

A Pilot Study Evaluating the Feasibility of Monitoring Oral Anticoagulant Therapy with Point-of-Care Testing in a Community Pharmacy

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ABSTRACT

Objective: To evaluate the quality of oral anticoagulant monitoring by means of point-of-care testing in a community pharmacy, performed under the supervision of staff in a specialized hospital oral anticoagulation clinic.

Methods: Participants consisted of patients receiving long-term warfarin therapy who were expected to require treatment for at least 3 months and who were patients of the hospital anticoagulation clinic or customers of the designated community pharmacy. The primary endpoint was the proportion of time for which international normalized ratio (INR) was within the expanded therapeutic range (within 0.2 INR units above or below the target therapeutic range) for 2 groups: patients who were managed through the community pharmacy and historical controls, whose treatment had been managed through oral anticoagulation clinics. Rates of thromboembolic and major hemorrhagic events and of patient satisfaction in the 2 groups were determined.

Results: Nineteen patients were enrolled in this study and had their warfarin therapy managed by community pharmacists. The INR level was within the expanded therapeutic range 84% of the time (95% confidence interval [CI] 75% to 93%) for these patients and 82% of the time (95% CI 78% to 85%) for the historical controls managed through oral anticoagulation clinics ($p = 0.58$). No thromboembolic or bleeding events occurred in any of the 19 study participants. There was no difference between the groups in responses on patient satisfaction questionnaires.

Conclusions: Community pharmacists using point-of-care testing under the supervision of staff in a hospital oral anticoagulation clinic provided warfarin management that was similar to warfarin management for historical controls attending oral anticoagulation clinics. The development of satellite anticoagulation clinics in community pharmacies may lead to a more individualized approach to therapy and eliminate the inconvenience of INR

RÉSUMÉ

Objectif : Évaluer la qualité de la surveillance de l'anticoagulothérapie orale dans une pharmacie communautaire au moyen d'épreuves effectuées au point d'intervention et sous la supervision du personnel de la clinique d'anticoagulothérapie orale d'un hôpital.

Méthodes : Les participants étaient des patients soit de la clinique d'anticoagulothérapie de l'hôpital, soit des clients de la pharmacie communautaire désignée et devaient recevoir un traitement prolongé à la warfarine d'une durée d'au moins trois mois. Le critère d'évaluation primaire était le nombre de fois, exprimé en pourcentage, où le rapport international normalisé (RIN) était à l'intérieur des limites de l'écart thérapeutique élargi (RIN supérieur ou inférieur de 0,2 unité à l'écart thérapeutique visé) dans deux groupes : un groupe de patients qui ont été pris en charge par la pharmacie communautaire et un groupe témoin historique dont le traitement avait été pris en charge par des cliniques d'anticoagulothérapie orale. On a déterminé les taux de thromboembolie et d'hémorragies graves ainsi que la satisfaction des patients dans les deux groupes.

Résultats : Dix-neuf patients, dont l'anticoagulothérapie a été prise en charge par des pharmaciens communautaires, ont participé à cette étude. Le RIN de ces patients était à l'intérieur de l'écart thérapeutique élargi 84 % du temps (intervalle de confiance [IC] à 95 % de 75 % à 93 %), alors que chez les patients du groupe témoin historique pris en charge par le personnel de cliniques d'anticoagulothérapie orale, il l'était 82 % du temps (IC à 95 % de 78 % à 85 %) ($p = 0,58$). Aucune thromboembolie ni hémorragie n'est survenue chez aucun des 19 participants à l'étude. On n'a observé aucune différence dans les réponses aux questions sur la satisfaction entre les deux groupes.

Conclusions : La prise en charge du traitement à la warfarine par des pharmaciens communautaires ayant recours aux épreuves au point d'intervention sous la supervision du personnel de la clinique

testing in hospital laboratories. Further studies of longer duration are required to determine whether community pharmacy management improves patient outcomes and is cost-effective.

