

Patient self-management of oral anticoagulation and external quality assessment procedures

E. T. MURRAY,¹ D. P. KITCHEN,² S. KITCHEN,² I. JENNINGS,² T. A. L. WOODS,² F. E. PRESTON²
AND D. A. FITZMAURICE¹ ¹Department of Primary Care and General Practice, The Medical School, University of Birmingham, Birmingham, and ²UK NEQAS for Blood Coagulation, Sheffield, UK

Received 21 January 2003; accepted for publication 16 May 2003

Summary. The role of external quality assessment (EQA) is a contentious issue for patient self-management (PSM) of oral anticoagulation. Patients from general practices in the West Midlands undertaking PSM were recruited to compare efficacy of patients' and health professionals' EQA procedure using the UK National External Quality Assessment Scheme (NEQAS). Patients using Coaguchek (Roche Diagnostics) were trained to perform EQA as part of their PSM training. They undertook PSM for 26 weeks and were asked to perform EQA using material provided by the UK NEQAS twice at home without supervision and twice at the practice with supervision. Patients' results were compared with health care professional users of Coaguchek S. Twenty-three PSM patients were compared with 75 health care professional users of the NEQAS scheme. The PSM group international

normalized ratio (INR) percentage time in range was 74%. There was no significant difference in the median results on NEQAS samples obtained by the patients and those obtained by professionals. Three patients were outwith consensus (results > 15% from the median INR) on more than one occasion. Patients were able to perform the EQA tests competently. The data show that good agreement can be achieved between patients analysing the same EQA samples, with coefficients of variation ranging from 22.3% to as low as 5.4%. Further study is required to determine how precision within these EQA schemes relates to the stability of treatment in patients' management of their own anticoagulation.

Keywords: oral anticoagulation, patient self-management, external quality assessment, training, supervision.

The expansion of clinical indications for warfarin (Lowe, 1992; Sweeney *et al.*, 1995), particularly non-rheumatic atrial fibrillation (AF) (Gustafson *et al.*, 1992; Sandercock *et al.*, 1992), has heightened concerns over where and how warfarin monitoring should be undertaken (Taylor *et al.*, 1993; Sudlow *et al.*, 1995). This is an important issue for all health care systems as current data show that, of patients aged over 65 years with identified AF, only one-third are currently receiving anticoagulation (Sudlow *et al.*, 1997).

Point of care (PoC) testing is increasingly being seen as a means of reducing the increasing workload for hospital-based anticoagulant clinics and improving the care of patients receiving anticoagulation therapy (Fitzmaurice *et al.*, 2000). A relatively new model of care involves patients measuring their own international normalized ratio (INR) using PoC equipment and interpreting the result themselves, in a similar way to diabetic patients monitoring

their own glucose control. This model is widespread in Germany and is known as patient self-management (PSM) (Taborski *et al.*, 1999). PSM for oral anticoagulation has a small evidence base, and one contentious issue is the role of external quality assurance (EQA) for patients (Fitzmaurice & Machin, 2001). This study was undertaken as part of a randomized controlled trial of PSM versus routine primary care management, which is reported elsewhere (Fitzmaurice *et al.*, 2002). Data from the trial indicate the efficacy of patient-managed EQA in comparison to health care professionals using the same samples.

The aim of this study was to compare the efficacy of patients EQA procedure with or without supervision, using the UK National External Quality Assessment Scheme (NEQAS), with the efficacy of health professionals from the same surveys.

