West Midlands regional quality control scheme for haematology

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SUMMARY A regional quality control scheme is described together with details of the organisation, preparation of material, and an evaluation of the results.

To meet a recognised need a scheme for inter-laboratory quality control was devised in May 1974 for six laboratories in the Birmingham area. The number of participating laboratories has since increased to 30, which constitutes the majority of haematology laboratories in the West Midlands Region. Trials are held fortnightly and statistical data are returned within 24 hours of testing the issued samples. The success of the scheme has been mainly due to the rapid return of results and statistical data. The scheme has also been shown to be complementary to the DHSS/BCSH Proficiency Assessment Service (Ward and Lewis, 1975).

Participants and methods

There is a diversity of participating laboratories and therefore a variety of instrumentation and methodology (Tables 1, 2). Each laboratory has a recognition code but the identity of each laboratory is known to all participants and therefore there is no anonymity within the scheme.

PREPARATION OF SAMPLES

Because of problems of stability two separate samples are prepared. Sample 1 is for haemoglobin (Hb), red cell count (RBC), mean cell volume (MCV), and white cell count (WBC). Sample 2 is for platelets. All samples are negative for hepatitis associated antigen activity.

Sample 1

Freshly collected blood which is unsuitable for transfusion is provided by the West Midlands Blood Transfusion Service. Occasionally patient venesection blood is used as the base for the trial sample. Gentamicin as a bacteriostatic agent is added to about 200 ml of blood in citrate phosphate dextrose

to give a minimum concentration of 10 µg/ml of blood. A stable WBC count is prepared by a modification of a method for stable RBC suspensions (Lewis and Burgess, 1966) as follows: 1.5 ml of the gentamicin-treated blood is washed three times in sterile physiological saline; 20 ml of freshly prepared 0.25% (v/v) glutaraldehyde in sterile phosphate buffer pH 7.4 is slowly added to the washed RBC deposit, with gentle shaking; this is allowed to stand at room temperature for 90 minutes, then centrifuged, and the supernatant discarded; 2 ml of distilled water is added to the deposit and this is vortex-mixed for two minutes; the volume is then made up to 20 ml with distilled water, centrifuged, and the supernatant discarded.

This procedure is repeated three times and then once more using physiological saline instead of distilled water. Some of the gentamicin-treated blood is added to the fixed red cell deposit; these are vortex-mixed for two minutes; a proportion (dependent on the level of WBC required) is then added to the bulk gentamicin-treated blood, mixed by inversion, and stored at 4°C for at least 24 hours before use.

Sample 2

A sterile stock solution of ethylene-diamine-tetraacetic acid dipotassium salt is prepared and, with aseptic precautions, 0.2 ml is taken for each 1 ml of blood required for the trial. Gentamicin is added to give a final minimum concentration of 10 µg/ml. The required volume of blood, freshly drawn from volunteer donors, is then added and mixed by inversion. This sample is prepared on the day of issue of the trial.

ISSUE OF SAMPLES

On the day of issue both samples are mixed for a minimum of 30 minutes. Then, using an automatic pipette (Macroset), sample 1 is aliquoted into 4-ml volumes and sample 2 into 1-ml volumes (except for

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Table 1 *Instrumentation for routine samples*

Instrument*	No. of laboratories
Coulter S	19
Coulter D + haemoglobinometer	3
Coulter Fn + haemoglobinometer	6
Coulter ZF6 + haemoglobinometer	2

*Coulter Electronics Ltd.

Table 2 *Methodology for platelet sample*

Method	No. of laboratories
Sedimentation†	9
Centrifugation‡	6
Visual§	13
Technicon Autocounter	1
Technicon SMA4A modified	1

†Bull *et al.* (1965).

‡Eastham (1963) modifications.

§Brecher and Cronkite (1950); Baker *et al.* (1966).

||Technicon Instruments Co. Ltd.

Table 3 *Statistics on drift standards*

Measurement	Standard deviation limits	Units of measurement
Hb	0.05-0.10	g/dl (g/100 ml)
RBC	0.03-0.08	$\times 10^{12}/l$ ($\times 10^6/mm^3$)
MCV	0.4 -1.1	fl (M^3)
WBC	0.5 -1.0	$\times 10^9/l$ ($\times 10^3/mm^3$)

Table 4 *Quality control sample*

Measurement	Mean	SD	CV*
Hb	9.24	0.14	1.51
RBC	3.27	0.09	2.82
MCV	82.68	1.32	1.60
WBC	4.08	0.40	9.8
Platelets	206.99	41.81	20.19

*Coefficient of variation (CV) = $\frac{\text{standard deviation} \times 100}{\text{mean}}$

laboratories requiring larger volumes for testing). The samples are then given trial code numbers, placed in self-sealing plastic envelopes, put with the instruction and record sheets into padded postal bags (Jiffy Packaging Co), and sent by first-class mail to arrive the following morning.

STABILITY

Samples prepared by the same method as for sample 1 are used in our laboratory as drift standards and have shown no deterioration in the daily mean value for up to seven days. The observed statistical data are shown in Table 3. Platelet counts have been made

on samples prepared as for sample 2 in routine test batches for up to 72 hours after preparation and have shown no change in the daily mean with a standard deviation range of $10\text{-}20 \times 10^9/l$.