Key words: warfarin, anticoagulants, drug monitoring, international normalized ratio, pharmacies

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d'anticoagulothérapie orale d'un hôpital était équivalente à la prise en charge de ce traitement par des cliniques d'anticoagulothérapie orale. La mise en place de cliniques d'anticoagulothérapie satellites dans des pharmacies communautaires pourrait contribuer à personnaliser davantage le traitement et à éliminer les visites inconfortables dans les laboratoires des hôpitaux pour la détermination du RIN. D'autres études à plus long terme sont nécessaires afin de déterminer si la prise en charge par les pharmacies communautaires améliore les résultats thérapeutiques et est efficace.

Mots clés : warfarine, anticoagulants, surveillance thérapeutique, rapport international normalisé, pharmacies

INTRODUCTION

Warfarin is an effective oral anticoagulant for the prevention and treatment of venous and arterial thrombosis.¹ Its anticoagulant effectiveness is monitored by measuring the international normalized ratio (INR). Careful monitoring of the INR and adjustment of the warfarin dose to maintain the INR within the targeted therapeutic range is critical for safe and effective use of this therapy. For patients who require long-term oral anticoagulant therapy, INR is usually monitored every 1 to 4 weeks in a hospital outpatient laboratory. The need for regular laboratory visits and subsequent telephone communications for warfarin dosage adjustments is inconvenient and time consuming for many patients.

With the availability of portable INR monitoring devices for point-of-care testing, the process of INR measurement is no longer confined to the hospital laboratory. These devices use capillary blood samples for INR measurement and provide results within minutes. Numerous studies have confirmed the accuracy and reliability of these instruments in relation to reference laboratory methods.²⁻¹⁴ In addition, the feasibility and accuracy of self-testing by selected patients who are willing to undertake this aspect of care and who have been suitably trained have shown encouraging results.¹⁵⁻¹⁸

Application of point-of-care testing in community pharmacies, by pharmacists certified in anticoagulation therapy management, may result in a more individualized approach and reduce the inconvenience of INR testing. Over a 3-month study period, we evaluated the quality of monitoring of oral anticoagulant therapy in a community pharmacy by means of point-of-care testing, performed under the supervision of staff in a specialized hospital oral anticoagulation clinic.

METHODS

Patients and Study Design

This prospective cohort pilot study was conducted at the Queen Elizabeth II Health Sciences Centre and a Shoppers Drug Mart community pharmacy, Halifax, Nova Scotia, from October 1 to December 31, 2002. The research protocol was approved by the hospital's ethics review board. The Nova Scotia College of Physicians and Surgeons approved the protocol to allow community pharmacists to monitor oral anticoagulant therapy as a delegated medical function under the supervision of the medical director of the anticoagulation clinic.

Patients receiving long-term warfarin therapy (duration of therapy at least 3 months) who were expected to require treatment for a minimum of 3 additional months and who were patients of the Anticoagulation Clinic, Queen Elizabeth II Health Sciences Centre, or who were customers of the designated community pharmacy were eligible for this study. Patients were excluded if they met one of the following criteria: life expectancy less than 3 months, major hemorrhagic contraindication to anticoagulation, refusal of the patient's family physician to participate, geographic inaccessibility for follow-up, and likelihood of poor compliance (e.g., patients who were unable to care for themselves, lacked adequate home support, or were unwilling to comply with the treatment plan).

Informed consent was obtained from all participants and their family physicians. All patients were initially seen by 1 of 4 community pharmacists, at the designated community pharmacy, 2 weeks before the start of the study. The 4 community pharmacists received monitor training, extensive anticoagulation education, and certification in anticoagulation therapy management over



the course of a 4-day workshop. At the preliminary visit for each patient, INR was measured by the community pharmacist using the point-of-care testing device (Coaguchek-S, Roche Diagnostics, Montréal, Quebec), and the patient received a standardized education package detailing the indication for therapy, the importance of complying with the regimen, the need for close monitoring, the potential risk of taking other medications, dietary considerations, and the importance of watching for evidence of bleeding or thromboembolic complications.

