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Evaluation and Optimization of Thromboprophylaxis in Hospitalized Cancer Patients by Pharmacist Intervention

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Abstract

Venous thromboembolism (VTE) is the second leading cause of death in cancer patients. This clinical survey aimed to study thromboprophylaxis in hospitalized cancer patients and the pharmacist's role in optimizing anticoagulant administration. Three hundred and three cancer patients were categorized into three groups: mild (5.9%), moderate (57.1%), and severe (37%), based on the Padua Prediction Score and Khorana score for VTE risk. The pharmacist evaluated all cases in accordance with thromboprophylaxis guidelines and recommended changes to anticoagulant therapy (switching from enoxaparin to unfractionated heparin for cost reasons) or initiation of therapy. The primary reasons for physicians' reluctance to initiate or change anticoagulants were also examined. Among the 303 hospitalized cancer patients evaluated, 285 (94.1%) required thromboprophylaxis based on the Padua and Khorana scores. Of these, 159 (55.8%) were already receiving anticoagulants, while 126 (44.2%) were not. Following the pharmacist's evaluation, heparin was recommended for 126 untreated patients, and physicians accepted the recommendation in 22 cases (17.5%), disagreed in 71 (56.3%), and 33 patients (26.2%) were unavailable for intervention. Among the 108 patients receiving enoxaparin, switching to heparin was proposed for economic optimization. Physicians agreed in 36 cases (33.3%), disagreed in 61 (56.5%), and 11 patients (10.2%) were unavailable for intervention. The main physician-related reasons for not initiating or changing therapy included preference for enoxaparin as first-line therapy, concerns about thrombocytopenia, or the patient's terminal condition. Overall, pharmacist interventions improved adherence to thromboprophylaxis guidelines and resulted in treatment initiation or switching in 58 of the 190 patients available for these interventions (30.5%), demonstrating significant clinical and economic benefits. Assessing VTE risk in cancer patients using the Padua Prediction Score and Khorana score provides a rational basis for prescribing anticoagulants. Collaboration with pharmacists in selecting and administering appropriate anticoagulants (type, dose, duration) can help reduce costs and improve outcomes in cancer patients.

Keywords: Cancer, Thromboprophylaxis, Heparin, Pharmacist intervention, DOAC, Enoxaparin.

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1. Introduction

Cancer remains one of the leading causes of mortality worldwide, with high annual incidence and substantial physical, psychological, and economic burdens on patients, families, and healthcare systems [1]. Cancer and its treatments can lead to diverse complications that vary among individuals, even with identical therapies [2, 3]. Common adverse effects include hair loss, infections, constipation, diarrhea, fatigue, sexual dysfunction, fertility issues, and hematologic complications such as anemia, bleeding, bruising, thrombocytopenia, and thrombosis [1].

Thrombosis involves the formation of blood clots that obstruct vessels, resulting in severe consequences depending on the site, including stroke, myocardial infarction, respiratory failure, or death [2]. Venous thromboembolism (VTE) encompasses deep vein thrombosis (DVT) and pulmonary embolism (PE). VTE accounts for 60,000-100,000 deaths annually in the United States [3]. DVT involves the formation of clots in deep veins; these clots may travels to an artery in the lung and cause PE. Pathogenesis includes venous stasis, endothelial injury, and hypercoagulability, with stasis being the predominant factor in hospitalized patients [4].

VTE is a major contributor to mortality in cancer patients [5]. These patients are at heightened risk due to surgery, hospitalization, immobility, central venous catheters, chemotherapy, and erythropoiesis-stimulating agents [6-8]. Approximately 15% of cancer patients experience VTE-related symptoms, with increased recurrence risk and greater bleeding potential during anticoagulation [9]. VTE in cancer patients causes pain, swelling, diminished quality of life, and a 40-50% increase in treatment costs [10-12]. Effective thromboprophylaxis is therefore essential to prevent morbidity and mortality. Thromboprophylaxis may involve pharmacological or mechanical methods, selected based on VTE risk. Established agents include vitamin K antagonists, heparins, and direct oral anticoagulants (DOACs) [13]. In cancer patients, careful selection, dosing, and monitoring are critical due to complex comorbidities and drug interactions. Clinical pharmacists play a vital role in optimizing therapy through prescription review, dose adjustment, and interaction monitoring [14, 15].

