PROFICIENCY TESTING IN FORENSIC DNA ANALYSIS

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INTRODUCTION

Quality assurance systems are now essential in any laboratory and a fundamental part of such systems is regular participation in an external quality assessment scheme. External quality assessment addresses variation in the results produced by different laboratories when analysing identical samples. The results are reported to all participants, providing a mechanism by which laboratories can assess their proficiency and the accuracy of their systems, thereby identifying areas for improvement. In the forensic setting, quality assessment allows laboratories to compare the results of their analysis of mock crime cases with those of other laboratories. This is particularly important when using new and rapidly-developing technologies such as DNA testing where reproducibility between laboratories and competence of individual members of staff must be demonstrated. In some countries participation in external proficiency testing schemes is now a requirement for laboratory accreditation. The International Quality Assessment Scheme (IQAS), in operation since April 1991, has examined and compared forensic DNA testing carried out in 58 laboratories in 16 countries using a range of different methodologies.

METHODS

IQAS is operated in accordance with guidelines issued by the American Society of Crime Laboratory Directors (ASCLD) and the Technical Working Group on DNA Analysis Methods (TWGDAM) (ref1). A mock case is distributed once every three months. Samples are chosen to reflect real forensic casework and each distribution contains a mock scene of crime sample, three control blood stains and a blank control for the crime sample as well as a brief description of the case. Participants are asked to analyse the samples using their normal laboratory methods, to record their results for each sample on the standard forms provided, and to return these within 16 weeks of receipt, identifying which of the control samples matches the mock crime sample. A questionnaire is also completed to provide details of the testing systems used. Results are collated into a report which is distributed to all participants. Participating laboratories remain anonymous and are identified only by code numbers. Details of the amount of DNA extracted from each sample, band sizes calculated for each single locus probe (VNTR) and alleles identified in PCR tests by each laboratory, are all included in the report.

RESULTS

Since 1991 17 IQAS distributions have been sent out to a total of 78 participants in 58 laboratories and 614 sets of results have been returned and reported.

Methodologies used have included DNA profiling using both HaeIII and HinfI with a

range of single locus probes (VNTR's), HLA DQα and PolyMarker (AmpliType®, Perkin Elmer), AMFLP D1S80 and short tandem repeat (STR) analysis (see Tables 1 and 2). Table 3 contains a sample of the DNA profiling results returned from distribution 9501. 38 participants analysed HaeIII digested K562 genomic control DNA with YNH24 and all allele sizes reported fell within ±1.2% of the sample mean allele sizes. The standard deviations calculated for the two alleles were 13.66 and 9.67 base pairs respectively. 39 participants analysed the mock crime sample (semen on a cotton wool swab) using HaeIII and YNH24. All allele sizes reported fell with ±2.5% of the sample mean allele sizes while the standard deviations calculated for the two alleles were 29.22 and 20.06 base pairs respectively. Similar results were reported by laboratories using HinfI (see Table 3). More than 600 sample matches have been reported to date using the various techniques and none has ever been incorrect.

DISCUSSION

Participation in proficiency testing schemes allows individual forensic scientists to compare the quality of their systems and the results they produce with those of their peers. This allows the rapid identification and correction of problems and poor performance as well as highlighting areas for improvement. Increasingly laboratories are being asked by courts and defence lawyers to demonstrate the quality of their work and the reproducibility of the technology itself. External proficiency testing results are invaluable in answering such questions.

REFERENCES

1. Guidelines for DNA Proficiency Test Manufacturing and Reporting. Crime Laboratory Digest, 1994 Vol 21, No 2, P27-32.

Table 1. Different methods reported by participants in IQAS distribution 9501 (March 1995)

METHOD OF ANALYSIS	NUMBER OF PARTICIPANTS
Single locus probing (VNTR's)	51
- using HaeIII	41
- using HinfI	10
PCR - HLA DQα	20
- PolyMarker	16
- STR's	7
- AMFLP D1S80	8

Table 2. Loci analysed by participants in IQAS distribution 9501 (March 1995)

SINGLE LOCUS PROBES		STR'S AND AMFLP'S
D2S44 (YNH24)	D4S139 (PH30)	HUMvWFA31/A
D1S7 (MS1)	D17S79 (V1)	HUMTHO1
D10S28 (TBQ7)	D5S110 (MS621,LH1)	HUMF13A01
D12S11 (MS43A)	D5S43 (MS8)	HUMFES/FPS
D7S21 (MS31)	D7S467 (PAC415)	HUMACTBP2
D16S309 (MS205)	D14S13 (CMM101)	D1S80
D7S22 (G3)	D17S26 (EFD52)	HPRTB

Table 3. *Example of Results Returned in Distribution 9501 (March 1995)*

RESTRICTION ENZYME	PROBE	SAMPLE	DATA	ALLELE 1 (bp)	ALLELE 2 (bp)
Hae III	YNH24	K562 Genomic Control	n mean range SD	38 2916 2880 - 2950 (98.8 - 101% of mean) 13.66	38 1794 1777 - 1820 (99 - 101% of mean) 9.67
	YNH24	Mock Crime Sample	n mean range SD	39 3364 3305 - 3414 (98.8 - 102.1% of mean) 29.22	39 2570 2505 - 2617 (97.5 - 101.8% of mean) 20.06
Hinf I	MS31	K562 Genomic Control	n mean range SD	8 7953 7862 - 8150 (98.9 - 102.5% of mean) 95.07	8 7060 6975 - 7150 (98.8 - 101.3% of mean) 64.76
	MS31	Mock Crime Sample	n mean range SD	9 8630 8360 - 8780 (96.9 - 101.7% of mean) 127.5	9 6829 6720 - 6930 (98.4 - 101.5% of mean) 58.95

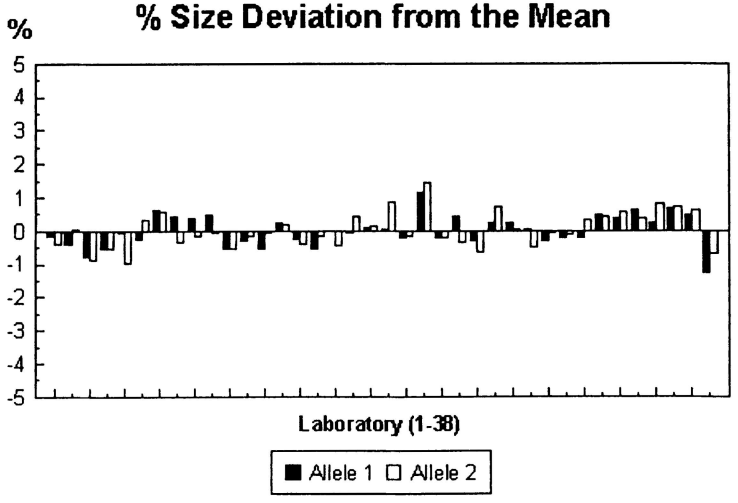

FIGURE 1. *Variation in allele sizes returned by 38 laboratories in Distribution 9501*