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Intercomparison of ^{67}Ga solution sources in UK Hospitals, 1996

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ABSTRACT

During 1995, as part of a routine QA programme for radionuclide calibrators in the North West region of the UK, it was observed that a group of radionuclide calibrators gave consistently low readings for ^{67}Ga when compared against the value predicted by a secondary standard calibrator. This shortfall ranged between 5.5 % and 6.7 %.

It was decided that a resolution of this problem could best be achieved by an intercomparison and an exercise was mounted between the National Physical Laboratory, Amersham International plc and the hospital physics community.

The conduct of that intercomparison is described here, the results are discussed and recommendations made.

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Approved on behalf of Managing Director, NPL,
by Mr A J Marks, Director, Centre for Ionising Radiation and Acoustics

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1 INTRODUCTION

Diagnostic nuclear medicine plays a critical role in the optimisation of healthcare. Whether or not the maximum benefit is achieved from its practice depends partly on the quality of the associated measurements and the ability to balance the level of useful information obtained against the detrimental effects of ionising radiation. This has led to the requirement that the total activity of any radioactive administration shall be known with confidence to a sufficiently high degree of accuracy and precision.

There are numerous techniques and facilities for determining activity but the most economic method is via the use of radionuclide calibrators. Their principle of operation is relatively simple and, used correctly, they will easily achieve the levels of accuracy required by the diagnostic community. Correct use implies certain pre-requisites such as trained operators, traceability, regular quality control procedures, control of operating conditions - in essence, a quality system.

A protocol for establishing and maintaining such a system has been recommended for use in UK hospitals[1]. Amongst many of the quality aspects it addresses are those of traceable calibration factors and regular recalibration. It is recognised that calibration factors are calibrator dependent, radionuclide dependent, and vary with sample geometry and container. It is important, therefore, that individual calibration factors are checked and confirmed on a regular basis. Generally, recalibrations are conducted according to individual hospital schedules. Occasionally, however, general concerns arise which are best addressed by the conduct of intercomparisons across the whole measurement community. Such intercomparisons serve not only as a means of recalibration but also of identifying and focusing attention on particular problem areas. In addition, these exercises can provide an overall estimate of the performance level of the measurement community and the confidence which can be placed in it.

During 1995, as part of a routine QA programme for radionuclide calibrators in the North West region of the UK, it was observed that a group of radionuclide calibrators gave consistently low readings for ^{67}Ga when compared against the value predicted by a secondary standard calibrator. This shortfall ranged between 5.5 % and 6.7 % and was reported in a Radionuclide Topic Group Newsletter[2] of the Institute of Physical Sciences in Medicine (now the Institute for Physics and Engineering in Medicine and Biology).

It was decided that a resolution of this problem could best be achieved by an intercomparison and an exercise was mounted between the National Physical Laboratory (NPL), Amersham International plc (AI) and the hospital physics community.

2 PARTICIPANTS

Participation was open to all UK hospitals and the exercise was publicised via the contact mailing lists of AI and NPL.

Several participants took the opportunity to share their sample by circulating it amongst several hospital departments in their region.

A list of participants is given in Appendix 1.

3 INTERCOMPARISON SAMPLES

A stock solution of ^{67}Ga was accurately sub-divided into a series of 4 ml aliquots in P6 vials. These samples were made available to users. Three aliquots from the same stock solution were also despatched to NPL for activity determinations.

At midday on the date of receipt of the samples, the total activity in each vial was approximately 40 MBq. The samples comprised ^{67}Ga in 0.1 M HCl with a carrier concentration of 0.1 mg g^{-1} Ga.

4 NPL MEASUREMENTS AND INTERNATIONAL EQUIVALENCE

The samples sent to NPL were assayed using a sealed, high-pressure, re-entrant ionisation chamber. This chamber had been previously calibrated for ^{67}Ga using solutions which had been standardised absolutely using the primary standardisation facilities and techniques available at NPL.