Pharmacist-led interventions in anticoagulant therapy have been shown to enhance guideline adherence, reduce inappropriate prescribing, and lower bleeding and hospitalization rates [16-18].

Recent studies have demonstrated the value of clinical pharmacists in enhancing drug therapy and outcomes across settings, including improved chronic disease control [19], reduced hospital readmissions through multifaceted medication review and follow-up strategies [20], and better oncology care with improved adherence, fewer complications, and higher patient satisfaction [21-24]. Integrating pharmacists into multidisciplinary oncology and thrombosis teams is crucial for safe, effective, and cost-efficient anticoagulant management in hospitalized cancer patients [25-27]. This study aimed to evaluate thromboprophylaxis practices in hospitalized cancer patients and assess the impact of pharmacist interventions on prescribing optimization.

2. Patients and Methods

Cancer inpatients in the oncology and hematology departments of Taleghani Hospital, Tehran, Iran, receive thromboprophylaxis in accordance with current guidelines. The objectives of this study were to investigate and improve VTE prevention in hospitalized cancer patients through pharmacist interventions, monitor patients on thromboprophylaxis for bleeding risk and hematologic stability, and replace more expensive anticoagulants with less expensive alternatives (e.g., switching from enoxaparin to unfractionated heparin) to reduce costs.

This observational-interventional study was conducted over approximately one year. The inclusion criteria were as follows: (1) adult patients (≥18 years) hospitalized in the oncology or hematology wards of Taleghani Hospital, (2) confirmed malignancy (solid tumor or hematologic cancer) based on clinical and pathological evidence, (3) hospital stay ≥48 hours, (4) sufficient clinical and laboratory data to calculate VTE risk scores (Padua or Khorana), (5) admission for chemotherapy, palliative care, or other cancer-related management, and (6) patient willingness to participate in pharmacist-led evaluation and intervention.

The exclusion criteria were as follows: (1) contraindications to anticoagulation (e.g., active bleeding, platelet count <50,000/mm^3, severe hepatic failure, recent intracranial hemorrhage), (2) known

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hypersensitivity to heparin, enoxaparin, or other anticoagulants, (3) full-dose anticoagulation for prior VTE, (4) pregnancy or lactation, (5) incomplete records for risk assessment or medication evaluation, and (6) lack of consent from the patient or attending physician.

Medical records, demographic information, and laboratory data (platelets, creatinine, liver enzymes, and catheter type) were reviewed and recorded. VTE risk was assessed using the Khorana score for chemotherapy patients and the Padua score for others. For patients receiving anticoagulation, dosage and appropriateness were evaluated, and changes were proposed under physician supervision. For untreated patients without contraindications, appropriate therapy was recommended. Patients were monitored for laboratory parameters and clinical status during hospitalization. Data were analyzed descriptively using SPSS software.

3. Results and Discussion

3.1. Results

This study evaluated 335 patients, of whom 32 were not included. Of the 303 patients, VTE risk was assessed in 42 using the Padua score and in the remaining patients using the Khorana score. **Figure 1** shows the study process. For patients receiving anticoagulants from the start of hospitalization, all heparin

