Primary care anticoagulant clinic management using computerized decision support and near patient International Normalized Ratio (INR) testing: routine data from a practice nurse-led clinic
DA Fitzmaurice, FDR Hobbs and ET Murray


**Background.** Increasing indications for warfarin therapy has led to increased pressure on primary care to undertake therapeutic monitoring.

**Objective.** This study evaluates a primary care model of oral anticoagulation monitoring which utilises computerized decision support (CDSS) and near patient testing (NPT) within a practice nurse-led clinic. Whilst this has been shown to be a successful model under trial conditions, this paper reports the first data from a long-standing clinic, outside a formal study.

**Method.** A prospective evaluation of therapeutic and clinical control of all patients taking warfarin within one inner city general practice. Data were collected via CDSS.

**Results.** 29 patients were seen in 208 appointments. The mean percentage of patients within therapeutic range was 72%. The costs to the practice were £1751. The costs the practice would have incurred had these patients been seen at the hospital with the same frequency would have been £2290.

**Conclusions.** The use of CDSS and NPT for nurse-delivered oral anticoagulation monitoring could enable the safe transfer of the majority of patients from secondary to primary care. Funding mechanisms to support the transfer of costs will be essential for most practices, as will be the maintenance of adequate staff training and quality assurance.

**Keywords.** Anticoagulants, computerized decision support, INR blood-testing, near patient testing.

---

**Introduction**

The majority of patients in the UK receiving oral anticoagulation undergo therapeutic monitoring through a hospital outpatient service, because of the need for INR blood testing and specialist interpretation of the result. Increased indications for warfarin therapy, particularly non-rheumatic atrial fibrillation, have led to pressure on general practice to undertake therapeutic monitoring. One model of care, developed to enable general practice safely to undertake this service, involves the utilization of a computerized decision support system (CDSS) and near patient testing (NPT) within a practice nurse-run clinic. Whilst this has been assessed under trial conditions, its ongoing effectiveness has not been previously reported. This paper presents 12 months' routine data from the first UK primary care anticoagulant clinic to use this technology.

**Method**

An anticoagulant clinic was established in an inner-city general practice serving a population of 7000 in September 1993. Initially CDSS was used for dosing, with INR estimation carried out in the local hospital laboratory. NPT for INR was introduced in September 1994 as a result of patient feedback showing dissatisfaction with the system of relying on the postal service for receipt of results and dosing advice. The CDSS, previously validated in hospital clinics, runs on a DOS-based 486 laptop computer. The NPT chosen was
the Thrombotrak, the only machine available which had undergone Department of Health evaluation.7

Anticoagulant patients are seen in a dedicated clinic managed entirely by a practice nurse, although medical support is available if necessary. All patients receiving warfarin are invited to attend the practice-based clinic, which runs for 2 hours per week (including domiciliary visiting time). Patients are booked in through the normal practice appointment system, although the CDSS also has this facility. Patients attending have an INR estimation using capillary blood in the NPT. This result is entered into the CDSS, which estimates the patients’ warfarin dosage and the date for the next test. Both the dosing and recall estimations can be overridden manually. The INR result, warfarin dose and date of next appointment are entered into the practice records and also into patients’ standard anticoagulation hand-held records.

Patients unable to attend the practice have a venous blood sample taken at home which is used for INR estimation at the practice. Results are then given to the patient by telephone. Audit of the clinic is performed regularly through the CDSS, which also provides identification of unstable patients and non-attendees. Internal quality assurance is undertaken at the start of each clinic. External quality assurance is provided through liaison with the local hospital laboratory. The percentage of time spent in range is calculated through the CDSS using point prevalence of patients’ INRs.8

