



Birmingham Quality

Birmingham Quality

Previously known as the *Wolfson EQA Laboratory*,
Birmingham Quality provides primarily
UK NEQAS External Quality Assessment
Services in Clinical Chemistry

UK NEQAS

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Innovations from Birmingham Quality [UK NEQAS Birmingham] for Newborn Screening EQA

Finlay MacKenzie

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Anne Green's July 2007 Meeting

There was agreement that Quality Assurance needed to be funded by commissioners and that there was support for a higher profile for Quality Assurance.

The group agreed the following:-

- That generic criteria should apply to all newborn screening schemes.
- New schemes should be established or current ones adapted to ensure that they meet all the generic criteria.
- There is a need to establish a multi professional group which focuses on newborn screening schemes and to oversee laboratory quality.

Activities of such a Quality group would include:-

- Provide input to existing EQA schemes.
- Set standards, provide criteria for new schemes.
- Co-ordinate and work with external QA providers for the five disorders including molecular testing.
- Report performance to the screening programme directors
- Provide information/guidance about EQA schemes and Lab procedures to CPA
- Advise on risks associated with Lab screening procedures.



UK NBS LQADG

This group transmogrified into the

UK Newborn Blood Spot Laboratory Quality Assurance Development Group [UK NBS LQADG]

Venue: Government Office for the West Midlands, Birmingham

Chair: Rowena Clayton, UKNSC and NHS SHA Screening Leads

Independent Chair, Terms of Reference etc etc

*I took it that **my** role was to have in place, by April 2010, a fully functional EQA Scheme for Newborn Screening which built on the existing Scheme for CHT and PKU, but would now include Tyrosine and cover MCADD and also include IRT for CF.*

Business Plans were submitted, funding agreed and the work started.....



Birmingham Quality's master plan

The key decision was that BQ put forward a case to run effective EQA for all the new analytes wef 1st April 2010.

The poisoned chalice was IRT, but the other analytes were not going to be without their problems.

Birmingham Childrens had already been successfully running an 'EQA-lite' programme for Acyl Carnitines

We had good co-operation from Birmingham, Liverpool and Manchester



Birmingham Quality's Pre-Pilot master plan

We looked at the basic recoveries of added material

We looked at PCVs and spot sizes

We looked at different types of base material

We sourced C8 and C10 from the Netherlands

We sourced two suppliers of IRT from the USA

We spoke in a conference call with CDC, Atlanta

[[Joanne Mei](#), [Harry Hannon](#) and [Jesus](#) ?]

We looked at protease inhibitors

We looked at frozen reagents and frozen cards.

We added specimens directly to the PE Delfia wells, to bypass elution concerns, at Alder Hey



Birmingham Quality's Pre-Pilot master plan

We essentially thought of most things and with help from Birmingham, Liverpool and Manchester we think we got the basics sorted out.

Even the liquid plasma Phenylalanine results from Edinburgh and Sheffield that we use as a cross-check gave conflicting data.

The proof of the pudding was in the between-lab picture, as the results coming back from the pre-pilot were internally consistent, but did exhibit marked biases between centres.

We ran with a couple of Pilots, looking at the numerical analytes, leaving the interpretations until we were happy with the numbers and until the Programs Centre's Protocols were in place.



Network Reports

Penalty Box Plot immediately identifies issues



Birmingham Quality

Birmingham Quality ~ Newborn British Isles

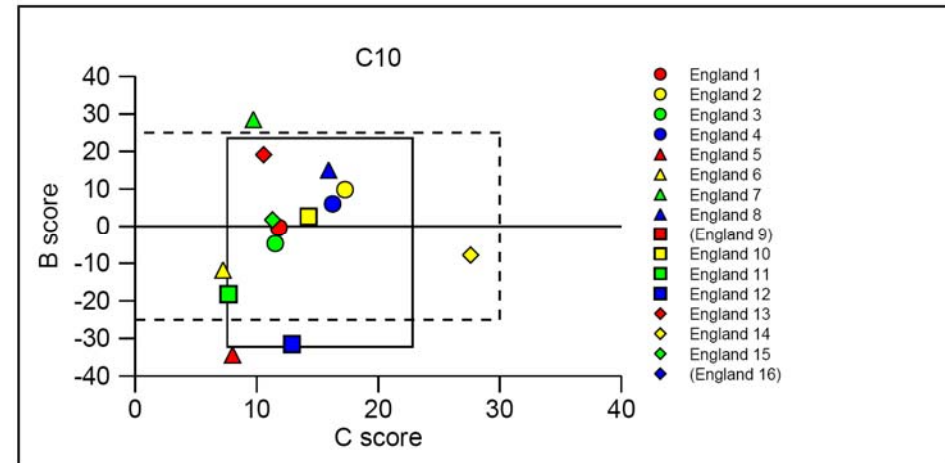
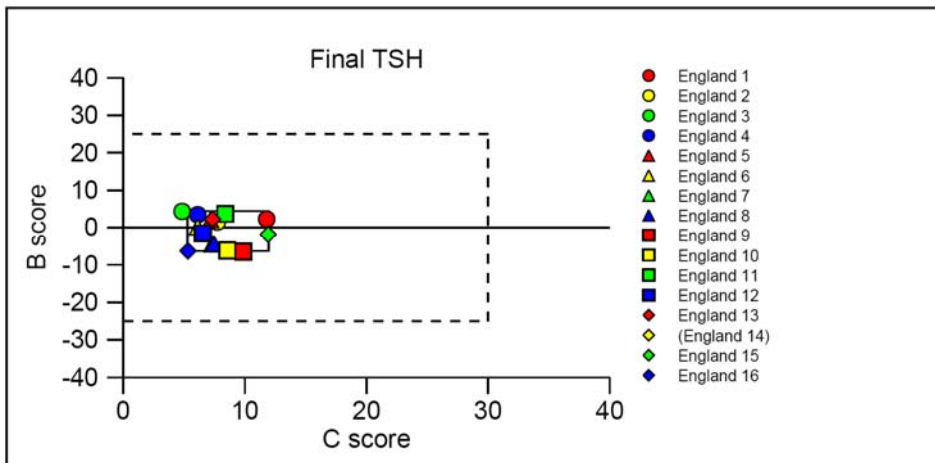
Laboratory :

Distribution : **212**

Date : 28-Nov-2010

Page 1 of 2

Penalty Box Plots



The Best versus The Worst ~ TSH and C10
this is the only slide you will ever need!





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Update from Birmingham Quality: Paper 7 for 7 September 2009

We are very slightly behind our notional proposed times-scale, but given the episodic intensive nature of our work we believe we are on schedule to go live with the 'established scheme' in April 2010.

1.1. Proposed timescale

Phase	Start	End
Obtain (initial) funding	July 2009	
Fact-finding trip	Aug 2009	
Pre-pilot phase	Aug 2009	Sept 2009
Pilot	Oct 2009	Dec 2009
Evaluation of pilot data	Jan 2010	Mar 2010
'Established scheme' launch	April 2010	
First interim report	October 2010	

The tasks already completed include:

- *Finalised and submitted Business Case and received approval*
- *Agreed with BCH, LCH and MCH to undertake analysis*
- *Spoken to CDC to obtain materials against which to cross check our own materials*
- *Agreed in principle with Perkin Elmer to check against their spots, where applicable*
- *Gleaned information on existing protocols*
- *Inform Screening Laboratories through Scheme that Pilot Phase will be taking place later in the year*
- *Designed flexible Pre-pilot study including specifications for internal and external activities*
- *Identified suppliers of raw materials and sourced same*
- *Visited BCH to ensure practicalities of pre-pilot specimens disc-cutting*
- *Changes to software to allow production of 3 specimen Scheme design and to enable full colour Network Report*

Finlay MacKenzie and Jane French, August 2009



Recovery data to help validate Targets

200X validity of target Recoveries

Phe

SPEC	PO	DIST	RETURN_DATE	expected	ALTM	LTMCV	% expected	diff	iff added	diff recov
200G		200X	29 Nov 2009	100	129.77	11.16	129.77	0.0	0	0
200H		200X	29 Nov 2009	200	211.42	11.74	105.71	81.7	100	81.65
200J		200X	29 Nov 2009	300	297.92	13.74	99.31	168.2	200	84.08
200K		200X	29 Nov 2009	400	391.62	13.56	97.91	261.8	300	87.28
200L		200X	29 Nov 2009	500	479.10	12.59	95.82	349.3	400	87.33
200M		200X	29 Nov 2009	600	553.30	11.67	92.22	423.5	500	84.71

Tyr

SPEC	PO	DIST	RETURN_DATE	expected	ALTM	LTMCV	% expected	diff	iff added	diff recov
200G		200X	29 Nov 2009	600	546.32	13.17	91.05	426.9	500	85.37
200H		200X	29 Nov 2009	500	443.71	15.71	88.74	324.3	400	81.06
200J		200X	29 Nov 2009	400	370.61	13.14	92.65	251.1	300	83.71
200K		200X	29 Nov 2009	300	299.25	19.16	99.75	179.8	200	89.89
200L		200X	29 Nov 2009	200	212.34	17.86	106.17	92.9	100	92.88
200M		200X	29 Nov 2009	100	119.46	19.35	119.46	0.0	0	

C8

SPEC	PO	DIST	RETURN_DATE	expected	ALTM	LTMCV	% expected	diff	iff added	diff recov
200G		200X	29 Nov 2009	0.4	0.41	11.50	103.25	0.0	0	
200H		200X	29 Nov 2009	0.8	0.69	10.72	86.63	0.3	0.4	70.00
200J		200X	29 Nov 2009	1.2	0.98	12.20	81.25	0.6	0.8	70.25
200K		200X	29 Nov 2009	1.6	1.41	10.92	88.31	1.0	1.2	83.33
200L		200X	29 Nov 2009	2	1.80	10.52	89.80	1.4	1.6	86.44
200M		200X	29 Nov 2009	3	2.45	11.68	81.50	2.0	2.6	78.15

C10

SPEC	PO	DIST	RETURN_DATE	expected	ALTM	LTMCV	% expected	diff	iff added	diff recov
200G		200X	29 Nov 2009	0.2	0.34	27.71	169.50	0.0	0	
200H		200X	29 Nov 2009	0.4	0.50	28.08	124.50	0.2	0.2	79.50
200J		200X	29 Nov 2009	0.6	0.71	27.95	117.67	0.4	0.4	91.75
200K		200X	29 Nov 2009	0.8	0.91	24.22	113.38	0.6	0.6	94.67
200L		200X	29 Nov 2009	1	1.11	26.19	111.30	0.8	0.8	96.75
200M		200X	29 Nov 2009	1.6	1.64	26.54	102.69	1.3	1.4	93.14

TSH

SPEC	PO	DIST	RETURN_DATE	expected	ALTM	LTMCV	diff	iff added	diff recov	recov
200G		200X	29 Nov 2009	20	19.96	11.42	0.0	0		99.80
200H		200X	29 Nov 2009	30	28.34	8.49	8.4	10	83.76	94.45
200J		200X	29 Nov 2009	40	35.66	11.23	15.7	20	78.48	89.14
200K		200X	29 Nov 2009	50	45.83	9.53	25.9	30	86.24	91.66
200L		200X	29 Nov 2009	60	56.15	11.23	36.2	40	90.47	93.58
200M		200X	29 Nov 2009	70	57.38	9.93	37.4	50	74.84	81.97

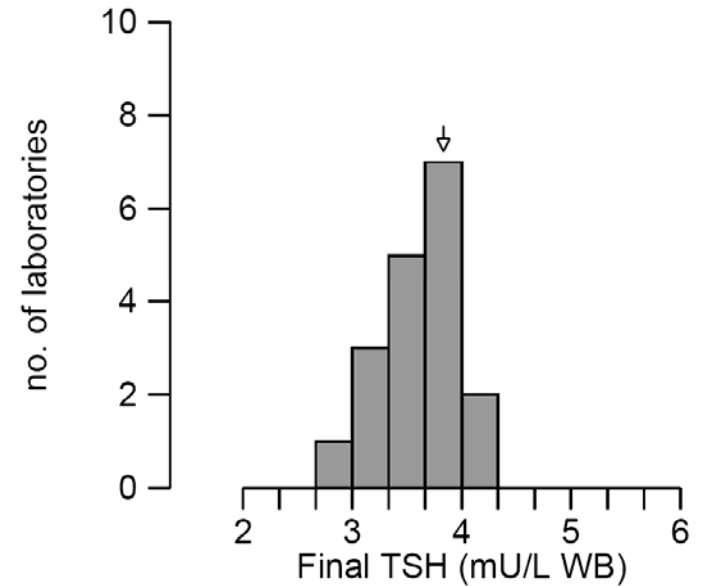
IRT

SPEC	PO	DIST	RETURN_DATE	ed, but no	ALTM	LTMCV	diff	iff added	diff recov	recov
200G		200X	29 Nov 2009	60	52.17	12.82				86.95
200H		200X	29 Nov 2009	60	45.31	13.41				75.51
200J		200X	29 Nov 2009	60	46.85	10.17				78.08
200K		200X	29 Nov 2009	60	35.01	9.35				58.36
200L		200X	29 Nov 2009	120	84.64	6.60				70.54
200M		200X	29 Nov 2009	120	73.09	6.28				60.91

NSB vs NSA - TSH

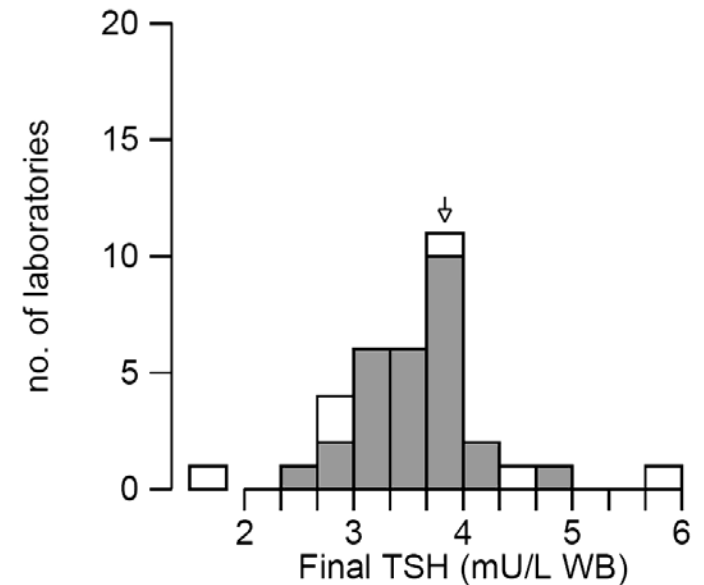
Specimen : 212B

	n	Mean	SD	CV(%)
All methods	18	3.7	0.4	11.5
PE DELFIA	18	3.7	0.4	11.5



Specimen : 212B

	n	Mean	SD	CV(%)
All methods	34	3.6	0.6	16.0
PE DELFIA	28	3.6	0.5	13.8
Undefined	6	3.6	1.2	34.6



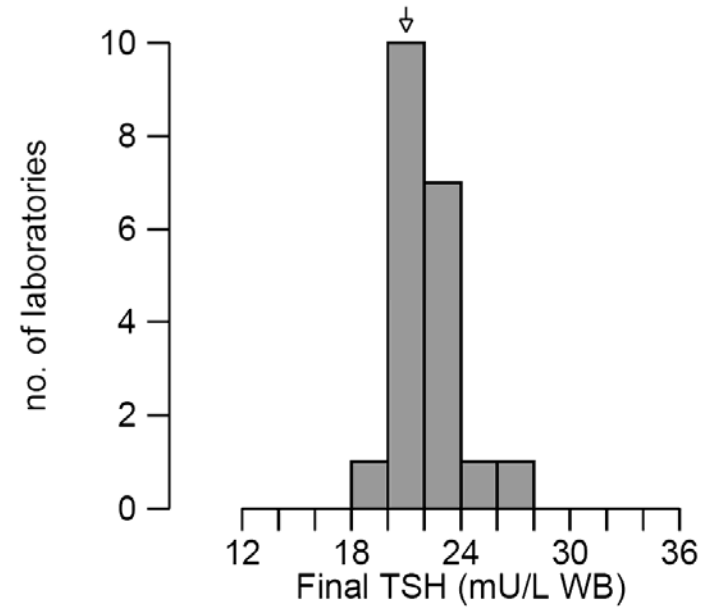
NSB vs NSA - TSH

Specimen : 211C

All methods

PE DELFIA

n	Mean	SD	CV(%)
20	22.2	1.6	7.2
20	22.2	1.6	7.2

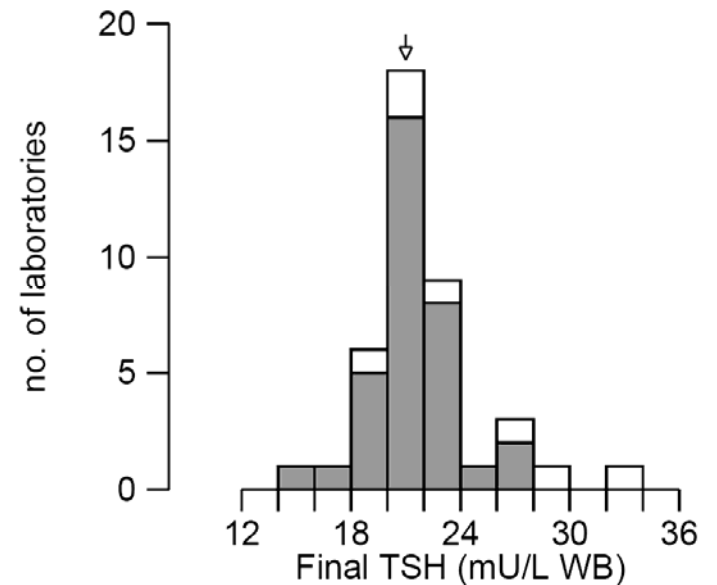


Specimen : 211C

All methods

PE DELFIA
Undefined

n	Mean	SD	CV(%)
41	22.0	2.5	11.3
34	21.6	2.0	9.2
7	24.7	5.1	20.7



Initial and Final IRT compared

Specimen : 211C

All methods

n	Mean	SD	CV(%)
17	115.1	12.1	10.6

PE DELFIA

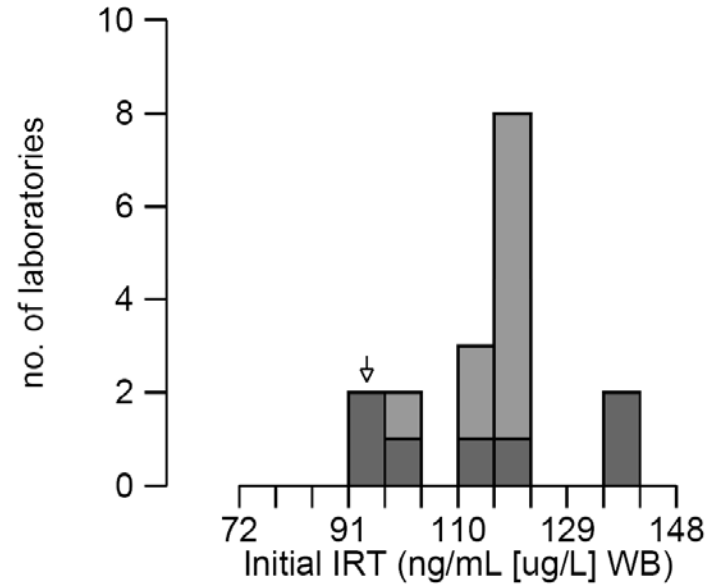
17	115.1	12.1	10.6
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Buddy Group A

10	117.3	4.7	4.0
----	-------	-----	-----

Buddy Group B

7	113.4	26.2	23.1
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Specimen : 211C