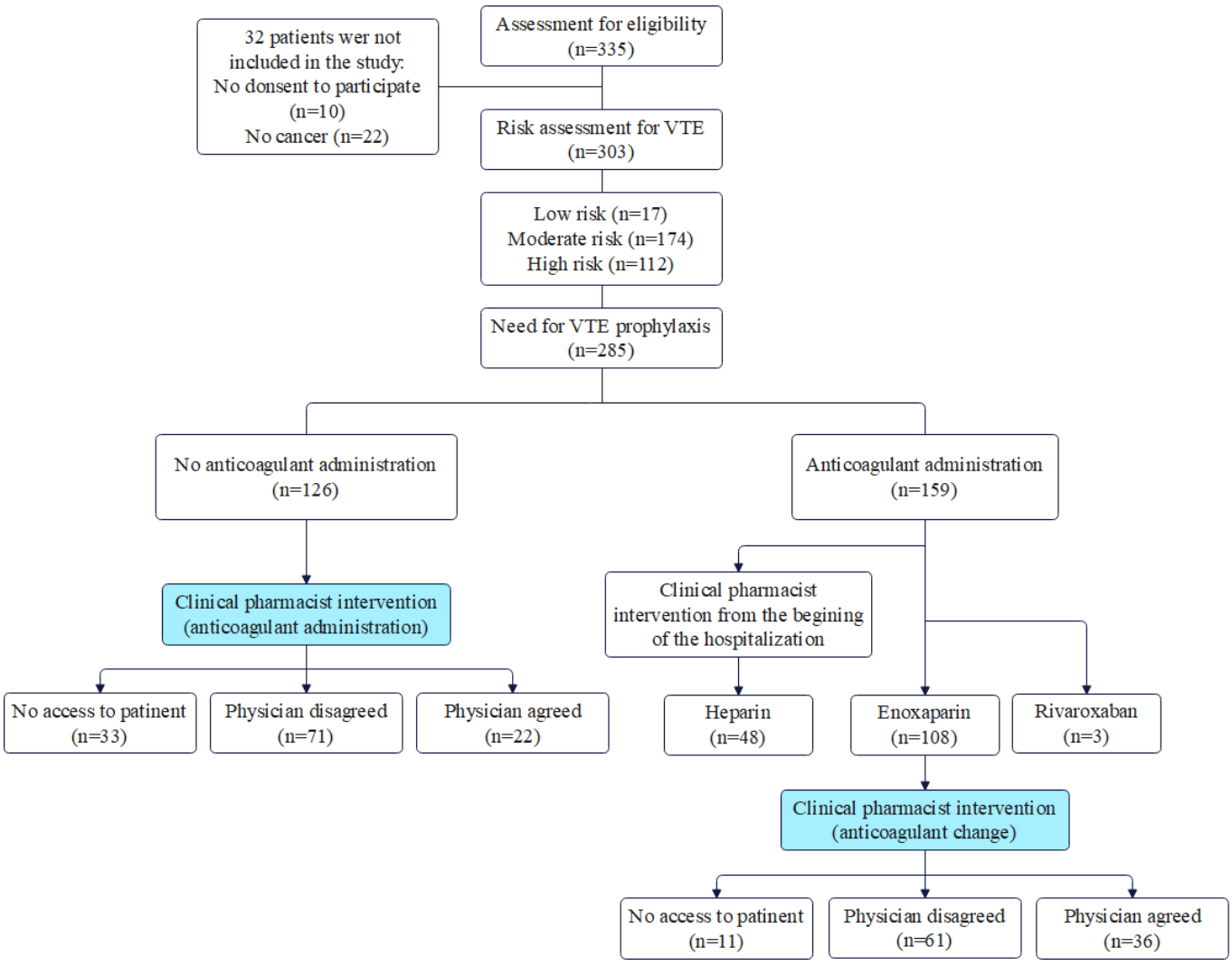


Figure 1. Process of study and anticoagulant administration

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Administration was based on the pharmacist's recommendation. **Table 1** presents the patients' demographic information.

A change in medication was not recommended for patients receiving rivaroxaban. The reasons were a preference for oral medication (2 patients) and the physician's preference based on the patient's history of thrombosis (1 patient). **Table 2** reports the patients' thrombosis risk and the medications they received. Because some patients were receiving enoxaparin before the pharmacist's intervention, a switch to heparin was proposed to reduce hospitalization costs. Heparin was also recommended for patients who had not received any anticoagulants since the start of hospitalization.