As part of NPL's remit to intercompare and maintain equivalence with other national standards laboratories, NPL has in the past submitted samples of ^{67}Ga to the international reference system (SIR) maintained by the International Bureau of Weights and Measures (BIPM) in Paris. The activity value submitted to BIPM was determined using the same high pressure ionisation chamber used in this exercise. From those comparisons, the NPL value was within 0.1% of the mean value determined from the values from all participating national standards laboratories: this is well within the statistical uncertainties.

5 MEASUREMENT AND REPORTING PROTOCOL

Participants were invited to assay their P6 vial in each of their radionuclide calibrators and to report their results directly to NPL. Subsequently participants were informed of the traceable activity content of their sample based on the NPL standardisation. They were encouraged to derive as much useful information as possible from this exercise by making measurements using both pre-set facilities and manual settings, where available, and additionally by transferring activity to other containers (such as syringes) and reporting measurements on these. Estimates of measurement uncertainties were also sought. A standard reporting form, as reproduced in Appendix 2, was provided.

6 CONFIDENTIALITY

All results were reported directly to NPL. Each reported calibrator was given a Code Number by NPL and the results in this Report are tabulated against those Code Numbers. The correlation between Code Number and calibrator (and hence participant) remains confidential to NPL.

7 ANALYSIS OF RESULTS

Each result was decayed to a common reference time of 12.00 GMT on 27 March 1996, using a half-life of 3.261 days[3]. In one case, the participant had made his own decay correction to the reference time. This had used a different half-life value but, from the data provided, it was possible to correct this using the NPL value.

It had been hoped that participants would estimate and report their uncertainties in the space provided on the reporting form: estimates could then be made of the significance or otherwise of differences between reported and NPL values. However, only a minority of participants provided such information and then sometimes incompletely or ambiguously.

From a knowledge of the total mass of solution dispensed to each vial (supplied by AI) and the activity concentration determined by NPL, the recorded activity values were compared with the correct values and the result recorded as a ratio.

In some cases, participants had subsequently transferred a weighed mass of solution to another container, such as a syringe. Both the solution in the new container and the residue in the P6 vial were assayed and activity values reported. The number of these additional measurements was small but some useful information was gleaned from them.

All the results are presented in Table 1. Summarised breakdowns by chamber type and container are given in Table 2. In these breakdowns, the results from syringes and residue vials have been separated from the original vial results. The results have also been displayed pictorially in histogram form in Figure 1.

A total of 118 independent results have been tabulated. Of this number, 11 relate to measurements made using syringes whilst 6 are for P6 vials containing less than the original 4 ml of solution (the "residue" containers).

8 DISCUSSION

8.1 ISOCAL II and PITMAN 238 SYSTEMS

The immediate objective was to resolve the concern surrounding the calibration of the ISOCAL II chamber. It should be noted that the ISOCAL II is the successor to the Pitman 238 chamber, being of similar design and response: hence, it is appropriate for these two chambers to be considered together. In the following discussion, references to ISOCAL II may be taken as applying to both chambers.

It is clear from the results that the calibration of the ISOCAL II is such that it will indicate activity values which, on average, are about 8 - 14% low, the single exception being that case where the response was 4% high. It should be noted that the ISOCAL II incorporates a small-volume chamber which is operated at atmospheric temperature and pressure. Correct operation depends on adjusting the electrometer gain to compensate for variations in the environmental variables. However, the data received does not necessarily suggest that is the cause of the problem. Because of the generally low readings, this suggests that the initial calibration was in error. Since this chamber is no longer available commercially, it is impossible to determine how the initial calibration was performed or, indeed, whether traceable sources were used.

8.2 OTHER SYSTEMS

If the ISOCAL II and Pitman 238 results are excluded, the overall picture is fairly good and, although there appears to be a slight bias towards underestimating the true activity, this is only of the order of 1 - 2 %. There are two extreme outliers (Code Numbers 16 and 67 with ratio values of 0.80 and 0.58 respectively), both being for PRESET positions. It was reported by the participant that these systems had not been used for several years for the assay of ^{67}Ga and as such their PRESET accuracies had not been checked. It is noteworthy that the DIAL SETTING option in both cases had produced acceptable results. This implies that a QA system may be being used which gives assurance for dial settings but does not for presets. Provided the operating protocol takes account of this, problems should not arise but it is perhaps a point that should be reviewed.