The community pharmacy held 2 morning clinics per week from 0900 to 1200 (noon) during the 3-month study period. Patient appointments were booked at 30-min intervals. During each appointment, the community pharmacist measured the INR with the point-of-care testing device and reviewed the test result with the pharmacist clinic coordinator (S.J.W.) or the medical director (D.R.A) of the hospital's anticoagulation clinic, discussing the need for any dosage changes as well as the date for the next INR test. Dosage adjustments were based on algorithms used by the hospital's oral anticoagulation clinic.

Before each clinic at the community pharmacy, 2 levels of electronic quality control were run to verify performance of the testing device. Liquid controls were run after every 15 INR tests or when a new lot of testing strips was started. Results obtained with the testing device were correlated with results from the hospital laboratory monthly.

Patients were told to report any bleeding or thrombotic events to the community pharmacists. The Division of Hematology at the Queen Elizabeth II Health Sciences Centre provided back-up for emergency-related calls outside the regular working hours of the hospital anticoagulation clinic.

At the end of the 3-month follow-up period, patients were asked to complete a questionnaire indicating their level of satisfaction with various aspects of the care provided and to return the completed questionnaire by mail to the hospital anticoagulation clinic. The questionnaire was the same as one used in a previous clinical trial.¹⁹ In addition, responsibility for patients' anticoagulant management was returned to their family physicians at that time. A letter was sent to each family physician outlining his or her patient's INR results and warfarin dosage instructions during the 3-month study period. Patients were instructed as to when the next INR laboratory test should be performed and were advised to resume care with the family physician.

The primary outcome was the proportion of time (over the 3-month period of management by the

community pharmacy) during which the INR for patients receiving long-term warfarin therapy was within 0.2 units above or below the target therapeutic range (the expanded therapeutic range); these data were compared with data for 112 historical controls managed through oral anticoagulation clinics in a previous clinical trial.¹⁹ For patients requiring warfarin for the prevention or treatment of thrombosis (standard risk), the target range was 2.0 to 3.0.²⁰⁻²⁴ For patients requiring warfarin for the prevention of cardioembolic complications due to mechanical valves or recurrent thrombosis (high risk), the target range was 2.5 to 3.5.²⁵ Because minor fluctuations defined by a variation of 0.2 units would be considered clinically unimportant and would not necessarily dictate the need for a dose adjustment, the defined expanded therapeutic ranges for this study were 1.8 to 3.2 for standard-risk patients and 2.3 to 3.7 for high-risk patients. "Panic" INR values, defined as INR less than 1.5 or greater than 5.0, were compared in the 2 groups as a minor outcome.

Anticoagulation control was calculated as the proportion of patient time within the expanded therapeutic range, according to the method of Rosendaal and others.²⁶ This method is a way to accurately determine the proportion of time a patient's INR remains within the therapeutic range. For patients whose warfarin therapy was temporarily interrupted either in preparation for upcoming surgical or dental procedures or because of thrombotic or bleeding complications, the interval between when the warfarin dose was first withheld until 5 days after resumption of the drug was censored from the analysis.

Secondary outcome measures included rates of thromboembolic and major hemorrhagic complications in the 2 groups. Thrombotic events that were considered to represent such outcome measures included acute myocardial infarction, stroke, peripheral arterial occlusion, deep vein thrombosis, and pulmonary embolism as defined by previously described criteria.²¹⁻²⁴ Major bleeding was defined as events that resulted in death or the need for acute medical or surgical intervention, as defined by previously described criteria.²⁷ Patient satisfaction as indicated by the questionnaire was also a secondary outcome measure. Patient satisfaction with the community pharmacy (this study) was compared with the satisfaction of historical controls who had been managed through oral anticoagulation clinics.