Table 1. Demographic data for patients participating in the study.

Patient characteristics (n=303)		Number (%)
Sex	Male	186 (61.4)
	Female	117 (38.6)
Type of Malignancy	Lung	10 (3.3)
	Hematologic	112 (37)
	Colon	54 (17.8)
	Gastric	45 (14.9)
	Liver	6 (2)
	Breast	20 (6.6)
	Sarcoma	6 (2)
	Small intestine	7 (2.3)
	Pancreas	12 (4)
	Ovary	7 (2.3)
	Rectum	10 (3.3)
	Prostate	2 (0.7)
	Medulloblastoma	4 (1.3)
	Other	8 (2.6)
Metastasis	No metastasis	226 (74.6)
	Metastatic	77 (25.4)
Reason of Hospitalization	Chemotherapy	228 (75.2)
	Palliative care	63 (20.8)
	Diagnosis	12 (4)
History of Surgery	No	177 (58.4)
	Yes	126 (41.6)
History of Thrombosis	No	296 (97.7)
	Yes	7 (2.3)
Other Complications	No	219 (72.3)
	Yes	84 (27.7)

Table 2. Thrombosis risk and medications received by patients.

		Number (%)
Thrombosis risk (n=303)	Low	18 (5.9)
	Moderate	173 (57.1)
	High	112 (37)
Anticoagulants administrations (n=159)	Enoxaparin	108 (67.9)
	Heparin	48 (30.2)
	Rivaroxaban	3 (1.9)

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Of the 126 patients initially receiving no anticoagulants, physicians agreed to initiate therapy in 22, disagreed in 71, and 33 were unavailable for intervention. Of the 108 patients receiving enoxaparin, physicians agreed to switch therapy in 36, disagreed in 61, and 11 were unavailable for intervention. **Tables 3** and **4** show the reasons for physicians' agreement or disagreement with changing or initiating anticoagulant therapy. According to the tables, the rate of physician agreement with changing anticoagulant therapy (37.1%) was higher than the rate of agreement with initiating therapy (23.7%).

3.2. Discussion

For decades, pathologists have observed thrombi in the vasculature and lungs of cancer patients [28]. Imaging studies have reported venous thrombosis in 52% of hospitalized patients with advanced cancer [29]. VTE in cancer patients prolongs treatment, increases bleeding and recurrence risks [30], elevates hospitalization rates threefold, and raises healthcare costs [31]. Recent evidence underscores the negative impact of VTE on mortality, quality of life, and costs, highlighting the need for targeted pharmacologic prevention [32]. Most VTE cases are preventable with appropriate prophylaxis. Individual risk assessment using validated scores and low-dose anticoagulants in high-risk patients is recommended. Early trials, such as that by Levine et al. (1994), demonstrated reduced thrombosis with low-dose warfarin [33]. Studies have been conducted with different classes of drugs and with different populations. For example, enoxaparin was used in two studies by Agnelli G. et al. in 1998 and Bergvist D. et al. in 2002 on surgically treated cancer patients, in which the thrombosis rate was reduced [34, 35]. After its introduction for patients undergoing chemotherapy, the Khorana scoring system was used in recent studies to assess patient risk, with acceptable results [36].

In 2011, Marie-Christine et al. conducted a study evaluating pharmacist intervention in thrombosis prevention, which showed that appropriate thromboprophylaxis increased 3-fold in high-risk patients [37]. In another study at the Canadian Health Research Institute in 2009, investigators examined the effectiveness of monthly pharmacist-led hospital training in improving the quality of anticoagulant prescribing. The study results indicated an improvement in the quality of drug administration [38].