All methods

n	Mean	SD	CV(%)
17	115.7	11.4	9.9

PE DELFIA

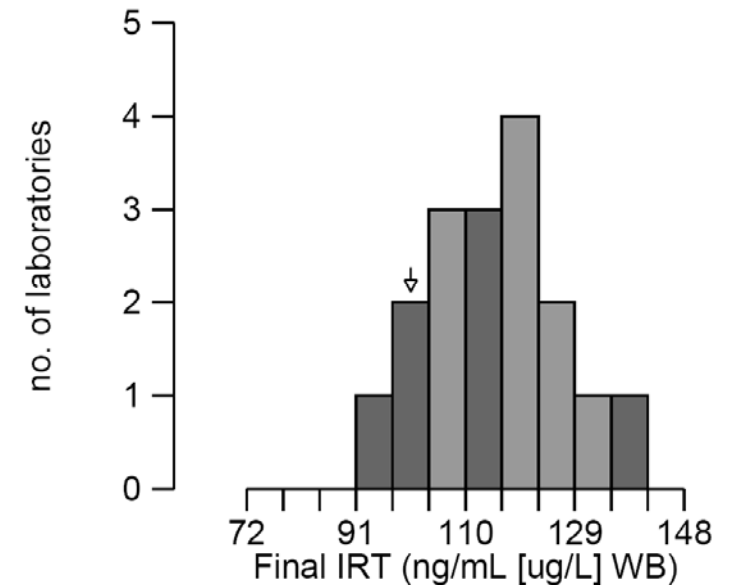
17	115.7	11.4	9.9
----	-------	------	-----

Buddy Group A

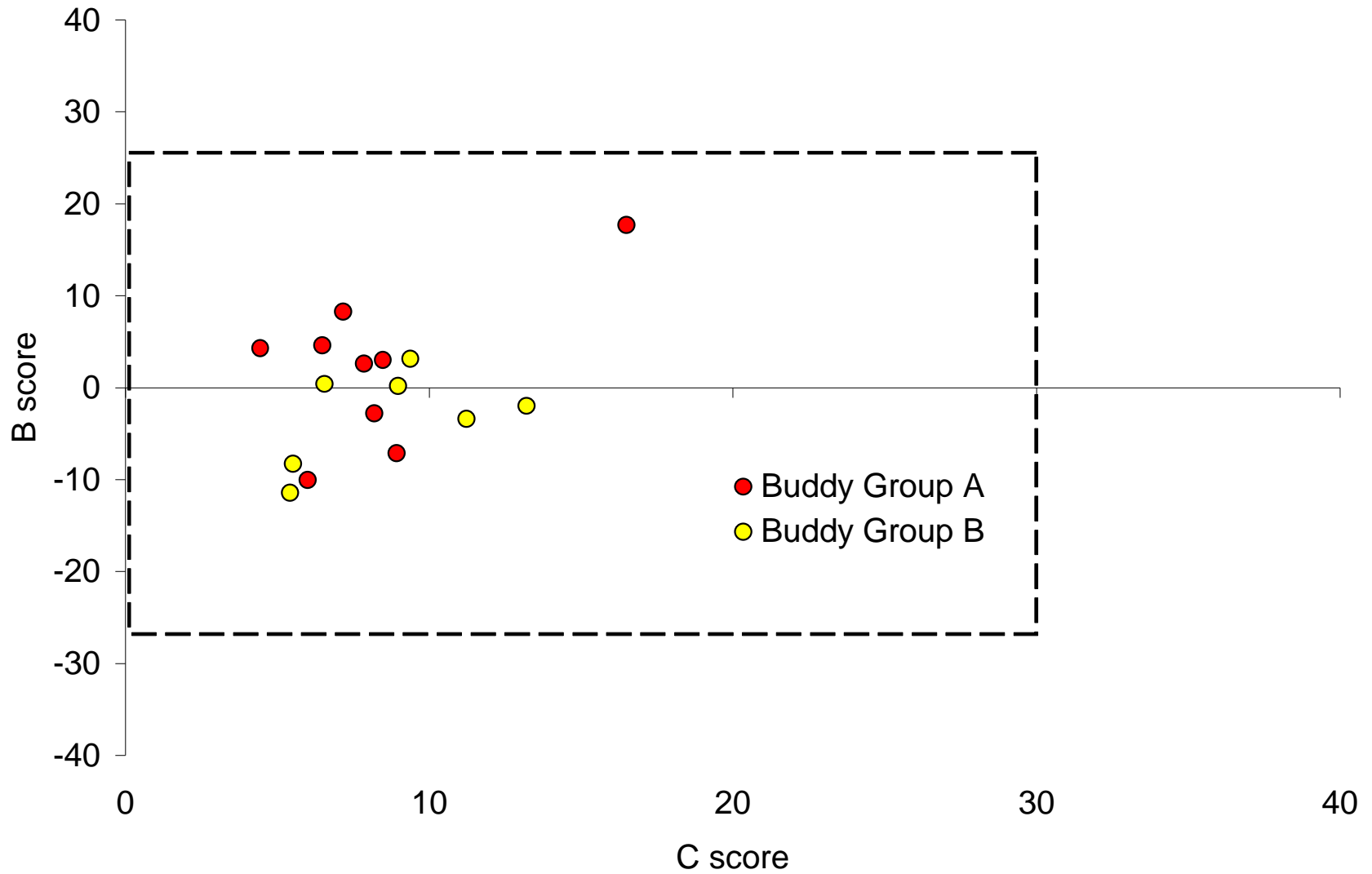
10	118.6	8.9	7.5
----	-------	-----	-----

Buddy Group B

7	109.7	12.1	11.0
---	-------	------	------



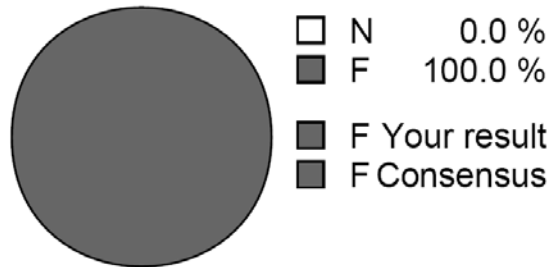
IRT Buddy Group at 205



Initial and Final IRT compared

Initial IRT

Specimen : 211C

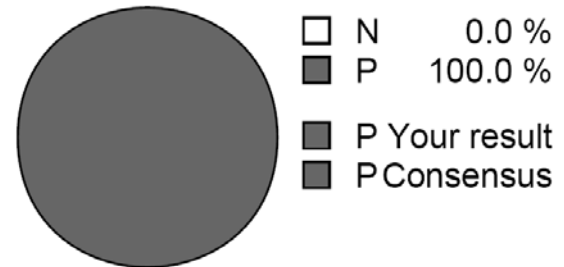


Your result	F
Total responses	17
N - No further action	0
F - Further action	17

115 ng/mL

Final IRT

Specimen : 211C



Your result	P
Total responses	17
N - Presumptive screen negative	0
P - Presumptive screen positive	17

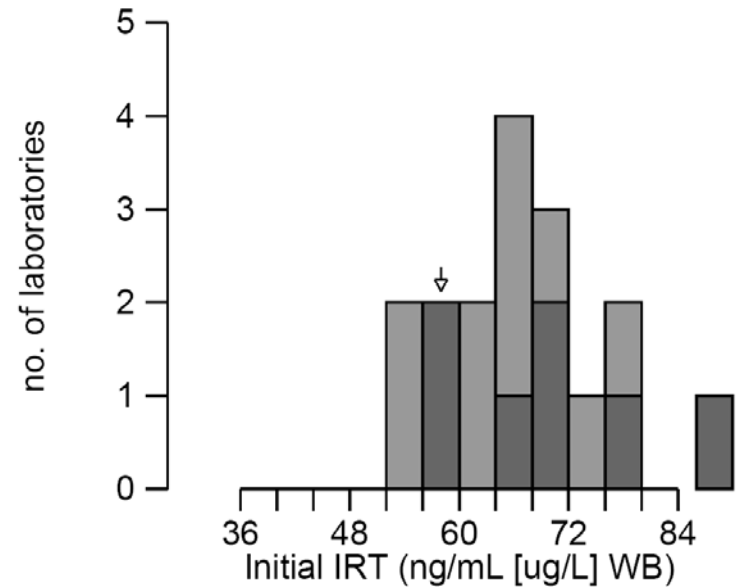
116 ng/mL



Initial and Final IRT compared

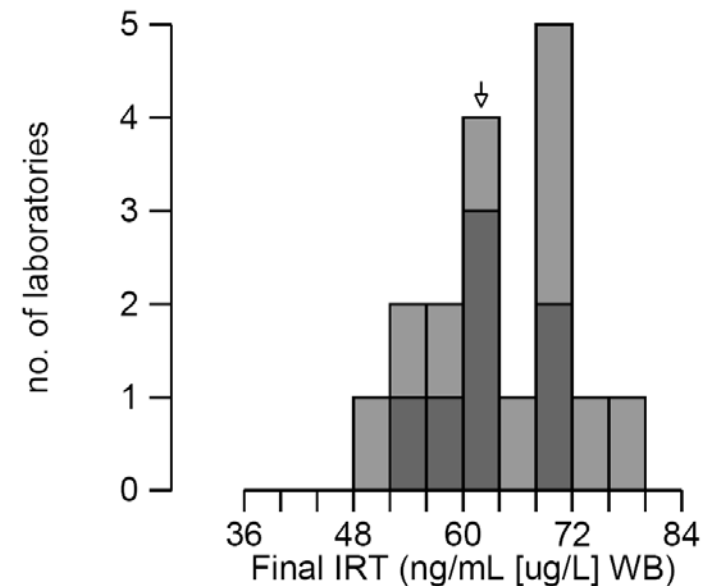
Specimen : 210A

	n	Mean	SD	CV(%)
All methods	17	67.0	8.3	12.3
PE DELFIA	17	67.0	8.3	12.3
Buddy Group A	10	65.8	8.2	12.5
Buddy Group B	7	68.4	10.3	15.1



Specimen : 210A

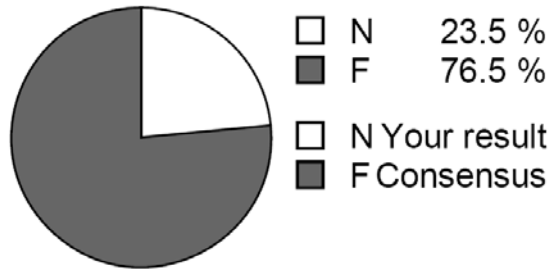
	n	Mean	SD	CV(%)
All methods	17	64.6	7.7	12.0
PE DELFIA	17	64.6	7.7	12.0
Buddy Group A	10	65.5	9.8	15.0
Buddy Group B	7	63.6	5.7	9.0



Initial and Final IRT compared

Initial IRT

Specimen : 210A



Your result	N
Total responses	17
N - No further action	4
F - Further action	13

67 ng/mL

Final IRT

Specimen : 210A



Your result	N
Total responses	17
N - Presumptive screen negative	9
P - Presumptive screen positive	8

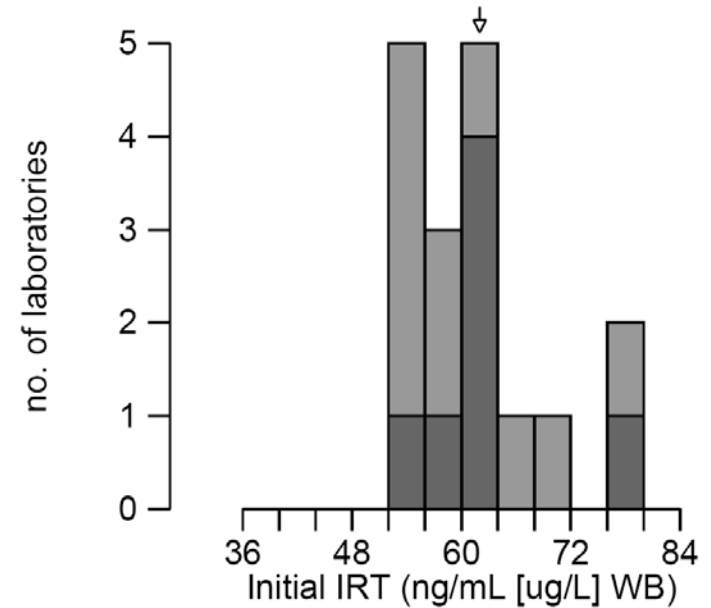
65 ng/mL



Initial and Final IRT compared

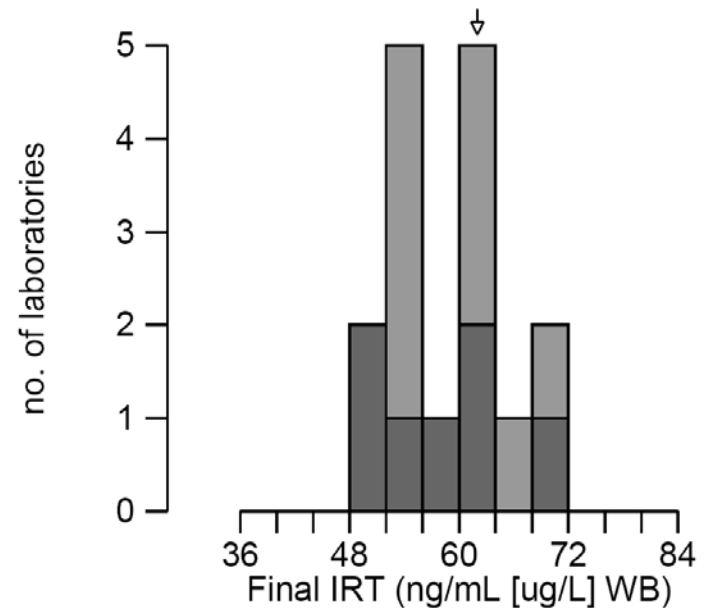
Specimen : 210B

	n	Mean	SD	CV(%)
All methods	17	60.5	7.4	12.2
PE DELFIA	17	60.5	7.4	12.2
Buddy Group A	10	59.0	7.2	12.2
Buddy Group B	7	61.1	2.9	4.7



Specimen : 210B

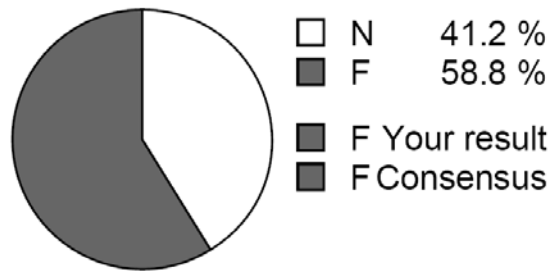
	n	Mean	SD	CV(%)
All methods	16	59.7	6.4	10.7
PE DELFIA	16	59.7	6.4	10.7
Buddy Group A	9	59.9	6.5	10.8
Buddy Group B	7	58.7	8.2	14.0



Initial and Final IRT compared

Initial IRT

Specimen : 210B

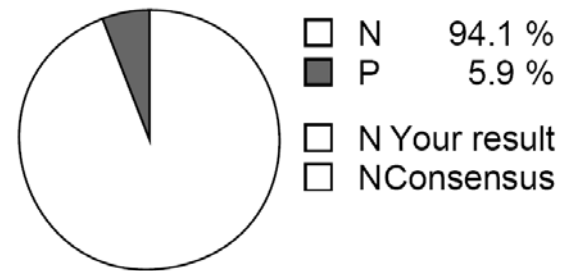


Your result	F
Total responses	17
N - No further action	7
F - Further action	10

60 ng/mL

Final IRT

Specimen : 210B



Your result	N
Total responses	17
N - Presumptive screen negative	16
P - Presumptive screen positive	1

60 ng/mL



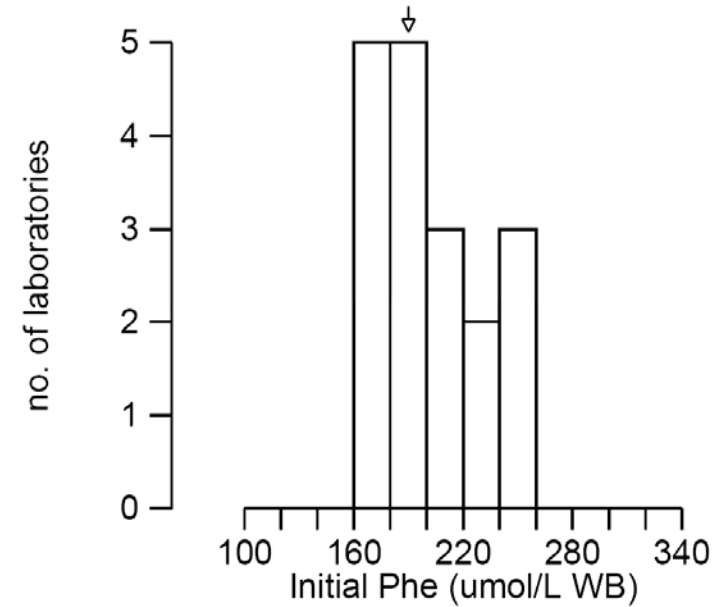
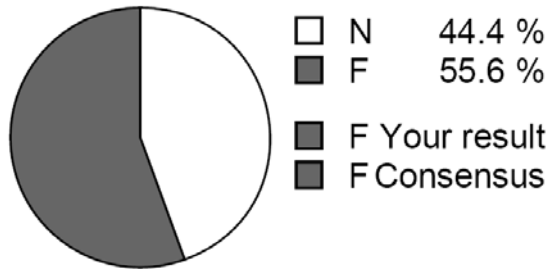
Initial Phe at 200 $\mu\text{mol/L}$ Cut-off

Specimen : 211A

n	Mean	SD	CV(%)
18	204	32	15.8

All methods

Specimen : 211A



Your result	F
Total responses	18
N - No further action	8
F - Further action	10

204 $\mu\text{mol/L}$



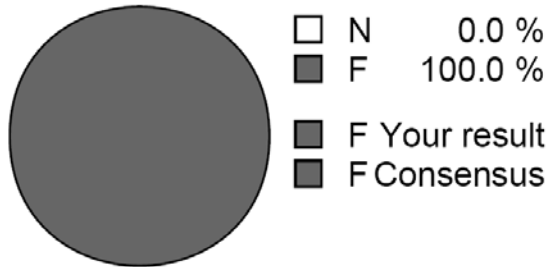
Initial C8 ~ everyone says F - Further action