INPUT DATA

The samples are tested by the participating laboratories between 10 am and 12 noon on the day of receipt. Three results are requested for each measurement (laboratories not routinely reporting measured MCV delete it from their report). They are telephoned to Good Hope Hospital Haematology Department at a predetermined time with 15 minutes allowed after the last allocated time for late results. The entire set of results are then processed through a Wang 2200 programmable calculator.

REPORTS AND RECORDS

Each laboratory is issued with a record sheet with every trial, which they keep as a permanent record of their trial result. As the results are telephoned in they are recorded on an input data sheet, which acts as a permanent record of all the trial results for the issuing laboratory. The calculator programme produces the mean, standard deviation, and coefficient of variation from all the results returned. Table 4 shows an example. Variance index (based on the mean of the three results) is calculated for each measurement from each laboratory (Table 5) and also presented in histogram form (Table 6). The calculator print-outs are then photocopied and the photocopies sent by first-class mail to all laboratories whether they returned results or not.

Discussion

The samples are issued on a Monday and tested on a Tuesday. The results analysed on Tuesday are received by participating laboratories on Wednesday. The prime advantages of this scheme are the speed of return of results and the frequency of trials. The results are directed to senior technicians in the haematology departments so that early attention is drawn to any discrepancies.

Meetings are held at six-monthly intervals of all the senior technicians in the scheme to discuss problems of conducting the scheme, quality of samples, results, etc. A report of the scheme is also submitted to the regional haematologists group, which has formed a subcommittee of three pathologists and two technicians to discuss any problems. Two problems have arisen, one concerning haemoglobin estimation and the other concerning platelet counting. The haemoglobin problem was shown both in our scheme and the DHSS/BCSH Proficiency Assessment Service by a divergence in the results

Table 5 *Variance indices**

Laboratory	Measurement				
	Hb	RBC	MCV	WBC	Platelets
A	-0.34	-0.33	-0.16	-0.50	+0.04
B	+0.04	+0.90	+0.90	+0.25	-0.24
C	-0.34	+0.96	-1.00	+1.00	+0.45
D	-0.47	+0.31	-0.37	-0.04	+1.16
E	+0.43	-0.11	+2.38	+0.20	-2.48
F	-0.47	-0.38	-0.58	+1.10	+0.86
G	+1.07	-1.88	NR	-1.83	-0.71
H	-0.47	+0.74	NR	-0.39	+0.54
J	+0.55	-0.22	-0.16	-0.71	-0.63
K	-0.34	+0.01	-1.85	+0.09	-0.52

*Variance index = $\frac{\text{mean} - \text{test result}}{\text{SD}}$

NR = no result.

Table 6 *Histogram of variance indices*

Hb	RBC	MCV	WBC	Platelets
-2SD -	-	-	-	-
*	*	*	*	*
*	*	*	G	M
*	*	*	*	*
*	*	S	*	*
*	V	W	*	V
*	*	*	*	*
G	*	*	*	*
-1SD -	-CM	-	-QTV	-
S	B	*	*	S
*	*	*	*	*
J	H	*	J	G
*	*	Q	AW	J
E	U	NTU	H	K
*	D	*	*	LW
*	*	L	*	U
Mean	K	*	D	B
BU	ELQ	*	K	A
M	JPR	AJ	EU	*
ACKLT	AS	DV	B	*
*	F	F	S	*
DFHQV	*	M	LP	CHNT
W	*	*	*	*
PR	W	C	M	P
*	*	*	C	F
+1SD +	+	+	F	QR
*	*	*	R	D
*	T	*	*	*
*	*	R	*	*
*	*	*	*	*
*	*	K	*	*
*	G	*	*	*
+2SD +	+	+	+	+

from laboratories using fully automated equipment and those from laboratories using semi-automated equipment. It appeared that some laboratories were using commercial reference controls as standards and not checking against a cyanmethaemoglobin

standard approved by the International Committee for Standardisation in Haematology (ICSH). Prangnell and Johnson (1976) showed that the stated value for haemoglobin for a commercial reference control differed by 0.5 g/dl from the reference

standards approved by the ISCH.

Platelet count results varied greatly. On analysis by method they showed consistent patterns within the visual and the centrifugation method groups but the sedimentation method appeared erratic. These impressions may be invalid owing to the small numbers of laboratories in each method group. There was, however, disparity in the mean values from each group, and an investigation into methodology was reported by Ashman (1976).

Comparisons between results from our scheme and the DHSS/BCSH Proficiency Assessment Service show that they closely agree. Difficulties have arisen in trying to assess the results cumulatively, mainly owing to lack of computer time. Trials of measuring vitamin B₁₂ and folate concentrations and prothrombin times and activated partial thromboplastin times have been held, but as yet we have insufficient data on which to comment.

Conclusion

A quality control scheme for haematology of the type described offers a more immediate form of inter-laboratory control for a reasonably large group of laboratories. A regional grouping, as in this scheme, provides sufficient data to be statistically viable and yet is small enough to nullify most problems caused by delay in sending specimens and receiving reports.

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