Table 3. Reasons for physicians' agreement and disagreement with changing anticoagulant therapy

Physician disagreement	Number (%) (n=97)
Based on the patient's condition, once-daily enoxaparin is preferred as first-line treatment	52 (53.6)
The patient's history of thrombosis and the physician's preference for enoxaparin	9 (9.3)
Physician agreement	
No contraindications or special medical conditions	36 (37.1)

Table 4. Reasons for physicians' agreement and disagreement with administering anticoagulants

Physician disagreement	Number (%) (n=93)
A decreasing platelet count that remained at or above 50,000	37 (39.8)
No perceived need for anticoagulants because of young age, despite high clinical risk	20 (21.5)
Hospitalization solely for diagnostic tests, biopsy, or port insertion	4 (4.3)
Preference for mechanical thromboprophylaxis	2 (2.2)
Other (transfer to other wards, no hope of improvement or survival, …)	8 (8.6)
Physician agreement	
No contraindications or special medical conditions	19 (20.4)
High creatinine level	3 (3.2)

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These findings are consistent with the results of a recent systematic review, which showed that pharmacist interventions in anticoagulant therapy improve guideline adherence, reduce bleeding, and decrease patient readmission rates [25]. In general, computer reminder systems or pharmacist involvement appear to improve the efficiency of thromboprophylaxis administration and reduce symptomatic venous thromboembolism [39]. In this study, the thromboprophylaxis process was examined and corrected while patients were monitored during hospitalization. To reduce hospital costs in the hematology and oncology departments, a switch from enoxaparin to heparin was suggested, taking into account the favorable effectiveness of heparin and the absence of a preference for enoxaparin in the available sources. Unlike most existing studies, which have examined the effectiveness of a specific anticoagulant class in a particular cancer type or chemotherapy regimen, this study examines and improves thrombosis prevention in hospitalized patients with cancer and adherence to existing guidelines. Of the initial population of 335 patients, 303 were included in the study. After thrombosis risk assessment, 285 (94.1%) patients required thromboprophylaxis. Of these, 159 (55.8%) received anticoagulants, whereas 126 (44.2%) had not received any thromboprophylaxis despite their thrombosis risk, representing a substantial number of patients. Following the pharmacist's intervention, 22 (17.5%) of the 126 patients who had not received medication were given heparin. When examining the reasons for treating physicians' disagreement with prescribing thromboprophylaxis, some justifications, such as young age despite high clinical risk, transfer to other wards, no hope of improvement or survival, or early discharge appear neither rational nor acceptable. Of the 126 patients, 71 (56.3%) did not receive thromboprophylaxis for irrational reasons, which is a significant and worrying number. It seems this process is not well managed in the hospital, and changes are necessary to improve the prescribing process, the use of valid scoring guidelines, and the presence of a resident pharmacist to provide consistent monitoring. Research has shown that pharmacists monitoring the process of prescribing anticoagulants in cancer patients can be beneficial, especially for drugs that require regular monitoring, such as warfarin; pharmacist involvement can greatly support patient treatment [40]. Additionally, a recent review found that pharmacist interventions in cancer patients significantly reduce medication-related problems, including drug interactions and inappropriate use, which supports the present findings regarding the corrective role of pharmacists [41].

One of the reasons for physicians' opposition to changing medication was the belief that enoxaparin is the first-line treatment rather than heparin. According to the guidelines, both drugs are considered first-line treatments, and insisting on enoxaparin would not be a justified reason. In addition, it would be more logical to use a less expensive treatment when clinical efficacy is similar and there are no contraindications. The physician's adherence to the guideline recommendations can be effective in the treatment process. In a study of cancer patients, physicians' adherence to 5 out of 8 thrombosis guidelines was reported to range between 59 and 100%, whereas adherence to the other 3 was no more than 1% [42].