If all the P6 vial results for 4 ml of solution are considered, the mean ratio is 0.981 with a standard deviation of ± 0.054. Excluding the two outliers, the corresponding values are 0.986 and ± 0.030 respectively. Further, if the ISOCAL II/Pitman 238 results are removed from the calculation, the mean ratio becomes 0.990 with a standard deviation of ± 0.023. In each case, the mean reported activity is not statistically different from the NPL value.

8.3 SYRINGE DATA

Because of the thinner, lower-density container wall, it would be expected that material contained in a syringe would produce a higher response than that in a P6 glass vial. This is indeed the case: the results indicate that, if no allowance is made for this effect, activities would, on average, be overestimated by about 4%.

8.4 UNCERTAINTIES

The response to the request for estimates of uncertainty was somewhat disappointing. There is an increased emphasis nowadays on such matters and indeed there has been a significant advance in the quality and depth of advice in this area over the last few years[4,5,6]. However, only one third of the participants made such estimates. For those who did, almost every possible reporting scenario occurred as may be seen from the summary of individual responses in Table 3.

For the estimation of random uncertainty, participants invariably determined the standard deviation of a number of consecutive readings. It was not clear whether this had been performed with the ^{67}Ga source supplied for this exercise or whether it was based on previous experiences with this or other nuclides. At the level of activity used in this exercise, it would be reasonable to expect relatively small, non-random uncertainties. If the source had decayed significantly before measurements were made, this might result in a larger uncertainty estimate. The value of 1.7%, however, is worryingly large and might suggest that the system has excessive background noise.

In respect of the non-random uncertainty estimates, their derivation was not always explained. Where it was, participants either had used the value given by the manufacturer in the calibration certificate or had adopted a value equal to the difference observed between the certificated activity of a traceable standard and the value indicated by the chamber when that source was assayed.

Only four estimates were made of overall uncertainty and there is a significant difference between them. No other comment is made here but it may be that the user community may wish to consider the importance, or otherwise, of these differences.

8.5 COMPARISON WITH PREVIOUS EXERCISES

The two similar exercises that have been conducted, both by NPL, in the UK took place in 1980 and 1986. The first[7] used ^{57}Co and ^{125}I as the intercomparison radionuclides whilst the second[8] used ^{99m}Tc and ^{131}I. It is not possible to make exact comparisons between the results of those exercises and the present one because of the differences in such aspects as radionuclides, container formats and distribution of calibrators. Nevertheless, some fairly crude comparisons can be made by looking at the distribution of all the reported results in each of the exercises: these are shown in Table 4.

As the table shows, there has been a continued improvement in the number of results falling within both ± 5% and ± 10% of the NPL value. Because of the differences between the intercomparisons, there may be other reasons for this apparent improvement but it is comforting to believe that this is, in part, due to improvements in quality assurance that participants have introduced into their measurement facilities.

8.6 ESTIMATE OF CONFIDENCE IN USER MEASUREMENTS

The overall uncertainty estimated by NPL on the activity concentration of the ^{67}Ga stock solution is ± 2.6% at the 95% confidence level. The distribution of results shows that 95% lie within ± 10% of the NPL value. The difference between these two uncertainty bounds may be attributable to a variety of effects such as background levels, electronic noise, variations in containers and their respective calibration factors, electronic drift in the current measuring system and variations between production chambers. It is not possible to determine easily whether any or all of these effects may be the cause of the results distribution. Indeed, it can be argued that these differences are not critical. However, it is reasonable to state with confidence that 95% of all assays of ^{67}Ga will produce activity values which are within ± 10% of the true value.