Analysis

The primary analysis compared the proportion of time that INR values were within the expanded therapeutic range for patients managed through the

community pharmacy with that for historical controls managed through oral anticoagulation clinics by means of non-paired Student *t*-test. A *p* value of less than 0.05 (2-tailed) was regarded as representing a statistically significant difference between the 2 groups. Rates of thrombotic or major hemorrhagic complications were compared between the 2 groups with Fisher's exact test. Ninety-five percent confidence intervals (CIs) based on the binomial distribution were calculated around these rates. Descriptive statistics and Fisher's exact test were used to compare results from the patient satisfaction questionnaire between the 2 groups.

RESULTS

Forty-four patients were identified as eligible for the study. Of these, 12 were satisfied with having their family physicians manage their oral anticoagulant therapy, 6 lacked transportation to the designated community pharmacy, and 7 were not interested in participating in a research study. The remaining 19 patients were enrolled. Of these 19 patients, 12 were clients of the community pharmacy and 7 were patients of the hospital anticoagulation clinic.

The characteristics of the patients are presented in Table 1. The primary indication for anticoagulation was atrial fibrillation in 8 patients (42%). All patients completed the 3-month study period. A total of 127 INR measurements were performed and managed by the community pharmacists. INR readings were within the expanded therapeutic range 84% of the time (95% CI 75% to 93%) for patients managed in the community pharmacy and 82% of the time (95% CI 78% to 85%) for the historical controls¹⁹ (*p* = 0.58). INR readings were within the actual therapeutic range 67% of the time (95% CI 55% to 79%) for patients managed in the community pharmacy and 64% of the time (95% CI 59% to 67%) for historical controls (*p* = 0.52). The proportion of patients who had at least one panic INR value was 21% (95% CI 6% to 46%) in the community pharmacy group and 30% (95% CI 39% to 59%) in the oral anticoagulation clinic group (*p* = 0.59). The average number of INR measurements was 6 per patient (95% CI 4.7 to 6.5) for those managed in the community pharmacy and 11 (95% CI 10 to 12) for those managed in the oral anticoagulation clinic.

No major bleeding or thromboembolic events occurred in the 19 patients managed in the community pharmacy. Of the 112 historical controls, one patient (1%) experienced a thromboembolic event and 2 patients (2%) experienced major bleeding events.

All 19 patients managed by the community pharmacy completed the patient satisfaction questionnaire. There

Table 1. Characteristics of Study Patients

Characteristic	No. (and %) of Patients* (<i>n</i> = 19)	
Mean age and range (years)	61	(25–88)
Sex (no. of men)	13	(68)
Indication		
Atrial fibrillation	8	(42)
Mechanical heart valve	6	(32)
DVT	3	(16)
Peripheral vascular disease	1	(5)
CVA	1	(5)
Target INR range		
2.0–3.0	12	(63)
2.5–3.5	7	(37)

DVT = deep vein thrombosis, CVA = cerebrovascular accident, INR = international normalized ratio.

*Except where indicated otherwise.

was no difference in responses for these 19 patients and the 95 historical controls who responded to the satisfaction questionnaire (Table 2). Seven patients were willing to pay less than \$5 for each INR blood test and warfarin consultation with the community pharmacist, 11 were willing to pay between \$5 and \$10, and 1 patient was willing to pay between \$16 and \$20.

DISCUSSION

In this study, community pharmacists certified in the management of anticoagulation therapy and working under the supervision of staff in a hospital anticoagulation clinic provided high-quality anticoagulant management. The expanded therapeutic INR range (within 0.2 units of the target therapeutic range) was achieved 84% of the time by the community pharmacists in this study and 82% of the time for historical controls managed through oral anticoagulation clinics in a previous clinical trial.¹⁹ In addition, the proportion of patients experiencing panic INR values (less than 1.5 or greater than 5.0) was similar for patients managed in the community pharmacy and those managed through oral anticoagulation clinics. Satisfaction with the quality of care was also similar between these 2 groups. No thromboembolic or bleeding events occurred in the 19 study participants, but a few such events occurred among the historical controls.