METHODS

Patients were selected from six general practices in the West Midlands, UK, using the Birmingham model of anticoagulation, practice nurse-managed, using PoC systems for INR estimation and computerized decision support software

Correspondence: E. T. Murray, Department of Primary Care and General Practice, The Medical School, University of Birmingham, Edgbaston, Birmingham B15 2TT, UK. E-mail: e.t.murray@bham.ac.uk

(CDSS) for dosing warfarin (Fitzmaurice *et al.*, 2000). Patients recruited to the trial were selected from those patients in the practices who were over 18 years old and had received long-term warfarin for a period of at least 6 months. Practice nurses then selected patients from this group for the trial, using broad criteria. The nurses were asked to select patients who: had a good record of treatment adherence in that they did not regularly miss appointments; had a stable INR, defined as achieving INR within 0.5 of the target value for at least 60% of the time in the previous 12 months; had no serious concurrent medical condition or the nurses felt would be too anxious to manage their warfarin; had no symptoms of dementia, were able to follow simple instructions and had enough manual dexterity to manage a PoC system. The selected patients were asked to attend an informal talk about the study, when the process of PSM and EQA was explained. They were asked to give written informed consent and then randomized to either intervention (PSM) or control (routine clinic management). All PSM patients used the CoaguChek (CUC) system (Roche Diagnostics, Lewes, UK) and were trained to perform EQA as part of the PSM training that took place at two 3-h training sessions. Patients undertook PSM for 26 weeks and were all asked to perform EQA using material provided by the UK NEQAS. Lyophilized plasma was prepared as described previously (Preston, 1995) and was provided with two diluents for reconstitution and recalcification. Patients were provided with instructions to perform the tests in exactly the same way as health professionals using the CUC instrument. EQA was performed four times during the study period, twice at home without supervision (weeks 10 and 20) and twice at the practice with supervision by research personnel (weeks 12 and 22). All four test samples were coded differently so patients were not aware that three were the same (sample A) and one was different (sample B). Results were compared with all health care professional users of CUC who participated in the UK NEQAS programme on two occasions using samples A and B. These centres were regular participants in this programme, with 70% from general practice, 20% pharmacists and 10% from hospitals. The median of all results for the same sample was calculated. In terms of performance, NEQAS define acceptable performance as being within 15% of the median result obtained (Preston, 1995). Results within these target limits are termed 'within consensus'. For patients who obtained INR results 'outwith consensus', the CUC monitor and the batch of test strips were assessed centrally as follows: a series of seven different UK NEQAS samples was analysed with the patient device under investigation using the same batch of test strips (batch 118) used by the patients and also using a second batch of test strips (batch 135). The same samples were also tested with these two test strip batches and a CUC monitor for which all results had been within consensus.

Internal quality control (IQC) provided by the manufacturer was performed at weeks 1, 8 and 20 of the study. This was undertaken to ensure the day-to-day consistency of INR results and give immediate and constant control of the monitor. The manufacturer's IQC is contained in a plastic

tube containing a glass ampoule of lyophilized plasma surrounded by a liquid diluent. It is simple to use: gentle pressure crushes the ampoule, and the plasma is dissolved into the diluent. After 2 min, the analysis is performed as for a patient blood sample. Patients were also asked to perform IQC if they recorded an unexpected INR result or when using a new batch of test strips.

RESULTS

Twenty-three PSM patients were compared with the results of 75 health care professionals using the EQA scheme. The mean age of the PSM group was 63 years, and the main clinical indications for anticoagulation were 55% for atrial fibrillation, 14% recurrent thromboembolism and 14% valve replacements. Other conditions included mitral stenosis, stroke/transient ischaemic attack and cardiomyopathy. All internal quality control results were in range according to the manufacturer's recommendations. The INR percentage time in range (Rosendaal *et al.*, 1993) for the PSM group was 74% (Fitzmaurice *et al.*, 2002). EQA results are summarized in Table I. There were no significant differences in the median results obtained by the patients in comparison with those obtained by professionals. The range and coefficient of variation (CV) obtained by the patients was comparable with that obtained by professionals and for one sample was considerably better. No significant difference was found in the number of 'outwith consensus' results, with 15 out of 76 (20%) of patients results 'outwith consensus' (result > 15% from the median INR) compared with 15 of 149 (10%) of the professionals' results (chi squared $P = 0.07$). Test 1 results are displayed in Fig 1. Three patients were outwith consensus on more than one occasion in the four surveys. Four CUC monitors were recovered from patients who had obtained outwith consensus results on NEQAS samples. The mean INR results of seven samples for the four monitors ranged from 2.90 to 3.21 for test strip batch 118, compared with 3.0 with a CUC monitor for which all results had been within consensus. Thus, the maximum difference between mean INR results on the five monitors was 10.7%, and these differences were not statistically significant. For test strip batch 135, this ranged from 2.86 to 3.01 for the four monitors under investigation and 2.9 for the monitor with consistently acceptable results. The maximum difference between results

Table I. EQA results: PSM study and health care professionals.

