Custom Cumulations

Surfacing the right pieces of the puzzle in your workspace

Where Are We Going?
Context = patterns, trends and scope

NHS
Cheshire and Merseyside
Provider Collaborative

- Haematinics
  - Manual commenting



Collection date	23.04.2026 11:20	21.04.2026 11:15	21.03.2026	13.03.2026 09:45	12.03.2026 08:35	10.03.2026
EGFR	>90	>90	>90	>90		>90
AST	< 8					
ALT	<7					
GGT	83					
CRP	232		117	117		112
LIPE	-	-	-	-		-
HEMO	-	-	-	-		-
ICTE	-	-	-	-		-
FE	1					
TRA	1.35					
FESAT	3					
B12	425					
FOL	18.3					
FER	561.5					
HAECOM	Raised ferritin with					
HFE						
C282Y						
H63D						
HGB	64.0		79.0	79.0		74.0
RBC	2.36		2.76	2.66		2.56
HCT	0.24		0.28	0.27		0.25
MCV	100.0		99.6	102.3		98.8

- Alkaline phosphatase (ALP)
  - Vetting sendaway requests
    - ALP isoenzymes electrophoresis
    - Bone-specific ALP measurement

```
Royal Liverpool Blood Sciences **  Live  **
Setup associated test groups       Group ALP              Editing Sets
                                    Name ALP.................

Sets included
 1) CAPR    2) SMAC    3) ECAPR   4) ECA     5) LFT     6) ELFT    7) LFTCAP
 8) ELFTCA  9) SASALP 10) SASBAP 11) VITDN5
```

Date\Time	Specimen	Adj Ca	Alk Ph	GGT	ALPISO	BSAP	VitD T
2607231330	C,23.1273724.S	2.39					
0306251453	C,25.1634388.G		232	20			
0608251207	C,25.1904350.Z		205	15			93
1108251215	C,25.1922141.K		206	16			
1908251800	C,25.1958705.A	2.43	206				
0110251518	C,25.2136316.P	2.48	208				
1610251755	C,25.2201334.Z					free	
F0112251311	C,25.6754198.G		NA				
F0112251311	C,25.6754198.G	2.36	NA	NA	free		
1501261144	C,26.6907077.M		180	20			67
310326NK	C,26.1302268.N		220				
310326NK	C,26.1302268.N	2.40	220	19			62

NHS
Cheshire and Merseyside
Provider Collaborative

Clinical Comments

Interpretation and guidance for next steps

Automated Commenting Pathways

NHS
Cheshire and Merseyside
Provider Collaborative

- Automated coded comments
  - High volume low complexity (and low risk?)
  - Stepwise implementation of auto-authorisation
  - Do not have to be auto-authorised!
- Reflexive testing
- What does good look like?
  - UKNEQAS Interpretative Comments
  - Evidence-based
  - NHS app – empowerment versus health anxiety
    - Plain English – average UK English reading age of 10
    - A clinical patient charter for pathology
    - Patient and public engagement (PPIE)?

Six categories of bad comments

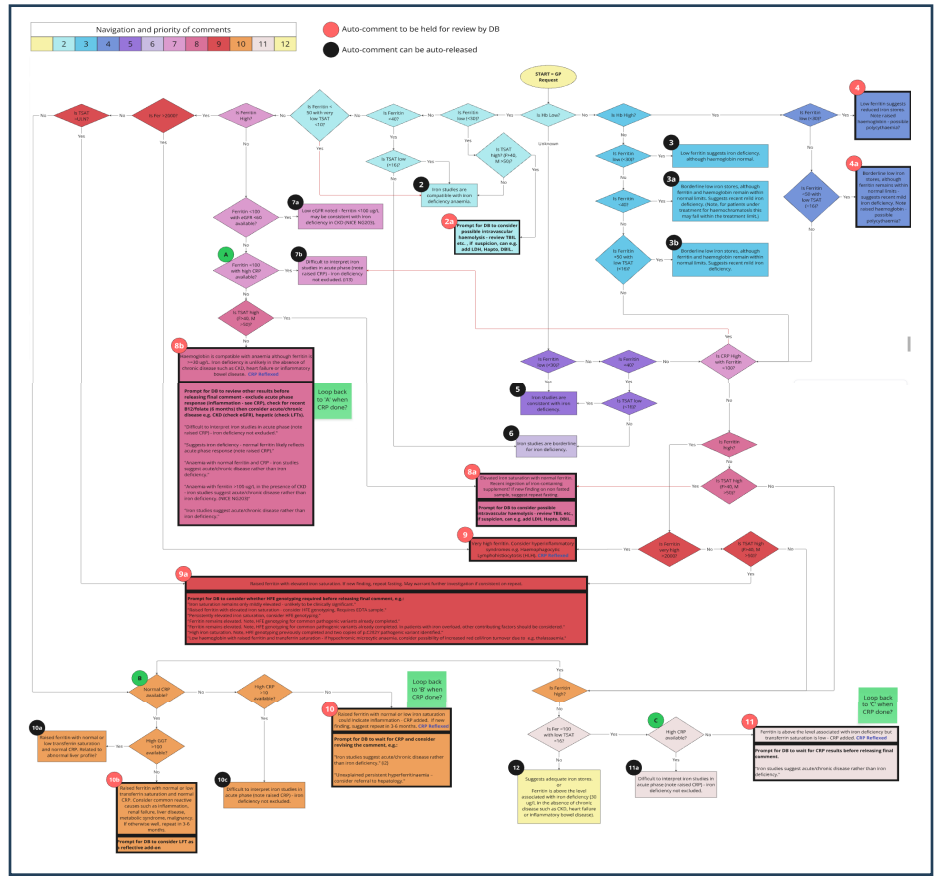
a. The asinine. Don't simply reproduce information already contained on the report form, eg 'high sodium'
b. The obvious. Don't tell a Renal Physician that the results are consistent with renal failure.
c. The crass. Don't tell Clinicians how they should examine a patient.
d. The dogmatic. Don't categorically state only one possibility, when more than one possibility exists.
e. The erroneous. We all of us make mistakes. We may completely misjudge a case. Alternatively, we may make a spelling mistake (typing 'hypo' when we mean 'hyper', analogous to an analytical blunder in conventional EQA). What is an acceptable prevalence of errors is a debatable point.
f. The foolhardy. Don't spoil an otherwise good comment by a reckless or unethical suggestion on follow-up or treatment. Experience has shown that such a suggestion dramatically reduces the perceived value of a comment.

G S Challand
12th June 2003
**and updated most recently in October 2018 by fm*

Case Study 1: Haematinics Pathway

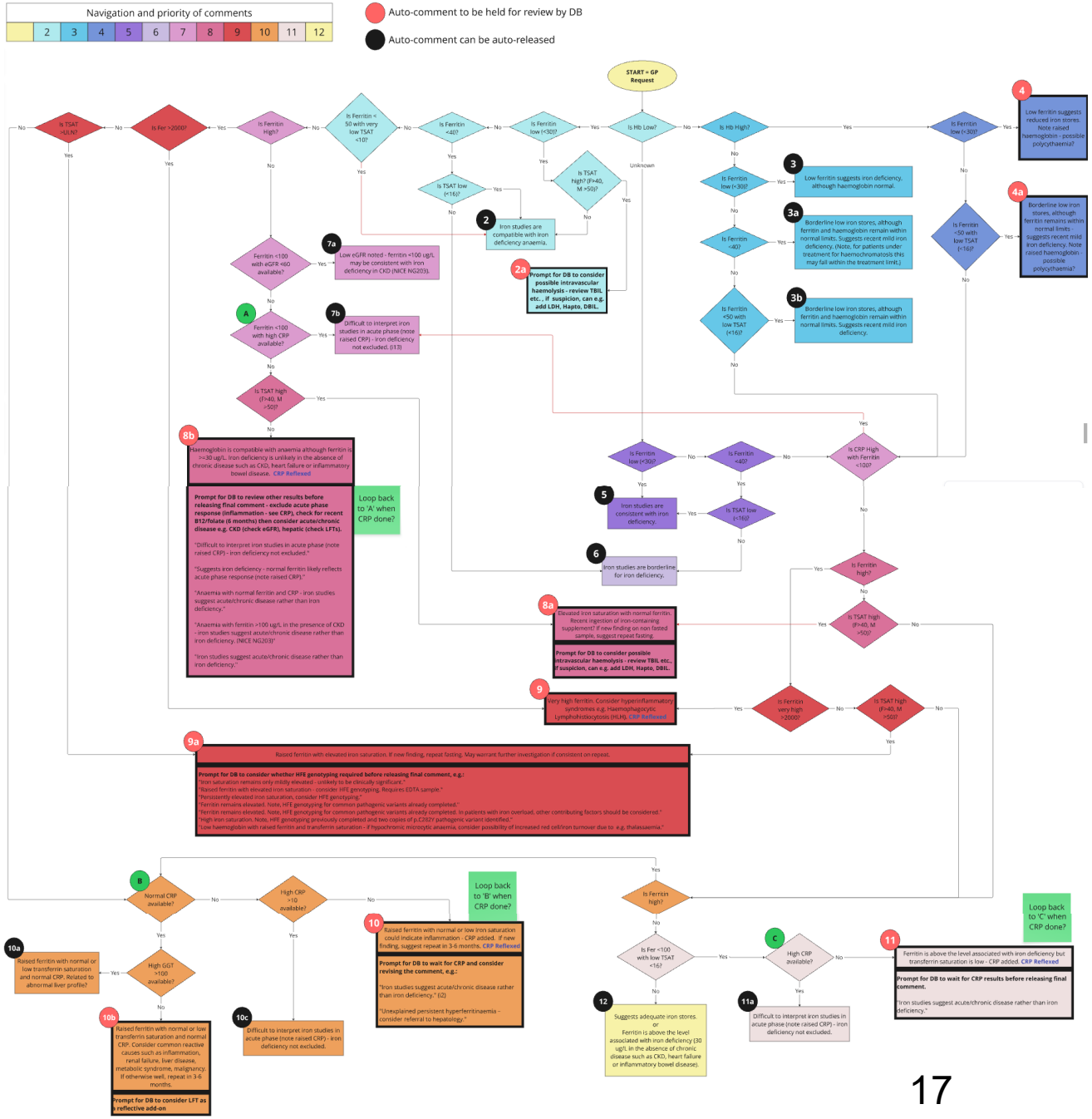
NHS
Cheshire and Merseyside
Provider Collaborative

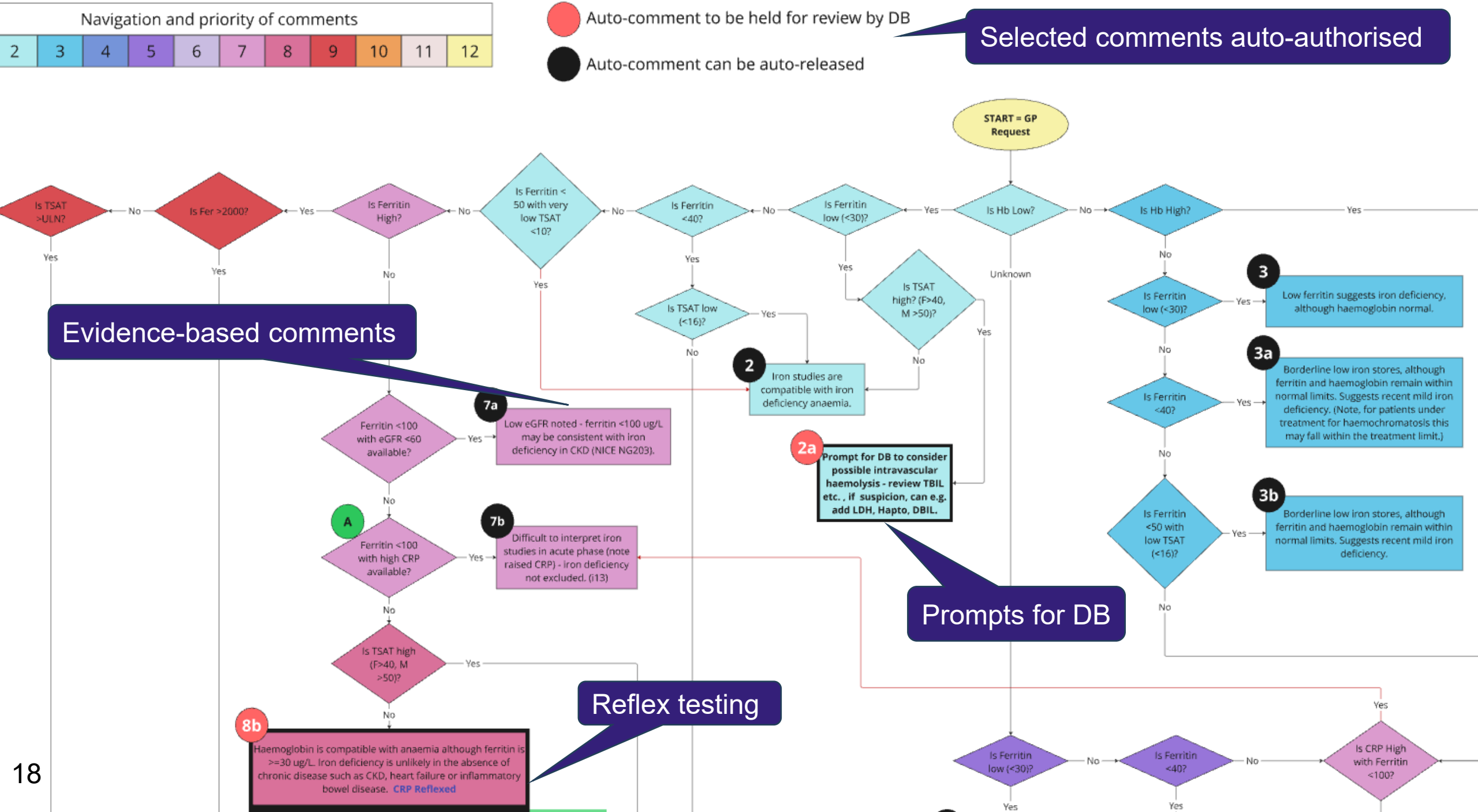
- Cyclical development process (3 iterations)
  - Workflow design – flowchart
  - Clinical review – consultation
  - Implementation – coding
  - Validation testing
  - Reflection in practice – refine workflow design
- Phase 4 = selective auto-reporting
- Phase 5 = impact evaluation