Specimen : 211B

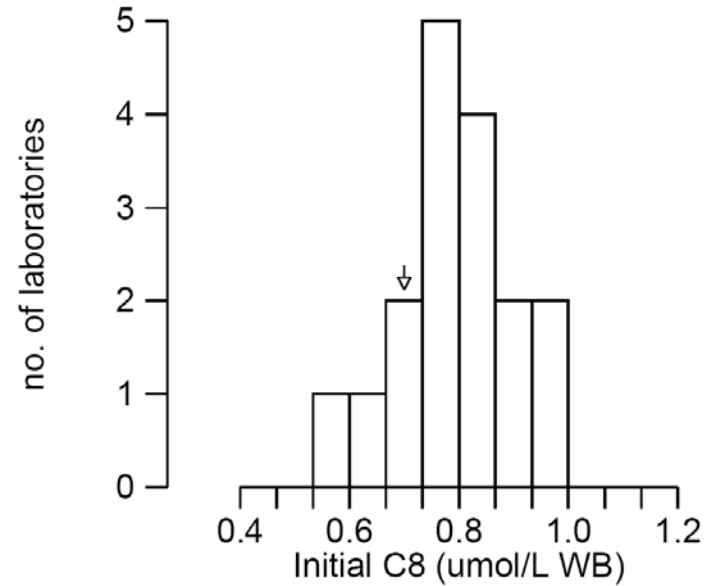
n	Mean	SD	CV(%)
17	0.80	0.10	12.5

All methods

Specimen : 211B



Your result	F
Total responses	17
N - No further action	0
F - Further action	17

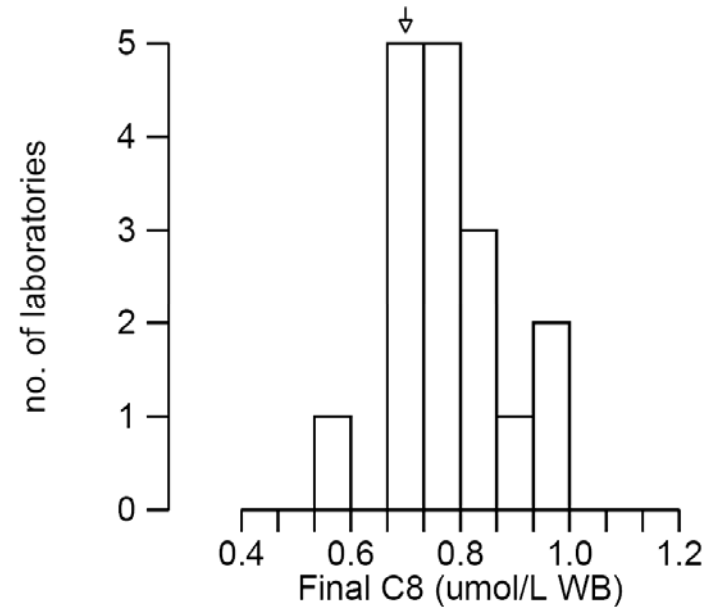


Individual C8 and C10 near cut-off ratio of 1.0

Specimen : 211B

n	Mean	SD	CV(%)
17	0.79	0.10	13.2

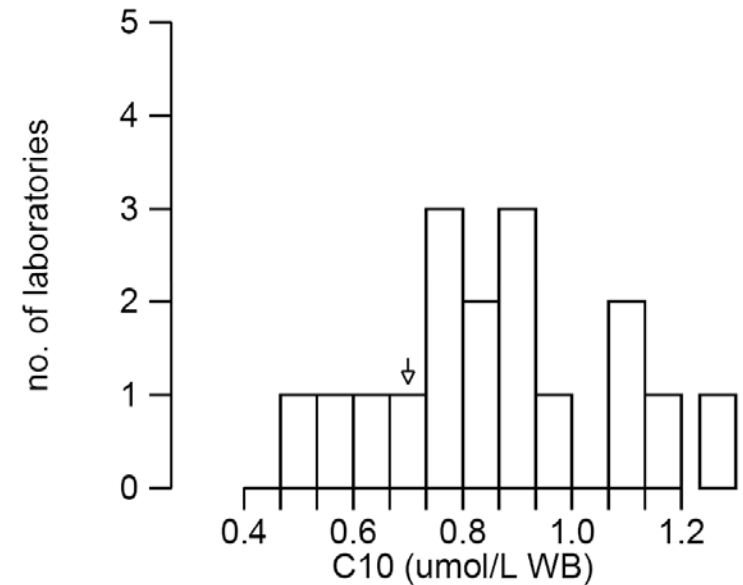
All methods



Specimen : 211B

n	Mean	SD	CV(%)
17	0.87	0.22	25.1

All methods



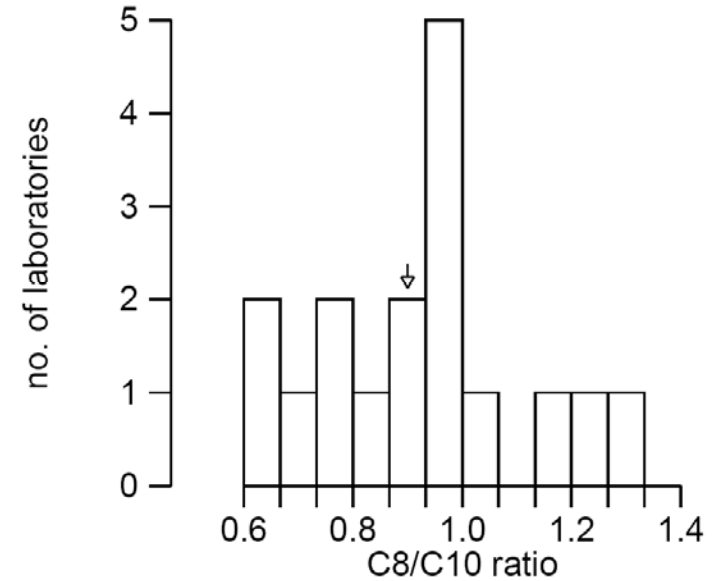
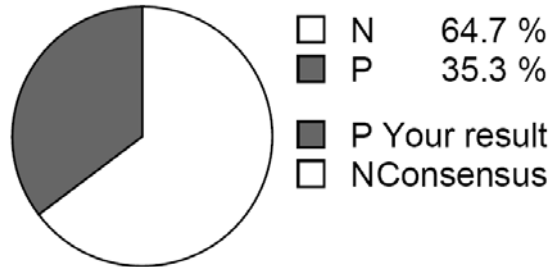
C8/C10 ratios near cut-off of 1.0

Specimen : 211B

n	Mean	SD	CV(%)
17	0.93	0.19	20.7

All methods

Specimen : 211B



Your result P

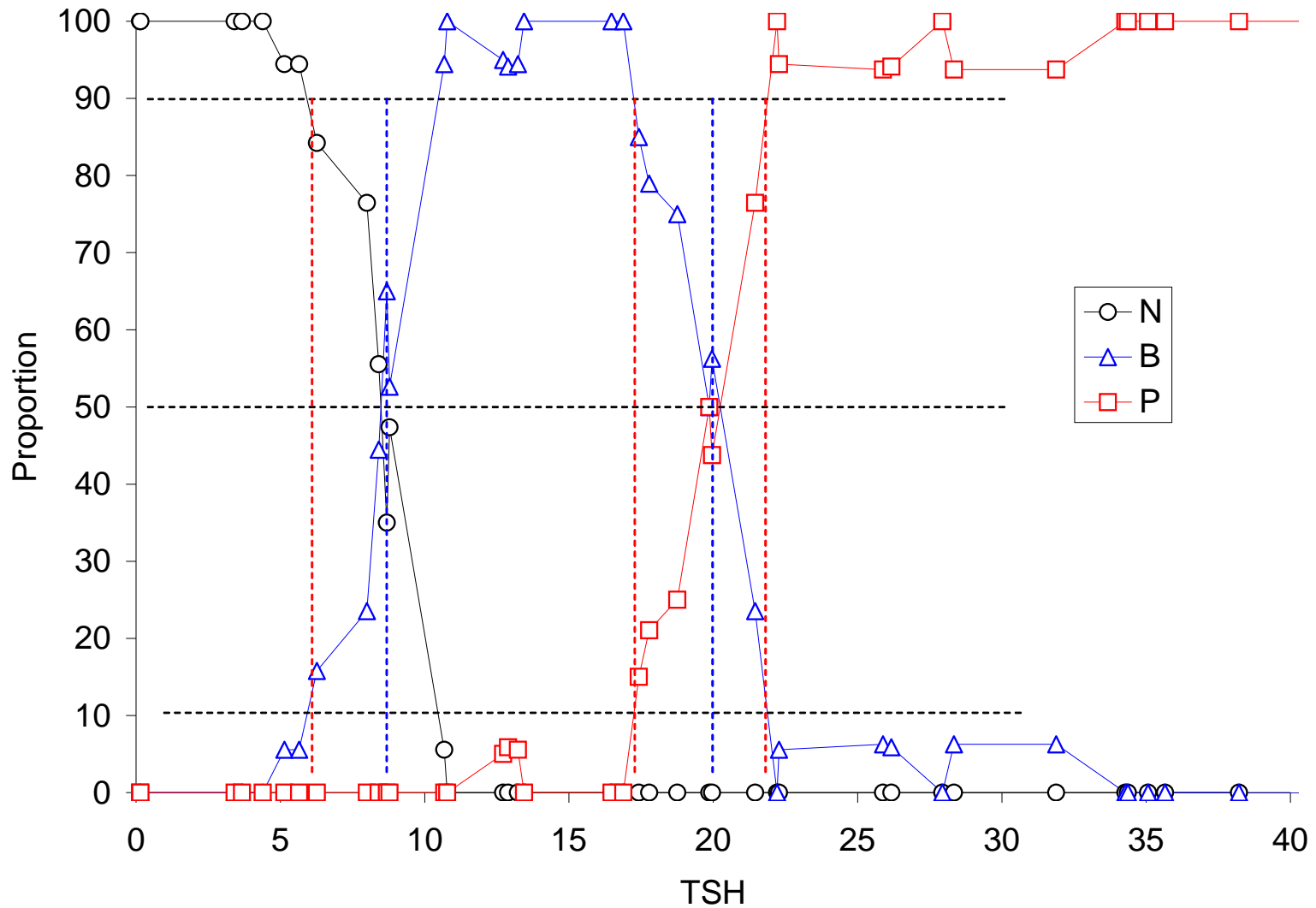
Total responses 17

N - Presumptive screen negative 11

P - Presumptive screen positive 6



Example Proportions and Empirical Cut-offs ~ TSH/CHT



Extract from Report ~ PKU Interpretation at 208

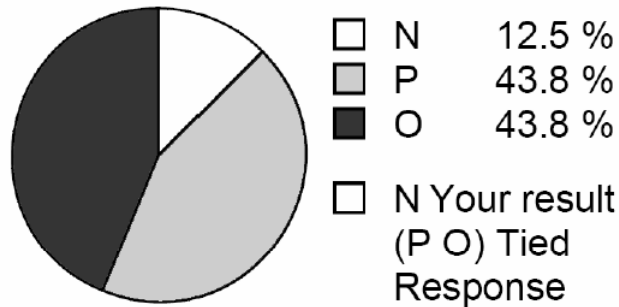
I have chosen to highlight a specimen which was enriched with 240 $\mu\text{mol/L}$ Phenylalanine and 240 $\mu\text{mol/L}$ Tyrosine. Given the difficulty of measuring low levels, we cannot be sure as to what the unspiked base value was, but the ALTMs of 37 and 35 $\mu\text{mol/L}$ are probably not too far from the truth. The recovery of added Phenylalanine was around 95%, while closer to 90% for Tyrosine. Not quantitative, but certainly acceptable for a screening assay. Even if all labs were rather good at the analysis, we all know that if I were to dispatch a specimen containing exactly 240 $\mu\text{mol/L}$ Phenylalanine I would have half the labs getting above and half the labs getting below. No one is disputing this. The issue for an EQA Organiser is to try to quantify this effect in some way. For example, would it be acceptable nationally if 80% of labs got values above 200 $\mu\text{mol/L}$ on such a sample? Would it have to be 90%? I am trying to collect data to try to help make the judgement between practical and theoretical considerations of both analysis and interpretations. I am trying to provide data to assist in the debate, not trying to stifle debate.



Extract from Report ~ PKU Interpretation at 208

British Isles subset

Specimen : 208B



Your result N

Total responses 16

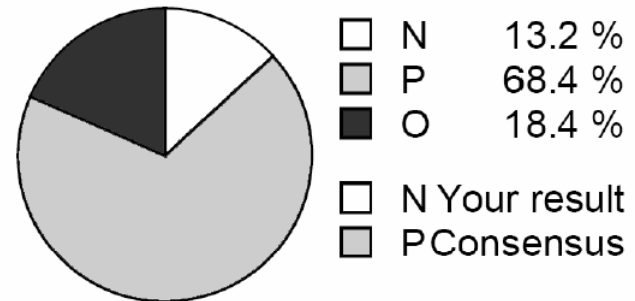
N - Presumptive screen negative 2

O - Screen positive - other 7

P - Presumptive screen positive 7

Full Scheme data

Specimen : 208B



Your result N

Total responses 38

N - Presumptive screen negative 5

O - Screen positive - other 7

P - Presumptive screen positive 26



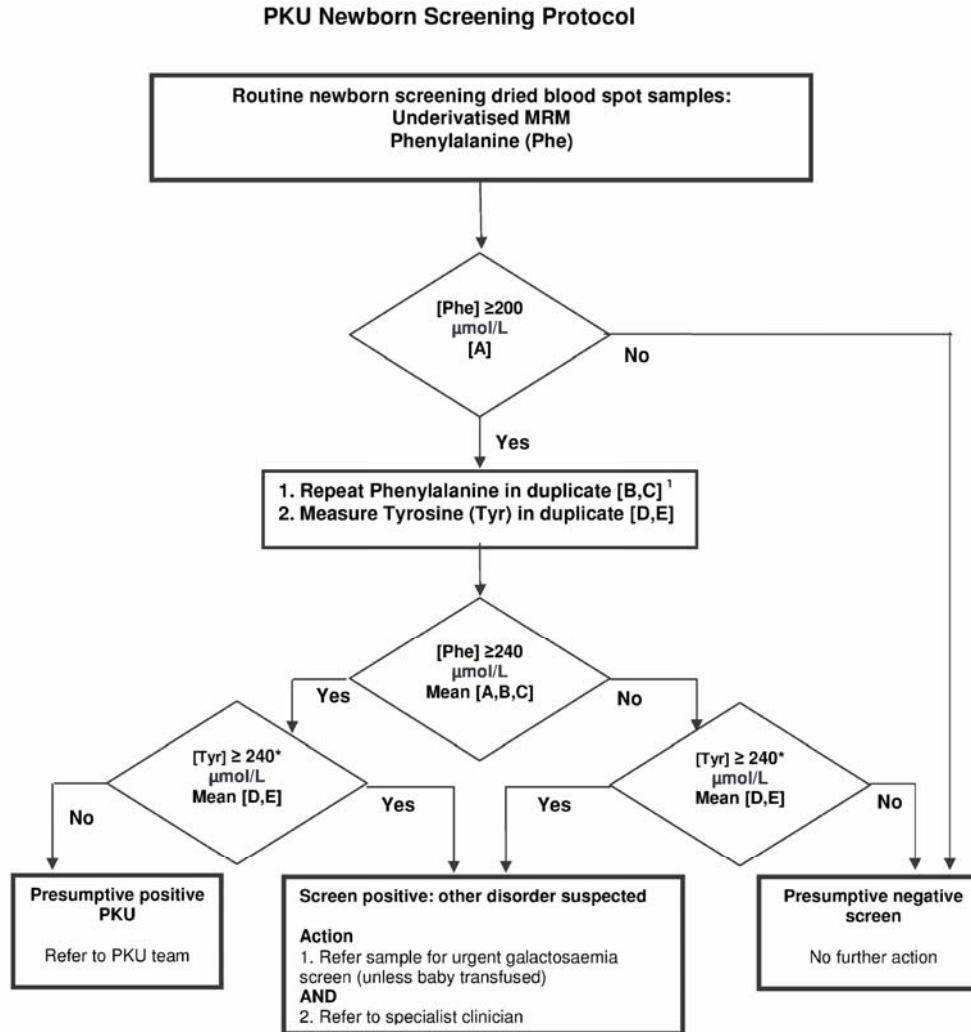
Extract from Report ~ PKU Interpretation at 208

Results for 208B, laboratories' data ranked by increasing Phenylalanine concentration.

<i>Phe rank</i>	Phe umol/L WB	Tyr umol/L WB	PKU I	Appropriate response for results?	Right answer?	Appropriate and Right?
1	195	182	N	Yes	No	No
2	232	230	N	Yes	No	No
3	242	243	O	Yes	Yes	Yes
4	247	234	P	Yes	No	No
5	248		O	No	Yes	No
6	254	230	O	No	Yes	No
7	255	283	P	No	No	No
8	256	231	O	No	Yes	No
9	264	214	P	Yes	No	No
10	268	226	P	Yes	No	No
11	270	239	P	Yes	No	No
12	272		P	Yes	No	No
13	274	283	P	No	No	No
14	277	285	no interpretation			
15	280	279	O	Yes	Yes	Yes
16	293	232	no interpretation			
17	320	258	O	Yes	Yes	Yes
18	328	326	O	Yes	Yes	Yes



Extract from Report ~ PKU Interpretation at 208



Multi-Analyte Decision Trees and Interpretations

Pathways and decision trees										
PKU Tree										
Phe	First Phe [A]	S		greater than or equal to	200 N					Presumptive SN
					200 Y					go on to measure Phe and Tyr
Phe	Repeat [B] and [C]	D	mean of [A]+[B]+[C]	greater than or equal to	240 N	and	Tyr	greater than or equal to	240 N	Presumptive SN
					240 Y			greater than or equal to	240 N	Presumptive Positive PKU
				greater than or equal to	240 N	and	Tyr	greater than or equal to	240 Y	Screen positive: other disorder
					240 Y			greater than or equal to	240 Y	Screen positive: other disorder
Summary										
										options
	numerical first Phe [A]			stats						
	Interpretation of [A]			gte 200 Y N						2
	mean of Phe [A]+[B]+[C]			stats						
	Interpretation of mean of Phe [A]+[B]+[C]			gte 240 Y N						2
	numerical Tyr			stats						
	Interpretation of Tyr			gte 240 Y N						2
	Final Interpretation			PP PKU						3
				or SP other disorder or P SN						
<i>Even though there are implicit responses, we MUST have EXPLICIT interpretations</i>										



Multi-Analyte Decision Trees and Interpretations

Pathways and decision trees									
MCADD Tree									
C8	FirstC8 [A]	S		greater than or equal to	0.40 N				Presumptive SN
					0.40 Y				go on to measure C8 and C10
C8	Repeat [B] and [C]	D	mean of [A]+[B]+[C]						
C10		?							
				Calculate C8 to C10 ratio					
C8			mean of [A]+[B]+[C]	greater than or equal to	0.50 N				Presumptive SN
					0.50 Y				
							C8 to C10 ratio greater than or equal to	1.00 N	Presumptive SN
					0.50 Y		C8 to C10 ratio greater than or equal to	1.00 Y	Presumptive Screen Positive
Summary									
									options
	numerical first C8 [A]			stats					
	Interpretation of [A]			gte 0.40 Y N					2
	mean of [A]+[B]+[C]			stats					
	Interpretation of [A]+[B]+[C]			gte 0.50 Y N					2
	numerical C10			stats					
	C8/C10 ratio			stats					
	Final Interpretation								4
				Screen Negative by virtue of initial C8					
				Screen Negative by virtue of mean C8					
				Screen Positive by virtue of mean C8 and C8:C10 ratio					
				Screen Negative by virtue of mean C8 and C8:C10 ratio					
<i>Even though there are implicit responses, we MUST have EXPLICIT interpretations</i>									



Birmingham Quality's Newborn Screening Live!

The Scheme will be 3-Specimen, Monthly for:-

- 1 **TSH**
- 2 **CHT interpretation**
- 3 **IRT**
- 4 **CF interpretation**
- 5 **Initial Phe**
- 6 **Initial Phe interpretation**
- 7 **Final Phe**
- 8 **Tyr**
- 9 **PKU interpretation**
- 10 **Initial C8**
- 11 **Initial C8 interpretation**
- 12 **Final C8**
- 13 **C10**
- 14 **C8/C10 ratio**
- 15 **MCADD interpretation**

9 numeric analytes
and
6 interpretations*

***2 analyte bifurcation interpretations**
and
***4 Disease state interpretations**

Even this has now been superseded



Birmingham Quality's Newborn Screening Current Live!

The Scheme will be 3-Specimen, Monthly for:-

- 1 Initial TSH
- 2 Initial TSH interpretation
- 3 Final TSH
- 4 CHT interpretation
- 5 Initial IRT
- 6 Initial IRT interpretation
- 7 Final IRT
- 8 CF interpretation
- 9 Initial Phe
- 10 Initial Phe interpretation
- 11 Final Phe
- 12 Tyr
- 13 PKU interpretation
- 14 Initial C8
- 15 Initial C8 interpretation
- 16 Final C8
- 17 C10
- 18 C8/C10 ratio
- 19 MCADD interpretation

11 numeric analytes
and
8 interpretations*

*4 analyte bifurcation interpretations
and
*4 Disease state interpretations



Fresh vs Frozen

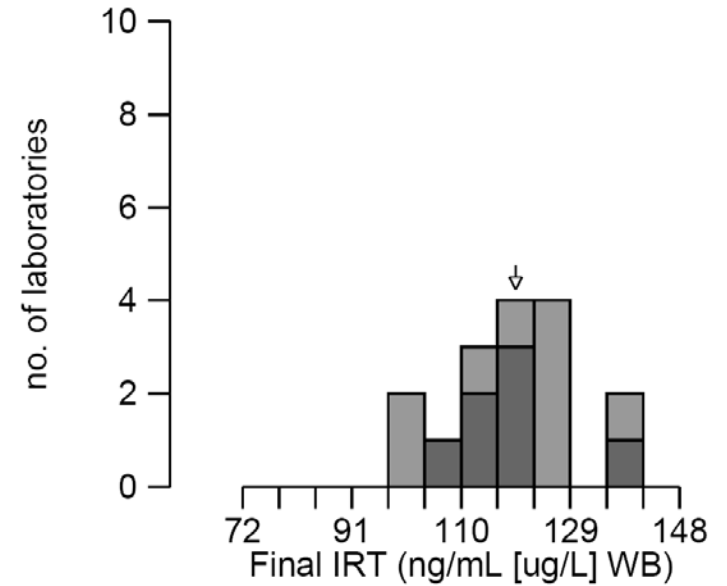
- ❖ At Distribution 211, we used cards that were 1st prepared for Distribution 205.
- ❖ They had been stored at -40°C since April 2010 and were dispatched again at October 2010.
- ❖ See the following slides for a comparison of 'Fresh versus Frozen.
- ❖ We can see that freezing cards at -40°C does not significantly affect the results.