Survey	Sample	Supervised	Group	Median		
				<i>n</i>	INR	Range CV (%)
1	A	No	Patient	20	3.65	2.7-5.1 13.6
2	A	No	Patient	19	3.80	2.9-7.1 22.3
3	A	Yes	Patient	21	3.70	3.0-5.7 17.2
	Professional		75	3.40	1.7-4.5 12.6	
4	B	Yes	Patient	16	2.90	2.6-3.2 5.4
	B		Professional	75	2.80	2.3-3.8 9.3

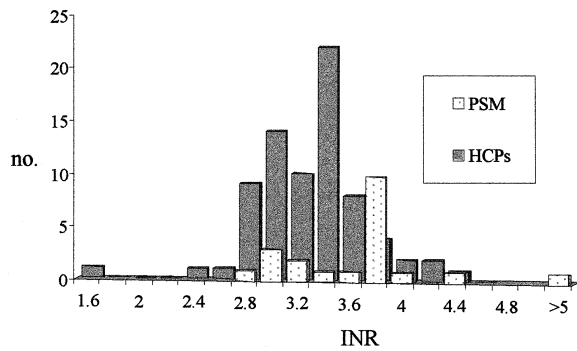


Fig 1. Histogram of Test 1 results. PSM, patient self-management; HCPs, health care professionals.

with test strip batch 118 and batch 135 for any of the five monitors was 7.4%.

Although 23 patients were enrolled, an incomplete set of results was obtained in each distribution. In survey 1, three patients reported a test error reading on the CUC. In survey 2, three patients did not attend the GP surgery, and one made an error in the test process. In survey 3, one patient reported a test error, and one failed to return their results; in survey 4, three patients made an error in the test process, and three did not attend the surgery. In summary, one patient was outwith consensus on three occasions, and a further two were outwith on two occasions. All patients obtained at least one result within consensus.

DISCUSSION

This study aimed to evaluate the efficacy of patient-managed EQA in comparison with EQA managed by health care professionals. Patients considered suitable for PSM were asked to participate in the UK NEQAS EQA scheme after training and assessment of competence with the CoaguChek system.

They managed the PoC monitor with minimal support and, in practical terms, were able to perform the EQA tests competently. However, this was a highly selective population, the practice nurses were extremely cautious in their selection, and nearly one-third refused to participate in the trial, so the results may reflect those of the most motivated patients.

These data demonstrate that good agreement can be achieved between patients for EQA samples with CVs ranging from 22.3% to as low as 5.4%. For comparison, CVs among hospital coagulation laboratories using routine thromboplastin reagents are typically around 10% and, in four recent surveys in the UK NEQAS scheme, CUC users in GP practices and hospital departments recorded CVs ranging from 8.6% to 14.1%.

The best survey performance with the patients in this study (5.4%) occurred with supervision when the health professional observed the test performance, perhaps ensuring that the patients took greater care with the procedure.

Of concern, however, is that, with the exception of survey 2, approximately one in five patients obtained a result > 15% from the median INR in each survey, recording an

INR sufficiently distant from the median to influence management for a clinical sample. Nevertheless, EQA is particularly designed to identify problems in long-term performance and, in this study, just three patients obtained results outside consensus on more than one occasion.

Patients had no problems with the IQC test supplied by the manufacturer to test day-to-day precision and, although this is to be expected as they have considerably larger target ranges (e.g. 1.7–3.7), it may highlight the limitations of this method.