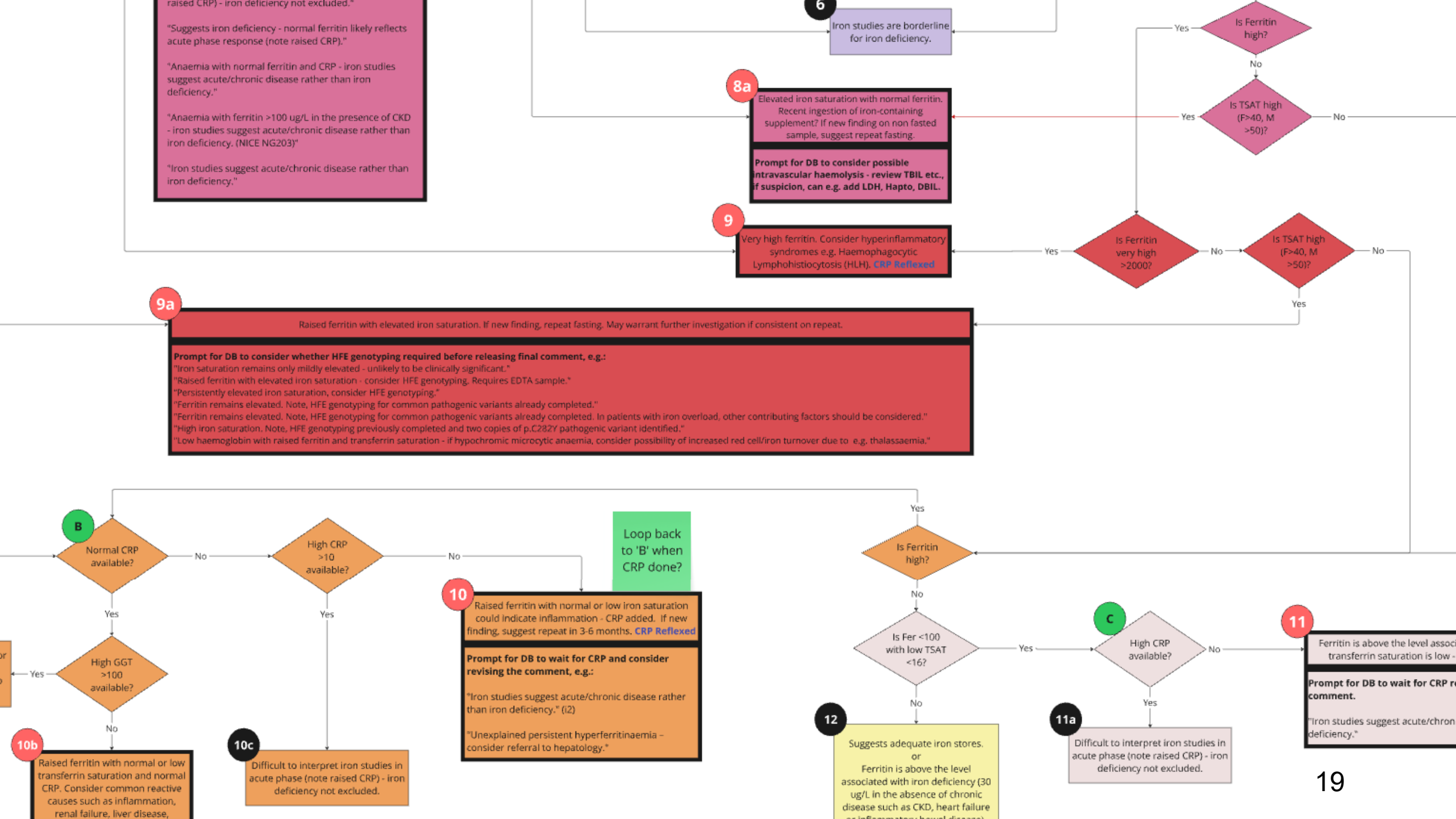


Haematinics Pathway: Flowchart

- Auto-comments for primary care
- Reflex testing – CRP
  - Anaemia with normal/high ferritin
- Clinical decision support
  - “Prompt for DB”
- Evidence-based
  - [Good Practice Paper for the laboratory diagnosis of iron deficiency in adults (excluding pregnancy) and children]
  - [Adult Iron Deficiency Anaemia Care Guidelines]
  - [Limitations of Serum Ferritin in Diagnosing Iron Deficiency in Inflammatory Conditions]
  - [How to diagnose iron deficiency in chronic disease: A review of current methods and potential marker for the outcome]
  - [Redefining Iron Deficiency in Patients With Chronic Heart Failure]
  - [Treating iron deficiency in patients with heart failure: what, why, when, how, where and who]
  - [Investigation and management of a raised serum ferritin]




Navigation and priority of comments
2
3
4
5
6
7
8
9
10
11
12
Auto-comment to be held for review by DB
Auto-comment can be auto-released
Selected comments auto-authorised
START = GP Request
Is Hb Low?
Unknown
Yes
No
Is Hb High?
Is Ferritin low (<30)?
Is TSAT high? (F>40, M >50)?
Is Ferritin <40?
Is TSAT low (<16)?
Is Ferritin < 50 with very low TSAT <10?
Is Ferritin High?
Is Fer >2000?
Is TSAT >ULN?
Evidence-based comments
2
Iron studies are compatible with iron deficiency anaemia.
3
Low ferritin suggests iron deficiency, although haemoglobin normal.
3a
Borderline low iron stores, although ferritin and haemoglobin remain within normal limits. Suggests recent mild iron deficiency. (Note, for patients under treatment for haemochromatosis this may fall within the treatment limit.)
3b
Borderline low iron stores, although ferritin and haemoglobin remain within normal limits. Suggests recent mild iron deficiency.
2a
Prompt for DB to consider possible intravascular haemolysis - review TBIL etc. , if suspicion, can e.g. add LDH, Hapto, DBIL.
Prompts for DB
7a
Low eGFR noted - ferritin <100 ug/L may be consistent with iron deficiency in CKD (NICE NG203).
Ferritin <100 with eGFR <60 available?
A
Ferritin <100 with high CRP available?
7b
Difficult to interpret iron studies in acute phase (note raised CRP) - iron deficiency not excluded. (i13)
Is TSAT high (F>40, M >50)?
Reflex testing
8b
Haemoglobin is compatible with anaemia although ferritin is >=30 ug/L. Iron deficiency is unlikely in the absence of chronic disease such as CKD, heart failure or inflammatory bowel disease. CRP Reflexed
Is Ferritin low (<30)?
Is Ferritin <40?
Is CRP High with Ferritin <100?


raised CRP) - iron deficiency not excluded."
"Suggests iron deficiency - normal ferritin likely reflects acute phase response (note raised CRP)."
"Anaemia with normal ferritin and CRP - iron studies suggest acute/chronic disease rather than iron deficiency."
"Anaemia with ferritin >100 ug/L in the presence of CKD - iron studies suggest acute/chronic disease rather than iron deficiency. (NICE NG203)"
"Iron studies suggest acute/chronic disease rather than iron deficiency."
6
Iron studies are borderline for iron deficiency.
Is Ferritin high?
Yes
No
8a
Elevated iron saturation with normal ferritin. Recent ingestion of iron-containing supplement? If new finding on non fasted sample, suggest repeat fasting.
Prompt for DB to consider possible intravascular haemolysis - review TBIL etc., if suspicion, can e.g. add LDH, Hapto, DBIL.
Is TSAT high (F>40, M >50)?
Yes
No
9
Very high ferritin. Consider hyperinflammatory syndromes e.g. Haemophagocytic Lymphohistiocytosis (HLH). CRP Reflexed
Is Ferritin very high >2000?
Yes
No
Is TSAT high (F>40, M >50)?
No
Yes
9a
Raised ferritin with elevated iron saturation. If new finding, repeat fasting. May warrant further investigation if consistent on repeat.
Prompt for DB to consider whether HFE genotyping required before releasing final comment, e.g.:
"Iron saturation remains only mildly elevated - unlikely to be clinically significant."
"Raised ferritin with elevated iron saturation - consider HFE genotyping. Requires EDTA sample."
"Persistently elevated iron saturation, consider HFE genotyping."
"Ferritin remains elevated. Note, HFE genotyping for common pathogenic variants already completed."
"Ferritin remains elevated. Note, HFE genotyping for common pathogenic variants already completed. In patients with iron overload, other contributing factors should be considered."
"High iron saturation. Note, HFE genotyping previously completed and two copies of p.C282Y pathogenic variant identified."
"Low haemoglobin with raised ferritin and transferrin saturation - if hypochromic microcytic anaemia, consider possibility of increased red cell/iron turnover due to e.g. thalassaemia."
B
Normal CRP available?
No
High CRP >10 available?
No
Loop back to 'B' when CRP done?
Yes
High GGT >100 available?
Yes
No
10
Raised ferritin with normal or low iron saturation could indicate inflammation - CRP added. If new finding, suggest repeat in 3-6 months. CRP Reflexed
Prompt for DB to wait for CRP and consider revising the comment, e.g.:
"Iron studies suggest acute/chronic disease rather than iron deficiency." (i2)
"Unexplained persistent hyperferritinaemia – consider referral to hepatology."
10b
Raised ferritin with normal or low transferrin saturation and normal CRP. Consider common reactive causes such as inflammation, renal failure, liver disease,
10c
Difficult to interpret iron studies in acute phase (note raised CRP) - iron deficiency not excluded.
Yes
Is Ferritin high?
No
Is Fer <100 with low TSAT <16?
Yes
No
C
High CRP available?
No
Yes
11
Ferritin is above the level associ
transferrin saturation is low -
Prompt for DB to wait for CRP re
comment.
"Iron studies suggest acute/chron
deficiency."
12
Suggests adequate iron stores.
or
Ferritin is above the level associated with iron deficiency (30 ug/L in the absence of chronic disease such as CKD, heart failure
11a
Difficult to interpret iron studies in acute phase (note raised CRP) - iron deficiency not excluded.

Haematinics Pathway:
Code = 'Molis Programming Language' (MPL)

NHS
Cheshire and Merseyside
Provider Collaborative

Criteria

Clinical comment

Authorisation status

```
127   if($stop!="Y")
128     if ($gp_flag="Y" && $hgb_cl_flag="N" &&  $fer_cl_flag="L") ; condition 3
129
130       RES{HAECOM} = "Low ferritin suggests iron deficiency, although haemoglobin within normal limits."
131       RES_ST{HAECOM}="2"
132       EDTFMTNB{HAECOM}="T"
133       $stop="Y"
134     endif
135   endif
136       ;if($stop_cond2!="Y" || $stop_cond3="Y")
137  ;message("Stop After Condition 3=%%$stop%%%")
138
139   if($stop!="Y")
140     if ($gp_flag="Y" && $hgb_cl_flag="N" && $fer #<40) ; condition 3a
141
142       RES{HAECOM} = "Borderline low iron stores, although ferritin and haemoglobin remain within normal limits. Suggests recent mild iron deficiency. (Note, for patients under treatment for
143       RES_ST{HAECOM}="2"
144       EDTFMTNB{HAECOM}="T"
145       $stop="Y"
146     endif
147   endif
148       ;if($stop_cond3!="Y" || $stop_cond3a="Y")
149  ;message("Stop After Condition 3a=%%$stop%%%")
150
151   if($stop!="Y")
152     if ($gp_flag="Y" && $hgb_cl_flag="N" &&  $fer #<50 && $tsat_cl_flag="L") ; condition 3b
153
154       RES{HAECOM} = "Borderline low iron stores, although ferritin and haemoglobin remain within normal limits. Suggests recent mild iron deficiency."
155       RES_ST{HAECOM}="2"
156       EDTFMTNB{HAECOM}="T"
157       $stop="Y"
158     endif
159   endif
160       ;if($stop_cond3a!="Y" || $stop_cond3b="Y")
161  ;message("Stop After Condition 3b=%%$stop%%%")
162
163    if ($stop!="Y")
164      if ($gp_flag="Y" && $hgb_cl_flag="H" &&  $fer_cl_flag="L") ; condition 4
165
166         RES{HAECOM} = "Low ferritin suggests reduced iron stores. Note raised haemoglobin - possible polycythaemia?"
167         RES_ST{HAECOM}="2"
```

Haematinics Pathway: In Practice (1)

NHS
Cheshire and Merseyside
Provider Collaborative

2 - Iron studies are consistent with iron deficiency anaemia.

To be validated									
☑	2		FER	FERRITIN		22.2	ug/L		22 - 322
☑	2		HAECOM	HAEMATINICS COMMENTS		Iron studie			
In sector validated									
	4		FE	IRON		13	umol/L		6 - 29
	4		TRA	TRANSFERRIN		2.60	g/L		2.15 - 3.8
	4		FESAT	% IRON SAT		20	%		16 - 50
	4		B12	VIT.B12		351	ng/L		180 - 910
	4		FOL	FOLATE		10.4	ng/mL		>5.4
	5		HGB	HB	↓	129.0	g/L		130 - 180

Fer < 30 ug/L
and
TSAT not high

OR

Fer < 40 ug/L
and
TSAT low

OR

Fer < 50 ug/L
and
TSAT <10%

Hb low

Auto-validate

Haematinics Pathway: In Practice (2)

Cheshire and Merseyside Provider Collaborative

3 - Low ferritin suggests iron deficiency, although haemoglobin within normal limits.

