Collection of Blood Samples (COBS) data collection carried out on behalf of the International Society of Blood Transfusion (ISBT) Biomedical Excellence for Safer Transfusion (BEST) Committee

Part II Rejected and miscollected samples

M.F Murphy & B.Stearn

We are very grateful to all the participating hospitals for undertaking the data collection.

Please direct any comments to:

Dr Mike Murphy
National Blood Service
John Radcliffe Hospital,
Headington,
Oxford, OX3 9BQ

Barbara Stearn
NBS Senior Clinical Audit Facilitator
Leeds Blood Centre
Bridle Path
Leeds
LS15 7TW

Introduction

The transfusion of ABO incompatible blood continues to represent a significant hazard to transfusion recipients. Incorrect blood component transfused (IBCT) is the most frequent serious incident associated with blood transfusion. Over its 5 reporting years 1996 to 2001, the Serious Hazards of Transfusion (SHOT) scheme has reported 11 deaths and 60 cases of major morbidity due to IBCT (SHOT, 2002). During the 2000-2001 reporting year the scheme received reports from 379 hospitals which between them transfused 92% of the blood used in the UK. A total of 213 IBCT incidents, including 3 deaths and 6 cases of major morbidity, were reported. In 190 incidents analysed, 344 errors were identified; 3% were due to errors during sample collection and 30% were due to errors when administering blood. Multiple errors frequently occurred, involving all stages of the process and many different types of staff.

The collection of the blood sample for pre-transfusion compatibility testing is at the beginning of a complex, chain of events in the process of clinical transfusion. This is the second part of a report which describes the UK contribution to an international study studying sampling and labelling in relation to blood transfusion within hospitals.

The results of the first part of the audit involving 185 hospitals were reported earlier this year. Policy and practice were examined in relation to the collection of blood samples.

In the second stage of the audit reported here, 110 hospitals (59.5% of the number participating in the first part of the audit) provided data on the number of samples submitted for testing, the number which were rejected, and the reasons for rejection over a 3 month period. 85 hospitals provided data on the number of samples which were repeat samples, and the number of samples where the blood group was different to previous historical results for ABO & RhD groups were identified as wrong blood in tube (WBIT).

Methods

Hospitals were asked to collect data for a 3 month period between October 2001-December 2001. The National Blood Service (NBS) and the International Society of Blood Transfusion (ISBT) Biomedical Excellence for Safer Transfusion (BEST) Working Party provided data collection sheets (Appendix 1). In the UK, data were returned to NBS Clinical Audit & Effectiveness for analysis.

Rejected samples

110 hospitals participated in this part of the study. They reported the total number of samples submitted to their laboratory for ABO & RhD grouping over a 3 month period, the number of samples that failed to meet their own local criteria for sample acceptance, and the reasons why.

Wrong Blood In Tube

85 of the participating hospitals reported the number of repeat samples submitted to their laboratory on patients where previous ABO & RhD results existed, and the number of instances where the observed ABO & RhD results did not match the result on file for that patient.

Using the above information, the rate of WBIT was calculated as follows:-

- The 'raw rate' of WBIT was determined as the number of samples whose result did not match the previous record divided by the number of repeat samples, and expressed as WBIT per million samples.
- The 'raw rate' of WBIT was corrected for 'silent WBIT' errors'. 'Silent WBIT' errors occur when the wrong patient's blood is collected, but the ABO & RhD group of the blood in the tube happens by chance to match the ABO & RhD group on record.
- The underlying frequency distribution of ABO & RhD groups in the population determines the chance frequency of 'silent WBIT' errors. To correct for these, the 'raw rate' was multiplied by a correction factor equal to 1/1-q where q represents the chance that two random individuals will have the same ABO and RhD groups. For the UK population, q = 0.295 making the correction factor 1.418 for the UK.
- The 'true rate' of WBIT results from the correction for silent errors, and is expressed as a ratio (i.e. 1 WBIT in x samples).