Fresh vs Frozen – Final IRT

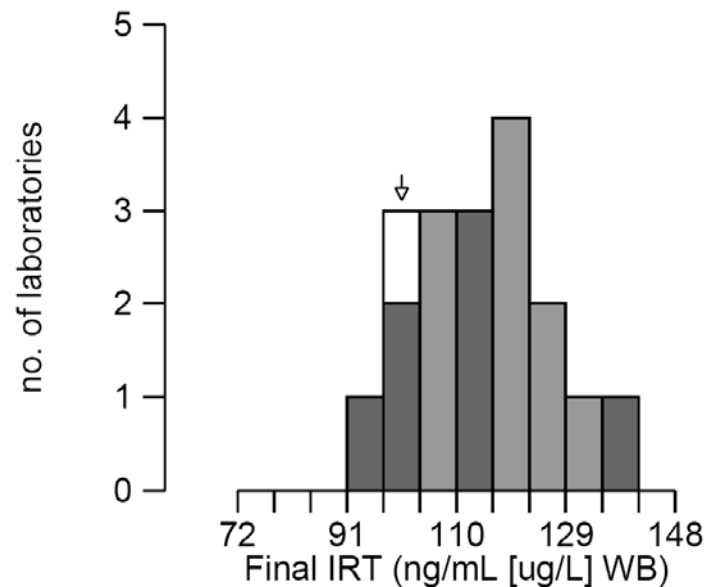
Specimen : 205C

	n	Mean	SD	CV(%)
All methods	16	119.1	12.0	10.1
PE DELFIA	16	119.1	12.0	10.1
Buddy Group A	9	120.4	12.6	10.5
Buddy Group B	7	116.8	5.6	4.8



Specimen : 211C

	n	Mean	SD	CV(%)
All methods	18	114.8	11.9	10.4
PE DELFIA	17	115.7	11.4	9.9
Buddy Group A	10	118.6	8.9	7.5
Buddy Group B	7	109.7	12.1	11.0