To be validated										
☑	2		FESAT	% IRON SAT			16	%		16 - 40
☑	2		HAECOM	HAEMATINICS COMMENTS			Low ferriti			
In sector validated										
	4		FE	IRON			11	umol/L		5 - 33
	4		TRA	TRANSFERRIN			2.74	g/L		2.15 - 3.8
	4		B12	VIT.B12			372	ng/L		180 - 910
	4		FOL	FOLATE			7.8	ng/mL		>5.4
	4		FER	FERRITIN			27.7	ug/L		10 - 291
	5		HGB	HB			150.0	g/L		115 - 165

Fer < 30 ug/L

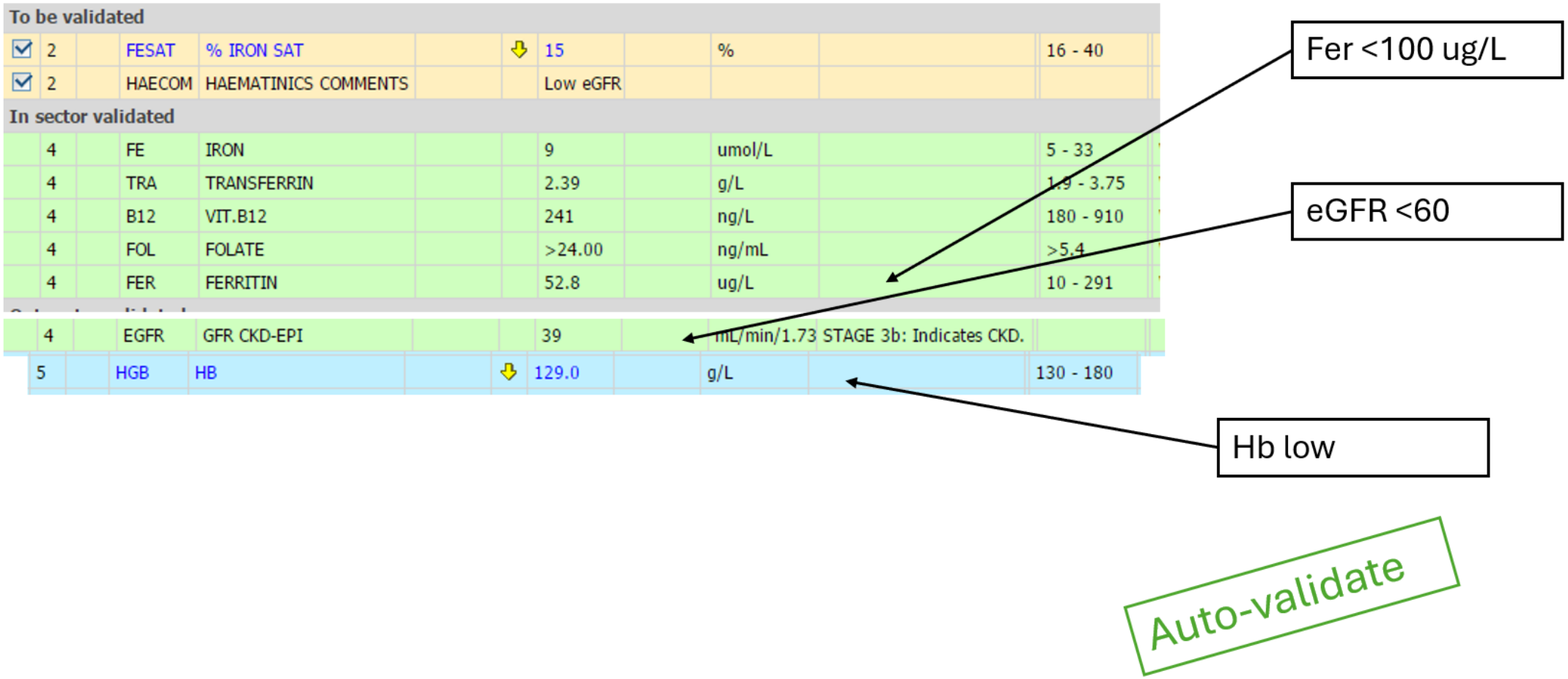
Hb normal

Auto-validate

Haematinics Pathway: In Practice (3)

Cheshire and Merseyside Provider Collaborative

7a - Low eGFR noted - ferritin <100 ug/L may be consistent with iron deficiency in CKD (NICE NG203).



Haematinics Pathway: In Practice (4)

Cheshire and Merseyside Provider Collaborative

8b - Haemoglobin is compatible with anaemia although ferritin is above the level associated with iron deficiency (30 ug/L in the absence of chronic disease such as CKD, heart failure or inflammatory bowel disease).

To be validated										
☑	2		B12	VIT.B12			191	ng/L		180 - 910
☑	2		HAECOM	HAEMATINICS COMMENTS			Haemoglo			
In sector validated										
	4		FE	IRON			12	umol/L		6 - 29
	4		TRA	TRANSFERRIN			2.16	g/L		1.9 - 3.75
	4		FESAT	% IRON SAT			22	%		16 - 50
	4		FOL	FOLATE		↓	2.7	ng/mL	Low folate. Consider therap	>5.4
	4		FER	FERRITIN			101.8	ug/L		22 - 322
	5		HGB	HB		↓	122.0	g/L		130 - 180

TSAT not high

Fer normal

Hb low

Wait for CRP

Hold for review

Haematinics Pathway: In Practice (5)

Cheshire and Merseyside Provider Collaborative

10 - Raised ferritin with normal or low iron saturation could indicate inflammation - CRP added. If new finding, suggest repeat fasting in 3-6 months.

To be validated										
☑	2		FE	IRON		↓	4		umol/L	6 - 29
☑	2		TRA	TRANSFERRIN		↓	1.88		g/L	1.9 - 3.75
☑	2		FESAT	% IRON SAT		↓	8		%	16 - 50
☑	2		FER	FERRITIN		↑	326.7		ug/L	22 - 322
☑	2		HAECOM	HAEMATINICS COMMENTS			Raised fer			

Hold for review

5		CRP	CRP			7		mg/L		<10

Raised ferritin with normal or low transferrin saturation and normal CRP. Consider common reactive causes such as inflammation, renal failure, liver disease, metabolic syndrome, malignancy. If otherwise well, repeat in 3-6 months.

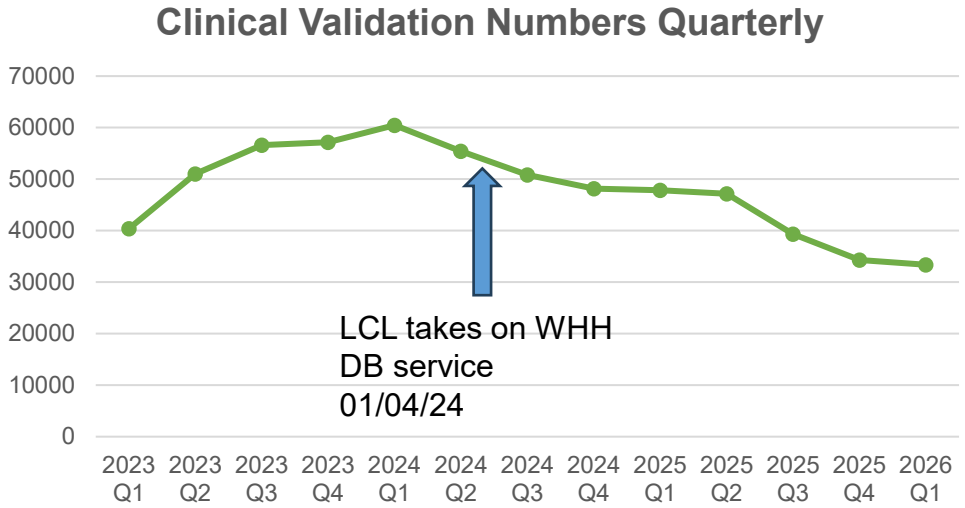
4		CRP	CRP		↑	71		mg/L		<10

Difficult to interpret iron studies in acute phase (note raised CRP) - iron deficiency not excluded.

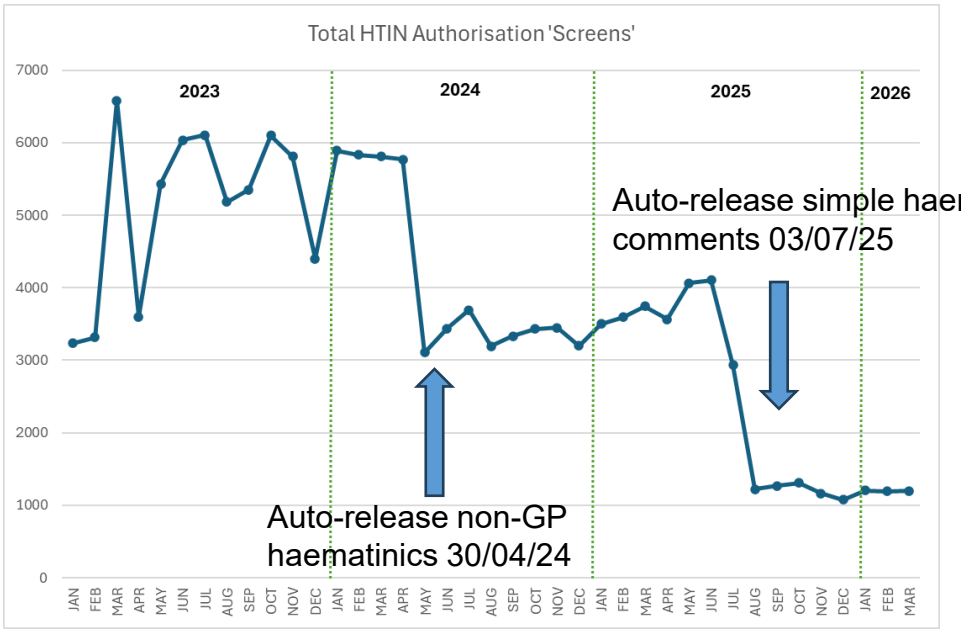
Haematinics Pathway: Impact

NHS
Cheshire and Merseyside
Provider Collaborative

All results trapped

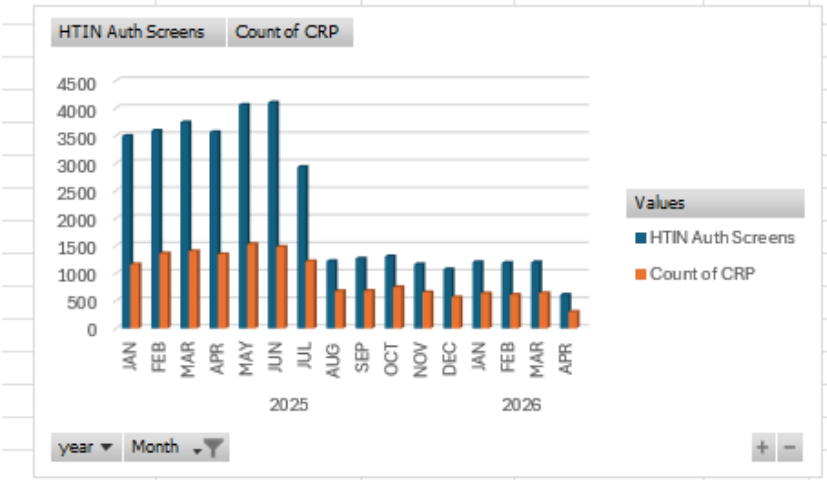


Haematinics results trapped



CRPs reflexed

Row Labels	HTIN Auth Screens	Count of CRP	% Cases with CRP
2025	31530	12841	40.72629242
JAN	3496	1165	33.32379863
FEB	3590	1363	37.96657382
MAR	3741	1402	37.47661053
APR	3565	1348	37.81206171
MAY	4063	1531	37.68151612
JUN	4102	1482	36.1287177
JUL	2934	1219	41.5473756
AUG	1221	676	55.36445536
SEP	1269	681	53.6643026
OCT	1308	751	57.41590214
NOV	1166	656	56.26072041
DEC	1075	567	52.74418605
2026	4204	2186	51.99809705
JAN	1204	634	52.65780731
FEB	1190	610	51.2605042
MAR	1200	641	53.41666667
APR	610	301	49.3442623
Grand Total	35734	15027	42.05238708

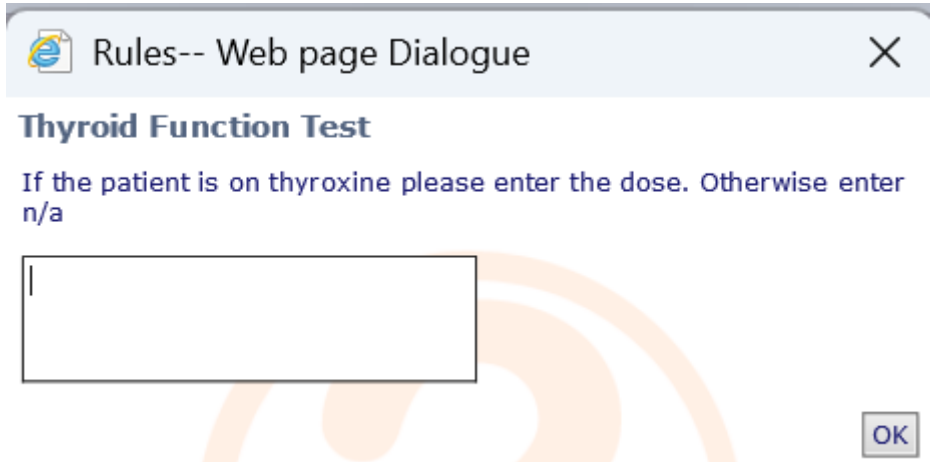


Case Study 2: Thyroid

Order questions for efficient result management

Cheshire and Merseyside
Provider Collaborative

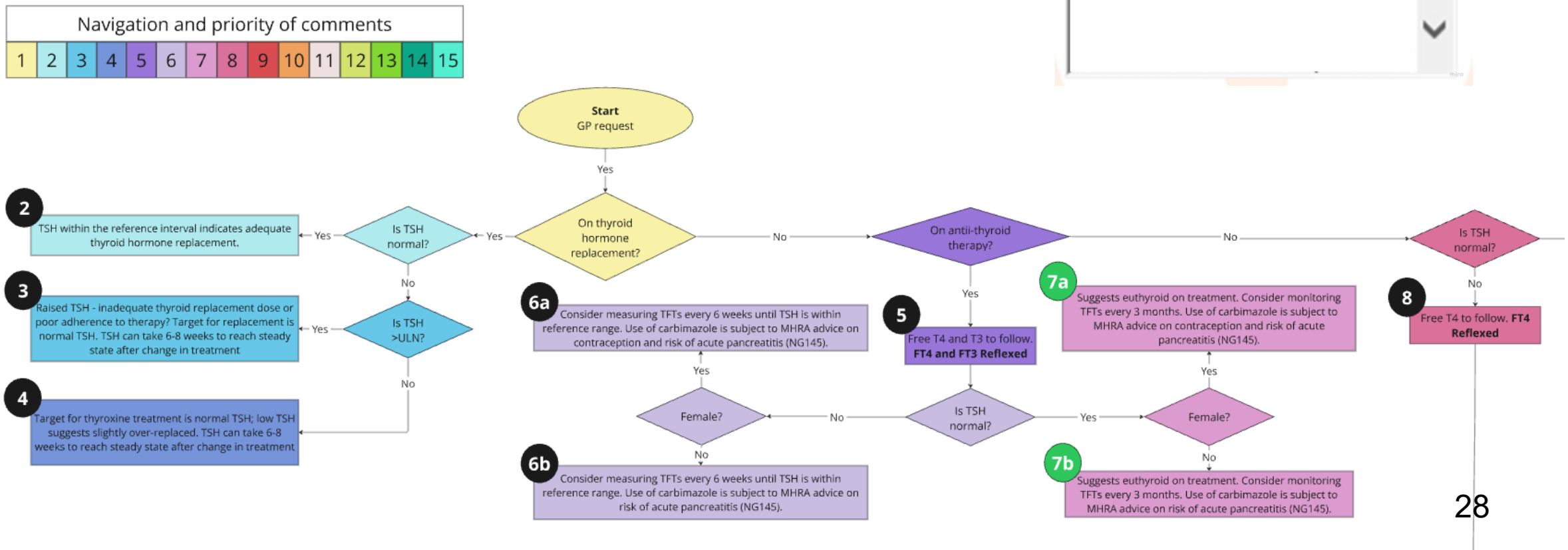
```
Note pad for [redacted] 28.03.26 13:16 (User:%SYS) --
Order: [redacted] HISS: AST TelePath: AGAP AST BF3 BHBA1
 Patient Location: Day Ward
LCLCORT Is patient on steroids?  Yes
LCLTFT1 Thyroid replacement  No
LCLTFT2 Antithyroid Therapy  No
LCLGLUR Glucose sample type  1^Random
```