Results

Rejected samples

A total of **445,726** samples were submitted of which **3.2%** (**14,114/445,726**) were rejected for various reasons shown in Figure 1. The most frequent reason for rejection was incomplete or missing information (49.5% of the total rejected samples). Other causes included mismatched information on the request form and sample tube (22.4%), the use of an addressograph label on the sample tube (6.3%), and unlabelled samples (3.3%).

Table 1 shows the total samples for each hospital in the study, the % rejected, the rejected rate per million samples, and the frequency of rejected samples occurring in each hospital expressed as a ratio (i.e. 1 in x number of samples) over the 3-month period of the study. The median number of samples submitted by each hospital was 3,979 (mean 4,052) (minimum 97, maximum 12,202). The median number of samples rejected was 78, mean 128. The median ratio of rejected samples was 1 in 40, and the central 50% rate for unacceptable samples was in a range from 1 in 23 to 1 in 76 as shown in Table 1.

Using the proportion of rejected samples for each hospital, the median proportion rejected was **2.5%**. Figure 2 illustrates the number of hospitals with rejected samples above and below this median.

The total number of samples submitted would be expected to influence the number of rejected samples. Figure 3 shows that there is a positive correlation between the number of samples submitted and the rejection rate (correlation coefficient r=0.61 and r^2= 0.36 i.e. 36% of the variation in one variable can be accounted for by the other). Figure 3 shows that there are 3 outliers; the correlation between rejection rate and samples would have been closer if these had been omitted.

Wrong Blood In Tube (WBIT)

85/110 (77.3%) hospitals were able to provide information on repeat samples; the detection of WBIT is obviously dependent on a historical sample being available and identifiable. 19/85 hospitals did not receive any repeat samples during the period of the study. A further 5 were unable to give full data for the 3 months, and these 24 hospitals were not used for further analysis on the incidence of WBIT.

Of the samples submitted, **133,600/231,357 (57.7%)** were repeat samples. When checking repeat samples against historical samples, **45/133,600 (0.03%)** were found to be incorrect, and classified as WBIT. 34/61 hospitals did not report any WBIT during the period of the study.

There was variation in the activity levels of the hospitals. The overall range of estimated WBIT was 1 in 238 to 1 in 3,303 samples (Table 2). The mean rate was 1 in 664. As the number of repeat samples received in some hospitals was very small the median observed rate of WBIT over the 3 month period was zero. When calculating the rate of WBIT these wide variations will cause the figures to become skewed. In the data set reported here where the mean is 1 in 664 (Standard error 127.14) the true population mean using a 95% confidence interval would be between 1 in 416 and 1 in 913. The central 50% of corrected rates for WBIT was in a range from 1 in $\propto$ to 1 in 1,802.

The correlation shown in Figure 4 between the number of repeat samples and the number of WBIT events is positive, but merely illustrates that 14% of variation in one variable is accounted for by the other (r=0.38. r^2=0.14). There is a positive correlation between the rate of rejected samples per million and the rate of WBIT per million (r=0.182 and r^2 =0.03).

Discussion

It is difficult to determine why there is such a variation in the rate of sample rejection as all the participating hospitals were found in part 1 of this audit to have procedures to deal with rejected samples. The frequency of unacceptably labelled samples in the hospitals in this audit varied between 1:5 to 1:1,800. This wide range suggests a low degree of standardisation between hospitals either in their practice for the collection of samples and/or their rejection. The first part of this audit showed that a high proportion of hospitals allow certain kinds of information to be added or corrected. The earlier audit also documented variations in policies for handling and documenting unacceptable samples.

It cannot be assumed that a low frequency of rejected samples implies better performance. This is illustrated by one hospital, which reported the implementation of a policy of "zero tolerance" during this study period. They found that the number of samples rejected increased substantially from an average of 26 rejected samples in the first 2 months of the study to 156 in the third month when the policy changed.

The rejection of samples by laboratory staff means that an error has occurred at the beginning of the clinical transfusion process. The process of rejecting samples may reduce the risk of a potential error becoming an actual error. It is recognised that human error will occur but that it is often the environments and systems within which people work that impact on the error rate. It is important to determine why these errors occur. It would be useful for hospitals to identify the causes of errors using Reasons' theoretical model discussed in Dean et al (2002). This framework identifies 4 causal aspects of error: latent conditions, error-producing conditions, active failures and defences.