9 CONCLUSIONS

The exercise has clearly been beneficial in confirming the observations that were made in 1995; that is that the ISOCAL II and Pitman 238 systems are likely to underestimate significantly the activities of ^{67}Ga solutions. Indeed, the evidence here suggests that the potential underestimation may be greater than originally suspected. In the course of the intercomparison and the analysis of results, several other aspects have been noted and addressed in the discussion section above. In the opinion of the authors, several conclusions may be drawn.

(a) Calibration factors for ^{67}Ga for the ISOCAL II and Pitman 238 systems are suspect and are likely to lead to significant underestimates of activity.

(b) Users of these systems should recalibrate using sources of ^{67}Ga which are directly traceable to national standards.

(c) Users of these systems should consider the advisability of checking the calibration accuracy for other radionuclides.

(d) Calibration factors for syringes are significantly different than those for P6 vials and users should consider the implications of this in respect of the accuracy of activity measurements.

(e) The accuracy of both DIAL SETTINGS and PRESET facilities should be checked regularly and confirmed against national standards.

(f) Excluding the ISOCAL II AND Pitman 238 systems, the overall accuracy of measurements is good and indicates a continuing improvement in quality.

(g) The reporting and understanding of uncertainties is poor and the user community should consider the significance of this.

(h) The exercise has been beneficial and similar intercomparisons should be considered for other specific radionuclides.

10 ACKNOWLEDGEMENTS

The authors are indebted to their colleagues at AI, in particular Penny Bird, Western Case and Steven Judge, for supplying the ^{67}Ga stock solutions and for dispensing and distributing the intercomparison samples.

Thanks are also due to all the participants for their cooperation and openness in reporting.

11 REFERENCES

(1) Protocol for Establishing and Maintaining the Calibration of Medical Radionuclide Calibrators and their Quality Control.
A Parkin, J P Sephton, E G A Aird, J Hannan, A E Simpson, M J Woods.
Proceedings of the joint IPSM/BIR Meeting on Quality Standards in Nuclear Medicine, BIR, London, February 1992. Institute for Physical Sciences in Medicine Report No.65 (1992) 60.

(2) Measurement of ^{67}Ga on Vinten Isocal II calibrators.
Institute of Physical Sciences in Medicine, Radionuclide Topic Group Newsletter No. 23 (July 1995).

(3) Recommended Nuclear Decay Data.
D Smith, S A Woods.
NPL Report RSA(EXT)53 (1995)

(4) ISO Guide to the expression of uncertainty in measurement.
International Organization for Standardization, Geneva, Switzerland (1993).

(5) Guide to the Expression of Uncertainties in Testing.
United Kingdom Accreditation Service, NIS 80 (1994).

(6) The Expression of Uncertainty and Confidence in Measurement for Calibrations.
United Kingdom Accreditation Service, NIS 3003 (1995).

(7) Intercomparison of ^{57}Co and ^{125}I in U.K. Hospitals 1980/81.
M J Woods.
NPL Report RS56 (1981).

(8) Intercomparison of ^{99m}Tc and ^{131}I by Radionuclide Calibrators in UK Hospitals, 1986.
M J Woods.
NPL Report RS(EXT)88 (1987).

Table 1. Reported results

Code numbers were allocated to individual calibrators.
Subsets (e.g. 2(a), 2(b), 2(c)) refer to measurements made with the same calibrator.

Code	Calibrator Manufacturer	Model	Dial setting	Reported activity (MBq)		NPL activity (MBq)	Preset/NPL	Dial/NPL
				Preset	Dial			
1	Vinten	ISOCAL IV	1052	40.6	40.6	43.22	0.939	0.939
2(a)	Capintec	CRC-15R	100	44.11	44.01	43.74	1.008	1.006
2(b)		(syringe)	100	9.77	9.78	9.34	1.046	1.047
2(c)		(residue)		34.52		34.40	1.003	
3	Capintec	ARC 120R	100	41.77	42.36	42.92	0.973	0.987
4	Capintec	CRC 15R	100	43.13	43.16	43.01	1.003	1.0035
5	Vinten	ISOCAL III		43.43		43.09	1.008	
6	Vinten	ISOCAL II		37.28		43.11	0.865	
7	Capintec	CRC-15R		42.58		43.11	0.988	
8	Capintec	CRC 10BC	100	42.57	42.57	43.13	0.987	0.987
9(a)	Capintec	CRC-15R	100	43.07	42.96	42.93	1.003	1.001
9(b)		(syringe)		10.28		10.08	1.020	
9(c)		(residue)		32.31		32.85	0.984	
10	Capintec	CRC 15R		44.16		43.09	1.025	
11	Pitman	270	10451	45.36	40.83	43.32	1.047	0.943
12	Capintec	CRC-15R		42.40		42.93	0.988	
13	Capintec	CRC 15R	100	42.50	42.50	42.92	0.990	0.990
14	Capintec	CRC-15R		43.05		43.11	0.999	
15(a)	Capintec	CRC-120	100	44.25	43.34	43.74	1.012	0.992