Case Study 2: Thyroid
Planning for the future - Flowchart

Cheshire and Merseyside
Provider Collaborative

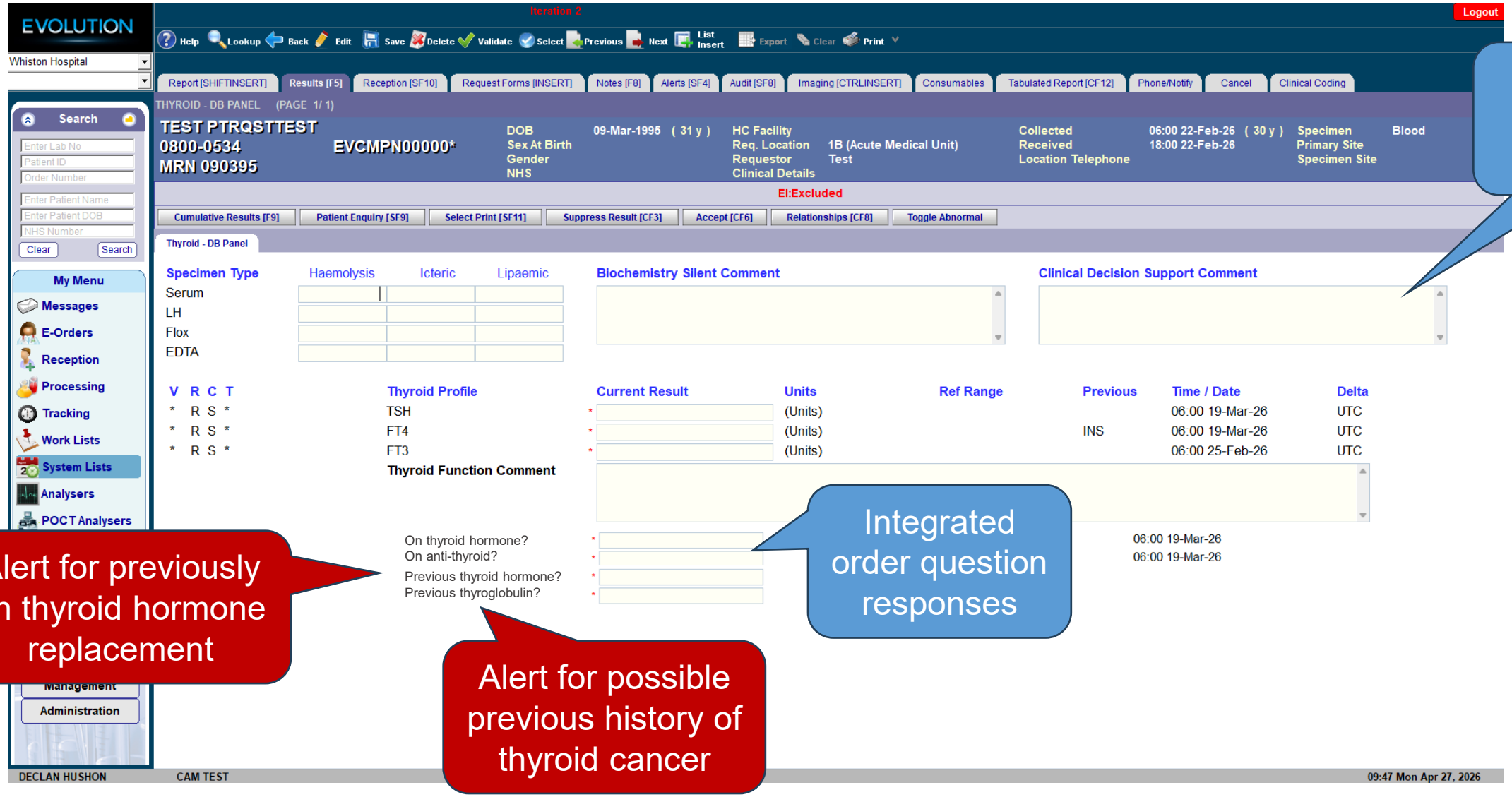
- Order questions fully integrated in workflow
- Autocomments (some trapped) and reflexes
- Internal alerts



Case Study 2: Thyroid

Planning for the future – 'Screen Mask'

NHS
Cheshire and Merseyside
Provider Collaborative



Clinical decision support

Integrated order question responses

Alert for previously on thyroid hormone replacement

Alert for possible previous history of thyroid cancer

NHS
Cheshire and Merseyside
Provider Collaborative

Interim Reporting

Issuing ‘ghost’ reports to optimise external clinical workflows

Interim Reporting

Cheshire and Merseyside
Provider Collaborative

- A preliminary or partial document, typically used for lab results or diagnostic reports, where information is available but not yet fully finalized or verified

NB. GHOST entry, Interim HISS report released. Press ESC

St	Tel	Test Code	Test Name	Reported	Cl	Result	Delta-Check	Unit
To be validated								
2		K	POTASSIUM		↑	6.2		mmol/L
In sector pending								
0		ACR	ALBCREAT RATIO					mg/mmol
In sector validated								
4		NA	SODIUM			140		mmol/L
4		CL	CHLORIDE	NR		102		mmol/L

First determine the validation status of the incorrect result/results.

Validation Status of Test	GP Request – Amended Report Required	Trust Request – Amended Report Required
1	No	No
2	No	Yes
3	No	Yes
4	No	Yes
5	Yes	Yes

NOTE: If the request is from a GP and the result status is at 4 immediate action is required to prevent the result from being reported by the MOLIS reporting module. The test should be immediately put into re-run or deleted – check departmental lab procedure.

- Commonly used in Microbiology, e.g. preliminary versus final growth
- Need to accommodate result filing/acknowledgement
- Needs careful risk assessment

Interim Reporting – Risk Assessment

NHS
Cheshire and Merseyside
Provider Collaborative

Ghosting/interim reporting (versus holding for final report) = Option 1	1	1.IF interim/ghost reports are issued (Option 1) THEN we might release reports that are erroneous (e.g. pre-analytical or technical issue) that would otherwise have been identified at clinical authorisation prior to release. a.Cause = Interim/ghost reports issued. b.Effect = Erroneous results issued (e.g. pre-analytical or technical issue). c.Hazard = Test on patient's sample incorrectly reported. d.Harm = Patient receives incorrect, inappropriate or missed referral, diagnosis or treatment, psychological harm.
	2	1.IF inter might cau a.Cause = b.Effect = c.Hazard d.Harm =
	3	1.IF inter reports th a.Cause = b.Effect = c.Hazard d.Harm =
NOT ghosting/interim reporting (versus holding for final report) = Option 2	1	1.IF inter a.Cause = b.Effect = c.Hazard d.Harm =
	2	1.IF interim/ghost reports are NOT issued (Option 2) and a clinically useful report is delayed THEN a test may be needlessly repeated by the clinical team who are unaware that the report is pending. a.Cause = Interim/ghost reports NOT issued. b.Effect = Clinicians unable to see relevant results c.Hazard = Uneccessary repeat investigations. d.Harm = Patient bled uneccessarily, psychological harm. Clinician frustrated and under increased stress. Financial impact on trust position.

	C	BD	BE	BF	BG	BH	BI	BJ	BK	BL	BM	BN	BO
1		Q8: Will any results be reviewed at clinical authorisation?	Q9: Does this test have critical limits that are phoned at technical validation?	Q10: Are ther any alerts run off the est e.g. (e.g. AKI, CRPs >150 in Careflow)	Q11: Would clinicians want to review results for this test within as short a time window as possible? E.g. might it affect immediate patient management or	Q12: Is the test currently ghosted from any lab					Q13: Is it feasible to mitigate for critical prenanalytical/ analytical errors via checks in the middleware? (Range limits, delta limits)	Q14: Is this test technically simple to interpret?	Q15: Are frequent manual additions or changes to comments unlikely?
2						COCH	LCL	MWL	WHH	WUTH			
3	(Unique Index)	If N - concept of ghost reporting is irrelevant - enter 'n/a' for Q9-15	If Y - results should probably be made available via ghosting	If Y - results should probably be made available via	If Y - results should probably be made available via ghosting, certainly in acute settings	(Default determined by entry at Q8; if '?', the cell should be overtyped.) If Y - results should arguably be made available via ghosting in settings accustomed to this process.					If N - results may not be suitable for ghost reporting	If N - results may not be suitable for ghost reporting	If N - results may not be suitable for ghost reporting
4	Na_Serum	Yes	Yes	No	Yes	No	Yes	?	Yes	?	Yes	No	Yes
5	K_Serum	Yes	Yes	No	Yes	?	Yes	?	Yes	?	Yes	Yes	Yes
6	Creatinine_Serum	Yes	Yes	Yes - AKI (all)	Yes	?	Yes	?	Yes	?	Yes	Yes	Yes
7	ALT_Serum	Yes	Yes	No	?	?	Yes	?	Yes	?	Yes	Yes	Yes
8	AST_Serum	Yes	Yes	No	?	?	Yes	?	Yes	?	Yes	Yes	Yes
9	Albumin_Serum	Yes	No	No	?	?	Yes	?	Yes	?	Yes	Yes	Yes
10	Paracetamol_Serum	Yes	Yes	No	Yes	?	Yes	?	Yes	?	Yes	Yes	Yes
11	Ferritin_Serum	Yes	No	No	?	?	n/a	?	Yes	?	Yes	No	?
12	PSA_Serum	Yes	No	No	?	?	No	?	Yes	?	?	Yes	Yes
13	TSH_Serum	Yes	Yes	No	?	?	No	?	Yes	?	?	No	?
14	Cortisol_Serum	Yes	Yes	No	Yes	?	?	?	Yes	?	?	Yes	?
15	Prolactin_Serum	Yes	?	No	?	?	No	?	Yes	?	n/a	Yes	?

NHS
Cheshire and Merseyside
Provider Collaborative

Calculations

Interpretation and guidance for next steps

Calculations For Clarity

Cheshire and Merseyside
Provider Collaborative

- To support clinical decisions
  - Osmolar gap
- To allow auto-commenting
  - Free androgen index
  - Calculated free testosterone

First reported 16.04.26

Test		Result	Units
Sodium		143	mmol/L
Potassium		3.1	mmol/L
Urea		20.4	mmol/L
Glucose		9.5	mmol/L
Osmolality	+	394	mmol/kg
Calc Osmo	+	319	mmol/kg
Osmo Gap	+	75	mmol/kg

To be validated

☑	2		SHBG	SHBG			19		nmol/L	Please note new reference	18 - 138	W_L1_IM1			
☑	2		FAI	FREE ANDROGEN INDEX		⇧	5.8		%	Raised FAI may be consiste	<4.5				

In sector validated

	4		TSH	TSH			1.1		mU/L						
	5		TFTCOM	TFT COMMENTS	NR		No comme								

Raised FAI may be consistent with a possible diagnosis of Polycystic Ovary Syndrome (PCOS). However, SHBG less than 30 nmol/L may overestimate FAI. Interpret with caution. Any signs or symptoms of androgen excess? (RCOG 2023 PCOS guideline).

ALB		41				5	A	0	N	0		ASERIE=#ALB:	35-50	40	09.04.26
FSH		8.9				5	A	0	N	0		ASERIE=FSH:C	0.9-13	7.5	09.04.26
LH		5.1				5	A	0	N	0		ASERIE=FSH:C	4.5-9.0	3.3	09.04.26
TES		9.9		SHBG/Albumin added		5	A	0	N	0		ASERIE=#TES:	8.0-36.0	7.4	09.04.26
SHBG		41		Please note new re		5	A	0	N	0		ASERIE=#SHBG	17-72		
CFT		0.170	L												
GONCOM		Low testosterone and LH c													

Zoom

Calculated Free Testosterone (CFT) less than 0.225 nmol/L. Possible testosterone deficiency (BSSM Guidelines 2022).