The overall rate of observed WBIT (0.03%) concurs with a potential error rate of 0.05% reported in one hospital over a 12 month period (Galloway et al, 1999). This study defined a potential error as one, which if gone undetected would have led to an actual error. An average rate of miscollection was 1 in 664 samples during this 3-month study period. Because WBIT can only be detected by a discrepancy of sample results from a prior test and because chance alone might produce a result in the correct ABO & RhD groups even if the wrong patients blood was drawn, a correction factor was applied to determine an actual rate of WBIT.

There is minimal association between the sample rejection rate and the rate of WBIT suggesting that WBIT is a random rather than a systematic error where a positive linear relationship would be evident between the rate of rejected samples and the rate of WBIT.

Knowledge of practice guidelines and research evidence is not sufficient to change practice (Wilson, 2002). The 1999 Effective Health Care Bulletin from the NHS Centre for Review & Dissemination identified that there was a need for a variety of strategies to implement change. Educational outreach, one-to-one feedback along with audit and reminder systems are some of the methods recommended.

Based on the results of the international study the BEST working party of the ISBT has strongly recommended that performance standards are established in the area of blood sample collection for blood banks. The precise performance standards could be determined for individual countries. Regular tracking of practice in individual hospitals against these standards could be used to identify poor performance requiring investigation and action such as staff re-training.

The experience from the national audit in England is that it is feasible to carry out such exercises on a national basis. It is hoped that individual hospitals will be encouraged to examine and improve their practice of sample collection for blood transfusion through a process of further national audits, and providing feedback to individual hospitals on their performance in comparison to others.

References

British Committee for Standards in Haematology (1999). The administration of blood and blood components and the management of transfused patients. *Transfusion Medicine*, **9**, 227-238.

Dean B et al. (2002). Causes of prescribing errors in hospital inpatients: a prospective study. *Lancet*, 359, (9315), 1373-1378

Galloway M et al. (1999). An audit of error rates in a UK district hospital transfusion laboratory. *Transfusion Medicine*, 9, 199-203.

Galloway M et al. (2002). Providing feedback to users on unacceptable practice in the delivery of a hospital transfusion service – a pilot study. *Transfusion Medicine*, 12, 129-132.

NHS Centre for Dissemination and Review. (1999). Getting evidence into practice. *Effective Health Care*. 5 (1).

Serious Hazards of Transfusion. Annual report 2000-2001 (2002). Serious Hazards of Transfusion Scheme. Manchester, UK.

Wilson P (2002). Improving clinical practice. *Clinical Governance Bulletin*. 3 (1) 5-6

Appendix 1

BEST Working Party of the ISBT: "COBS Study"
COLLECTION OF BLOOD SAMPLES:
AN INTERNATIONAL ASSESSMENT OF PRACTICE

Results of Data Collection on Rejected Blood Samples and Wrong Blood In Tube

Hospital _____

Part 1 Rejected Samples

	June 2002	**July 2002**	**August 2002**
Number of Samples submitted for testing			
Number of Samples Rejected			

Reasons for Rejection

Unlabelled			
Illegible; unreadable			
Incomplete or missing information			
Information on tube did not match information on request form			
Other reason			

Part 2: <u>Wrong Blood in Tube</u>

	June 2002	**July 2002**	**August 2002**
Number of samples received where a previous ABO/Rh result was on file for the patient. (Exclude first time samples from this number)			
Number of samples where ABO/Rh result did **not** match previous result on file			

ANNEXE A

Legends

Figure 1 Reasons for sample rejection

Figure 2 Percentage of samples rejected in 110 hospitals, identifying the median as a benchmark