Table 1. Reported results

Code	Calibrator Manufacturer	Model	Dial setting	Reported activity (MBq)		NPL activity (MBq)	Preset/NPL	Dial/NPL
				Preset	Dial			
15(b)		(syringe)	100	9.86	9.64	9.34	1.056	1.032
15(c)		(residue)		34.95		34.40	1.016	
16	Capintec	CRC 10R	100	34.96	41.59	43.01	0.804	0.967
17	Pitman	238		38.8		43.22	0.898	
18	Vinten	ISOCAL II		39.03		42.86	0.911	
21	PTW	Curiementor2	495	41.48	41.48	43.22	0.960	0.960
22	Capintec	CRC 10R	100		42.75	43.01		0.994
23	Capintec	CRC 15R		43.94		43.09	1.02	
25	Vinten	ISOCAL IV		42.82		43.01	0.996	
26	Vinten	ISOCAL III	464	42.40		43.09	0.984	
27	Capintec	CRC 120B	100	42.91	43.05	43.32	0.991	0.994
28	Capintec	CRC 15R	100	42.33	42.52	42.92	0.986	0.991
30	Capintec	ARC 120	100	42.58	42.84	43.01	0.990	0.996
31	Vinten	ISOCAL II	1056	39.56	39.39	42.93	0.922	0.916
32	Atomic Product	Atomlab 100		41.79		43.11	0.969	
33	Vinten	ISOCAL IV		43.44		43.01	1.01	
34	Capintec	CRC 15R		43.60		43.09	1.012	
35	Vinten	ISOCAL IV	464	44.47		43.09	1.032	
36	Capintec	CRC 30BC	100	40.82	40.82	43.32	0.942	0.942
37(a)	Capintec	CRC-15R	100	44.28	44.29	43.74	1.012	1.0125
37(b)		(syringe)	100	9.65	9.66	9.34	1.033	1.034

Table 1. Reported results

Code	Calibrator Manufacturer	Model	Dial setting	Reported activity (MBq)		NPL activity (MBq)	Preset/NPL	Dial/NPL
				Preset	Dial			
37(c)		(residue)		34.71		34.40	1.009	
38	Capintec	CRC-15R	100	42.9	42.9	43.22	0.993	0.993
40	Capintec	ARC 120	100	43.11	43.71	43.09	1.0005	1.014
43	unspecified		1052	38.50		43.01	0.895	
44(a)	Capintec	ARC 120R	100	42.55	42.55	42.92	0.991	0.991
44(b)		(repeat)	100	41.87	41.87	42.92	0.976	0.976
44(c)		(syr 1ml)	100	11.10	11.20	10.70	1.037	1.047
44(d)		(syr 2ml)	100	21.52	21.68	21.40	1.006	1.013
44(e)		(P6 1ml)	100	9.60	9.60	10.82	0.887	0.887
46	SIEL	BIC		44.92		43.22	1.039	
47	Capintec	CRC-15R	100	42.34	42.06	42.86	0.988	0.981
48	Capintec	CRC-15R		42.89		43.11	0.995	
49	Capintec	CRC 10RB	100	42.98	42.99	43.09	0.997	0.998
50	SIEL	BIC-1	151	42.34	41.54	43.13	0.982	0.963
52	PTW	Curiementor E(B)		42.7		43.22	0.988	
53	Capintec	ARC 120	100	42.97	43.44	43.09	0.997	1.008
54	Vinten	ISOCAL II		44.55		42.93	1.038	
56	Vinten	ISOCAL IV		42.30		43.09	0.982	
57	Capintec	CRC 10BC	100	42.83	42.69	42.92	0.998	0.995
58	Capintec	ARC 120		42.48		43.01	0.988	
59	Atomic Product	Atomlab 100		43.19		43.13	1.001	