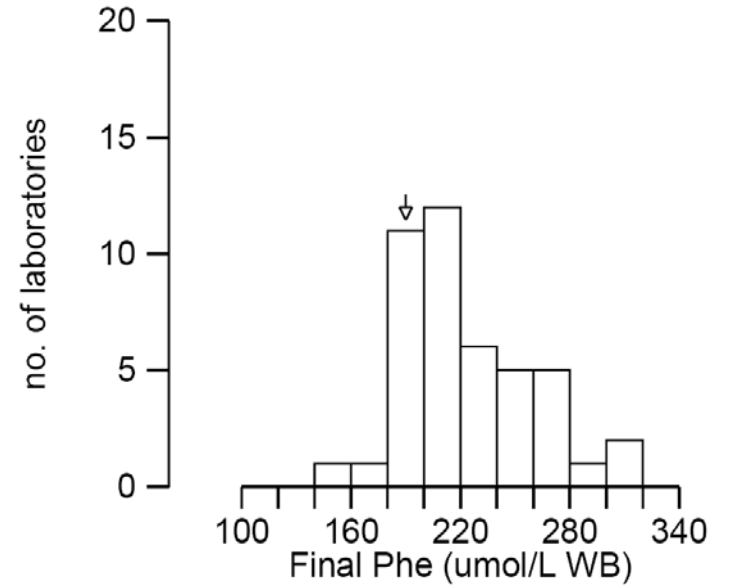


Fresh vs Frozen – Final Phe

Specimen : 205A

n	Mean	SD	CV(%)
44	221	35	15.8

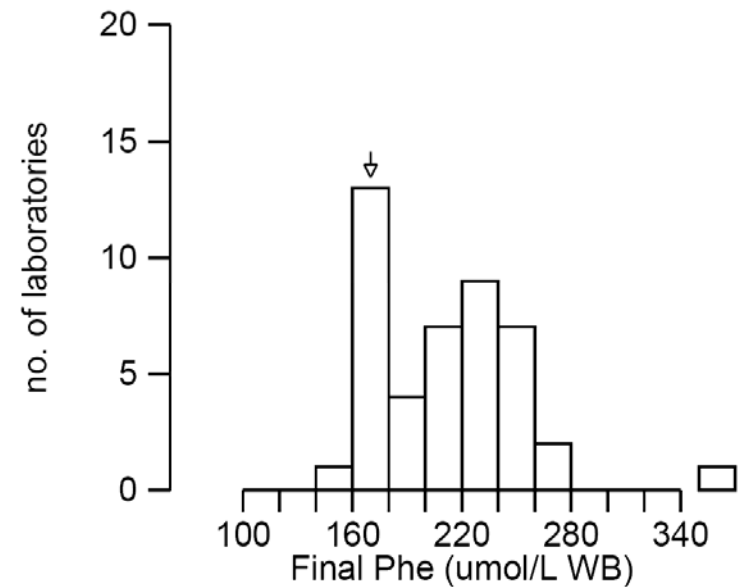
All methods



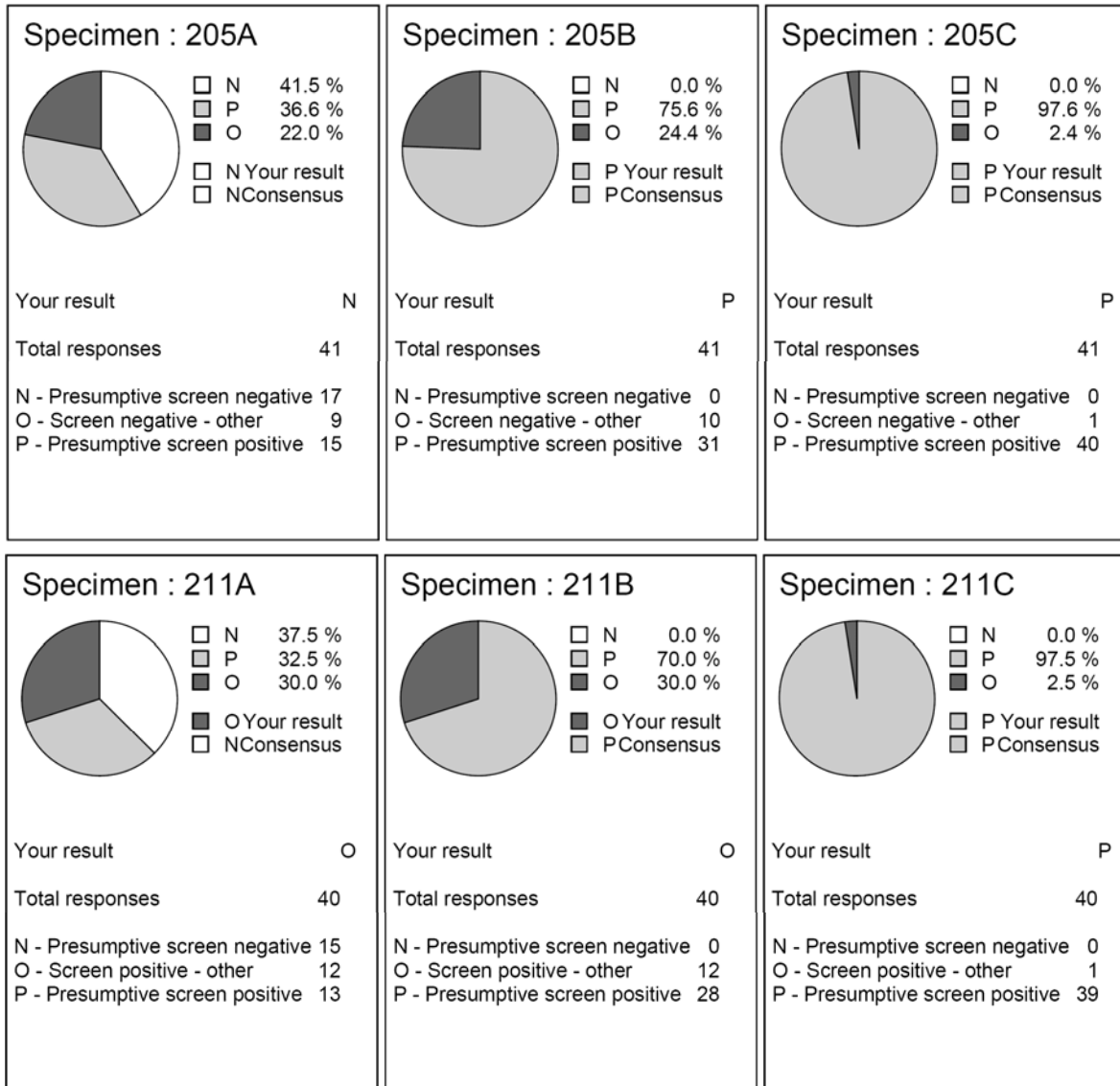
Specimen : 211A

n	Mean	SD	CV(%)
44	212	38	18.1

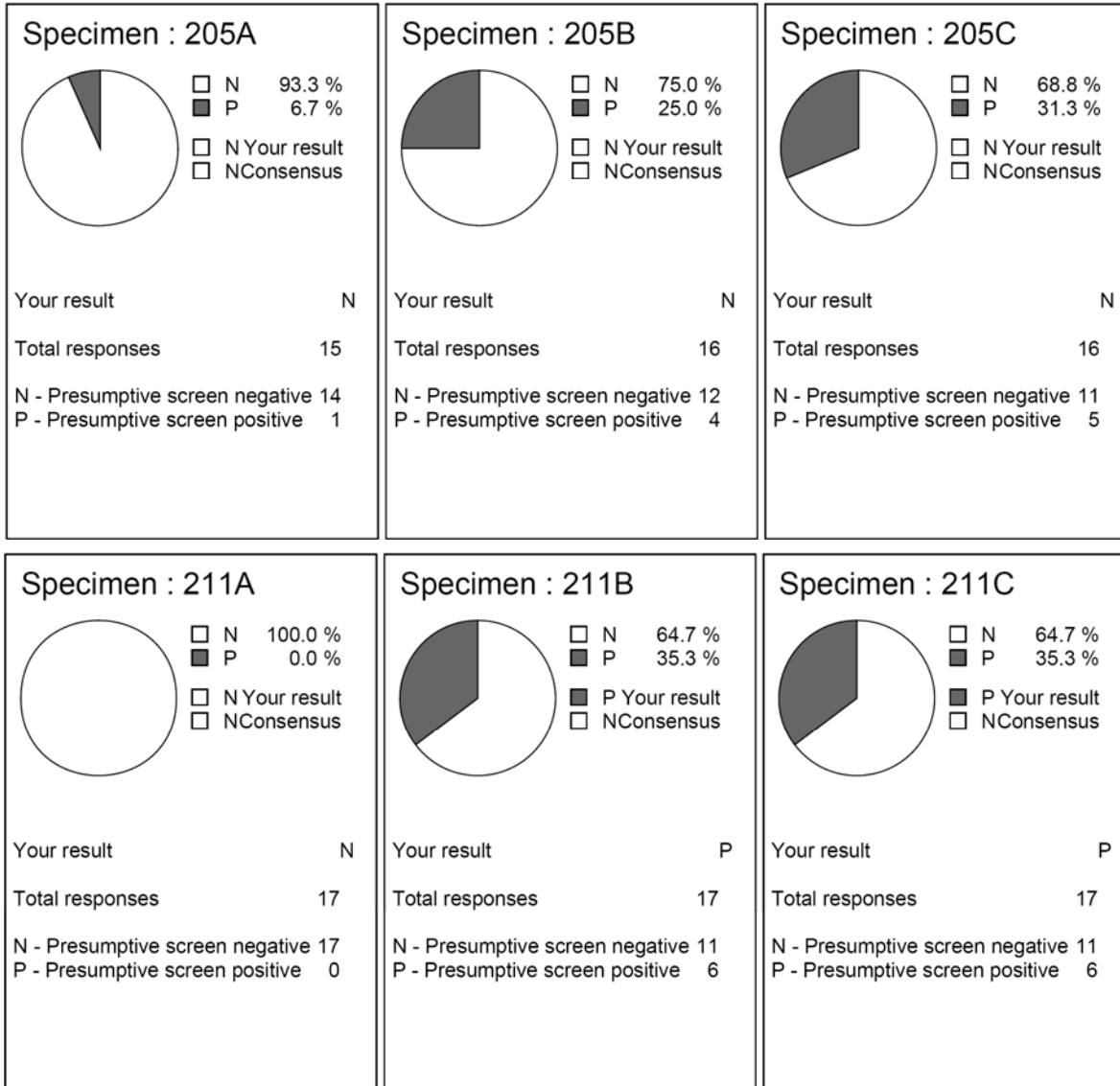
All methods



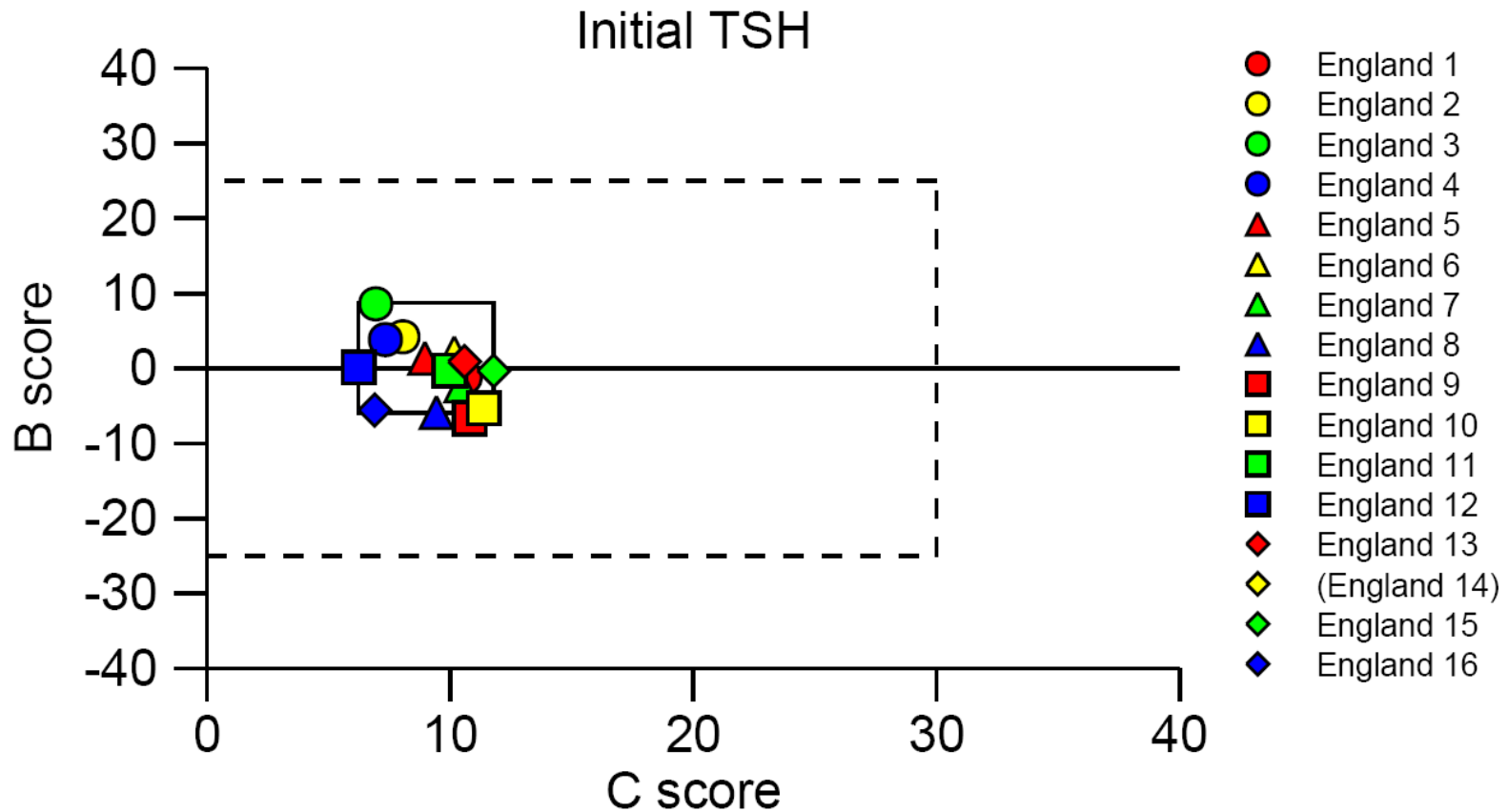
Fresh vs Frozen – PKU Interpretation



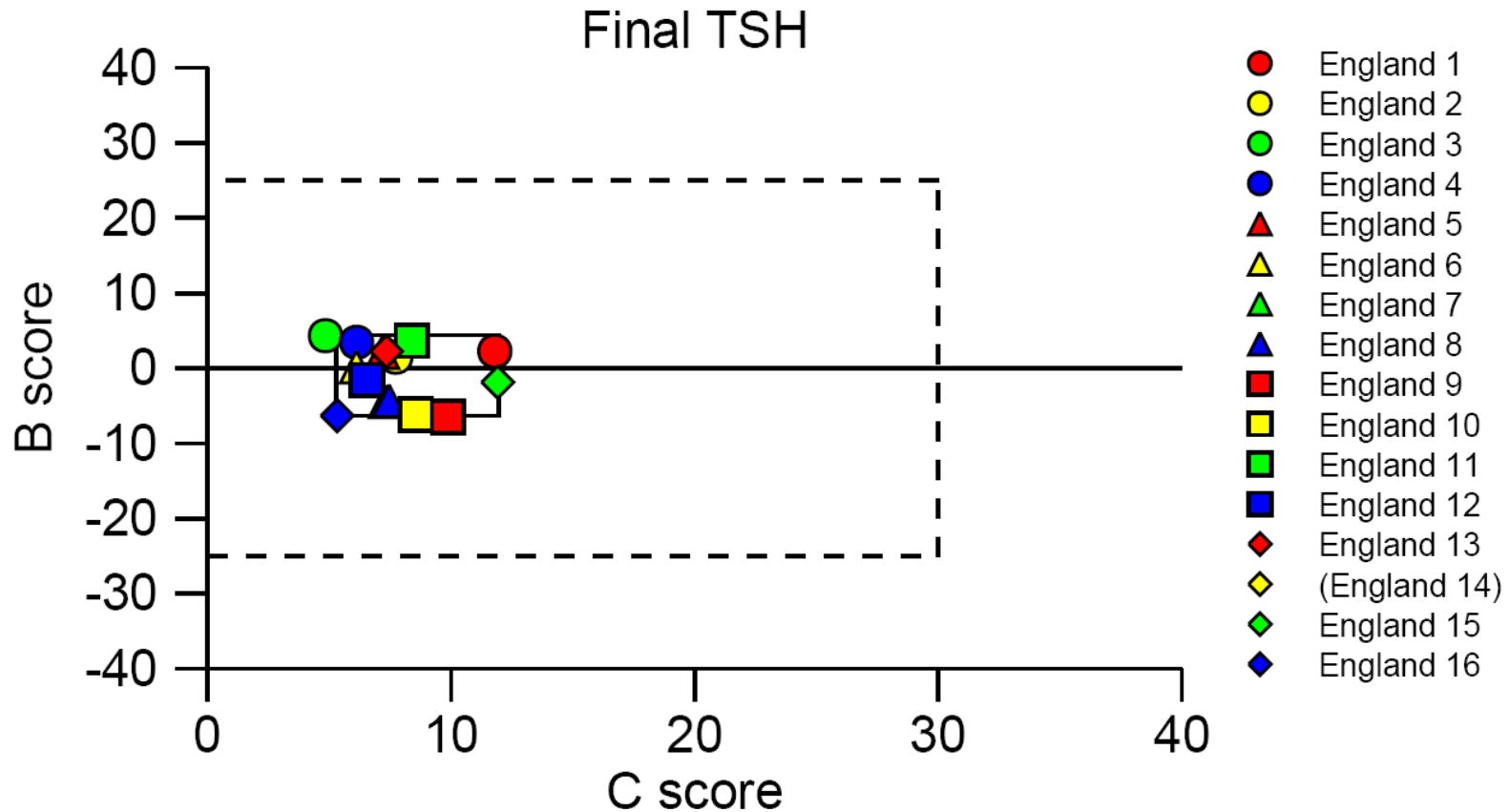
Fresh vs Frozen – MCADD Interpretation



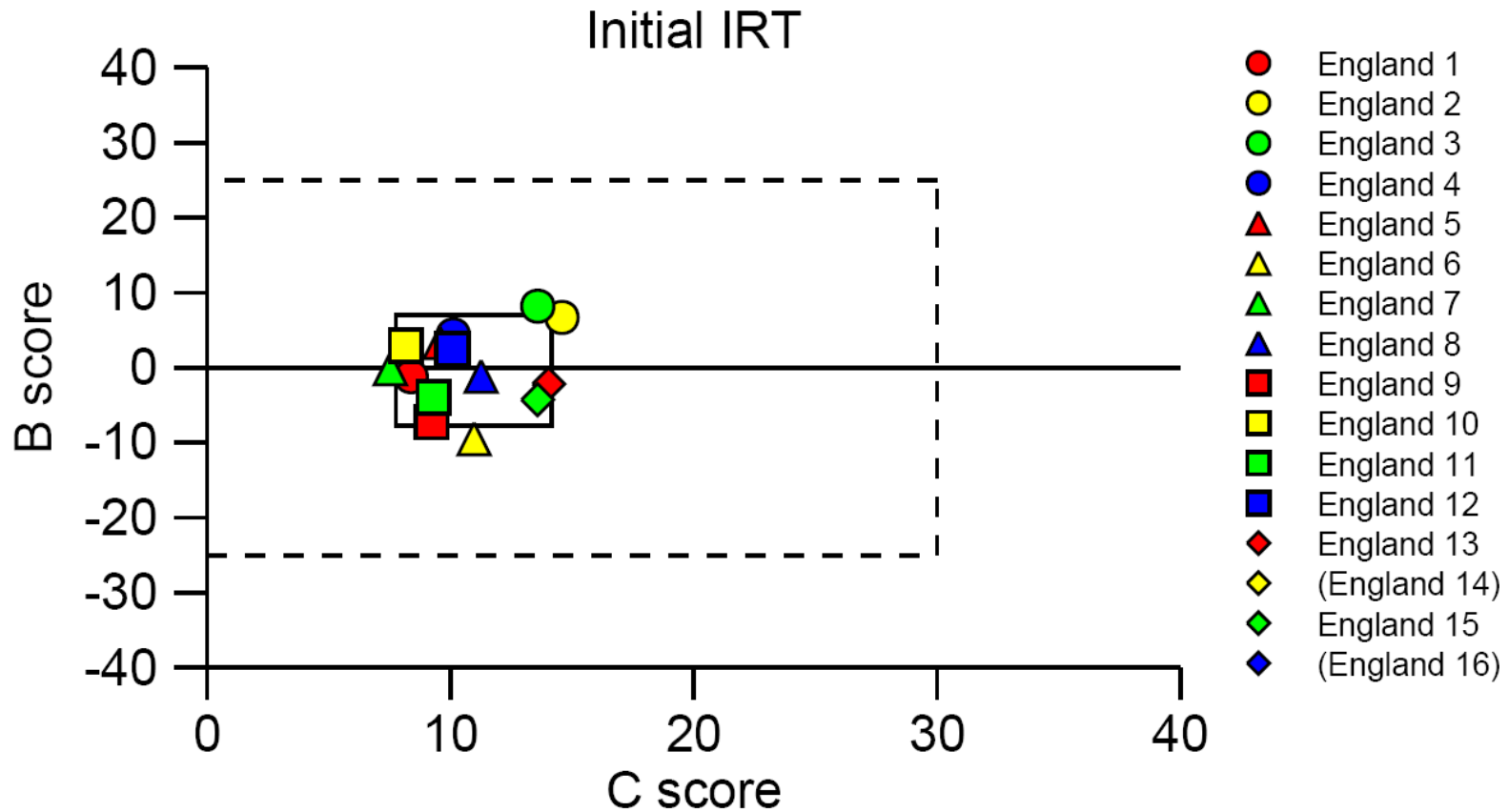
Penalty Box Plot ~ British Isles / English Labs



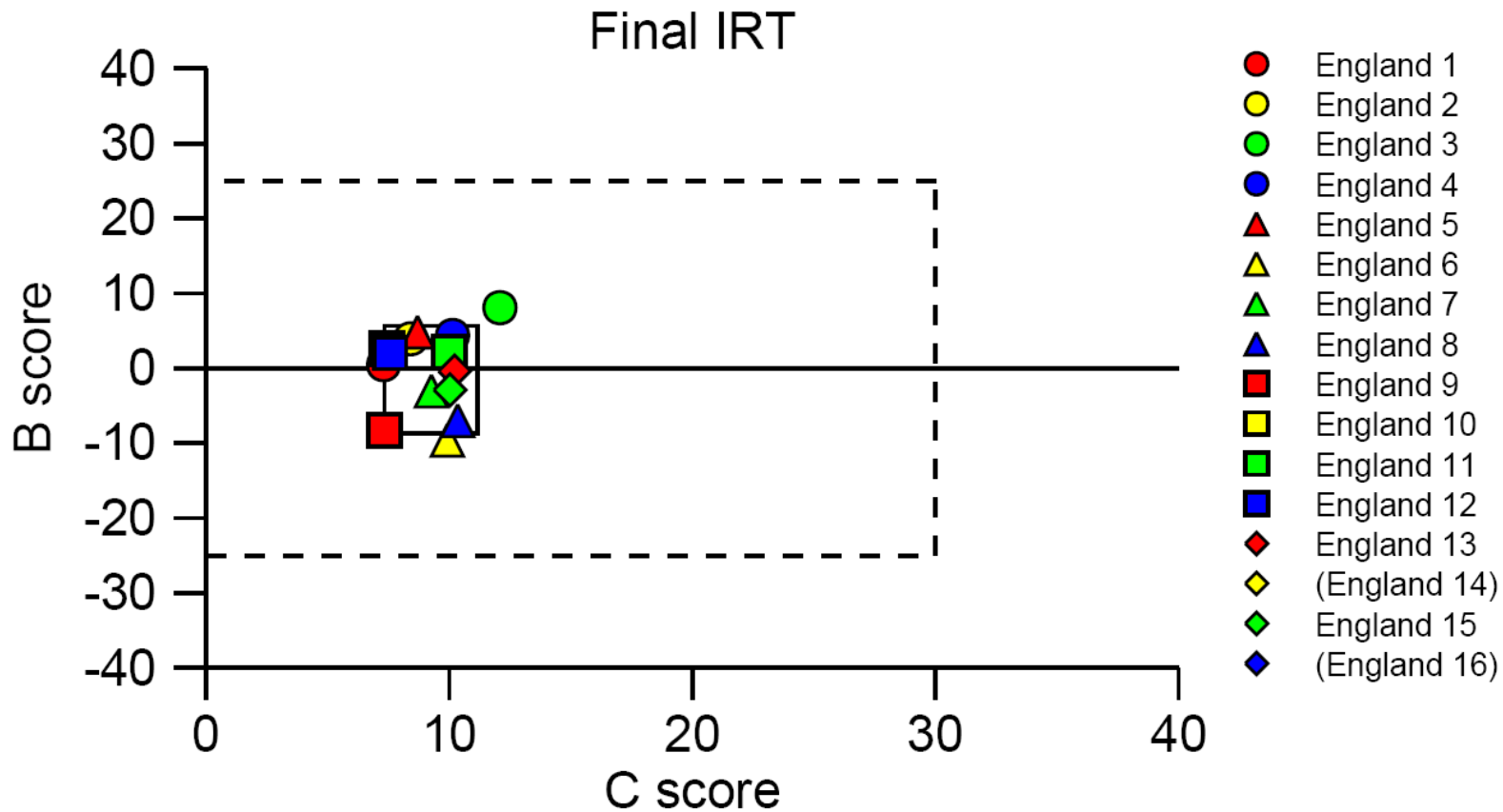
Penalty Box Plot ~ British Isles / English Labs



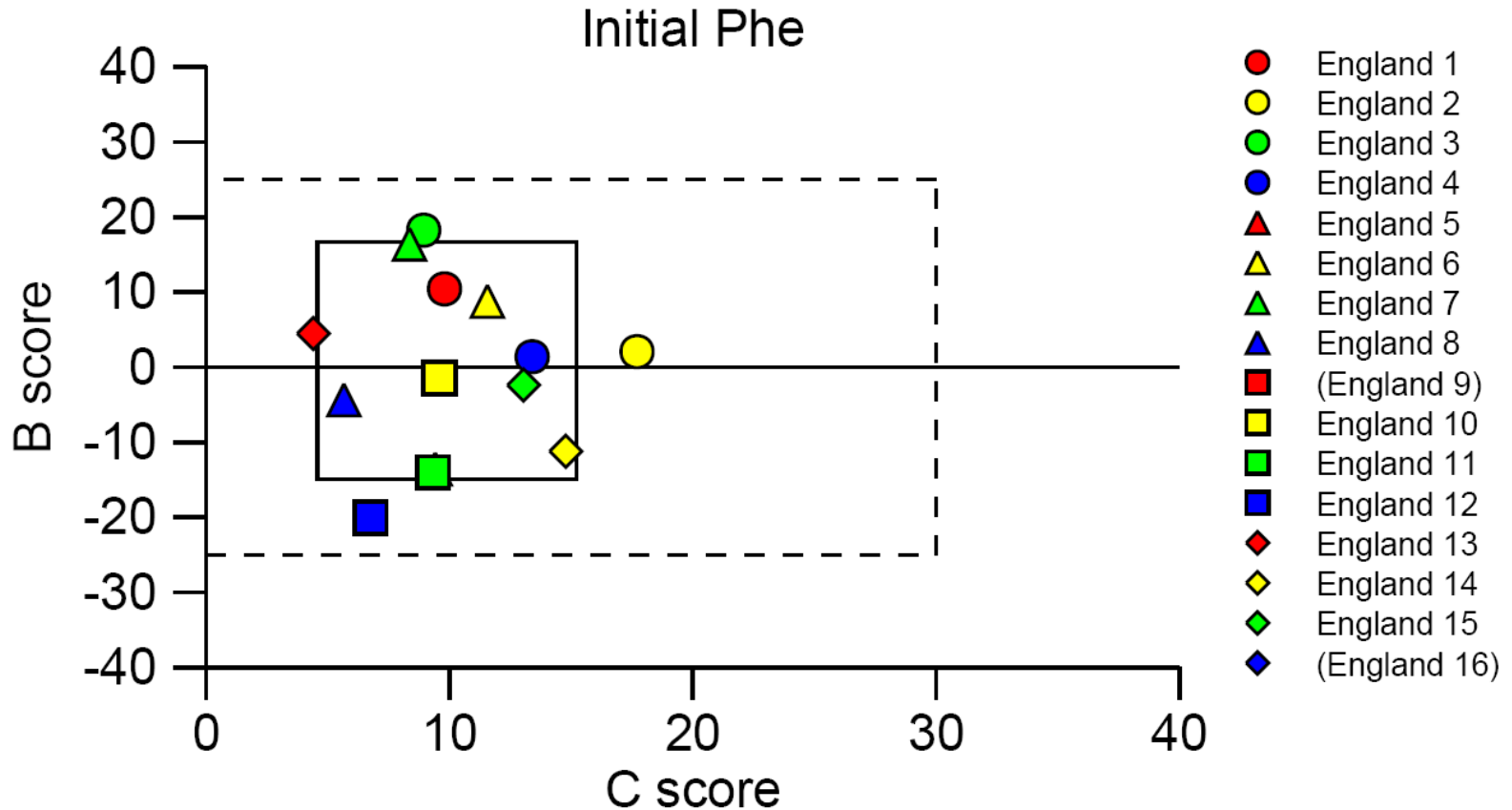
Penalty Box Plot ~ British Isles / English Labs



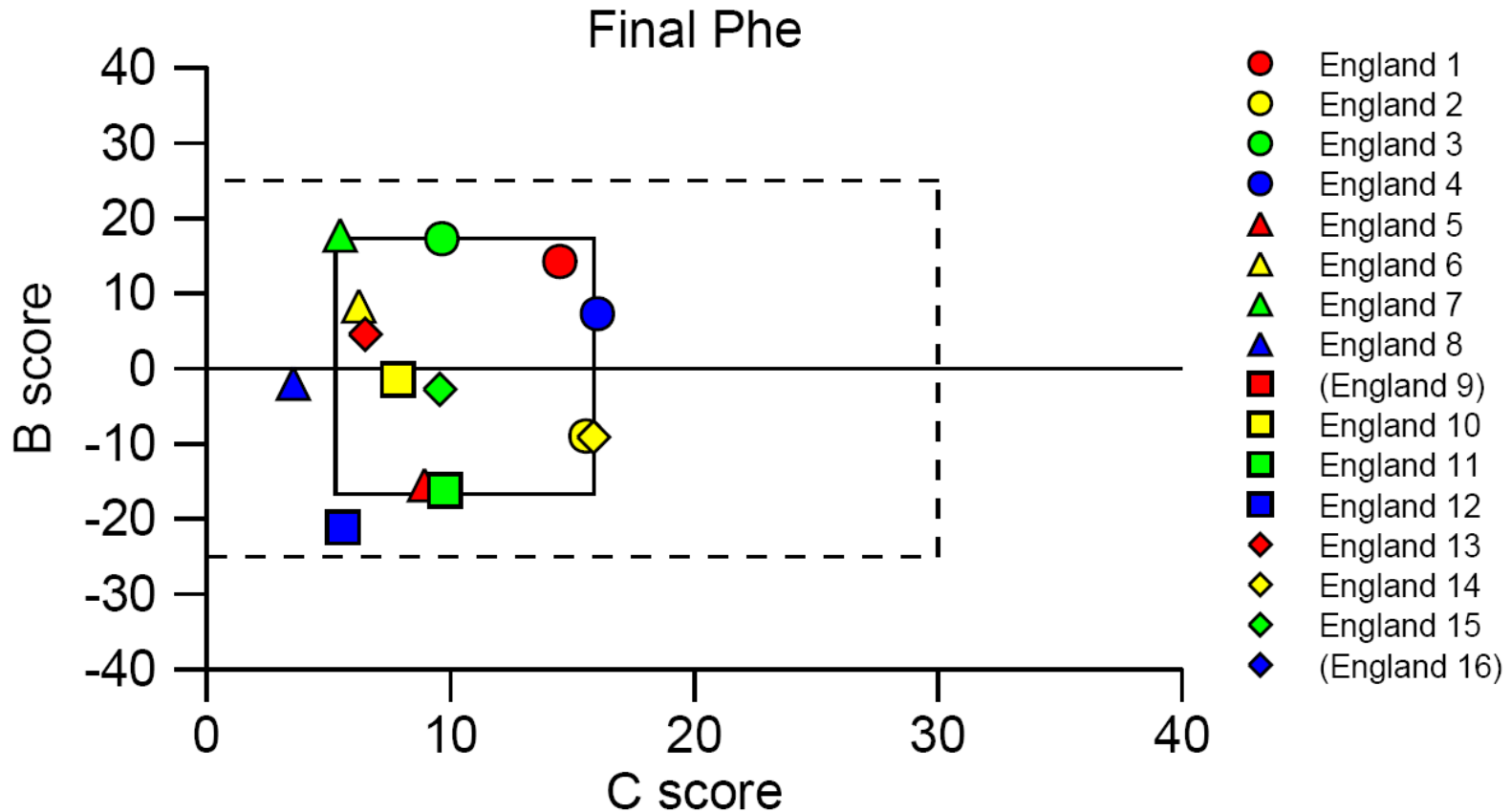
Penalty Box Plot ~ British Isles / English Labs



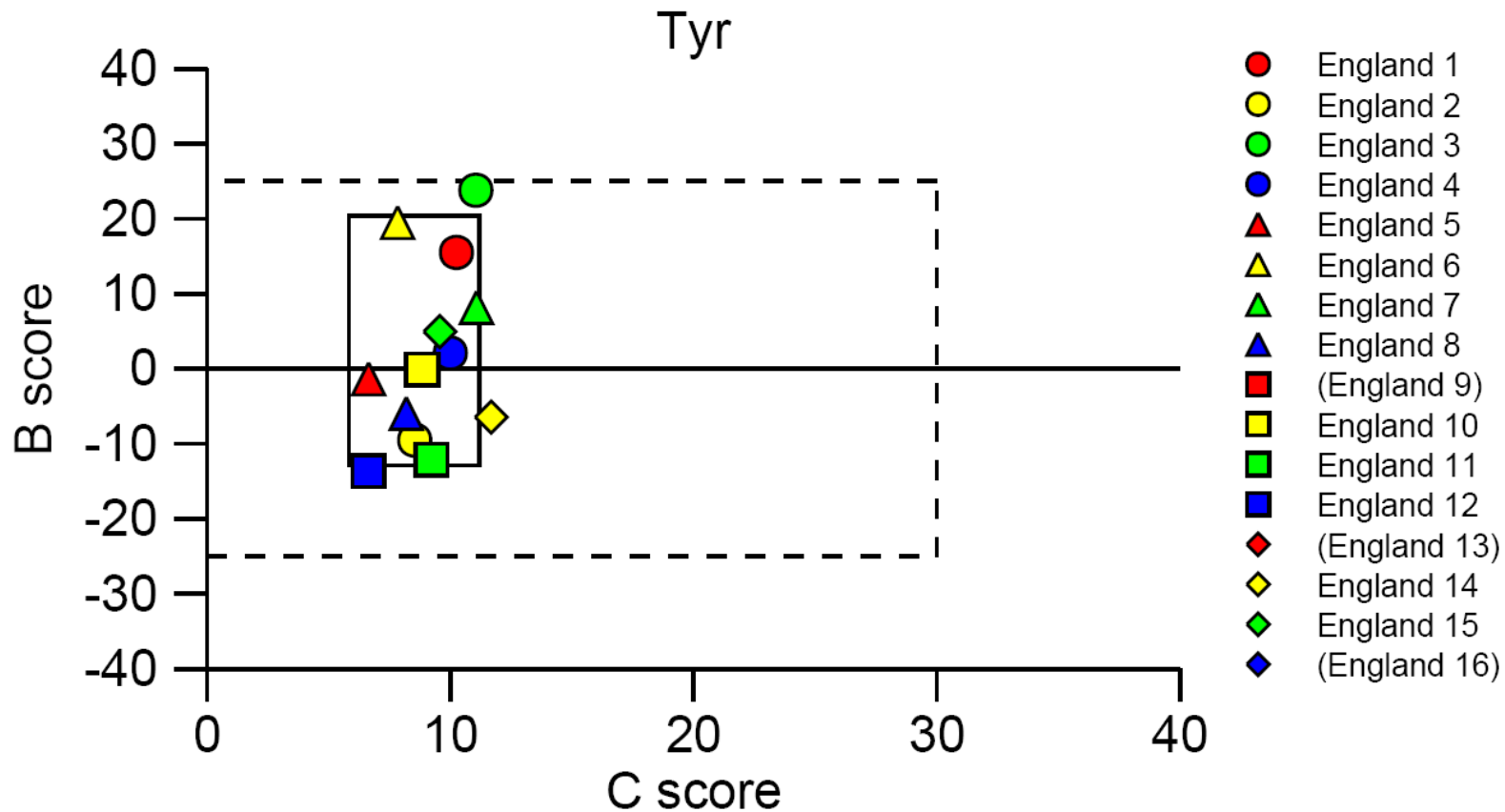
Penalty Box Plot ~ British Isles / English Labs