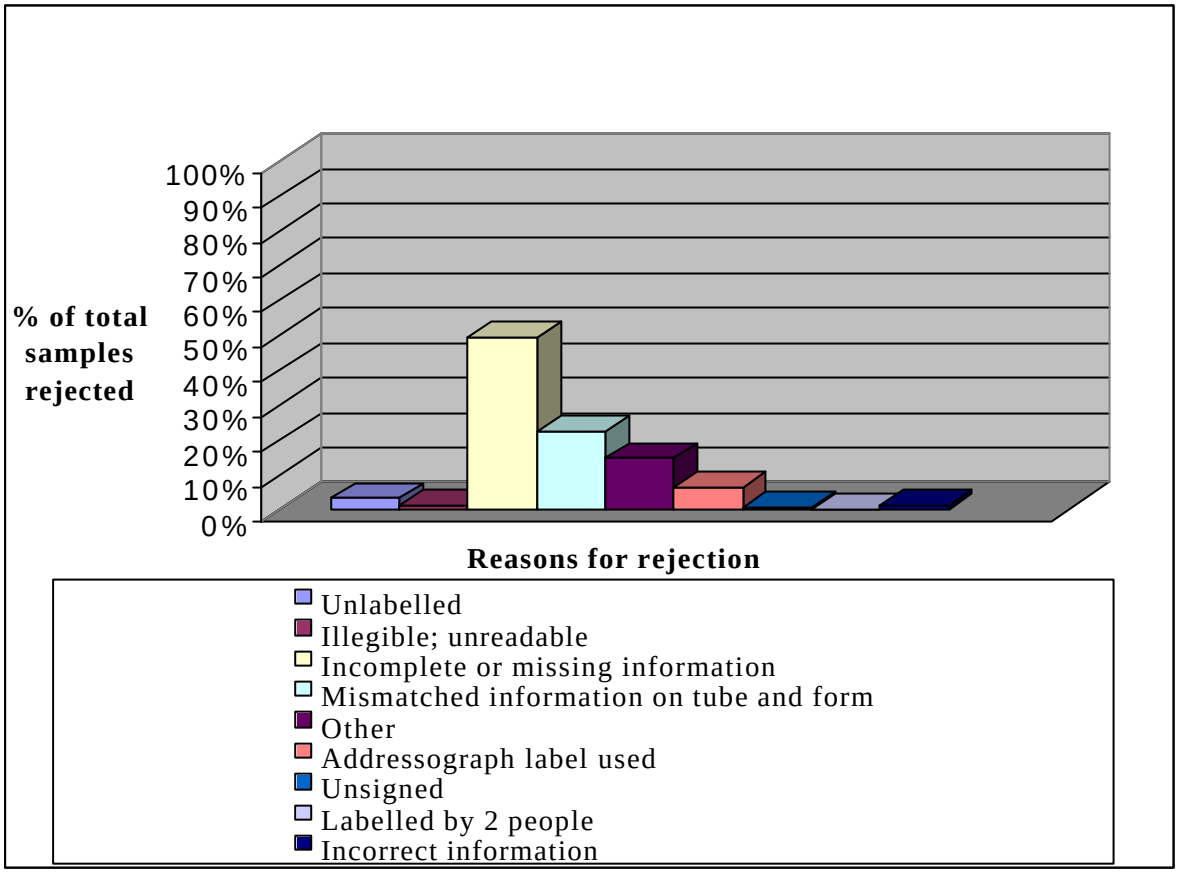
Figure 3 Scattergraph showing association between the number of samples submitted and rejected samples

Figure 4 Scattergraph to determine association between the number of repeat samples collected and WBIT observed

Table 1 Frequency of mislabelled samples

Table 2 Frequency of miscollected samples as measured by WBIT

Figure 1



Reason for rejection	No. samples rejected	Rejected as % of total rejected samples (denominator=14114)	Rejected samples as % of total samples submitted for testing (denominator=445726)
Labelled by 2 people	7	0.05	0.00
Unsigned	133	0.94	0.03
Illegible; unreadable	170	1.20	0.04
Incorrect information	209	1.48	0.05
Unlabelled	471	3.34	0.11
Addressograph label used	892	6.32	0.20
Other	2080	14.73	0.47
Mismatched information on tube and form	3164	22.42	0.71
Incomplete or missing information	6988	49.51	1.57