NHS
Cheshire and Merseyside
Provider Collaborative

Clinical Decision Support

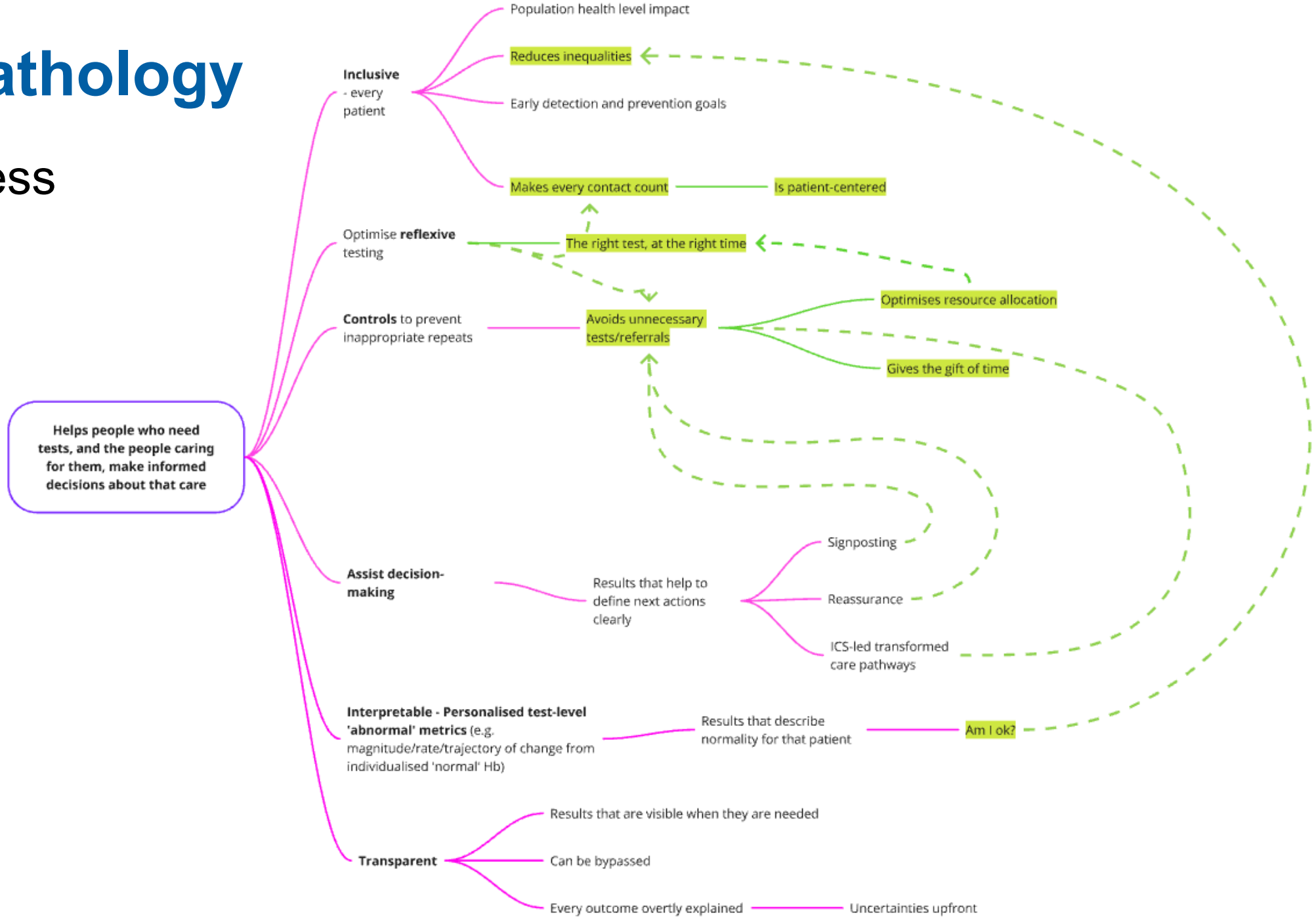
Digital tools that can support clinicians to make more equitable, evidence-based decisions - providing the right information, to the right person, in the right format, through the right channel, at the right time

NHS England » Supporting clinical decisions with health information technology

CDS In Pathology

Critical success factors:

- Inclusive
- Intelligent
- Integrate
- Impactful
- Interpretable
- Interoperable



Clinical Decision Support – Internal (DB)

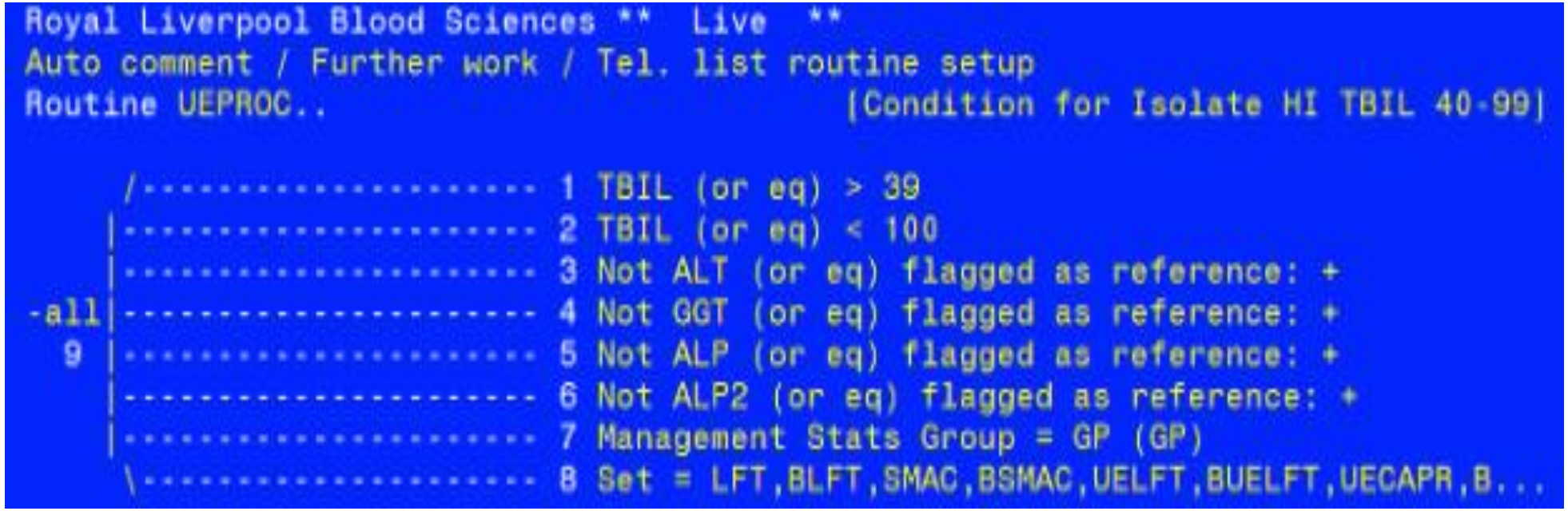
NHS Cheshire and Merseyside Provider Collaborative

“Isolated increase in bilirubin” = external comment

Internal prompts on LFTs = not printed on reports:

DB: new/ongoing/deterioration? Could this be decompensation?

DB: would reflex of DBIL/HAPTTO and/or ISOBIL comment add value?



Clinical Decision Support – Internal (DB)

NHS
Cheshire and Merseyside
Provider Collaborative

"Abnormal liver profile with increased ALT – exclude medication effects and review alcohol intake" = external comment

Internal prompts on LFTs = not printed on reports:

DB: new/unexplained finding – remove if known

DB: Recent lipids? Would FIB4 add value? (FBC?) FIB4AD or NOFIB4

```
Royal Liverpool Blood Sciences **  Live  **
Auto comment / Further work / Tel. list routine setup
Routine UEPROC..                        [Condition for Abn LFT HI ALT normal TBIL]

     /--------------------- 1 ALT (or eq) > 99
    |---------------------- 2 GGT (or eq) flagged as reference: +
-all|---------------------- 3 Not TBIL (or eq) flagged as reference: +
  6 |---------------------- 4 Management Stats Group = GP (GP)
     \--------------------- 5 Set = LFT,BLFT,SMAC,BSMAC,UELFT,BUELFT,LFTCAP,B...
```

Clinical Decision Support – Internal (DB)

NHS
Cheshire and Merseyside
Provider Collaborative

"Abnormal liver profile with increased ALT – exclude medication effects and review alcohol intake" = external comment

Internal prompts on LFTs = not printed on reports:

DB: new/unexplained finding – remove if known

DB: Recent lipids? Would FIB4 add value? (FBC?) FIB4AD or NOFIB4

```
Royal Liverpool Blood Sciences **  Live  **
Auto comment / Further work / Tel. list routine setup
Routine UEPROC..                        [Condition for Abn LFT HI ALT normal TBIL]

     /--------------------- 1 ALT (or eq) > 99
    |---------------------- 2 GGT (or eq) flagged as reference: +
-all|---------------------- 3 Not TBIL (or eq) flagged as reference: +
  6 |---------------------- 4 Management Stats Group = GP (GP)
     \--------------------- 5 Set = LFT,BLFT,SMAC,BSMAC,UELFT,BUELFT,LFTCAP,B...
```

Clinical Decision Support – Internal (DB)

Cheshire and Merseyside Provider Collaborative

Internal prompts on LFTs = not printed on reports:

DB: Raised ALP in absence of bone profile – would this add value?

Internal prompts on CAPR = not printed on reports:

DB: Raised ALP in absence of LFT – would this add value?

```
Royal Liverpool Blood Sciences TRAINING System
Auto comment / Further work / Tel. list routine setup
Routine UEPROC..                                [Condition for Non-hepatic ALP?]

    /any /---------------- 1 ALP (or eq) > 180
    |  3  \---------------- 2 ALP2 (or eq) > 180
    |---------------------- 4 Not GGT (or eq) flagged as reference: +
-all|---------------------- 5 Not ALT (or eq) flagged as reference: +
  10|---------------------- 6 Not TBIL (or eq) flagged as reference: +
    |---------------------- 7 Age '[ Y018
    |---------------------- 8 Management Stats Group = GP (GP)
    \---------------------- 9 Set = LFT,SMAC,BLFT,ELFT,LFTCAP,ESMAC,UELFT,LFT...
```

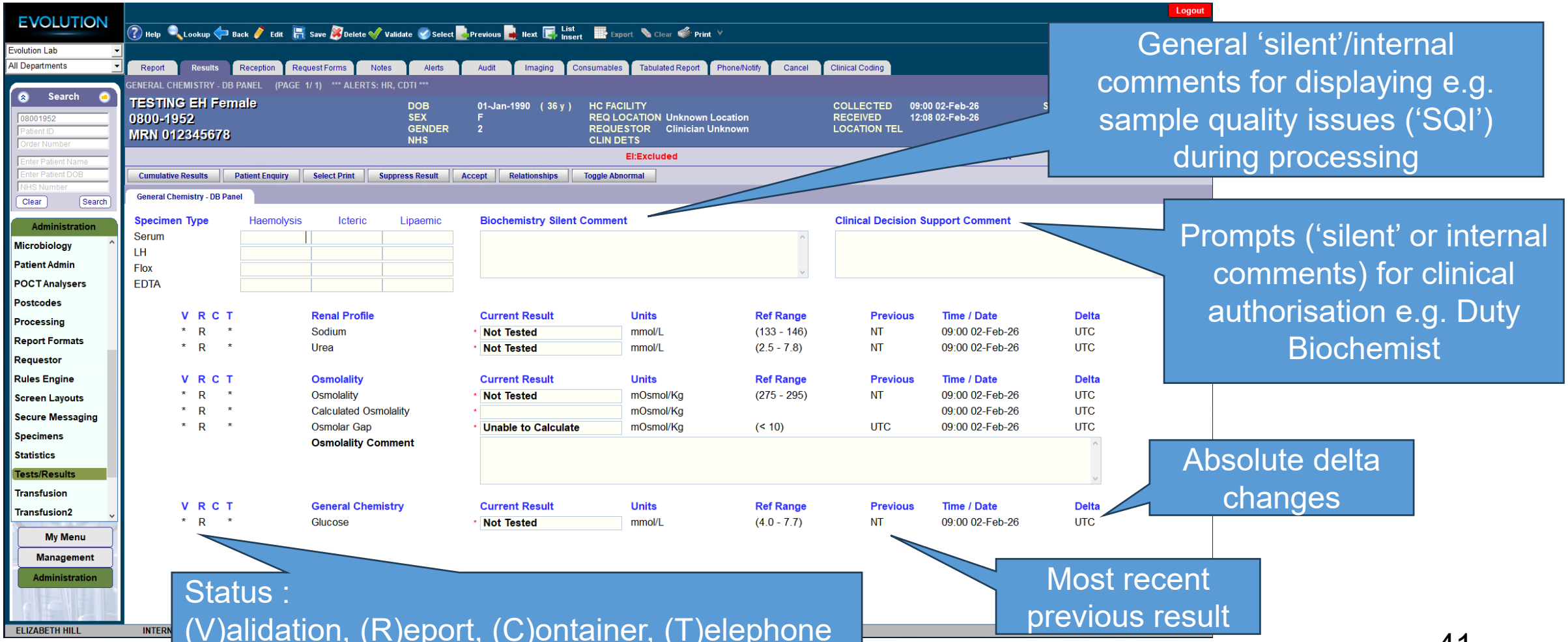
```
Royal Liverpool Blood Sciences **  Live  **
Auto comment / Further work / Tel. list routine setup
Routine UEPROC..                                [Condition for Add LFT?]

    /any /---------------- 1 ALP (or eq) > 180
    |  3  \---------------- 2 ALP2 (or eq) > 180
    |---------------------- 4 Management Stats Group = GP (GP)
    |---------------------- 5 Set = BCAPR,BECAPR,CAPR,ECAPR,EUECAP,UECAPR,BUECAP
    |---------------------- 6 Not Set LFT exists
    |---------------------- 7 Not Set SMAC exists
    |---------------------- 8 Not Set BLFT exists
    |---------------------- 9 Not Set ELFT exists
-all|----------------------10 Not Set LFTCAP exists
  19|----------------------11 Not Set ESMAC exists
    |----------------------12 Not Set UELFT exists
    |----------------------13 Not Set LFT2 exists
    |----------------------14 Not Set BUELFT exists
    |----------------------15 Not Set BESMAC exists
    |----------------------16 Not Set BLFTCA exists
    |----------------------17 Not Set BSMAC exists
    \----------------------18 Not Set ELFTCA exists
```

Clinical Decision Support – Internal (DB)

Cheshire and Merseyside Provider Collaborative

Planning for the future: CDS box customisation in Evolution vLab



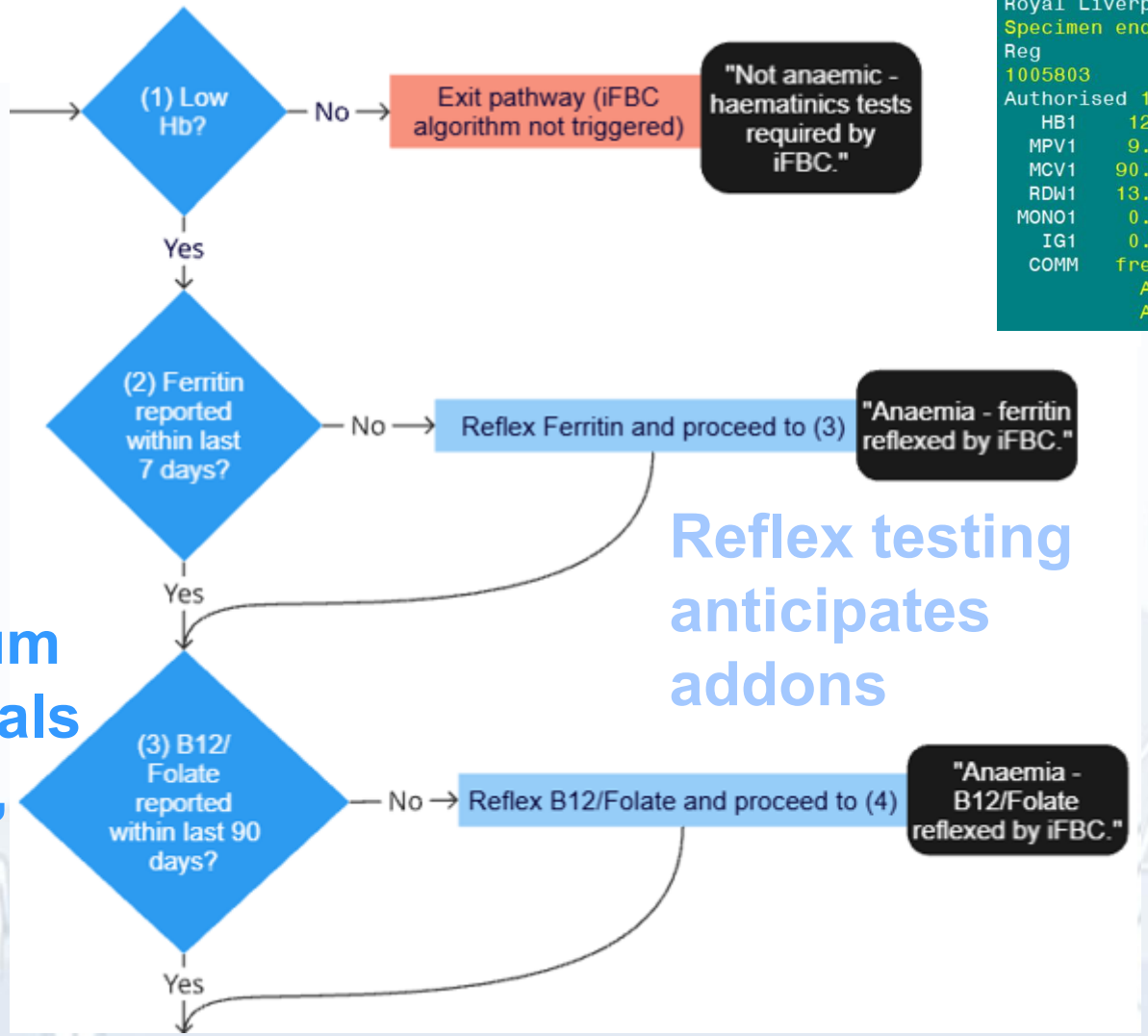
NHS
Cheshire and Merseyside
Provider Collaborative