Results

Twenty-nine patients were seen in a total of 208 appointments during the 12 months from 31 January 1995. Eighteen patients attended throughout the 12 months, while six patients commenced warfarin, two patients stopped warfarin and three patients died during the same period. None of the deaths was related to warfarin therapy. Twenty-two patients had conditions requiring INRs between 2 and 3 while seven patients required INRs between 3 and 4.5. Clinical results are summarized in Table 1. Overall, the mean percentage of total patients in the appropriate therapeutic range was 72%: the mean percentage of patients in therapeutic range 2.0–3.0 was 71% and in therapeutic range 3.0–4.5 it was 75%. The software does not allow the exact percentage of time spent in range to be calculated, but these figures do conform to internationally recognized parameters.8 A total of 111/208 (53.4%) of INRs were within therapeutic range, and these results are summarized in Table 2. There were no adverse events throughout the 12-month period, and no patients required referral back to hospital.

The costs to a fundholding practice, if these patients had been seen at this frequency in the local provider unit, would have been £2290 based on six new patient appointments at £45 each and 202 follow-up appointments at £10 each. The actual costs to the practice were £1751. This is calculated from six new patient appointments at £7 each, 135 clinic follow-up appointments at £3 each, 67 domiciliary follow-up appointments at £12 each (based on nursing consultation time at £15 an hour) plus overhead costs including CDSS maintenance and quality assurance costs at £500.

Discussion

These data demonstrate the clinical efficacy of this model of care. While there are increasing numbers of
patients receiving warfarin therapy, alternative models to traditional hospital out-patient monitoring will be needed. Taylor et al.\textsuperscript{10} describe hospital-based moves away from medical review at every visit. McGregor et al.\textsuperscript{10} have reported on the effectiveness of pharmacy-run anticoagulant clinics, although their results do not use standard parameters. We have published successful trial data from primary care clinics utilizing CDSS and NPT,\textsuperscript{4} although this is the first report from a clinic using the system as a long-standing routine clinical service for several years. These data demonstrate that clinical performance is maintained outside trial conditions. Furthermore, absence of adverse events supports current views that the incidence of adverse events associated with warfarin therapy is much lower than has been traditionally reported.\textsuperscript{11}

This form of warfarin management offers several advantages CDSS provides a consistent, reliable dosing recommendation which can be overridden in exceptional circumstances. It has the capacity to record bleeding and thrombotic events, allows rapid identification of unstable patients and provides a database for drug interactions. The availability of an audit package enables rapid performance review, which is essential for comparison with other centres and for identification of poor performance. In general practice, CDSS also allows for different staff members to run the clinic with consistent results. Improved clinical control results in increased mean recall times, resulting in fewer tests being performed. NPT has several advantages over transporting samples to a local laboratory. The sample begins to clot as soon as venepuncture is performed, and time delay may cause a change in the INR result. Furthermore, providing the patient with results, dosing advice and recall data whilst still in the surgery enables explanation and advice on any changes in dose.\textsuperscript{2}

Use of this model will create practice savings, but only for fundholders. Total savings are likely to be even greater given the improved clinical control associated with using CDSS.\textsuperscript{5} Savings to the NHS would be substantial, especially since domiciliary patients require hospital transport in order to attend out-patient clinics. However, close collaboration between practice clinics and local laboratories is essential to maintain quality assurance. One solution would be for the capital investment in equipment to be made by hospital laboratories, as an outreach service, with responsibility for maintenance and quality assurance remaining with the laboratory. In this model, general practices wishing to develop an anticoagulation clinic would need to meet and maintain specified standards, mirroring the current accreditation of hospital laboratories.

The use of CDSS and NPT for nurse-delivered oral anticoagulation monitoring could enable the safe transfer of the majority of patients from secondary to primary care. Funding mechanisms to support the transfer of costs will be essential for most practices, as will be the maintenance of adequate staff training and quality assurance.

References

4 Fitzmaurice DA, Hobbs FDR, Murray ET, Gilbert M, Rose PE. A randomised controlled trial comparing primary care oral anticoagulant management utilising computerised decision support (CDSS) and near patient testing (NPT) with traditional management. Fam Pract 1995; 12: 253–254.