Figure 2

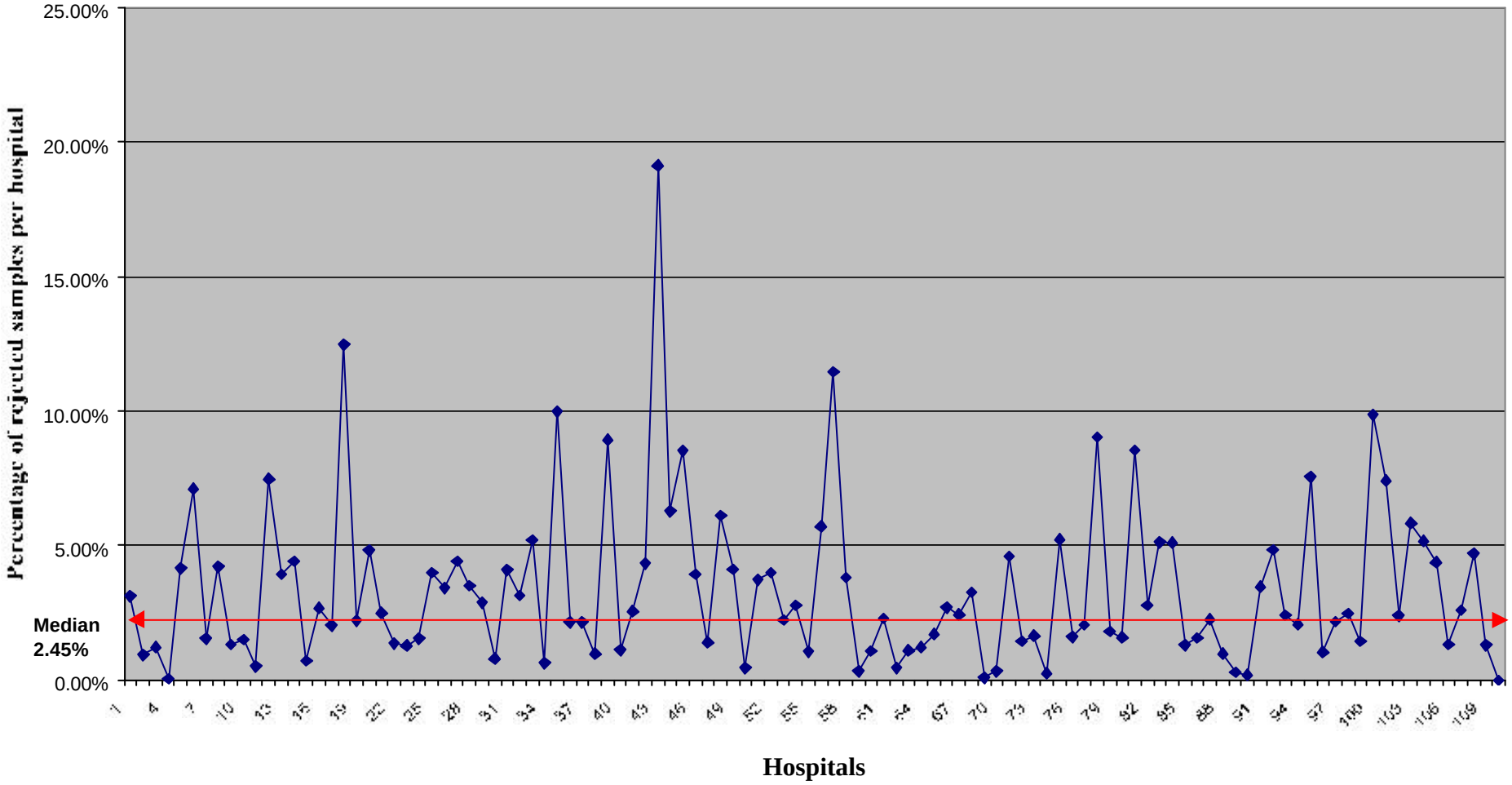


Figure 3

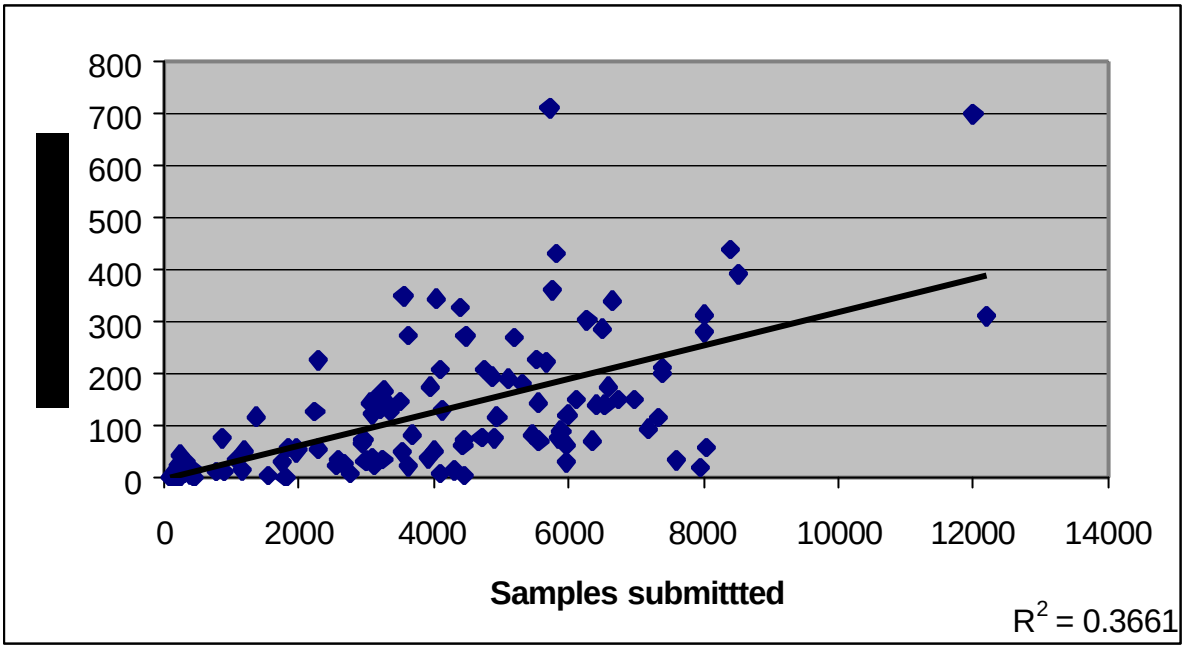


Figure 4

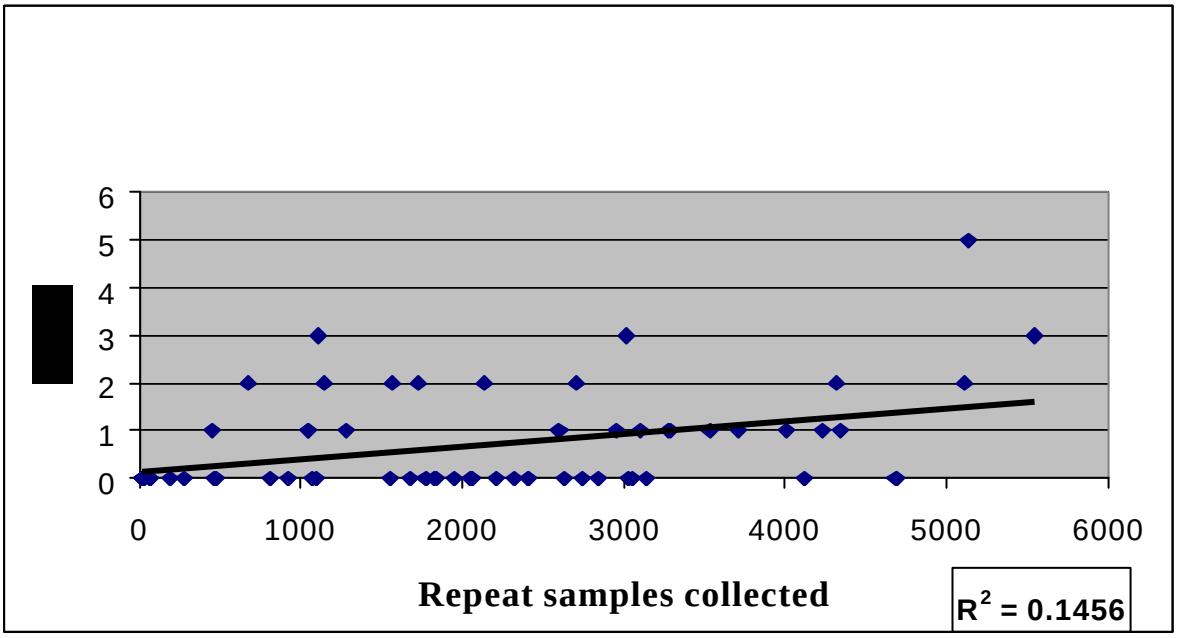


Table 1 **Frequency of mislabelled samples.**

Total samples	Total rejects	% rejected	Rejected rate per million	Rejected samples 1 per "x" samples	
456	0	0.00%	0	n/a	
1800	1	0.06%	556	1800	
4462	4	0.09%	896	1116	
4098	8	0.20%	1952	512	
7958	20	0.25%	2513	398	
2762	8	0.29%	2896	345	
1537	5	0.33%	3253	307	
4296	14	0.33%	3259	307	
224	1	0.45%	4464	224	
7590	34	0.45%	4480	223	
5969	30	0.50%	5026	199	
3622	23	0.64%	6350	157	
8049	58	0.72%	7206	139	
3109	25	0.80%	8041	124	
2563	24	0.94%	9364	107	
3918	38	0.97%	9699	103	
2659	26	0.98%	9778	102	
191	2	1.05%	10471	96	
5969	64	1.07%	10722	93	
3249	35	1.08%	10773	93	
2986	33	1.11%	11052	90	
6340	71	1.12%	11199	89	
244	3	1.23%	12295	81	
3076	38	1.24%	12354	81	
5561	71	1.28%	12767	78	
1159	15	1.29%	12942	77	
4000	52	1.30%	13000	77	
5848	77	1.32%	13167	76	
7190	95	1.32%	13213	76	