Case Study 3 - ‘Intelligent’ FBC (iFBC)

Clinical decision support and diagnostic stewardship from ordering to reporting

iFBC Workflow

NHS
Cheshire and Merseyside
Provider Collaborative




```
Royal Liverpool Blood Sciences **  Live  **
Specimen enquiry. Display results       Set (FBC) FBC
Reg                 Surname              Inits Sex  Loc.    Specimen
1005803             MOUSE                 M      M   RLCL    C,25.0033684.D
Authorised 13.06.25 18:31 by Sarah Curtis (Mgr)e (PS) Plasma\Serum\Blood
   HB1    129              WBC1    6.0              PLT1    300
  MPV1    9.0              RBC1    5.00             HCT1    0.40
  MCV1    90.0             MCH1    30.0             MCHC1   350
  RDW1    13.0             NEUT1   4.0              LYMP1   2.0
 MONO1    0.5              EOSIN1  0.5              BASO1   0.1
   IG1    0.0              NRBC1                    FILMA
  COMM    free               MAC   free
          Anaemia - B12 and Folate added by iFBC for GPs.
          Anaemia - ferritin added by iFBC for GPs.
```

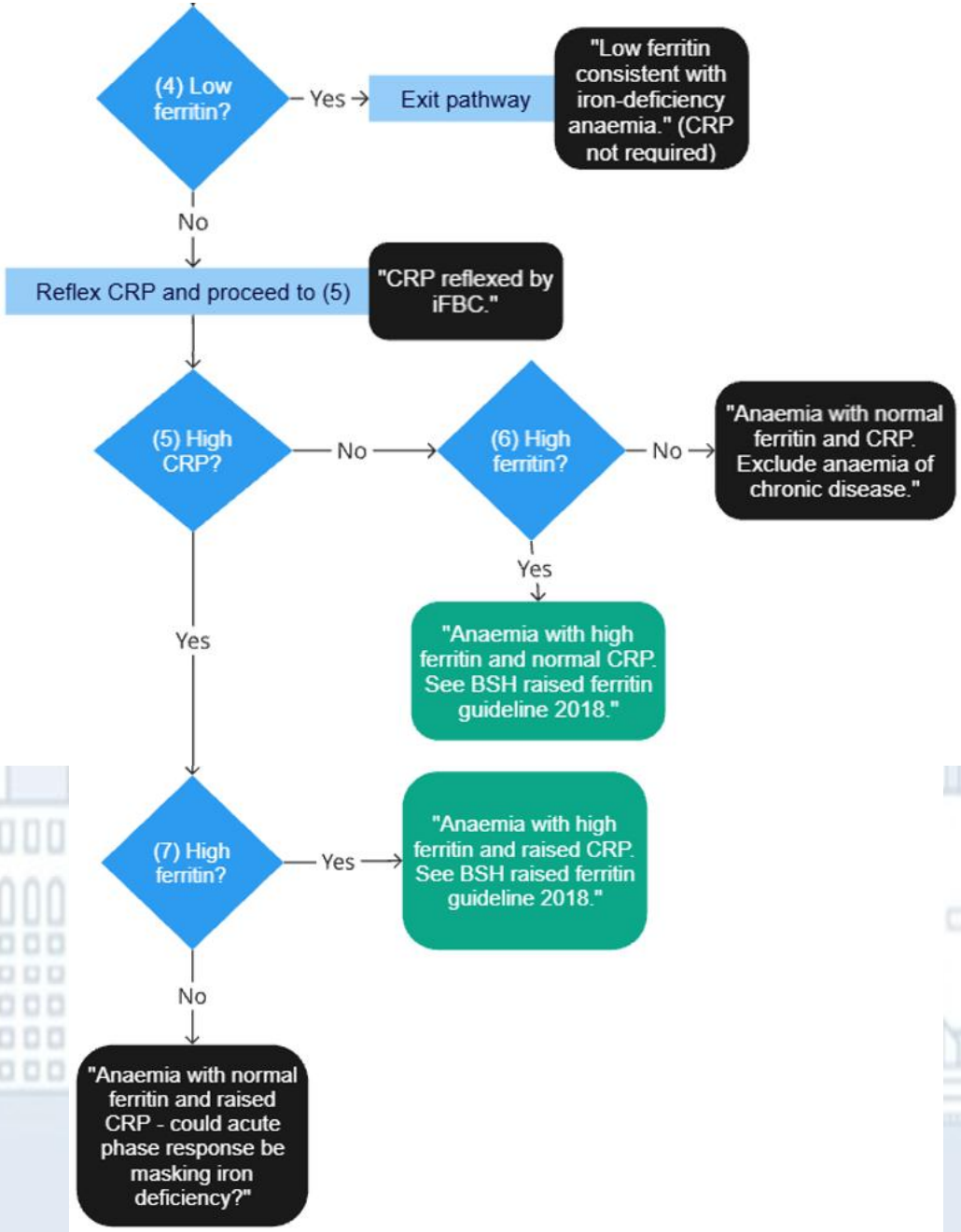
Diagnostic stewardship: custom minimum retesting intervals for ferritin, B12, folate and CRP

Reflex testing anticipates addons

Transparent reporting – tests added or denied by iFBC rules

iFBC Workflow

Data Dashboard
- Lab impact?
- Clinical impact?



Clinical Interpretation

NHS
Cheshire and Merseyside
Provider Collaborative

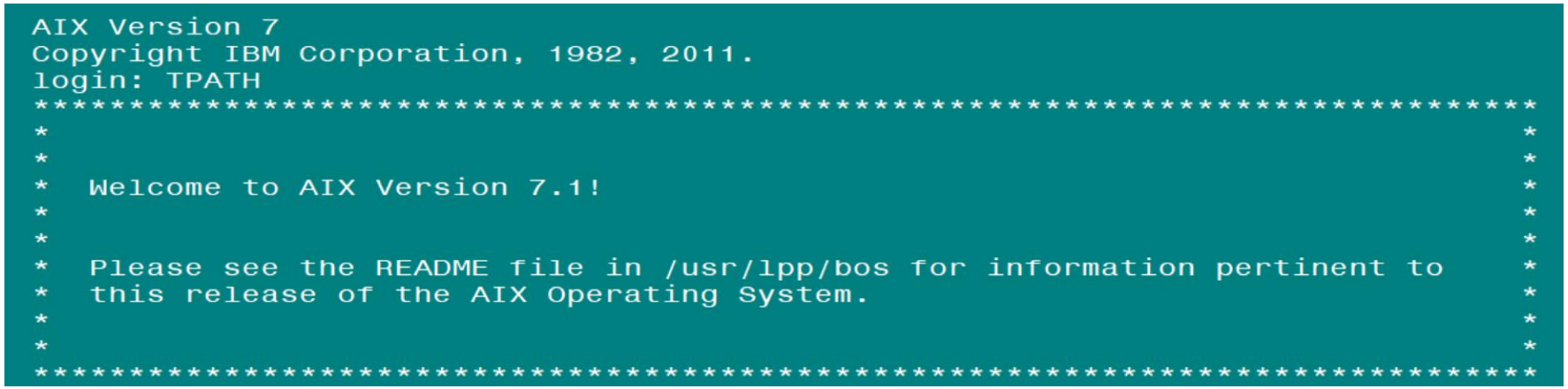
How To Streamline Your Queues

Practical steps for clinical authorisation optimisation

When To Review Your Queues

NHS
Cheshire and Merseyside
Provider Collaborative

- Dated LIMS? Have the queues ever been overhauled or have they been allowed to grow organically and unchecked?



- Safety concerns? Known gaps or existing system not understood?
- Team restructure? Do queues meet needs of required roles?
- Planning a new LIMS? Don’t copy what you have, be intentional in your designs!

How To Improve Your Queues (1)

Safety first - is everything trapping that is required to be phoned?

NHS
Cheshire and Merseyside
Provider Collaborative

- Review a data gather: manual versus system-authorised
  - Some labs phone results from the middleware – does these also need to be trapped in the LIMS?
    - LIMS as safety-net?
    - Unnecessary duplication?
- Compare with your telephone policy
- Also a good time to review phone limits, e.g. in line with latest RCPath Guideline on Communication of Critical and Unexpected Pathology Results

How To Improve Your Queues (2)

Pattern recognition - observe and record what you see whilst on duty

NHS
Cheshire and Merseyside
Provider Collaborative

- What do you not act on? Why not?
  - The type of test?
  - The level of the test? (Not high or low enough)
  - The location?
  - The clinical specialty?
  - The comment?
- Assess your internal ‘rejection’ logic…
  - Translate it into a rationale that can be configured as limits or rules
  - Would increased auto-commenting and/or reflexive testing help?
  - Focus on high volume low complexity

How To Improve Your Queues (2)

Pattern recognition - observe and record what you see whilst on duty

Cheshire and Merseyside Provider Collaborative

	A	B	C	F
1	Priority	List	Idea	Target Date
2	1	Haematinics	Stop trapping ferritin 50-200 and non-GPs	05/01/2024
3	2	Chemistry	Autocomment GTTs	24/06/2024
4	3	Gonads	IgE – normal values (or all?) Consider asking for opinion from CK - what would we not want to miss?	15/07/2024
5	4	Chemistry	Borderline high (and low) Ca (introduce delta change?), previously a problem with low calciums – now resolved	15/07/2024
6	5	Chemistry	IgA/G/M - don't do anything with these?	15/08/2024
7	6	Chemistry	Globulin – low values, "Unable to calc"	07/08/2024
8	7	Chemistry	eGFR – "Unable to calc"	07/08/2024
9	8	Chemistry	Anion gap – low values, "Unable to calc"	07/08/2024
10	9	Chemistry	Alb/Creat Ratio – "Unable to calc"	07/08/2024
11	10	Gonads	PTH from dialysis locations/renal clinics	26/07/2024
12	11	Chemistry	Low chloride	21/07/2024
13	12	Gonads	Autocomment progesterones as per LCL	21/07/2024
14	12	Gonads	Stop trapping progeterones except paeds	21/07/2024
15	13	Gonads	Stop trapping NTproBNP < phone limit and introduce CMPN comment	30/08/2024
16		Gonads	Stop trapping normal prolactins (see 14)	03/01/2025
17		Gonads	Autocomment inappropriate FSH by age (females) (as per NICE guideline)	
18	14	Gonads	Autocomment prolactins, stop trapping normals (approved but retain borderlines) and review macroprolactin rule	30/09/2024
19	15	Gonads	Stop trapping normal cortisols unless from a GP	30/09/2024
20	16	Gonads	Stop trapping normal male testos (<12) except paeds	30/09/2024
21	17	Gonads	Stop trapping normal PTH with normal ACa (add AUCOM & auto-authorise)	03/01/2025
22	18	Chemistry	Introduce AKI delta limit/rule	30/09/2024
23	18	Chemistry	Stop eGFR trapping	30/09/2024
24	19	Chemistry	Review K delta limit/rule	30/09/2024

How To Improve Your Queues (2)

Pattern recognition - observe and record what you see whilst on duty

NHS
Cheshire and Merseyside
Provider Collaborative

	A	B	C	F
1	Priority	List	Idea	Target Date
25	20	Chemistry	Review urea delta limit/rule	30/09/2024
26	21	Chemistry	Review Na delta limit/rule	30/09/2024
27	22	Chemistry	Introduce ALP/GGT delta limit/rule	30/09/2024
28	23	Chemistry	Introduce HbA1c delta limit/rule	30/09/2024
29	24	Haematinics	Autocomments for IDA/IDWA	30/08/2024
30	24	Haematinics	Stop trapping some autocomments for IDA/IDWA	30/08/2024
31	25	Haematinics	Still some normal ferritins trapping (80902779),	30/08/2024
32	26	Haematinics	Stop trapping TIBC - we will never want to see this if abnormal in isolation	30/08/2024
33	27	Haematinics	Stop trapping B12 and folate retesting interval comments	30/09/2024
34	28	Haematinics	Low/high B12 - autocomment if needed, do not need to trap	30/09/2024
35	29	Gonads	Lose TRABs. Review autocomment.	30/09/2024
36	30	Gonads	Stop trapping TPOs. Review autocomments.	30/09/2024
37	31	Chemistry	Stop trapping normal (all?) bile acids. Review autocomment.	30/09/2024
38	32	Chemistry	Stop trapping low lipids - e.g. cholesterol, LDL e.g. see 80788617	30/09/2024
39		Chemistry	Borderline high (and low) Mg (introduce delta change?)	
40		Chemistry	Anion gap – low values	
41		Chemistry	NOT currrently seeing changes in albumin/protein (?dilutions)	
42		Chemistry	NOT currrently flagging valproate levels >100 mg/L to phone (may be associated with toxicity)	
43		Chemistry	No ACR limit for paeds?	
44		Chemistry	Protein/albumin delta?	
45		Gonads	PTH level is appropriate for normocalcaemia comment for GPs	31/03/25
46		Gonads	Thyroid autocomments	
47		Chemistry	RENAL/BONE/LIVER comment 'no sample'	