Table 1. Reported results

Code	Calibrator Manufacturer	Model	Dial setting	Reported activity (MBq)		NPL activity (MBq)	Preset/NPL	Dial/NPL
				Preset	Dial			
60	Capintec	ARC 120	100	43.07	43.49	43.09	0.9995	1.009
61	Capintec	CRC-15R	100	43.4	43.4	43.22	1.004	1.004
62		(residue)		34.71		34.40	1.009	
63	PTW	Curiementor E		38.99		42.86	0.910	
64	SIEL	BIC-3P		43.40		43.13	1.006	
66	Capintec	CRC 15R	100	42.20	42.05	42.92	0.983	0.980
67	Capintec	ARC 120	100	24.86	42.06	43.01	0.578	0.978
68	SIEL	BIC		43.8		43.22	1.013	
70	Capintec	CRC-15R	100	42.32	42.22	42.86	0.987	0.985
71	Capintec	CRC 10RB	100	42.93	42.95	43.09	0.996	0.997
72	Capintec	CRC-15R		42.86		43.11	0.994	
73	Vinten	ISOCAL 284/119		42.79		43.11	0.993	
75	Capintec	CRC 10RB	100	42.96	42.98	43.09	0.997	0.997
76	Capintec	ARC 120R	100	42.34	42.84	42.92	0.986	0.998

Table 2. Results summarised by calibrator and container

DATA GROUPS		Numbers of ratio results (reported value/NPL value) in given ranges										
		0.57 to 0.81	0.86 to 0.89	0.89 to 0.91	0.91 to 0.93	0.93 to 0.95	0.95 to 0.97	0.97 to 0.99	0.99 to 1.01	1.01 to 1.03	1.03 to 1.05	1.05 to 1.07
ALL DATA		2	3	3	3	5	5	28	46	11	11	1
P-6 VIAL DATA (4 ml solution only)												
PRESET DATA		2	1	3	2	2	2	18	24	6	4	-
DIAL DATA		-	-	-	1	3	3	9	19	2	-	-
RESIDUE DATA (P6 vials)		-	2	-	-	-	-	1	2	1	-	-
SYRINGE DATA		-	-	-	-	-	-	-	1	2	7	1
CHAMBER DATA (4ml solution only)												
	CAPINTEC 7	-	-	-	-	-	-	-	2	-	-	-
	CAPINTEC 10	1	-	1	-	-	1	2	9	-	-	-
	CAPINTEC 15	-	-	-	-	-	-	10	14	5	-	-
	CAPINTEC 30	-	-	-	-	2	-	-	-	-	-	-
	CAPINTEC 120	1	-	-	-	-	-	11	12	2	-	-
	ISOCAL II/PITMAN 238	-	1	1	3	-	-	-	-	-	1	-
	ISOCAL III	-	-	-	-	-	-	1	2	-	-	-
	ISOCAL IV	-	-	-	-	2	-	1	2	-	1	-
	PITMAN 270	-	-	-	-	1	-	-	-	-	1	-
	SIEL	-	-	-	-	-	1	1	1	1	1	-
	ATOMLAB	-	-	-	-	-	1	-	1	-	-	-
	PTW	-	-	1	-	-	2	1	-	-	-	-