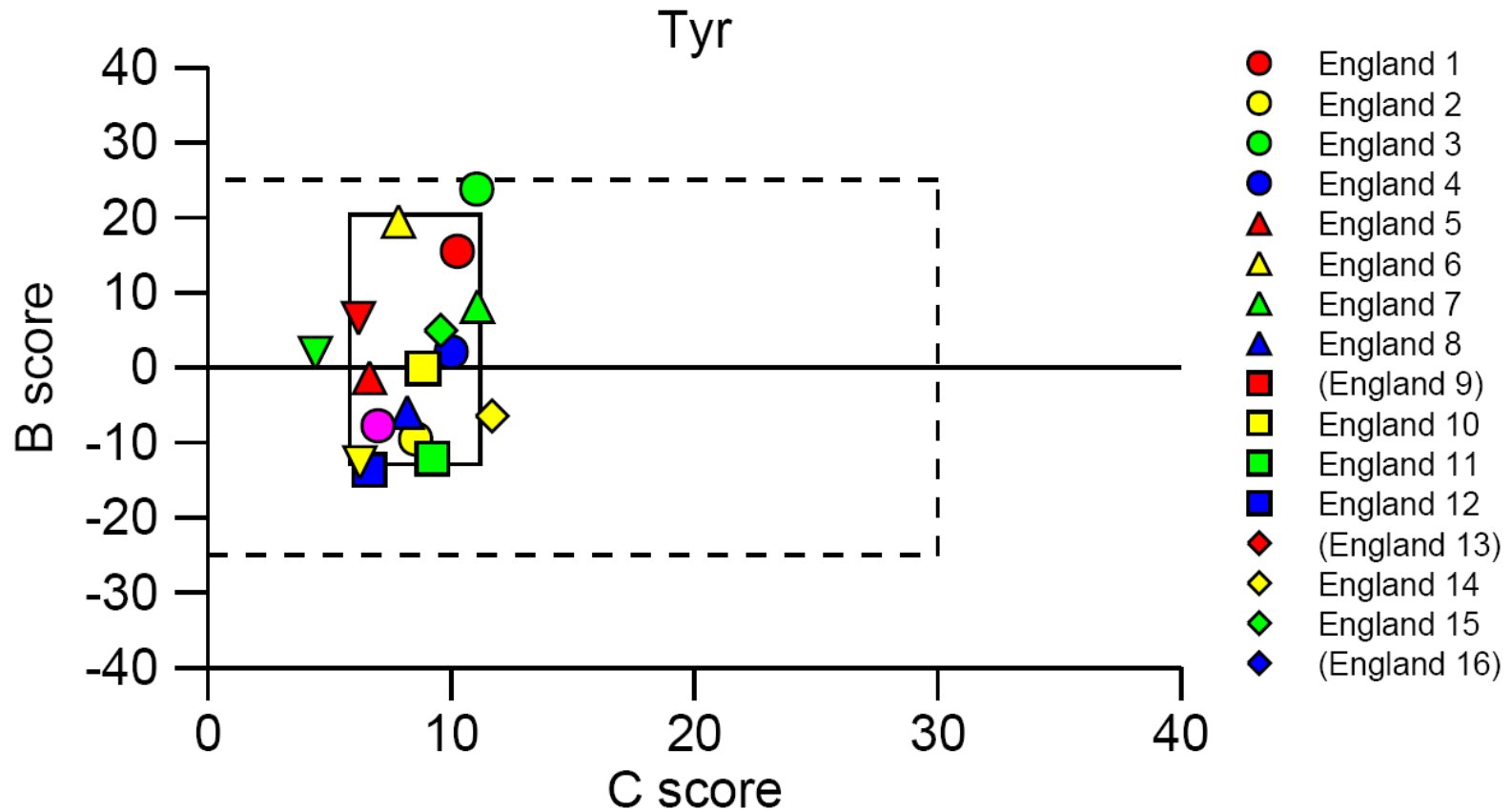
Penalty Box Plot ~ British Isles / English Labs



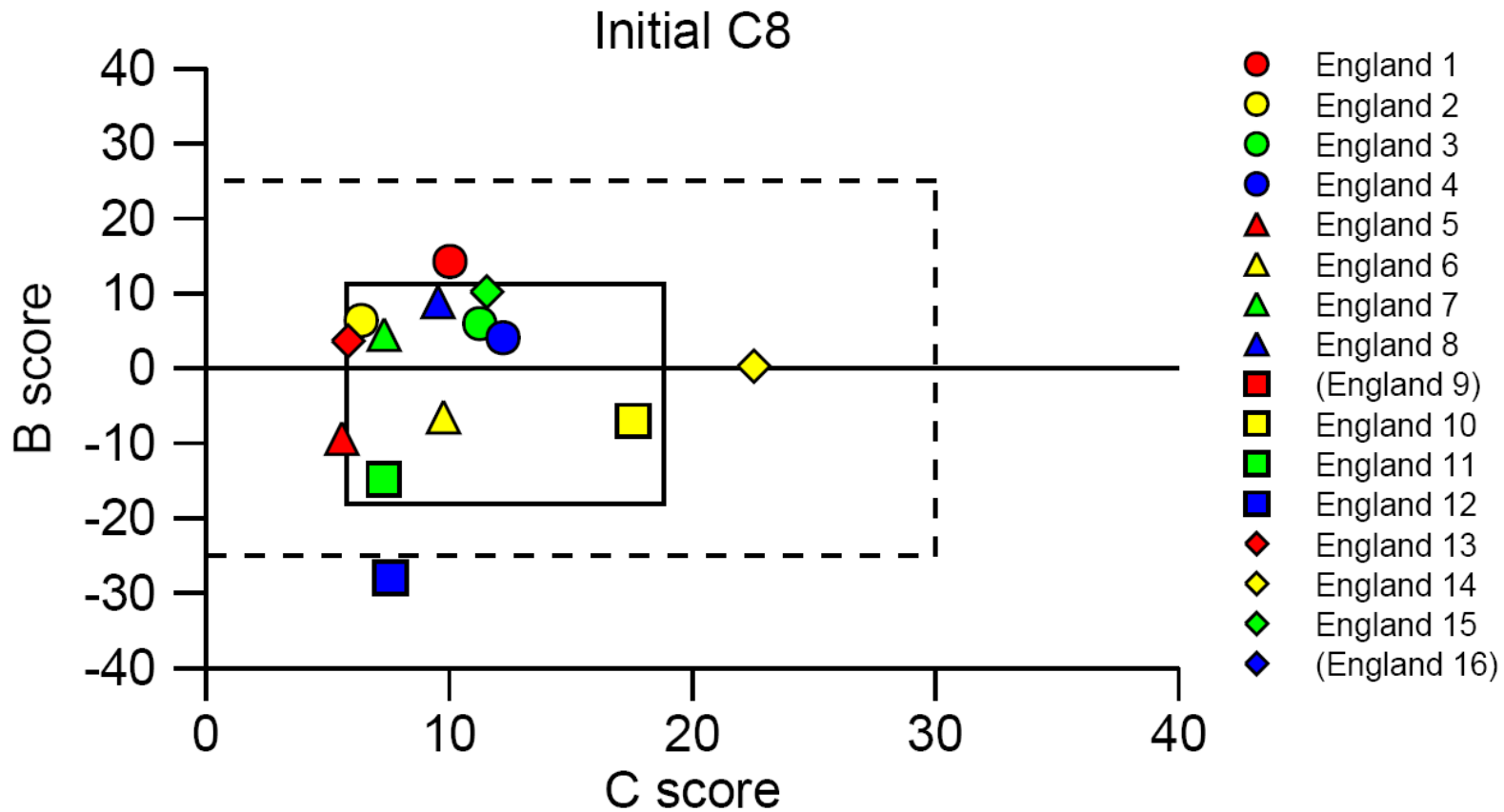
Penalty Box Plot ~ British Isles / English Labs



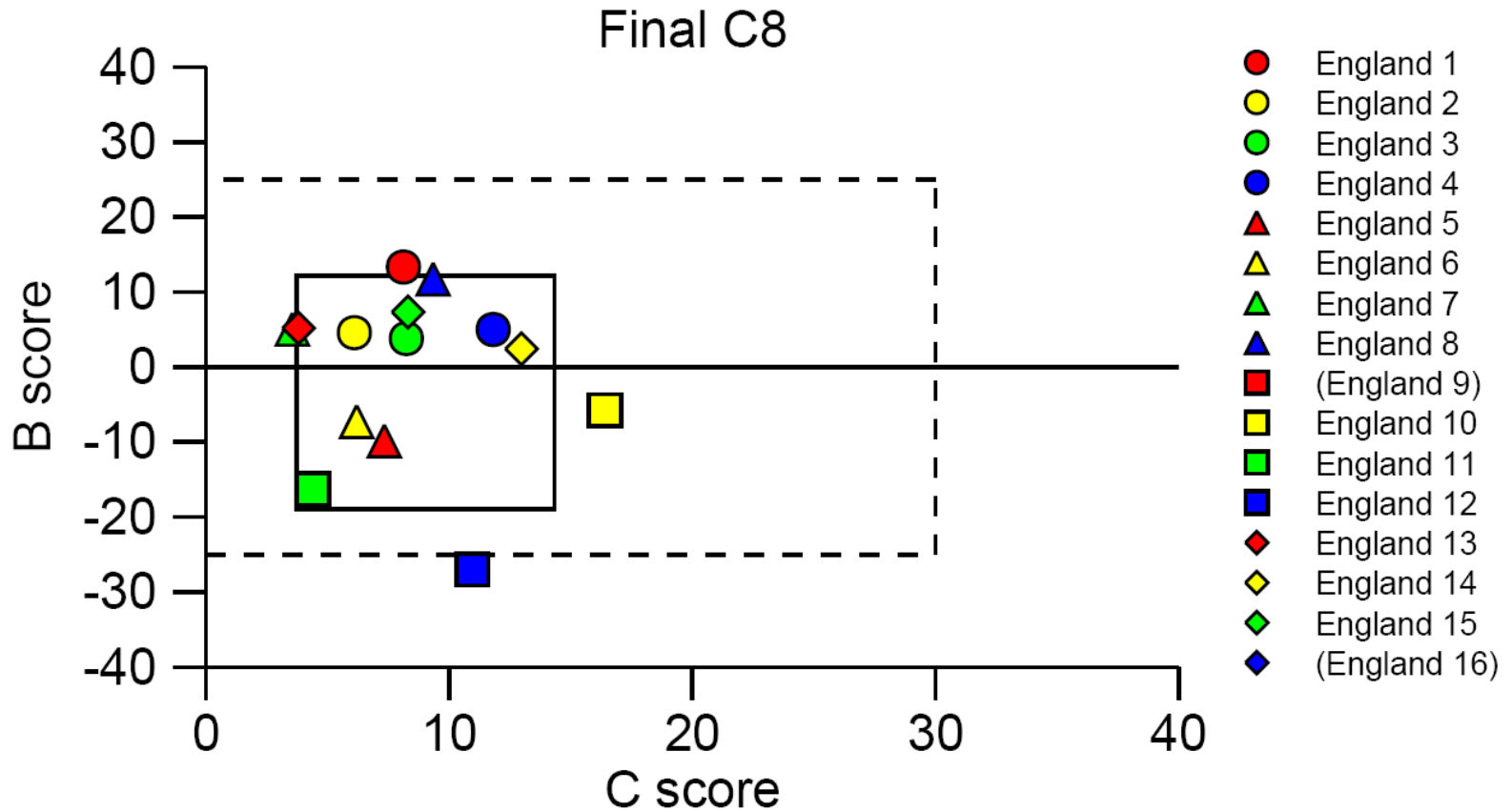
Penalty Box Plot ~ British Isles / all British Labs



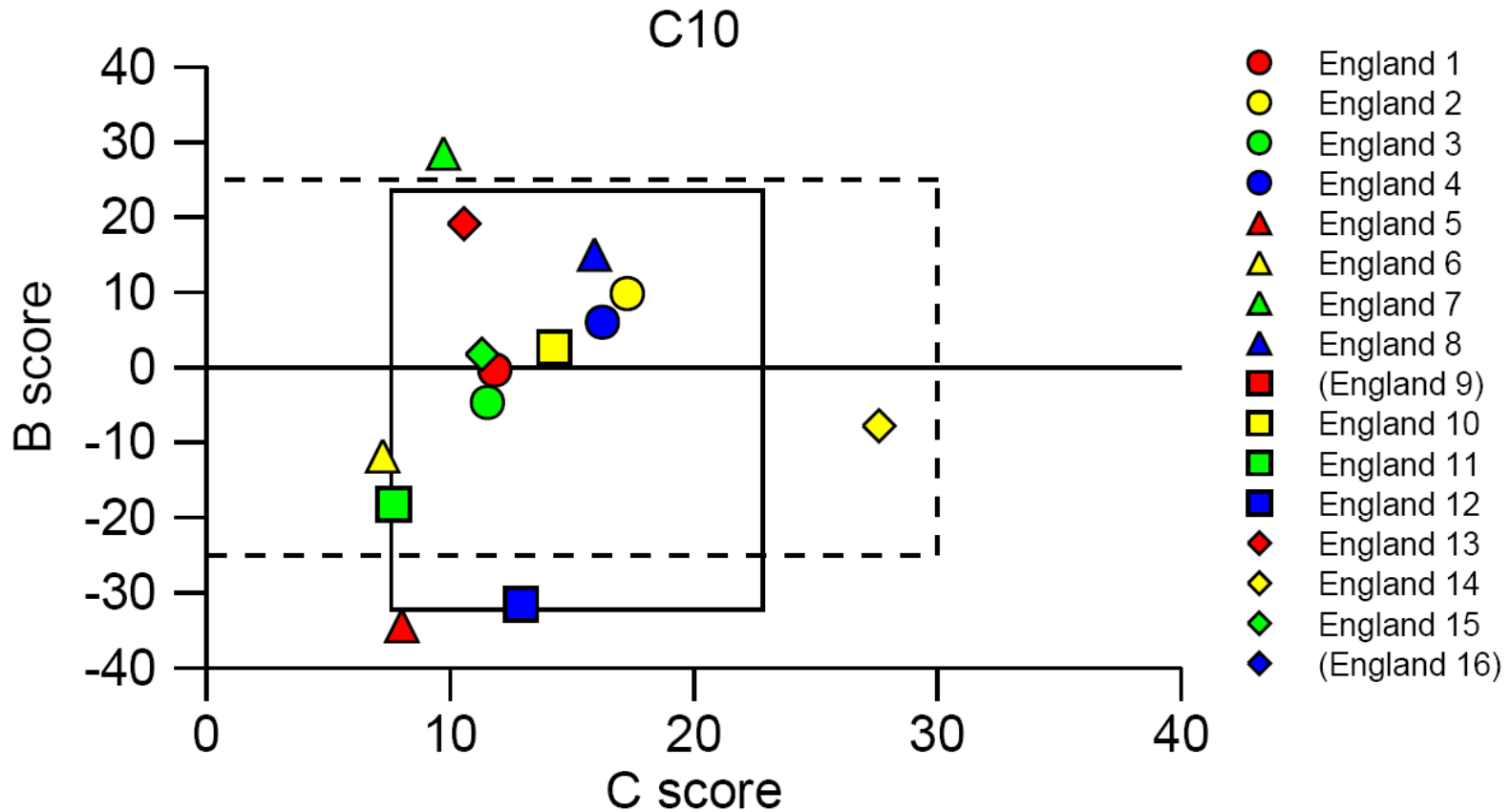
Penalty Box Plot ~ British Isles / English Labs



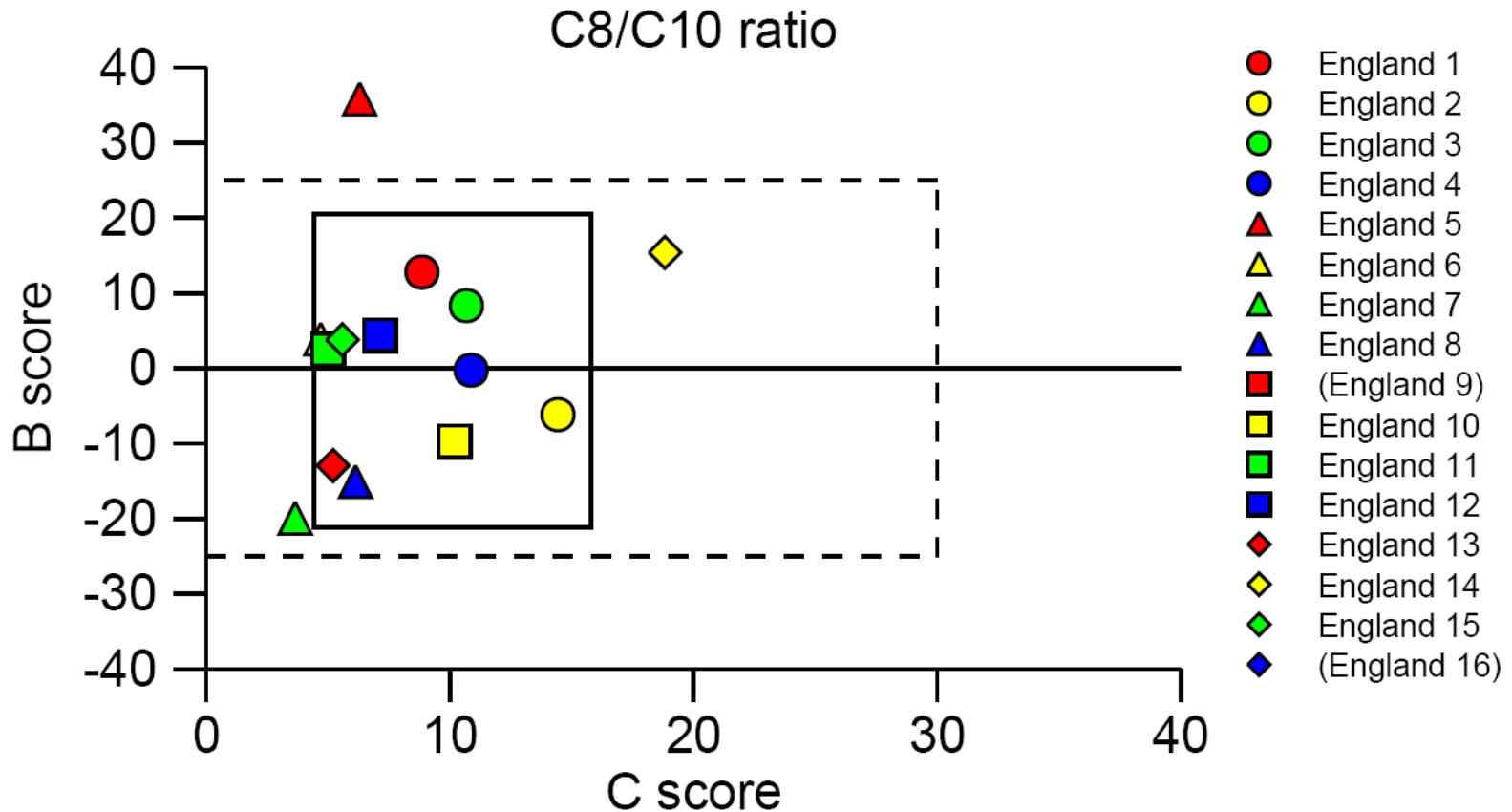
Penalty Box Plot ~ British Isles / English Labs



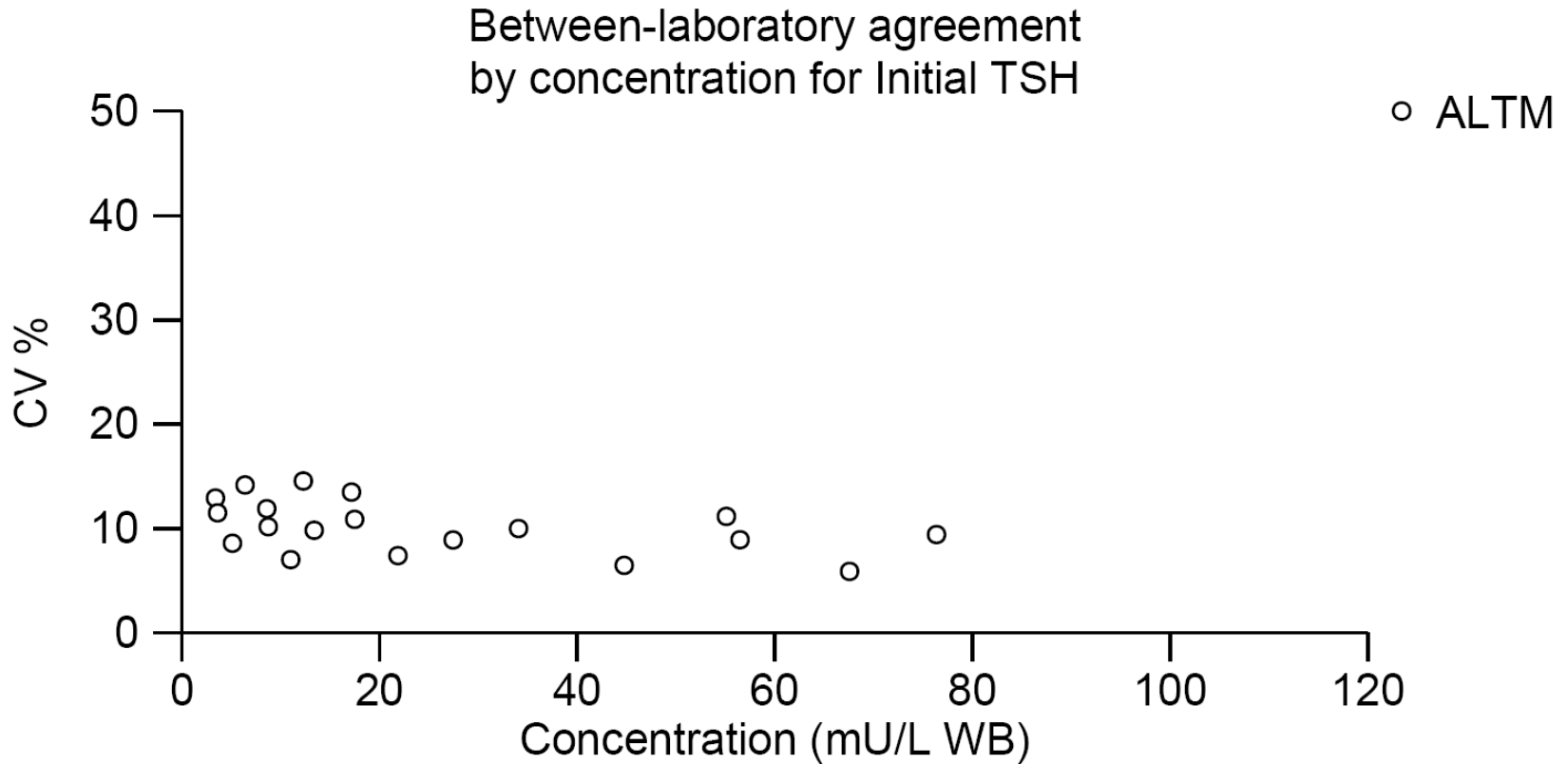
Penalty Box Plot ~ British Isles / English Labs