How To Improve Your Queues (3)
Learn how your LIMS queues work

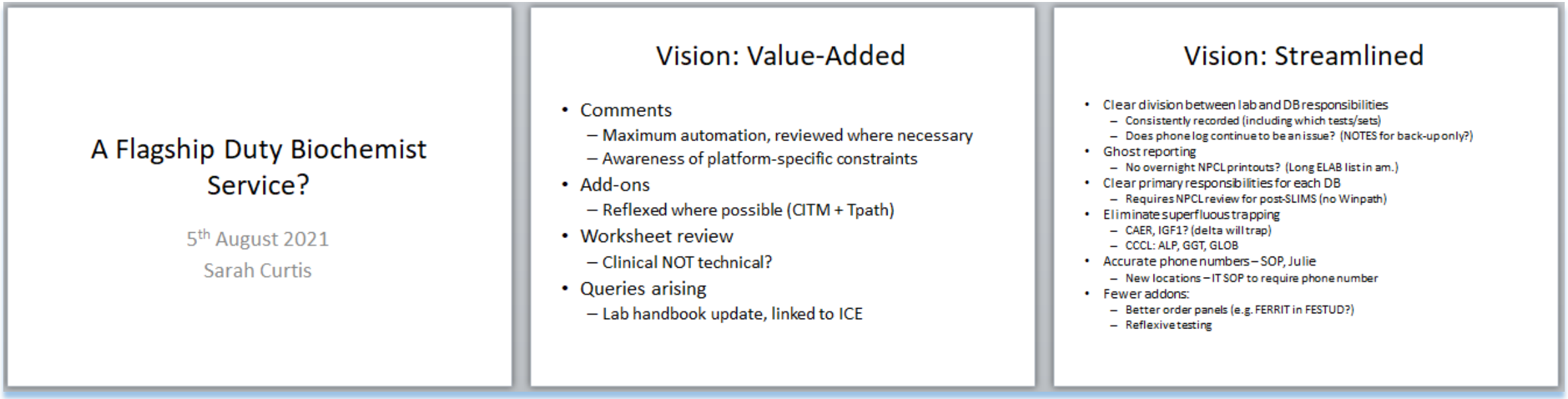
NHS
Cheshire and Merseyside
Provider Collaborative

- Whilst on duty, observe WHY each episode that you are presented with has trapped
  - Did one or more tests fail a reference or critical limit?
  - Did one or more tests fail a delta check?
  - Default rule-in?
- Get friendly with your pathology IT leads (harder if trust IT, but not impossible… they sometimes need you too!)
  - Ask to see ‘under the bonnet’
  - What are the available fields for trapping and filtering?
  - Order of operation / prioritisation

How To Improve Your Queues (4)
Full top-to-bottom review

Cheshire and Merseyside
Provider Collaborative

1. Get the team onboard and establish the vision…



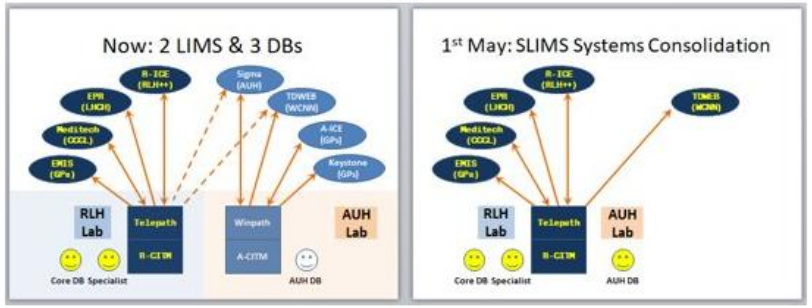
How To Improve Your Queues (4)
Full top-to-bottom review

NHS
Cheshire and Merseyside
Provider Collaborative

… motivators and expected benefits

Planning: Background

- 'Single Laboratory Information System' (SLIMS) project necessitates cross-site duty biochemist (DB) service
- NPCL lists outdated, wasteful, not clinically effective



- Existing system poorly understood - high risk
- Clinical harmonisation learning = opportunity

Planning: Benefits Profile

Ref	Outcome	Benefit	Metric
1	Fewer NPCL lists to navigate	Easier to manage workload – will not lose sight of results, all results collated chronologically	Absolute number of lists to navigate
2	Reduced workload for duty biochemist to authorise	Releases staff to perform other 'value-added' activities	Number of reports trapped for clinical authorisation
3	Increased auto-commenting	Releases staff to perform other 'value-added' activities	Number of reports auto-commented
4	More streamlined service	Improved experience for service users (clinicians and patients)	TAT for reports trapped reduced
5	Fewer DB hours required to complete rota	Releases staff to perform other 'value-added' activities	Number of operators required for duty biochemist service
6	Simpler NPCL 'rules'	Easier to understand for trouble-shooting and also future developments.	Number of rules and clauses within authorisation pathway
7	Updated NPCL SOP	Easier to understand for trouble-shooting and also future developments.	Release of documentation

How To Improve Your Queues (4)
Full top-to-bottom review

NHS
Cheshire and Merseyside
Provider Collaborative

2. Establish project deliverables

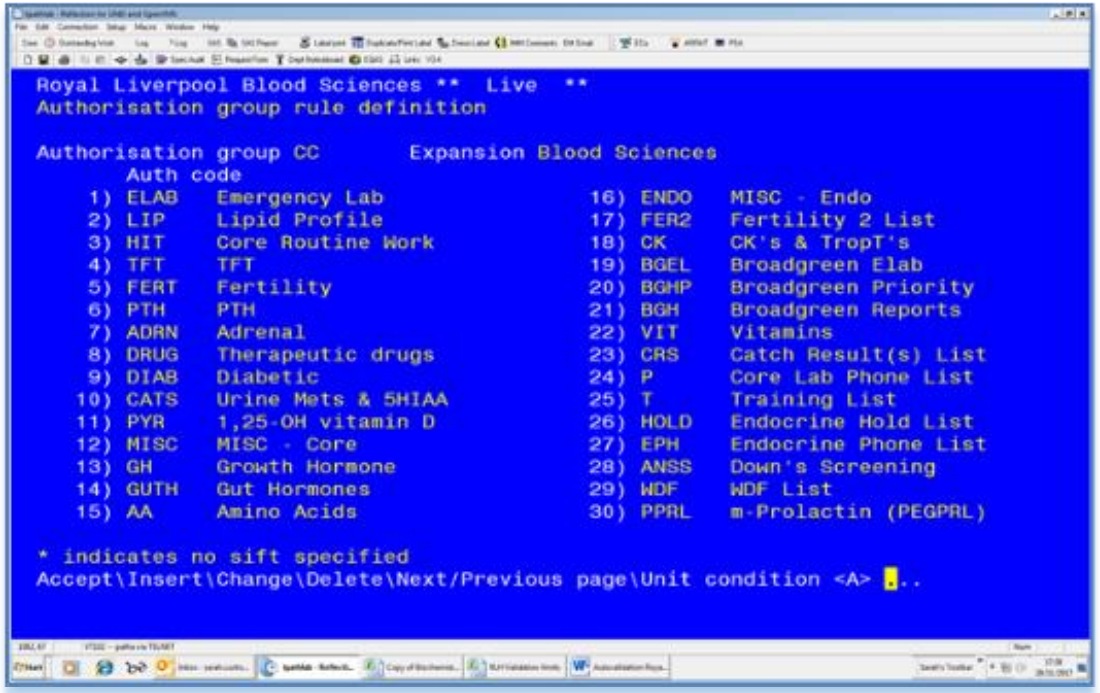
Planning: Expected Outcomes / Deliverables
Mission, Vision, Values

1. New NPCL authorisation process meeting clinical, scientific and workforce requirements
2. Reduced DB workload through efficient trapping
3. Simplified algorithms, easy to update
4. Updated documentation with full description

How To Improve Your Queues (4)
Full top-to-bottom review

NHS
Cheshire and Merseyside
Provider Collaborative

3. Make a list of what queues you have
4. Establish the crude criteria for trapping to each list



Priority	NPCL Code	NPCL List Name	Range Check fails	SET	CC	SI	LOC
1	ELAB	Emergency Lab	Abnormal	Y	N	N	Yes
2	LIP	Lipid	Abnormal	Y	N	N	N
3	HIT	Core Routine Work	Abnormal	Y	N	N	N
8	DRUG	Therapeutic drugs	Abnormal	Y	N	N	N
12	MISC	MISC - Core	Abnormal	Y	N	N	N
20	BGHP	Broadgreen Priority	Abnormal	Y	N	N	N

How To Improve Your Queues (4)
Full top-to-bottom review

Cheshire and Merseyside
Provider Collaborative

5. Establish a list of tasks

6. Consider your stakeholders – would a RACI analysis help?

RACI: Responsible, Accountable, Consulted, Informed

	Clinical Director	Clinical Informatics Lead (myself)	DB Team	I.T. Team	Quality Team
Task 1: Review existing mechanisms for filtering (SNPCL)		A, R		C	
Task 2: Review existing mechanisms for trapping (NPSET)		A, R		C	
Task 3: Review of Duty Biochemist SOP/RCPath standards		A, R			
Task 4: Options appraisal for new mode of working – design of first draft	I	A, R		C	
Task 5: FOCUS model. Coach team with regard to 'art of the possible' then present draft options appraisal, inviting further suggestions – establish areas of agreement and possible conflict through collaborative working	A	R	C		
Task 6: Options appraisal for implementation strategy	A	R	C		
Task 7: Establish KPIs		A, R			
Task 8: Updates to configuration including change control and end-to-end testing	I	A, R	I	I	
Task 9: Evaluate progress/success – KPIs, meetings	A	R	C		
Task 10: Agreement on trial of new DB rota	A		R		
Task 11: Update NPCL SOP and DB SOP ('Freeze' NPCL configuration from further changes)	A	R			A

How To Improve Your Queues (4)
Full top-to-bottom review

NHS
Cheshire and Merseyside
Provider Collaborative

7. Would a SWOT analysis help?

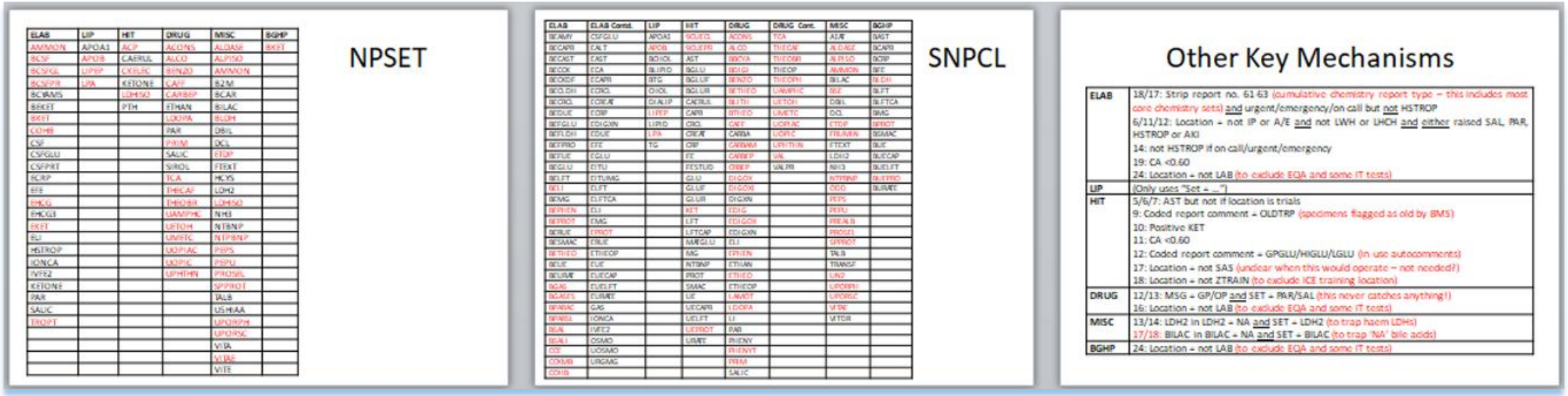
SWOT: Strengths, Weaknesses, Opportunities, Threats

	Helpful	Harmful
Internal	**Strengths** Comprehensive understanding of current catalogue	**Weaknesses** DB team too busy to engage Work pressures on clinical informatics lead (myself)
External	**Opportunities** SLIMS project – install of Telepath at AUH BMS team ready to take on additional responsibilities Approaching more to RLH new hospital building	**Threats** Delay to SLIMS go-live Lack of availability of I.T. team Ongoing Covid-19 pandemic situation

How To Improve Your Queues (4)
Full top-to-bottom review

Cheshire and Merseyside
Provider Collaborative

8. Review each queue with a fine toothcomb looking for waste and omissions – review system rules (e.g. ask for screenshots)
9. Gap analysis = “What we have” versus “What we want”



NPSET

ELAB	LIP	HIT	DRUG	MISC	BGHP
AMMON	APOA1	ACP	ACONS	ALDASE	BKET
BCSP	APOB	CAERUL	ALCO	ALPISO	
BCSFGL	LIPEP	CKELEC	BENZO	AMMON	
BCSFPR	LPA	KETONE	CAFF	B2M	
BCBAMS		LDHISO	CARBEP	BCAR	
BBKET		PTH	ETHAN	BILAC	
BKET			LDOPA	BLDH	
COHB			PAR	DBIL	
CSF			PRIM	DCL	
CSFGLU			SALIC	FTDP	
CSFPRT			SERDL	FTEXT	
ECRP			TCA	HCYS	
EFE			THECAF	LDH2	
FHCG			THEOBR	LDHISO	
FHCGS			UAMPHC	NHS	
IKET			UFTOH	NTBNP	
ELI			UNITIC	NTPBNP	
HSTROP			UOPIAC	PSPS	
IONCA			UOPIC	PSPU	
IVFE2			UPHTPH	PROSRL	
KETONE				SPPROT	
PAR				TALB	
SALIC				USHAA	
TROPT				UPORPH	
				UPORSC	
				VITA	
				VITBE	
				VITE	