Of the 285 patients requiring thromboprophylaxis, 44 were unavailable for intervention, leaving 241 patients. Of these, 190 were available for treatment initiation or switching; the remaining 51 were already receiving heparin or rivaroxaban. This intervention was undertaken to improve economic efficiency, which was one of the secondary goals of this study. The pharmacist's recommendations resulted in 22 treatment initiations and 36 switches from enoxaparin to heparin. Among patients available for intervention, physicians agreed to initiation in 22 of 93 cases (23.7%) and to switching in 36 of 97 cases (37.1%). Thus, the observed acceptance rate was higher for switching than for initiating therapy. These results show that checking and improving the thromboprophylaxis process, which was the main goal of this study, can be achieved with the constant presence of a pharmacist from the first day of hospitalization and a routine strategy for monitoring thromboprophylaxis. Steward et al. also obtained similar results in their study on the pharmacist's intervention in prescribing anticoagulants. According to this study, after the intervention of the pharmacist, the rate of anticoagulant prescribing increased from 3% to 70%. The acceptance rate for pharmacist interventions showed

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that physicians at their center collaborated more with pharmacists than those at our center. The same study states that if there is no pharmacist, the prescribing rate will decrease from 70% to 59%. This indicates the educational and supervisory role of the pharmacist in the process of drug administration [43]. Further studies are needed because the effect of pharmacists on mortality and morbidity remains unclear [44].

4. Conclusion

Pharmacist-led interventions significantly reduce medication-related problems, including inappropriate use and interactions, reinforcing the role of pharmacists in optimizing care in cancer care. Continuous pharmacist involvement, targeted education, and protocol updates can substantially improve thromboprophylaxis in hospitalized cancer patients.

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Conflict of interest

The authors have no relevant financial or non-financial interests to disclose.

Data availability

The data that support the findings of this study are available on request from the corresponding author.

Author contributions

Conceptualization: 1, 5, 6; Data curation: 2, 4; Formal analysis: 3; Investigation: 4; Methodology: 1, 2, 5; Project administration: 1, 5; Resources: 3, 4; Software: 6; Supervision: 1, 5, 6; Validation: 1; Visualization: 6; Writing original draft: 1, 2, 3, 4; Writing review and editing: 5, 6.

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Use of artificial intelligence

AI was used for grammatical proofreading.

References

1. Siu, A.L. and U.P.S.T. Force, Screening for breast cancer: US Preventive Services Task Force recommendation statement. Annals of internal medicine, 2016. **164**(4): p. 279–296.
2. Morelli, T., et al., Infections due to dysregulated immunity: an emerging complication of cancer immunotherapy. Thorax, 2021.
3. Cameron, A.C., R.M. Touyz, and N.N. Lang, Vascular complications of cancer chemotherapy. Canadian Journal of Cardiology, 2016. 32(7): p. 852–862.
4. Devlin, E.J., L.A. Denson, and H.S. Whitford, Cancer treatment side effects: a meta-analysis of the relationship between response expectancies and experience. Journal of pain and symptom management, 2017. 54(2): p. 245–258. e2.
5. Chang, H.-M., et al., Cardiovascular complications of cancer therapy: best practices in diagnosis, prevention, and management: part 1. Journal of the American College of Cardiology, 2017. 70(20): p. 2536–2551.
6. Stone, J., et al., Deep vein thrombosis: pathogenesis, diagnosis, and medical management. Cardiovascular diagnosis and therapy, 2017. **7**(Suppl 3): p. S276.
7. Franchini, M., et al. Arterial thrombosis in cancer patients: an update. in Seminars in Thrombosis and Hemostasis. 2021. Thieme Medical Publishers, Inc. 333 Seventh Avenue, 18th Floor, New York.
8. Van Es, N., et al., Screening for occult cancer in patients with unprovoked venous thromboembolism: a systematic review and meta-analysis of individual patient data. Annals of internal medicine, 2017. 167(6): p. 410–417.
9. Falanga, A., et al., Mechanisms and risk factors of thrombosis in cancer. Critical reviews in oncology/hematology, 2017. 118: p. 79–83.
10. Salla, E., et al., Venous thromboembolism in patients diagnosed with lung cancer. Angiology, 2016. 67(8): p. 709–724.
11. Azimi, S., et al., Efficacy and Safety of a DOAC Compared to Unfractionated Heparin and A Low Molecular Weight Heparin in the Prevention of Thromboembolism in Hematopoietic Stem Cell Transplant Recipients. Iranian Journal of Pharmaceutical Research: IJPR, 2024. **23**(1): p. e143213.
12. Carrier, M., et al., Lack of evidence to support thromboprophylaxis in hospitalized medical patients with cancer. Am J Med, 2014. 127(1): p. 82–6.e1.
13. Benelhaj, N.B., et al., Cancer patients' experiences of living with venous thromboembolism: a systematic review and qualitative thematic synthesis. Palliative Medicine, 2018. 32(5): p. 1010–1020.
14. Kourlaba, G., et al., The humanistic and economic burden of venous thromboembolism in cancer patients: a