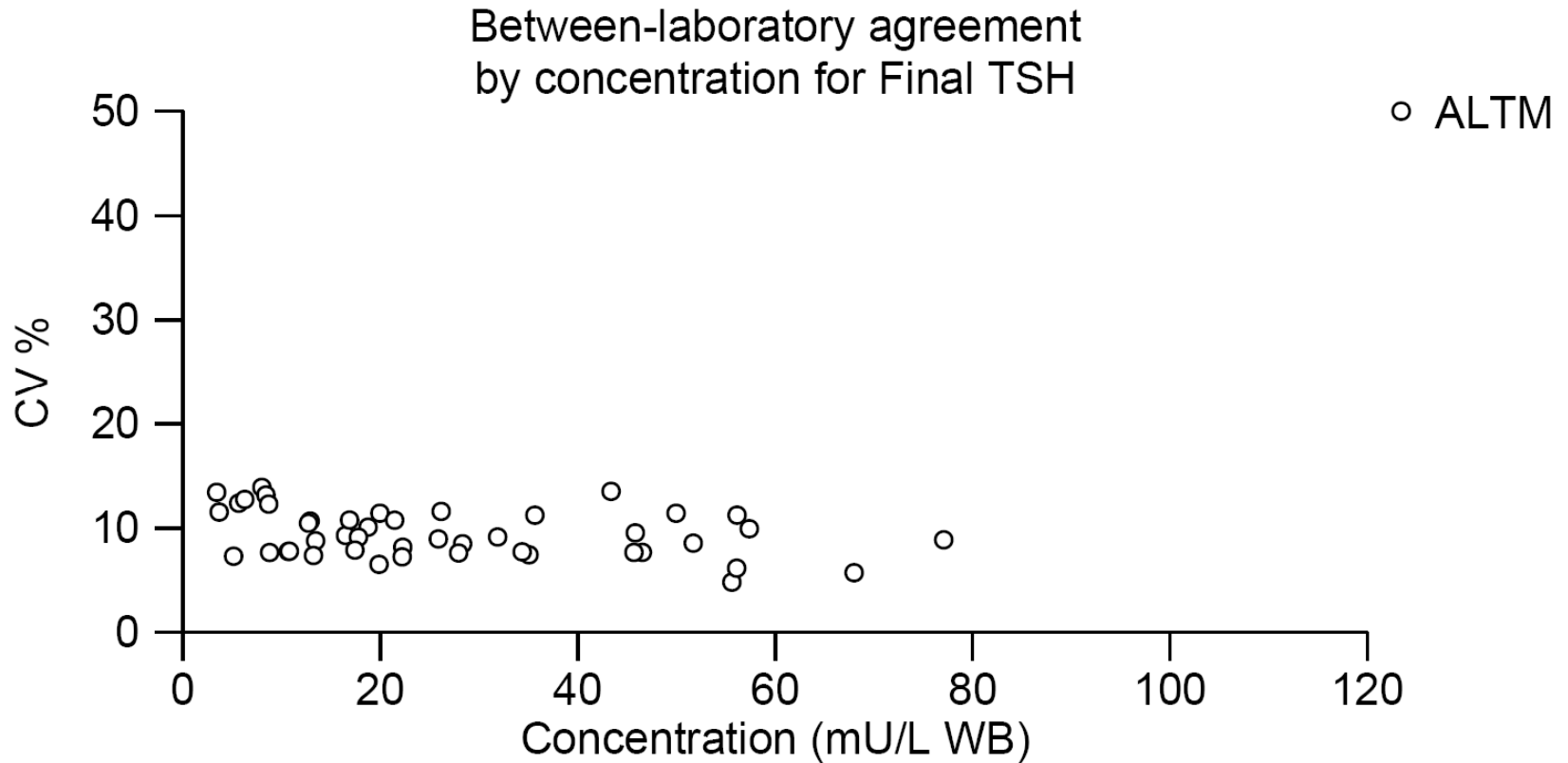
Penalty Box Plot ~ British Isles / English Labs



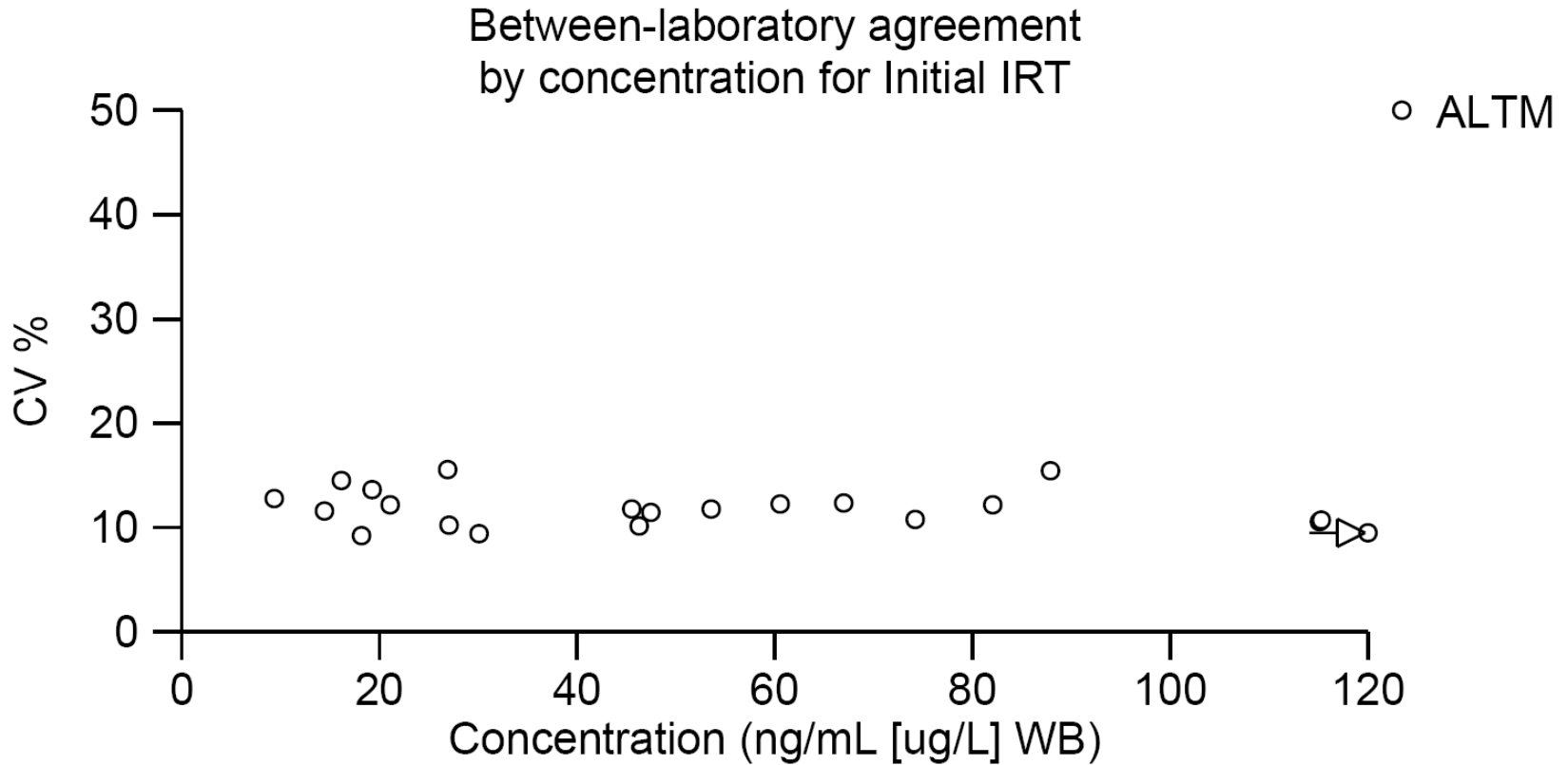
Between-Laboratory Agreement Plot ~ All British Isles



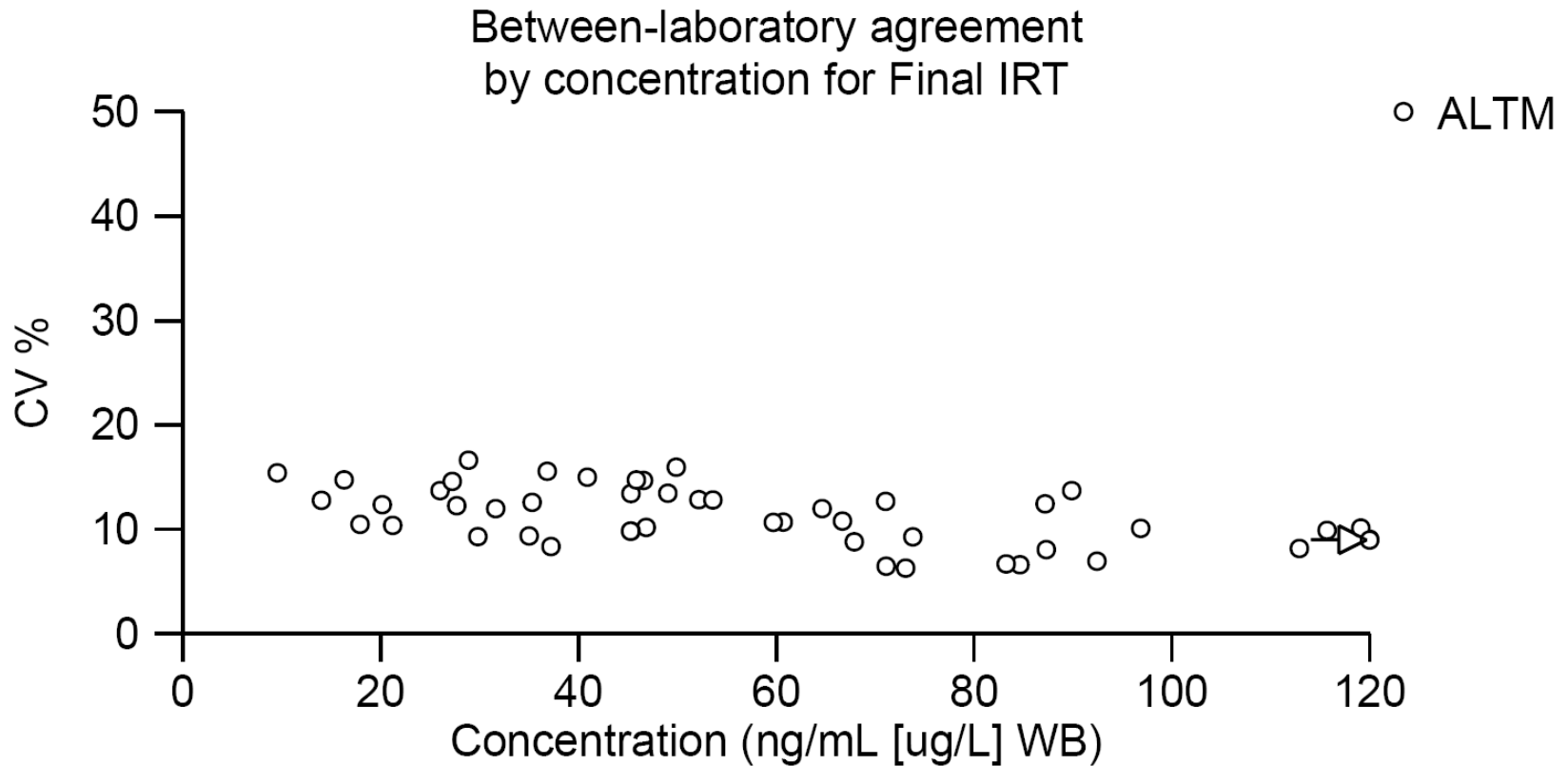
Between-Laboratory Agreement Plot ~ All British Isles



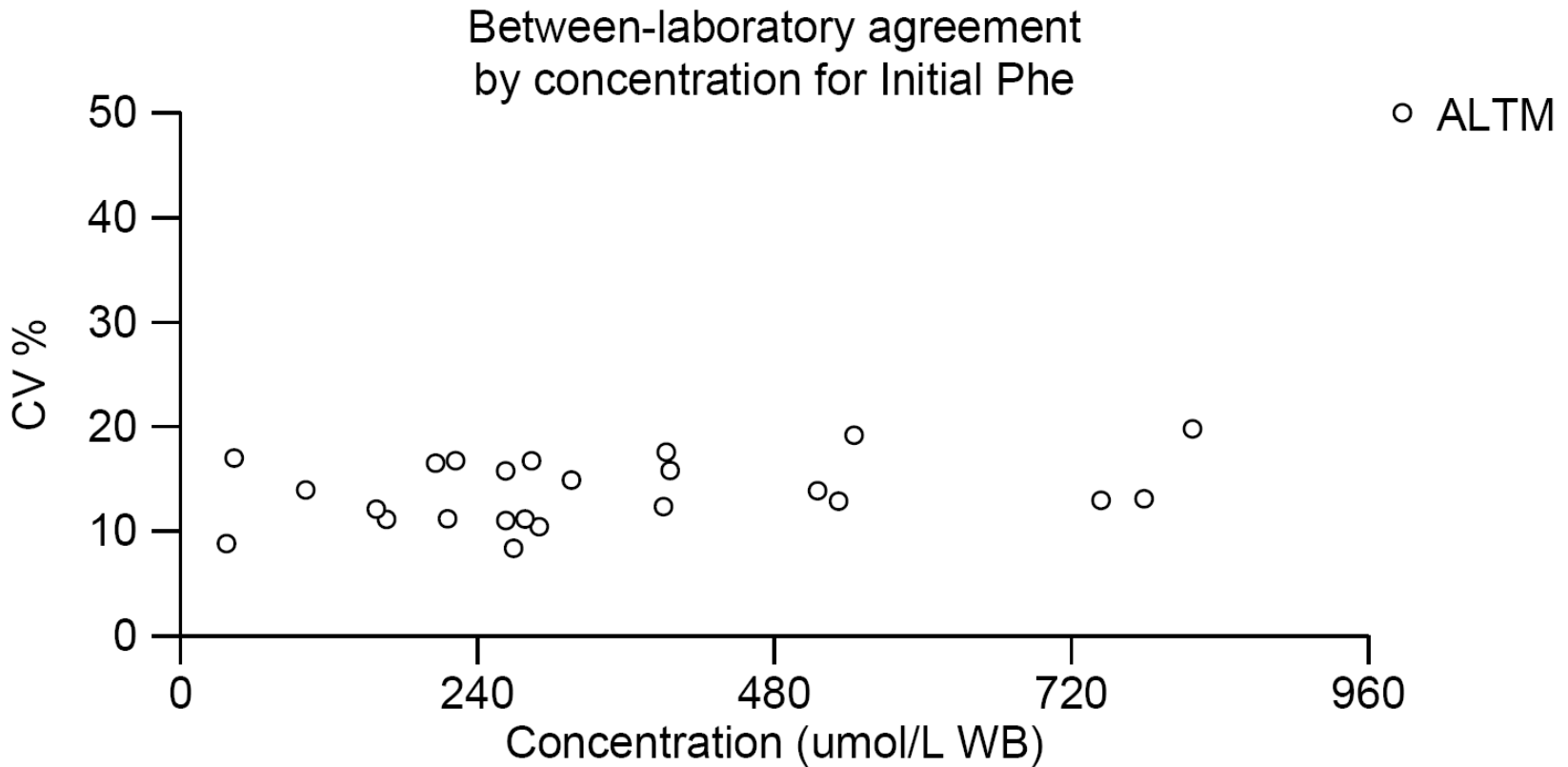
Between-Laboratory Agreement Plot ~ All British Isles



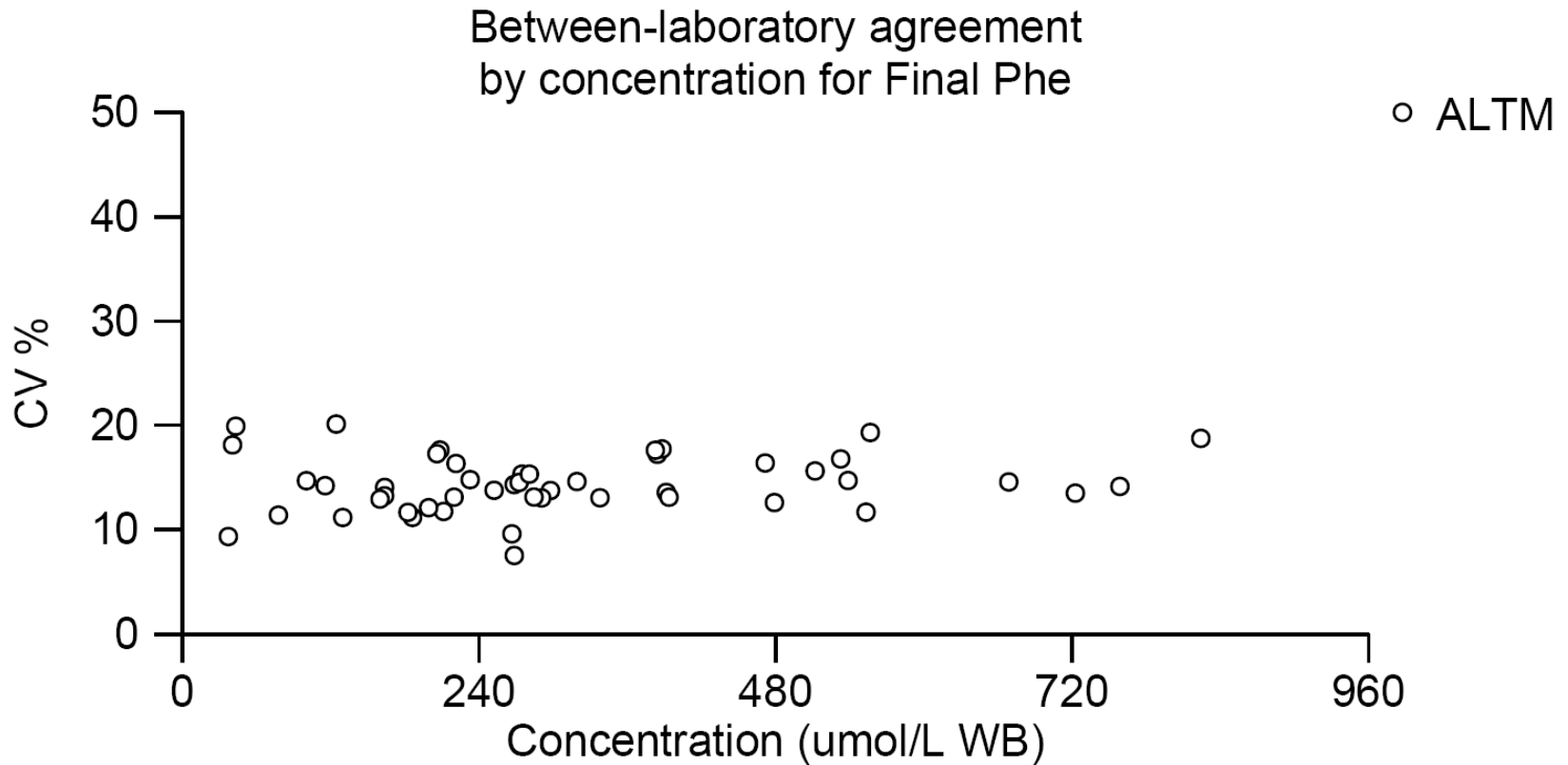
Between-Laboratory Agreement Plot ~ All British Isles