SNPCL

ELAB	ELAB Contd.	LIP	HIT	DRUG	DRUG Cont.	MISC	BGHP
BCAMY	CSFGLU	APOA1	SCUEO	ACONS	TCA	ALAE	BAST
BECAPR	EALT	APOB	SCUEPR	ALCO	THECAF	ALDASE	BCAPR
BECAST	EAST	BCHOL	AST	BBCYA	THEOBR	ALPISO	BCRP
BECCK	ECA	BLIPID	BGLU	BENZO	THEOP	AMMON	BFE
BECKDP	ECAPR	BTG	BGLUF	BENZO	THEOPH	BILAC	BLDH
BECLDH	ECRCL	CHOL	BGLUR	BETHEO	UAMPHC	BSE	BLFT
BECRCL	ECREAT	DIALIP	CAERUL	BLITH	UFTOH	DBIL	BLFTCA
BEDUE	ECRP	LIPEP	CAPR	BTHEO	UNITIC	DCL	BMG
BEFGLU	EDIGXN	LIPID	CBCL	CAFF	UOPIAC	ETDP	BPROT
BEFLDH	EDUE	LPA	CREAT	CARBA	UOPIC	FBUMEN	BSMAC
BEFPRO	EFE	TG	CRP	CARBAM	UPHTPH	FTEXT	BUE
BEFUE	EGLU		FE	CARBEP	VAL	LDH2	BUECAP
BEGLU	EITU		FESTUG	CKBEP	VALPR	NHS	BUELFT
BELFT	EITUMG		GLU	DIGOX		NTPBNP	BUEPRO
BELI	ELFT		GLUF	DIGOXI		ODO	BURATE
BEMG	ELFTCA		GLUR	DIGXN		PEPS	
BEPHEN	ELI		KET	EDIG		PEPU	
BEPROT	EMG		LFT	EDIGOX		PREALB	
BETUE	EPROT		LFTCAP	EDIGXN		PROSEL	
BESMAC	ETAUE		MAGLU	ELI		SPPROT	
BETHEO	ETHEOP		MG	EPHEN		TALB	
BEUE	EUE		NTBNP	ETHAN		TRANSF	
BEURAE	EUECAP		PROT	ETHEO		UN2	
BGAS	EUELFT		SMAC	ETHEOP		UPORPH	
BGASES	EURATE		UE	LMWOT		UPORSC	
BPARAC	GAS		UECAPR	LDOPA		VITAE	
BPARSL	IONCA		UELFT	LI		VITOR	
BSAL	IVFE2		UEPROT	PAR			
BSALI	OSMO		URATE	PHENY			
CCE	UOSMO			PHENYT			
CDIVB	URGMG			PRIM			
CDRB				SALIC			

Other Key Mechanisms

ELAB	18/17: Strip report no. 61 63 (cumulative chemistry report type – this includes most core chemistry sets) and urgent/emergency/on call but not HSTROP 6/11/12: Location = not IP or A/E and not LWH or LHCH and either raised SAL, PAR, HSTROP or AKI 14: not HSTROP if on call/urgent/emergency 19: CA <0.60 24: Location = not LAB (to exclude EQA and some IT tests)
LIP	(Only uses "Set = ...")
HIT	5/6/7: AST but not if location is trials 9: Coded report comment = OLDTRP (specimens flagged as old by BMS) 10: Positive KET 11: CA <0.60 12: Coded report comment = GPGLU/HIGLU/LGLU (in use autocomments) 17: Location = not SAS (unclear when this would operate – not needed?) 18: Location = not ZTRAIN (to exclude ICE training location)
DRUG	12/13: MSG = GP/OP and SET = PAR/SAL (this never catches anything!) 16: Location = not LAB (to exclude EQA and some IT tests)
MISC	13/14: LDH2 in LDH2 = NA and SET = LDH2 (to trap haem LDHs) 17/18: BILAC in BILAC = NA and SET = BILAC (to trap 'NA' bile acids)
BGHP	24: Location = not LAB (to exclude EQA and some IT tests)

How To Improve Your Queues (4)
Full top-to-bottom review

NHS
Cheshire and Merseyside
Provider Collaborative

10. Communicate new design to stakeholders for review

    Easy wins – pressure points, accumulating simple changes

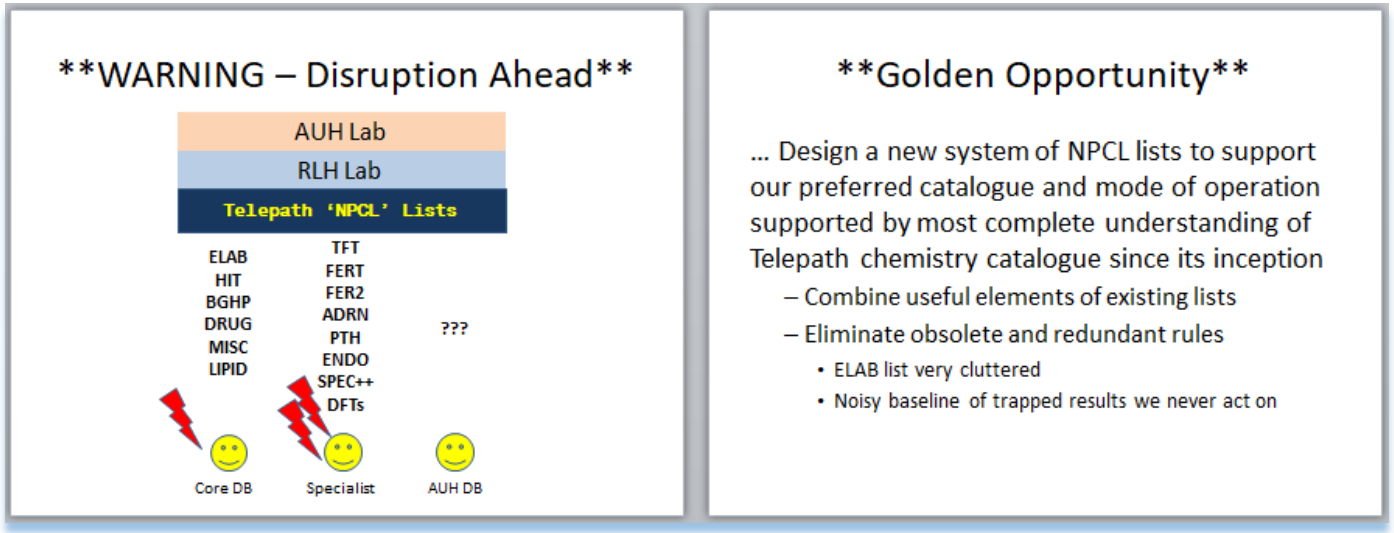
11. Implement changes (follow local change control process!)

    Risk assessment

    End-to-end testing

    Documentation

    Communication



How To Improve Your Queues (4)
Full top-to-bottom review

Cheshire and Merseyside
Provider Collaborative

12. Impact analysis – Benefits? KPIs?

			Sat	Sun	Mon	Tue	Wed	Thu	Fri	TOTAL	Abs Delta	% Delta	Weekday Av
	BASELINE		392	176	778	1218	1382	1115	1014	6074			1154
May-21	Week 1		1012	314	388	1471	2505	1922	2117	9729	3655	60%	2004
	Week 2		839	674	1691	2251	2172	2075	1693	11395	5321	88%	1976
	Week 3		658	471	1541	1773	2097	1884	1645	10069	3995	66%	1788
	Week 4		732	390	1316	1605	1649	1731	1644	9067	2993	49%	1589
Jun-21	Week 5		690	493	446	2454	1473	1669	1875	9100	3026	50%	1868
	Week 6		624	418	1261	1285	1673	1548	1565	8374	2300	38%	1466
	Week 7		492	405	770	1488	1504	1257	1589	7505	1431	24%	1322
	Week 8		448	395	1220	1439	1466	1383	1142	7493	1419	23%	1330
Jul-21	Week 9		509	360	935	1398	1353	1387	1346	7288	1214	20%	1284
	Week 10		532	303	1295	1222	1539	1434	1475	7800	1726	28%	1393
	Week 11		527	329	878	1216	1240	1284	1521	6995	921	15%	1228
	Week 12		500	339	944	1381	1478	1465	1129	7236	1162	19%	1279
	Week 13		533	310	948	1205	1182	1400	1646	7224	1150	19%	1276
Aug-21	Week 14		539	363	885	1152							

Volume of sets authorised

	A	B	C	D	E	F	G
1		1,216			1,179		
2	Baseline			Post			
3	Count	No/Day	Delta	Days	No/day	Row Labels	Count of Set
4	219	5	135	96	140	RP	13430
5	2883	64	44	96	108	LFT	10343
7	2158	48	32	96	80	CAPR	7680
9	3671	82	-30	96	52	UE	4955
12	2150	48	-18	96	30	CORT	2882
13	1909	42	-15	96	28	PROL2	2677
15	1705	38	-15	96	23	SMAC	2181
18	1277	28	-12	96	17	PSA	1618
33	564	13	-6	96	7	CEA5	669
38	420	9	-4	96	6	CA125	544
46	595	13	-9	96	5	HCGNP3	439
48	727	16	-12	96	4	AFPNP3	398
59	506	11	-8	96	3	CA199	319
69	188	4	-2	96	2	THYG	234
71	807	18	-16	96	2	ELFT	219
73	852	19	-17	96	2	ECAPR	198
79	177	4	-2	96	2	FERRIT	168
86	156	3	-2	96	1	BUELFT	133
87	723	16	-15	96	1	TRAB1	133
92	996	22	-21	96	1	NTBNP	124
94	200	4	-3	96	1	FESTUD	119
102	396	9	-8	96	1	PROG	99
103	253	6	-5	96	1	BILAC	98

Figure 7: Cumulative progress in reduction of trapping by set at end of week 6 post SLIMS go-live. 'Post - No/day' (column E) was the average number of sets of that type that had been manually authorised per day in the 6 weeks following SLIMS go-live on 1st May 2021.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1			Sat	Sun	Mon	Tue	Wed	Thu	Fri	TOTAL	Abs Delta	% Delta	Wkday Av	Delta	% Delta
2	May-21	Week 1	1012	314	388	1471	2505	1922	2117	9729			2004		
3		Week 2	839	674	1692	2252	2172	2075	1693	11397	1668	17%	1977	-27	-1%
4		Week 3	658	471	1542	1773	2099	1886	1645	10074	345	4%	1789	-215	-11%
5		Week 4	733	390	1318	1607	1649	1731	1645	9073	-656	-7%	1590	-414	-21%
6		Week 5	691	493	446	2455	1473	1669	1876	9103	-626	-5%	1868	-136	-7%
7		Week 6	625	418	1261	1285	1675	857							

Figure 8: Daily progress in reduction of total manual authorisation workload by end of week 6 post SLIMS go-live. Owing to the reduction in workload on weekends and bank holidays,

	A	C	D	E	F	P	Q	R	S	T	U	AE	AF	AG
1														
2														
3			Daily Average						Weekly Average					
4			Baseline	Week1	Week2	Week12	Week13		Baseline	Week1	Week2	Week12	Week13	
5	TOTAL TRAPPED	(All)	1191	2004	1976	1279	1276		5656	9729	11395	8374	8242	
6	Abs Delta			813	785	88	85			4073	5739	2718	2586	
7	% Delta			68%	66%	7%	7%			72%	101%	48%	46%	
8	Summary													
9	CHEM+ENDO/SPEC	TOTAL	615	1140	1350	796	645		3474	6586	7935	5800	5363	
10	ENDO/SPEC		292	509	810	363	270		1569	2796	4578	2623	2405	
11		TFT	113	257	492	219	157		611	1389	2827	1589	1437	
12		FERT	62	72	99	59	46		334	437	577	388	368	
13		Other ENDO	55	104	102	74	57		302	561	569	568	534	
14		ENDO	55	76	94	11	9		294	405	494	77	65	
15		SAS	7	1	22	0	0		28	4	111	1	1	
16	CHEMISTRY		323	630	540	433	376		1906	3790	3357	3177	2958	
17		CORE 1 (Drop	47	55	34	3	2		254	332	192	24	21	
18		CORE 2 (Red	277	576	506	430	373		1652	3458	3165	3153	2937	

March-April 2021 - Baseline

	Mon	Tue	Wed	Thu	Fri	Sat	Sun	5851 TOTAL	1069 Wkday Av
Week 1	699	535	868	920	1043	443	144	4652	813
Week 2	977	912	983	1064	1102	306	149	5493	1008
Week 3	865	1006	1181	1380	983	332	175	5922	1083
Week 4	895	1366	1016	1214	1198	384	170	6243	1138
Week 5	663	1187	1391	967	325	245	162	4940	907
Week 6	256	1957	2391	1323	938	541	167	7573	1373
Week 7	980	1105	1053	906	1040	527	244	5855	1017
Week 8	765	1139	1603	808	1536	355	199	6405	1170
Week 9	823	1071	1440	1255	988			5577	1115
	769	1142	1325	1093	1017	392	176		

Figure 9: Baseline activity of total manual authorisation workload in the nine weeks prior to SLIMS go-live.

How To Improve Your Queues (4)
Full top-to-bottom review

NHS
Cheshire and Merseyside
Provider Collaborative

13. Feedback/Review

Evaluation: Project Delivery

- Quality deliverables accomplished:
  - Streamlined NPCL algorithm even simpler than planned
  - Reduced DB workload sufficient to permit restructure of rota
    - **1 WTE released for value-added activities**
  - Clear documentation
- Careful risk management
  - Robust change control and end-to-end checks
  - No safety issues arising
- Project costs recouped within 7 weeks
  - Incremental implementation + scope creep (10 days' work) = £2,000 added cost

Very impressive!
That ELAB tree looks a lot healthier with fewer branches.

New rota allocations are now below - hopefully we will all see the benefits of less days tied to the authorising seat and thank you to Sarah C for all the time refining the lists to enable this! I know we discussed on-site AUH days - if possible, Andrew and

'Clean' system, fully documented
Dividends ahead: training, future updates

Take Home Messages

- ‘Duty Biochemist’ is a value-added service – embed opportunities into your clinical LIMS workflows
- Good clinical LIMS workflows start with good ordering and sharing of information
- Observe your own Duty Biochemist experience with your systems
- Understand what you are seeing (and missing) and why
- Be curious and seek insights…discover opportunities
- Make improvements… add clinical value!
- Create time… reconfigure your team’s day!

“Workforces behave like expanding foam, filling the available time”

Acknowledgements

- **Warrington team**
  - **Emma Henly** – MPL wizard
  - **Lynsey Burke** – Data wizard
  - Charlotte Harborrow, Ceri Rowe, Hannah Fearon
  - Warrington Pathology IT team
- **Liverpool team**
  - Liverpool DB team
  - LCL Pathology IT team
- **Cheshire & Merseyside Pathology Network (CMPN)**
  - Biochemistry clinical reference group- Jen Atherton, Niamh Horton and many others
  - CMPN Evolution 'new LIMS' programme Team - **Declan Hushon** and many others