Table 3. Reported uncertainties

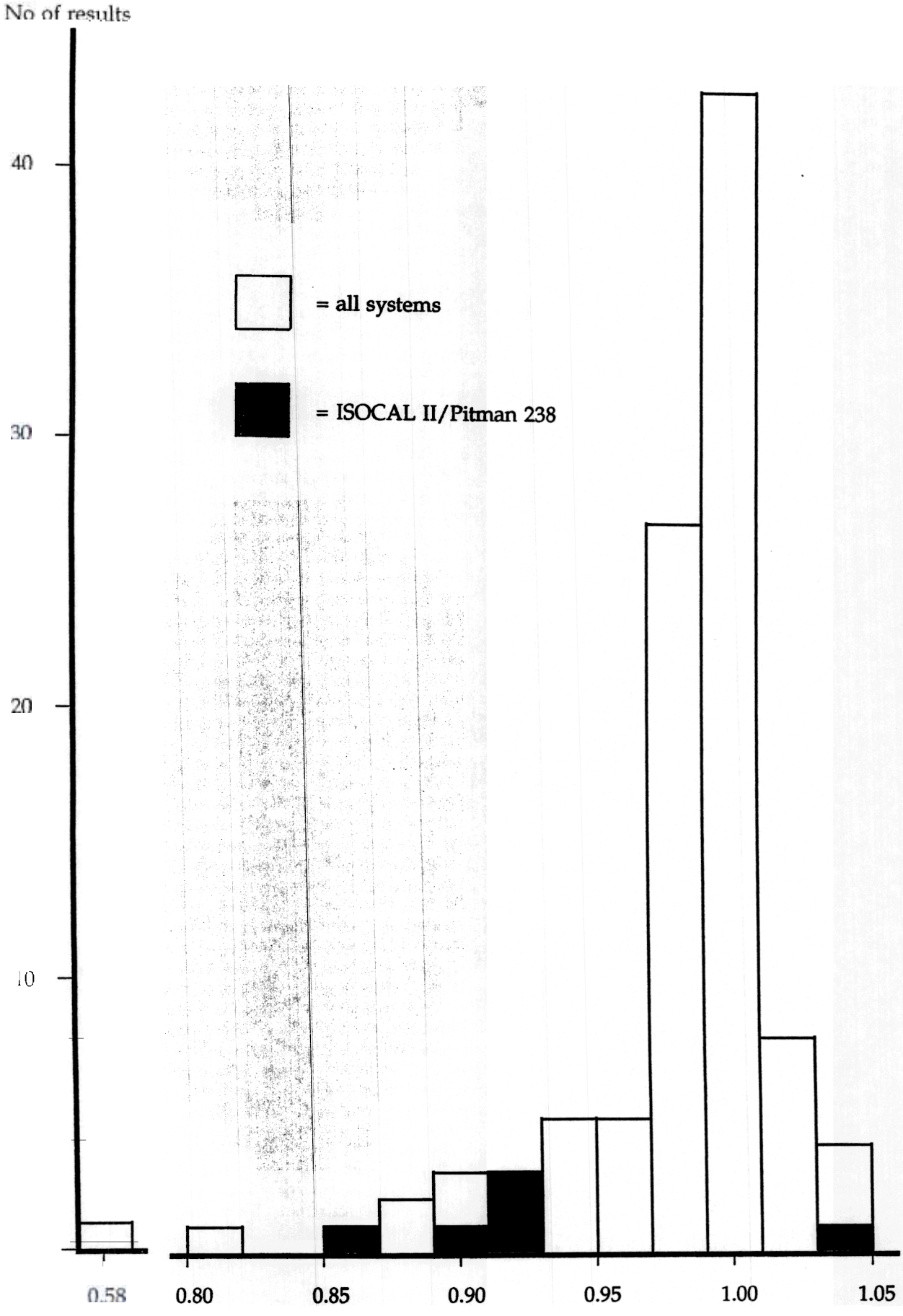
Participants	Type A uncertainty (random)	Type B uncertainty (non-random)	Overall uncertainty
a	0.015%	0%	0.15%
b1	0.4%	not quoted	not quoted
b2	0.2%	not quoted	not quoted
c1	0.15%	0.4%	not quoted
c2	0.15%	0.1%	not quoted
c3	0.2%	not quoted	not quoted
d1	1.7%	5%	6.7%
d2	0.4%	2.73%	3.13%
e	not quoted	not quoted	10%