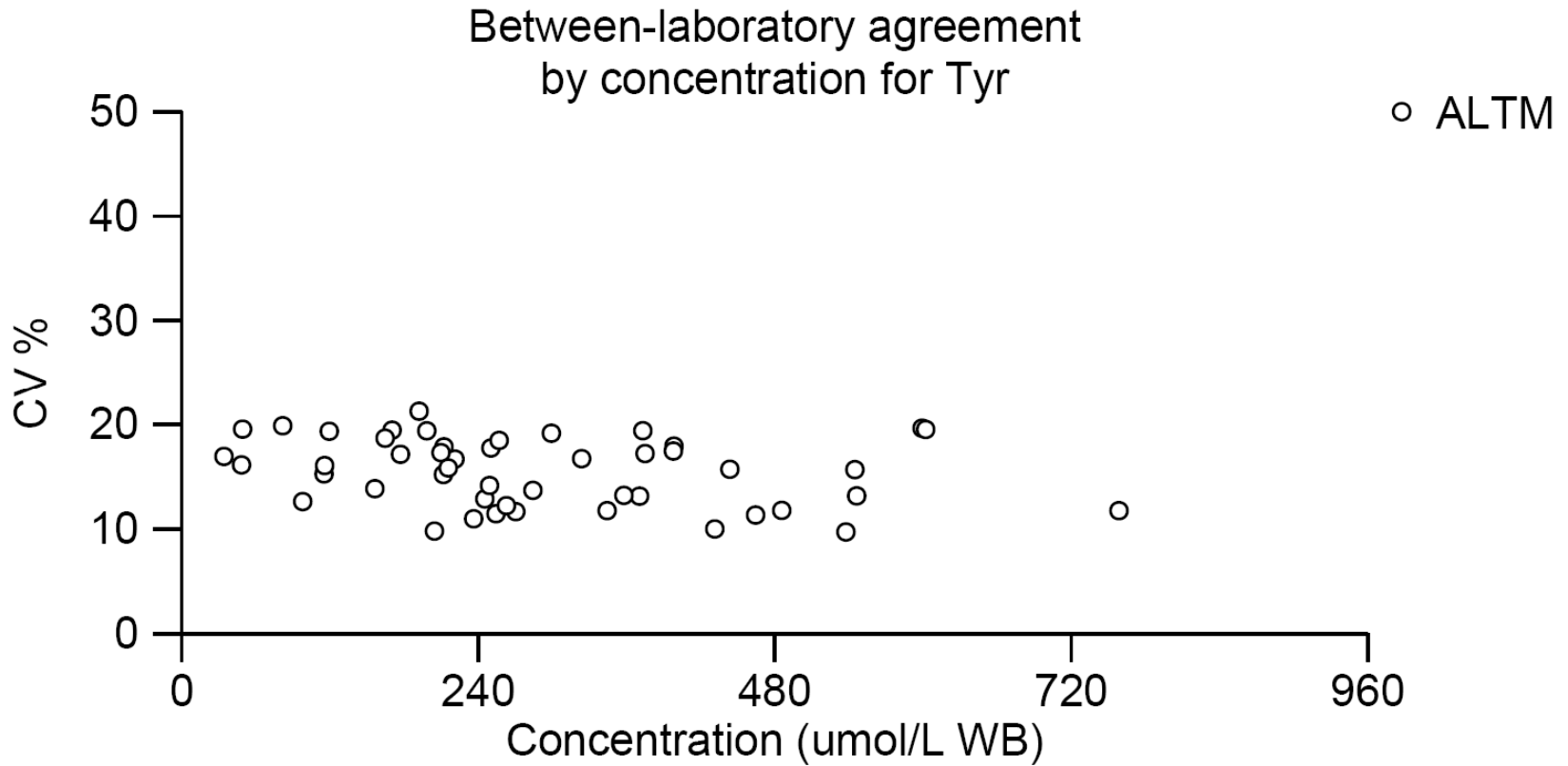
Between-Laboratory Agreement Plot ~ All British Isles



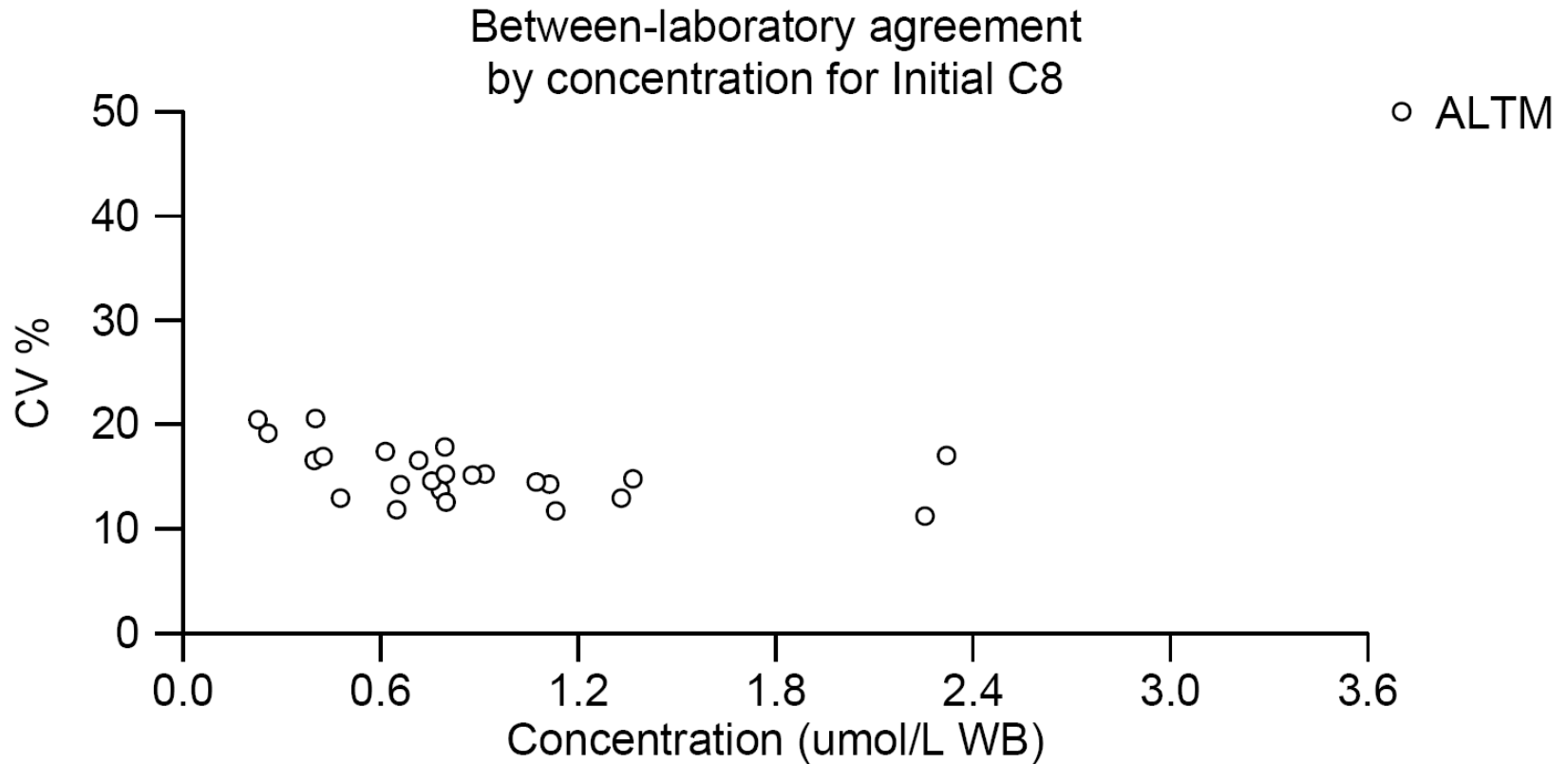
Between-Laboratory Agreement Plot ~ All British Isles



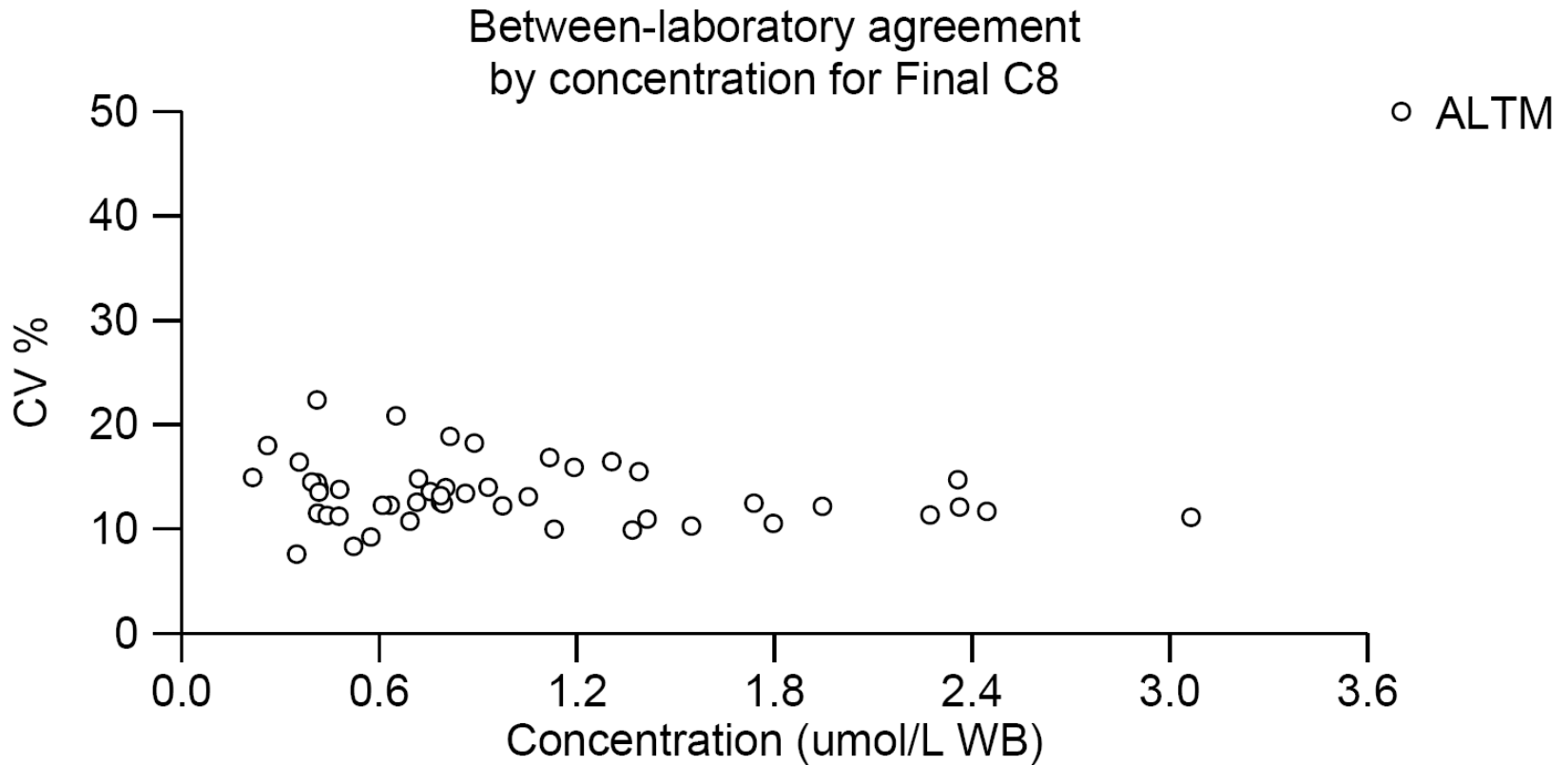
Between-Laboratory Agreement Plot ~ All British Isles



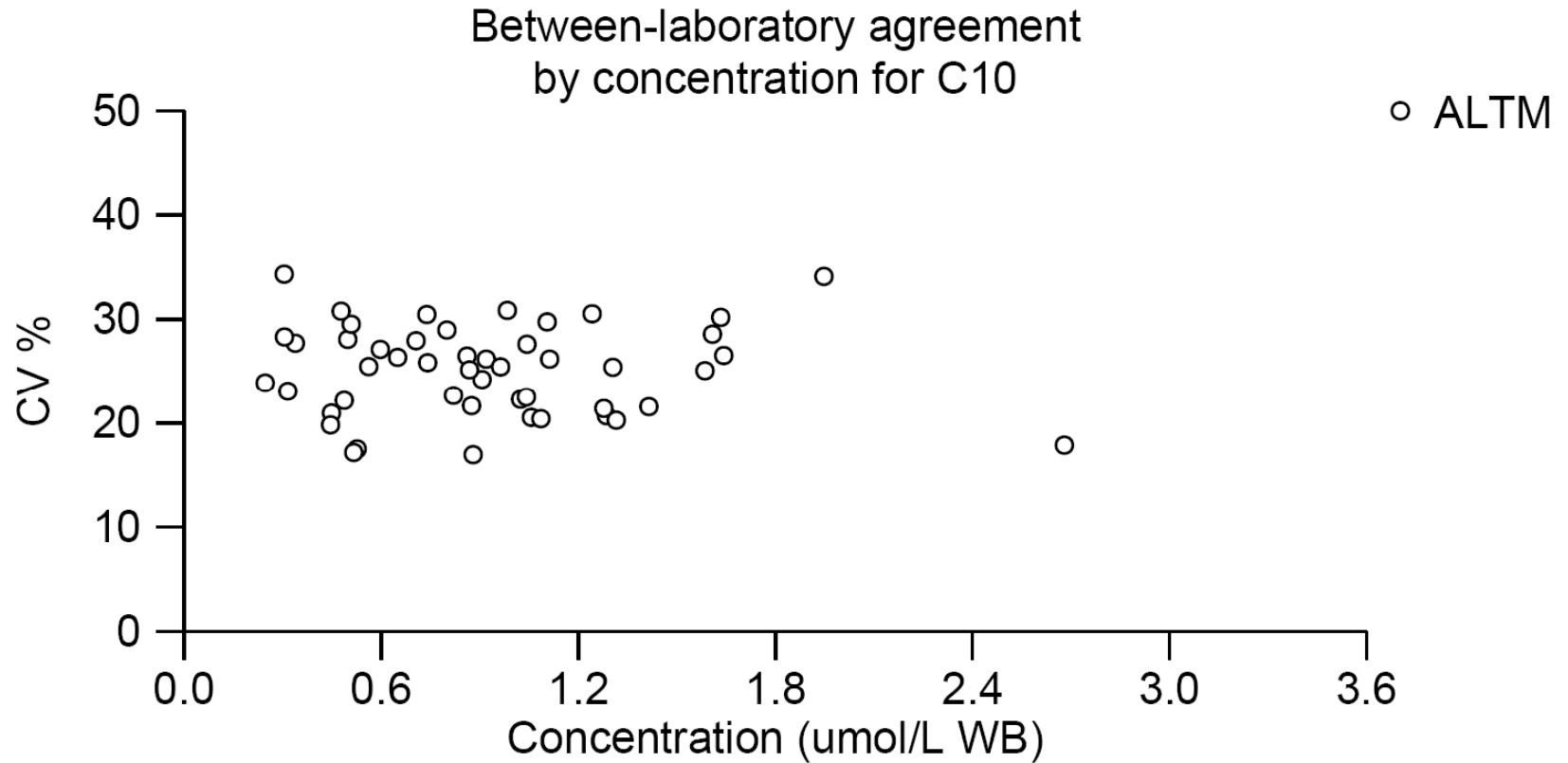
Between-Laboratory Agreement Plot ~ All British Isles



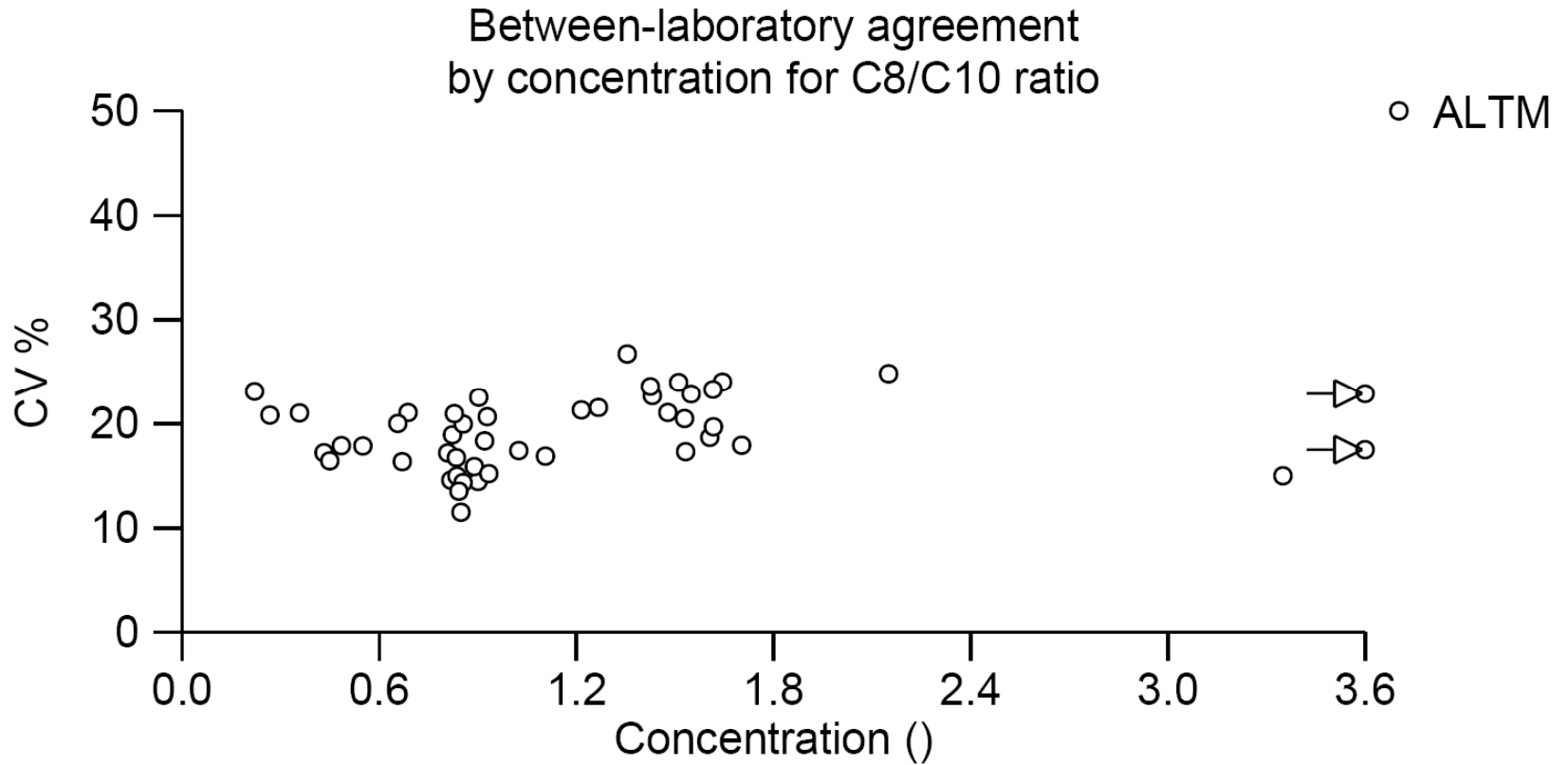
Between-Laboratory Agreement Plot ~ All British Isles



Between-Laboratory Agreement Plot ~ All British Isles



Between-Laboratory Agreement Plot ~ All British Isles



Acknowledgements:

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Jane French, Laura Allen, Andy Robins and all my troops

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especially Paul Newland, Sheila Bennett and David Isherwood*

[*as a most loyal friend and supporter of UK NEQAS over the last twenty years or more]

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especially Lesley Tetlow

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The UK Newborn Blood Spot Laboratory Quality Assurance Development Group

Chairman and members, for the endless meetings.....

The MetBioNet for inviting me here today!