The care provided by the community pharmacists in this study would be regarded as high quality compared with that reported in uncontrolled or registry studies.^{16,28-31} In addition, although this study was not designed to compare the quality of oral anticoagulant monitoring provided by community pharmacists and family physicians, monitoring may be comparable, according to

Table 2. Responses on Patient Satisfaction Questionnaire

Item on Questionnaire and Site of Warfarin Monitoring	Level of Satisfaction; % of Patients*					p value
	Very Satisfied	Satisfied	Dissatisfied	Very Dissatisfied	No Opinion	
Information and instruction received						0.16
Community pharmacy	58	32	0	0	10	
Oral anticoagulation clinic	80	17	0	0	4	
Support provided						>0.20
Community pharmacy	63	16	0	0	21	
Oral anticoagulation clinic	74	18	0	0	7	
Time spent						0.74
Community pharmacy	74	26	0	0	0	
Oral anticoagulation clinic	72	20	0	0	7	
Helpfulness of staff						>0.20
Community pharmacy	84	10	0	0	5	
Oral anticoagulation clinic	85	15	0	0	0	
Availability of staff in an emergency						0.10
Community pharmacy	63	0	0	0	37	
Oral anticoagulation clinic	65	18	2	2	13	
Way in which questions and concerns were handled by staff						>0.20
Community pharmacy	74	21	0	0	5	
Oral anticoagulation clinic	74	22	2	0	2	
Overall effects on health						>0.20
Community pharmacy	63	21	0	0	16	
Oral anticoagulation clinic	65	28	2	0	6	
Overall satisfaction with warfarin monitoring						0.74
Community pharmacy	79	16	0	0	5	
Oral anticoagulation clinic	74	24	0	0	2	

*Responses were available from 19 patients managed through the community pharmacy and from 95 of 112 historical controls managed through oral anticoagulation clinics (reported in a previous trial¹⁹).

the findings of the study that was the source of historical controls for the current study.¹⁹ That earlier study was a randomized controlled trial comparing oral anticoagulant management in anticoagulation clinics with management by family physicians; patient INR levels were within the expanded therapeutic range 82% of time for patients managed in the clinics and 76% of the time for those managed by family physicians ($p = 0.03$). In addition, panic INR values were more commonly observed among patients managed by family physicians (50%) than those managed by anticoagulation clinics (30%) ($p < 0.01$). Patients whose anticoagulant management was managed through anticoagulation clinics were more satisfied than those managed by family physicians ($p < 0.01$).

The findings of a pilot study performed in 3 community pharmacies in the United States provide further support for monitoring of oral anticoagulant therapy by community pharmacists.³² In that study, 21 patients participated in a year-long anticoagulation education and monitoring program based in community

pharmacies. A total of 235 INR measurements were performed by the community pharmacists. Eighty-one percent of the patients had INR values within an expanded therapeutic range (± 0.2 units) at least 60% of the time. These results are comparable to the results of the pilot study described here, as well as values reported for anticoagulation clinics.

There are several limitations to this study. First, the 19 study patients had been taking warfarin for at least 3 months, whereas the historical controls in the previous clinical trial were new users of warfarin. This factor probably accounted in part for the greater frequency of INR measurements in the historical control group. Second, in the current study, the community pharmacists contacted the clinic coordinator or medical director of the anticoagulation clinic during each patient visit, relying on these hospital staff members for assistance with dosing. This assistance may have contributed to the high quality of anticoagulant management in this study. However, over the course of the study, community pharmacists directed



the dosing within guidelines used by the Anticoagulation Clinic of the Queen Elizabeth II Health Sciences Centre, with minimal input from clinic staff. Third, the follow-up period was relatively short. It is possible that, with time, differences in compliance or follow-up could differentially affect the quality of anticoagulant care. Finally, the study was underpowered to detect differences in clinical outcomes, which would be the ideal endpoint for comparing models of oral anticoagulant care.