There are several possible causes of outwith consensus INR results of UK NEQAS samples, including the monitor itself, error in the calibration of the test strip, deterioration of test strips during storage and inappropriate handling of the EQA sample. Analysis of the study test strips (comparing the batch lot used by the patients with a second lot) showed good agreement, and the maximum difference between NEQAS samples on different CUC monitors was approximately 10%. This suggests that the cause of outlying results was not the monitor used or the calibration of the test strip batch, although alterations during storage by patients could not be excluded from our data. Inappropriate storage or handling of the EQA material could also have contributed to the variation in results obtained by patients.

Our data suggest that patients considered suitable for self-management can participate in an EQA programme and obtain similar results to those obtained by health care professionals experienced in this type of exercise. An EQA programme of the type described here could be one approach in helping to ensure that PoC INR tests are under control. Further study is required to determine how precision within these EQA schemes relates to the stability of treatment in patients managing their own anticoagulation.

ACKNOWLEDGMENTS

This study was funded by Roche Diagnostics UK. D.F. is funded by an NHS Career Scientist Award. E.M. is an MRC Research Fellow.

REFERENCES

- Fitzmaurice, D.A. & Machin, S.J. (2001) Recommendations for patients undertaking self management of oral anticoagulation. *British Medical Journal*, **323**, 985–989.
- Fitzmaurice, D.A., Hobbs, F.D.R., Murray, E.T., Holder, R.L., Allan, T.F. & Rose, P.E. (2000) Randomised controlled trial of oral anticoagulation using computerised decision support (CDSS) and near patient testing (NPT). *Archives of Internal Medicine*, **160**, 2343–2348.
- Fitzmaurice, D.A., Murray, E.T., Gee, K.M., Allan, T.A. & Hobbs, F.D.R. (2002) A randomised controlled trial of patient self-management of oral anticoagulation treatment compared with primary care management. *Journal of Clinical Pathology*, **55**, 845–849.
- Gustafson, C., Asplund, K., Britton, M., Norrving, B., Olsson, B. & Marke, L.A. (1992) Cost effectiveness of primary prevention in atrial fibrillation: Swedish national perspective. *British Medical Journal*, **305**, 1457–1460.

- Lowe, G.D.O. (1992) Anti-thrombotic treatment and atrial fibrillation. *British Medical Journal*, **305**, 1445–1446.
- Preston, F.E. (1995) Quality control and oral anticoagulation. *Thrombosis and Haemostasis*, **74**, 515–520.
- Rosendaal, F.R., Cannegieter, S.C., vd Meer, F.J.M. & Briet, E. (1993) A method to determine the optimal intensity of oral anticoagulant therapy. *Thrombosis and Haemostasis*, **69**, 236–239.
- Sandercock, P., Bamford, J., Dennis, M., Burn, J., Slattery, J., Jones, L., Boonyakarnkul, S. & Warlow, C. (1992) Atrial fibrillation and stroke. prevalence in different types of stroke and influence on early and long term prognosis. (Oxfordshire Community Stroke Project). *British Medical Journal*, **305**, 1460–1465.
- Sudlow, C.M., Rodgers, H., Kenny, R.A. & Thomson, R.G. (1995) Service provision and use of anticoagulants in atrial fibrillation. *British Medical Journal*, **311**, 558–561.
- Sudlow, M., Rodgers, H., Kenny, R.A. & Thomson, R. (1997) Population based study of use of anticoagulants among patients with atrial fibrillation in the community. *British Medical Journal*, **314**, 1529–1530.
- Sweeney, K.G., Pereira-Gray, D., Steele, R. & Evans, P. (1995) Use of warfarin in non-rheumatic atrial fibrillation: a commentary from general practice. *British Journal of General Practice*, **45**, 153–158.
- Taborski, V.W.E., Wittstamm, F.J. & Bernada, A. (1999) Cost-effectiveness of self-management anticoagulant therapy in Germany. *Seminars in Thrombosis and Haemostasis*, **25**, 10–107.
- Taylor, F., Ramsey, M., Voke, J. & Cohen, H. (1993) GPs not prepared for monitoring anticoagulation. *British Medical Journal*, **307**, 1493.