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systematic review. Blood Coagul Fibrinolysis, 2015. 26(1): p. 13–31.
15. Cohoon, K.P., et al., Direct medical costs attributable to cancer-associated venous thromboembolism: a population-based longitudinal study. The American journal of medicine, 2016. 129(9): p. 1000. e15–1000. e25.
16. Roberts, L.N., et al., Thromboprophylaxis for venous thromboembolism prevention in hospitalized patients with cirrhosis: guidance from the SSC of the ISTH. Journal of Thrombosis and Haemostasis, 2022. 20(10): p. 2237–2245.
17. Al-Ansari, A.M., et al., Thromboprophylaxis for inpatient with advanced cancer receiving palliative care: A retrospective study. European Journal of Haematology, 2022. 109(5): p. 494–503.
18. Kiracı, Z.K., et al., Education and clinical pharmacist-led management strategies for the risk and prophylaxis of venous thromboembolism in general surgery. Thrombosis journal, 2023. 21(1): p. 86.
19. Santschi, V., et al., Improving Blood Pressure Control Through Pharmacist Interventions: A Meta-Analysis of Randomized Controlled Trials. Journal of the American Heart Association, 2014. 3(2): p. e000718.
20. Ravn-Nielsen, L.V., et al., Effect of an In-Hospital Multifaceted Clinical Pharmacist Intervention on the Risk of Readmission: A Randomized Clinical Trial. JAMA Internal Medicine, 2018. 178(3): p. 375–382.
21. Colombo, L.R.P., et al., The effects of pharmacist interventions on adult outpatients with cancer: A systematic review. Journal of Clinical Pharmacy and Therapeutics, 2017. 42(4): p. 414–424.
22. Staynova, R., E. Gavazova, and D. Kafalova, Clinical Pharmacist-Led Interventions for Improving Breast Cancer Management—A Scoping Review. Current Oncology, 2024. 31(8): p. 4178–4191.
23. Shrestha, S., et al., Pharmacist Involvement in Cancer Pain Management: A Systematic Review and Meta-Analysis. The Journal of Pain, 2022. 23(7): p. 1123–1142.
24. Choukroun, C., et al., Impact of a pharmacist and geriatrician medication review on drug-related problems in older outpatients with cancer. Journal of Geriatric Oncology, 2021. **12**(1): p. 57–63.
25. Kefale, B., et al., The effect of pharmacist-led interventions on the appropriateness and clinical outcomes of anticoagulant therapy: a systematic review and meta-analysis. European Heart Journal - Quality of Care and Clinical Outcomes, 2024. 10(6): p. 488–506.
26. Bakey, K.H. and C.-T.N. Nguyen, Impact of a Pharmacist Intervention in the Emergency Department on the Appropriateness of Direct Oral Anticoagulants Prescribed in Venous Thromboembolism Patients. Journal of Pharmacy Practice, 2022. 35(4): p. 599–605.
27. Kurimura, T., et al., Significance of pharmacist intervention to oral antithrombotic therapy in the pharmaceutical outpatient clinic of cardiovascular internal medicine: a retrospective cohort study. Journal of Pharmaceutical Health Care and Sciences, 2023. 9(1): p. 28.
28. Ambrus, J.L., et al., Causes of death in cancer patients. J Med, 1975. **6**(1): p. 61–4.
29. Johnson, M.J., M.W. Sproule, and J. Paul, The prevalence and associated variables of deep venous thrombosis in patients with advanced cancer. Clin Oncol (R Coll Radiol), 1999. 11(2): p. 105–10.