The development of satellite anticoagulation clinics in community pharmacies, using point-of-care testing, may result in a more individualized approach and minimize the cost and inconvenience of INR testing in hospital laboratories. The patients who participated in this study were willing to pay between \$5 and \$20 for INR testing and warfarin consultation with the community pharmacist. The results from this study may be useful in obtaining reimbursement from third-party insurance companies to help cover the cost of the test strips for the INR monitors and for professional pharmacy services.

In summary, community pharmacists under the supervision of staff in a hospital oral anticoagulation clinic provided high-quality oral anticoagulant management using point-of-care testing. Further studies of longer duration are required to determine whether community pharmacy management improves patient outcomes and is cost-effective.

References

- Hirsch J, Dalen JE, Anderson DR, Poller L, Bussey H, Ansel J, et al. Oral anticoagulants: mechanism of action, clinical effectiveness, and optimal therapeutic range. *Chest* 2001;119:8S-21S.
- Leaning KE, Ansell JE. Advances in the monitoring of oral anticoagulation: point-of-care testing, patient self-monitoring, and patient self-management. *J Thromb Thrombolysis* 1996;3:377-83.
- Lucas FV, Duncan A, Jay R, Coleman R, Craft P, Chan B. A novel whole blood capillary technique for measuring prothrombin time. *Am J Clin Pathol* 1987;88:442-6.
- Yano Y, Jambayashi J, Murata K, Shiba E, Sakon M, Kawasaki T. Bedside monitoring of warfarin therapy by a whole blood capillary coagulation monitor. *Thromb Res* 1992;66:583-90.
- Weibert RT, Adler DS. Evaluation of a capillary whole blood prothrombin time measurement system. *Clin Pharm* 1989;8:864-7.
- Gosselin R, Owings JT, White RH, Hutchinson R, Branch J, Mahackian K, et al. A comparison of point-of-care instruments designed for monitoring oral anticoagulation with standard laboratory methods. *Thromb Haemost* 2000;83:698-703.
- McCurdy SA, White RH. Accuracy and precision of a portable anticoagulation monitor in a clinical setting. *Arch Intern Med* 1992;152:589-92.
- Tripodi A, Arbin AA, Chantarangkul V, Bettega D, Mannucci PM. Are capillary whole blood coagulation monitors suitable for the control of oral anticoagulant treatment by the international normalized ratio? *Thromb Haemost* 1993;70:921-4.
- Oberhardt BJ, Dermott SC, Taylor M, Alkadi ZY, Abruzzini AG, Gresalfi NJ. Dry reagent technology for rapid, convenient measurements of blood coagulation and fibrinolysis. *Clin Chem* 1991;37:520-6.
- Rose VL, Dermott SC, Murray BF, McIver MM, High KA, Oberhardt BJ. Decentralized testing for prothrombin time and activated partial thromboplastin time using a dry chemistry portable analyser. *Arch Pathol Lab Med* 1993;117:611-7.
- Fabbrini N, Messmore H, Balbale S, Panza L, Edward SB, Flynn C. Pilot study to determine use of a TAS analyzer in an anticoagulation clinic setting [abstract]. *Blood* 1995;82(Suppl 1):869a.
- Tripodi A, Chantarangkul V, Clerici M, Negri B, Mannucci PM. Determination of the international sensitivity index of a new near-patient testing device to monitor oral anticoagulant therapy. *Thromb Haemost* 1997;78:855-8.
- Kaatz AA, White RH, Hill J, Mascha E, Humphries JE, Becker DM. Accuracy of laboratory and portable monitor international normalized ratio determinations. *Arch Intern Med* 1995;155:1861-7.
- Ansell J, Becker D, Andrew M, Becker R, Triplett D, Cimini C, et al. Accurate and precise prothrombin time measurement in a multicentre anticoagulation trial employing patient self-testing [abstract]. *Blood* 1995;86(Suppl 1):864a.
- Anderson D, Harrison L, Hirsh J. Evaluation of a portable prothrombin time monitor for home use by patients who require long-term oral anticoagulant therapy. *Arch Intern Med* 1993;153:1441-7.
- White RH, McCurdy SA, von Marenstorff H, Woodruff DE, Leftoff L. Home prothrombin time monitoring after the initiation of warfarin therapy: a randomized, prospective study. *Ann Intern Med* 1995;111:730-7.
- Eldor A, Schwartz J. Self-management of oral anticoagulants with a whole blood prothrombin-time monitor in elderly patients with atrial fibrillation. *Pathophysiol Haemost Thromb* 2002;32(3):99-106.
- Oral Anticoagulation Monitoring Study Group. Point-of-care prothrombin time measurement for professional and patient self-testing use: a multicenter clinical experience. *Am J Clin Pathol* 2001;115:288-96.
- Wilson SJ, Wells PS, Kovacs MJ, Lewis GM, Martin J, Burton E, et al. Comparing the quality of oral anticoagulant management by anticoagulation clinics and by family physicians: a randomized controlled trial. *CMAJ* 2003;169:293-8.
- Geerts WH, Heit JA, Clagett GP, Pineo GF, Colwell CW, Anderson FA, et al. Prevention of venous thromboembolism. *Chest* 2000;119(Suppl):132S-175S.
- Hyers TM, Angelli G, Hull RD, Morris TA, Samama M, Tapson V, et al. Antithrombotic therapy for venous disease. *Chest* 2000;119(Suppl):176S-193S.
- Albers GW, Dalen JE, Laupacis A, Manning WJ, Peterson P, Singer DE. Antithrombotic therapy in atrial fibrillation. *Chest* 2000;119(Suppl):194S-206S.
- Cairns JA, Theroux P, Lewis HD, Ezekowitz M, Meade TW. Antithrombotic agents in coronary artery disease. *Chest* 2000;119(Suppl):228S-252S.
- Albers GW, Amarenco P, Easton JD, Sacco RL, Teal P. Antithrombotic and thrombolytic therapy for ischemic stroke. *Chest* 2000;119(Suppl):300S-320S.
- Stein PD, Alpert JS, Bussy HI, Dalen JE, Turpie AGG. Antithrombotic therapy in patients with mechanical and biological prosthetic heart valves. *Chest* 2000;119(Suppl):220S-227S.
- Rosendaal FR, Cannegieter SC, van der Meer FJM, Briet E. A method to determine the optimal intensity of oral anticoagulant therapy. *Thromb Haemost* 1993;39:236-9.