Letters (e.g. d) indicate individual participants
Numbered subsets (e.g. d1, d2) indicate different calibrators for the same participant

Table 4. Distributions of results from past and present intercomparisons (expressed as percentage of results within given range of NPL value)

		Range	
Year	Nuclide	0.95 - 1.05	0.90 - 1.10
1981	^{125}I	13%	26%
1981	^{57}Co	52%	76%
1986	^{99m}Tc	73%	94%
1986	^{131}I	88%	95%
1996	^{67}Ga	91%	95%

Figure 1 Distribution of results (4 ml solution only)



APPENDIX 1

PARTICIPANTS

Participant	Hospital
R Barber	Addenbrookes
N Boyce	St Marys Hospital (Portsmouth)
S Dave	St Marys Hospital (Praed St, London)
M Evans	Royal United (Bath)
C Green	Northwich Park Royal Orthopaedic
G Hughes	Singleton
L Jansson	Poole Royal Bournemouth
J MacDonald	Glan Clwyd
C Marshall	County (Lincoln)
I Negus	Mount Vernon
J Nettleton	Manchester Royal Infirmary
C Nottage	Oldchurch Harlow Broomfield
D Parry-Jones	Queen Elizabeth (King's Lynn)
A Smith	Leeds General Infirmary
H Stockdale	Royal Liverpool University

APPENDIX 2

AMERSHAM INTERNATIONAL/NATIONAL PHYSICAL LABORATORY

INTERCOMPARISON OF ^{67}Ga ACTIVITY - MARCH 1996

Organisation ..... Participant

Address ..... Tel No.

..... Fax No.

..... e-mail

.....

Vial identifier Nominal volume: 4.0 ml

Chem. form: 0.1 mg/g Ga in 0.1 M HCl

DETAILS OF RADIONUCLIDE CALIBRATOR (If more than one calibrator is used, please photocopy this reporting form and use a separate form for each calibrator)

Manufacturer

Model/Type

Serial No

Measurement in original container (P6 vial)

Calibration factor/dial setting used

Time of measurement (GMT) Month ..... Day ..... Hour ..... Min ..

Measured activity (after bgd subtraction) ..... MBq

If you used a preset setting, it would help to repeat the reading on the manually adjustable setting (if available) using the figure recommended by the manufacturer. Please record below.

Calibration factor/dial setting used

Time of measurement (GMT) Month ..... Day ..... Hour ..... Min .....

Measured activity (after bgd subtraction) ..... MBq

P.T.O.

Assays are often made in different containers (e.g. syringe). If you do this routinely, it would help to make a similar measurement here. In order to check the accuracy of such an assay, we need to know how much solution was transferred from the P6 vial to the new container. This could be determined by weighing the new container empty and then after the solution has been added. An additional check would be to remeasure the P6 vial after the transfer.

Measurement in different container (please give details .....)

Mass/volume transferred ..... g or ml

Calibration factor/dial setting used

Time of measurement (GMT) Month ..... Day ..... Hour ..... Min .....

Measured activity (after bgd subtraction) ..... MBq

If you used a preset setting, it would help to repeat the reading on the manually adjustable setting (if available) using the figure recommended by the manufacturer. Please record below.

Calibration factor/dial setting used

Time of measurement (GMT) Month ..... Day ..... Hour ..... Min .....

Measured activity (after background subtraction) ..... MBq

Remeasurement of P6 vial after removal of solution

Calibration factor/dial setting used

Time of measurement (GMT) Month..... Day.....Hour.....Min.....

Measured activity (after background subtraction) ..... MBq

Uncertainties

Please provide an estimate of the uncertainty (at the 1σ level) on your measurements

Random (Type A) ± .....%, Non-random (Type B) ± .....%, Overall ± .....%

It would be useful if you could indicate below how these values were estimated

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Please return this form (together with any additional comments you would like to add) to:

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