2576	35	1.36%	13587	74	
3535	50	1.41%	14144	71	
4433	64	1.44%	14437	69	
894	13	1.45%	14541	69	
5465	82	1.50%	15005	67	
778	12	1.54%	15424	65	
5888	91	1.55%	15455	65	
4906	77	1.57%	15695	64	
7322	116	1.58%	15843	63	
4453	72	1.62%	16169	62	
4710	78	1.66%	16561	60	
1759	30	1.71%	17055	59	
386	7	1.81%	18135	55	
5980	121	2.02%	20234	49	
97	2	2.06%	20619	49	
145	3	2.07%	20690	48	
186	4	2.15%	21505	47	
6541	141	2.16%	21556	46	
6976	151	2.16%	21646	46	
6404	141	2.20%	22017	45	
6725	150	2.23%	22305	45	
3675	83	2.26%	22585	44	
2953	68	2.30%	23027	43	
4939	118	2.39%	23891	42	
2282	55	2.41%	24102	41	
2955	72	2.44%	24365	41	
6111	151	2.47%	24710	40	
1966	49	2.49%	24924	40	
12202	312	2.56%	25570	39	
5542	144	2.60%	25983	38	
6580	176	2.67%	26748	37	
7392	200	2.71%	27056	37	
287	8	2.79%	27875	36	
1970	55	2.79%	27919	36	
7397	213	2.88%	28795	35	
1851	58	3.13%	31334	32	
4128	130	3.15%	31492	32	
1075	35	3.26%	32558	31	
5311	182	3.43%	34268	29	
433	15	3.46%	34642	29	
8006	281	3.51%	35099	28	