27. Anderson DR, Levine M, Gert M, Hirsch J. Validation of a new criteria for the evaluation of bleeding during antithrombotic therapy [abstract]. *Thromb Haemost* 1993;69:650.
28. Palareti G, Leali N, Coccheri S, Poggi M, Manotti C, D'Angelo A, et al. Bleeding complications of oral anticoagulant treatment: an inception-cohort, prospective collaborative study (ISCOAT). *Lancet* 1996;348:423-8.
29. Cannegeiter SC, Rosendaal FR, Wintzen AR, van der Meer FJM, Vandenbroucke JP, Briet E. Optimal oral anticoagulant therapy in patients with mechanical heart valve. *N Engl J Med* 1995;333:11-7.
30. Garabedian-Ruffalo SM, Gray DR, Sax MJ, Ruffalo RL. Retrospective evaluation of a pharmacist-managed warfarin anticoagulant clinic. *Am J Hosp Pharm* 1985;42:304-8.
31. Ansel JE, Patel N, Ostrovsky D, Nozzolillo E, Peterson AM, Fish L. Long-term patient self-management of oral anticoagulation. *Arch Intern Med* 1995;155:2185-9.
32. Knowlton CH, Thomas OV, Williamson A, Gammaitoni AR, Kirchain WR, Buttaro ML, et al. Establishing community pharmacy-based anticoagulation education and monitoring programs. *J Am Pharm Assoc* 1999;39:368-74.

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