30. Arora, M. and T. Wun, Adverse impact of venous thromboembolism on patients with cancer. Semin Thromb Hemost, 2014. 40(3): p. 313–8.
31. Khorana, A.A., et al., Health care costs associated with venous thromboembolism in selected high-risk ambulatory patients with solid tumors undergoing chemotherapy in the United States. Clinicoecon Outcomes Res, 2013. **5**: p. 101–8.
32. Ades, S., et al., Venous thromboembolism prevention program implementation in a community oncology practice: a cohort study. The Lancet Regional Health – Americas, 2024. 38.
33. Levine, M., et al., Double-blind randomised trial of a very-low-dose warfarin for prevention of thromboembolism in stage IV breast cancer. Lancet, 1994. 343(8902): p. 886–9.
34. Agnelli, G., et al., Enoxaparin plus compression stockings compared with compression stockings alone in the prevention of venous thromboembolism after elective neurosurgery. N Engl J Med, 1998. 339(2): p. 80–5.
35. Bergqvist, D., et al., Duration of prophylaxis against venous thromboembolism with enoxaparin after surgery for cancer. N Engl J Med, 2002. 346(13): p. 975–80.
36. Khorana, A.A., et al., Dalteparin thromboprophylaxis in cancer patients at high risk for venous thromboembolism: A randomized trial. Thromb Res, 2017. 151: p. 89–95.
37. Bernier, M.C., et al., Implementation and evaluation of a pharmacy-led thromboprophylaxis campaign in a community hospital. J Thromb Thrombolysis, 2011. 32(4): p. 431–8.
38. Cook, D., et al., Thromboprophylaxis for hospitalized medical patients: a multicenter qualitative study. J Hosp Med, 2009. 4(5): p. 269–75.
39. Kahn, S.R., et al., Effectiveness of interventions for the implementation of thromboprophylaxis in hospitalised patients at risk of venous thromboembolism: an updated abridged Cochrane systematic review and meta-analysis of randomised controlled trials. BMJ Open, 2019. 9(5): p. e024444.
40. Jones, K.L., et al., Clinical outcomes of a pharmacist-managed anticoagulation service for breast cancer

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patients. Journal of Oncology Pharmacy Practice, 2012. 18(1): p. 122–127.
41. Ranjan Dash, S. and M. Kumar Sahu, Pharmacists-led interventions to improve medication adherence in global health settings. Journal of Neonatal Surgery, 2025. **14**(1S): p. 566–.571.
42. Kandemir, E.A., A. Bayraktar-Ekincioglu, and S. Kilickap, Assessment of adherence to cancer-associated venous thromboembolism guideline and pharmacist's impact on anticoagulant therapy. Supportive Care in Cancer, 2021. 29(3): p. 1699–1709.
43. Steward, V.M., H. Hamid, and K. Hooker, Impact of Pharmacists' Interventions on Prescribing Patterns for the Treatment of VTE in Patients with Cancer. Journal of Hematology Oncology Pharmacy, 2012. 2(4).
44. Pelletier, R., Assessing the risk of venous thromboembolism (VTE) in ambulatory patients with cancer: Rationale and implementation of a pharmacist-led VTE risk assessment program in an ambulatory cancer centre. Journal of Oncology Pharmacy Practice, 2021. **27**(4): p. 911–918.

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