5109	191	3.74%	37385	27	
3350	128	3.82%	38209	26	
8000	314	3.93%	39250	25	
5661	223	3.94%	39392	25	
3085	123	3.99%	39870	25	
4876	195	4.00%	39992	25	
3198	131	4.10%	40963	24	
5534	228	4.12%	41200	24	
3503	146	4.17%	41679	24	
3315	140	4.22%	42232	24	
1198	52	4.34%	43406	23	
4744	208	4.38%	43845	23	
3958	175	4.42%	44214	23	
6488	287	4.42%	44236	23	
8516	392	4.60%	46031	22	
3064	144	4.70%	46997	21	
3105	150	4.83%	48309	21	
6270	304	4.85%	48485	21	
6657	340	5.11%	51074	20	
4082	209	5.12%	51200	20	
3254	168	5.16%	51629	19	
5186	270	5.21%	52063	19	
8410	440	5.23%	52319	19	
2238	128	5.72%	57194	17	
12000	700	5.83%	58333	17	
4467	273	6.11%	61115	16	
5761	362	6.28%	62836	16	
183	13	7.10%	71038	14	
5825	432	7.42%	74163	13	
4387	328	7.48%	74766	13	
3630	274	7.55%	75482	13	
1373	117	8.52%	85215	12	
4028	344	8.54%	85402	12	
336	30	8.93%	89286	11	
853	77	9.03%	90270	11	
3549	350	9.86%	98619	10	
2274	227	9.98%	99824	10	
218	25	11.47%	114679	9	
5712	712	12.46%	124650	8	
230	44	19.13%	191304	5	

Table 2. Frequency of miscollected samples as measured by Wrong Blood In Tube

Hospital	Total Samples submitted	Repeat Samples received	No. WBIT observed	WBIT/million samples	WBIT corrected for silent error	Corrected ratio of WBIT (1 in x samples)
A	2563	2061	0	0	0	n/a
B	3503	2325	0	0	0	n/a
C	778	466	0	0	0	n/a
D	4387	2628	0	0	0	n/a
E	8049	4692	0	0	0	n/a
F	2576	1100	0	0	0	n/a
G	3085	1550	0	0	0	n/a
H	4128	1677	0	0	0	n/a
I	186	29	0	0	0	n/a
J	336	17	0	0	0	n/a
K	6340	4122	0	0	0	n/a
L	230	62	0	0	0	n/a
M	5109	2848	0	0	0	n/a
N	1970	1075	0	0	0	n/a
O	218	65	0	0	0	n/a
P	3350	1771	0	0	0	n/a
Q	3249	2209	0	0	0	n/a
R	2953	1841	0	0	0	n/a
S	224	21	0	0	0	n/a
T	1075	475	0	0	0	n/a
U	4710	2409	0	0	0	n/a
V	4453	3050	0	0	0	n/a
W	386	20	0	0	0	n/a
X	287	189	0	0	0	n/a
Y	4906	2747	0	0	0	n/a
Z	3918	3136	0	0	0	n/a
A1	2762	920	0	0	0	n/a
A2	894	275	0	0	0	n/a
A3	3549	1829	0	0	0	n/a
A4	4744	2408	0	0	0	n/a
A5	5848	2056	0	0	0	n/a
A6	5542	3026	0	0	0	n/a
A7	3064	1950	0	0	0	n/a
A8	1159	809	0	0	0	n/a
A9	8516	4685	1	213	303	3303
A10	6580	4343	1	230	327	3062
A11	5980	4234	1	236	335	2985
A12	5311	4006	1	250	354	2824
A13	5661	3710	1	270	382	2616
A14	5888	3532	1	283	402	2490
A15	7190	3290	1	304	431	2319
A16	4098	3273	1	306	433	2307
A17	5969	3100	1	323	458	2186
A18	7397	2958	1	338	480	2085
A19	4000	2600	1	385	546	1833
A20	8006	5111	2	391	555	1802
A21	6488	4318	2	463	657	1522
A22	6976	5544	3	541	768	1303
A23	4028	2713	2	737	1046	956
A24	1851	1277	1	783	1111	900
A25	3630	2138	2	935	1327	754
A26	1759	1050	1	952	1351	740
A27	2282	1044	1	958	1359	736
A28	7958	5131	5	974	1382	723
A29	5712	3016	3	995	1411	709
A30	3109	1727	2	1158	1643	609
A31	3675	1561	2	1281	1817	550
A32	3315	1146	2	1745	2475	404
A33	1800	450	1	2222	3152	317
A34	2274	1110	3	2703	3834	261
A35	1373	675	2	2963	4203	238