

Research



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Patient and institutional-related barriers to the uptake of anticoagulation service at Moi Teaching and Referral Hospital, Eldoret, Kenya

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Abstract

Introduction: anticoagulants are essential for preventing and treating thromboembolism; however, uptake of anticoagulation services remains low in resource-limited settings, such as Kenya. Despite the recognized benefits, many patients struggle with adherence, and contributing factors remain poorly understood. This study explored patient and institution-related barriers to the uptake of anticoagulation services at Moi Teaching and Referral Hospital (MTRH), Kenya. In particular, the study focused on knowledge, adherence, satisfaction, attitudes, service quality, and access. **Methods:** a cross-sectional study was conducted among 282 adult patients (≥ 18 years) on anticoagulation therapy for at least three months. Participants were selected through consecutive sampling. Data was collected via a pre-tested, researcher-administered semi-structured questionnaire. Quantitative data were analyzed descriptively, and qualitative responses were thematically analyzed. **Results:** while nearly 70% of participants could identify their anticoagulant, only 42.6% of the respondents understood how diet, drug interactions, or missed doses affected treatment. Only 33.5% of the participants maintained therapeutic International Normalized Ratio (INR) levels. Non-adherence was

reported in 40% of patients, with frequent missed doses and irregular clinic visits. Confusion about follow-up and INR monitoring was common, with 31.7% of patients reporting uncertainty about their medication regimen and 9.3% not knowing it at all; clinicians and pharmacists cited inadequate time (65.4%), lack of structured education programs (58.2%), and limited patient engagement tools (42.1%) as key barriers. **Conclusion:** despite high patient satisfaction and trust in providers, significant gaps in knowledge, adherence, and system support hinder optimal anticoagulation care. Gender and age-related disparities further complicate service uptake. Strengthening patient education, improving INR monitoring awareness, and integrating structured counseling into care models are crucial to improving anticoagulation outcomes in resource-limited settings like MTRH.

Introduction

Thromboembolic disorders such as atrial fibrillation, deep vein thrombosis, pulmonary embolism, and valvular heart disease remain the leading cause of cardiovascular morbidity and mortality worldwide. These conditions account for a substantial portion of global Disability-Adjusted Life Years (DALYs) and healthcare expenditure, with anticoagulation therapy forming a central pillar of management [1-5]. While Direct Oral Anticoagulants (DOACs) have increasingly become the standard of care in high-income settings due to their safety profile and ease of use, Vitamin K Antagonists (VKAs), particularly warfarin, remain the mainstay in many Low- and Middle-Income Countries (LMICs) due to cost and accessibility challenges [6-10]. Effective use of VKAs is highly dependent on maintaining patients within the therapeutic International Normalized Ratio (INR) range, which requires regular monitoring, patient education, and a robust healthcare infrastructure [2,11,12]. However, LMICs often face systemic barriers such as erratic INR monitoring, lack of standardized anticoagulation protocols, limited availability of DOACs, and inadequate healthcare worker training [2,9,12-14].

These gaps contribute to poor anticoagulation control, increasing the risk of thrombotic events or major bleeding. In sub-Saharan Africa, the burden of conditions requiring long-term anticoagulation is growing.

Rheumatic Heart Disease (RHD), which remains endemic in many parts of Africa, is a leading cause of valvular heart disease requiring anticoagulation for conditions such as atrial fibrillation or mechanical valve replacement [2,15,16]. Additionally, the rising incidence of venous thromboembolism (VTE) associated with malignancies, surgeries, and sedentary lifestyles has heightened the need for sustainable anticoagulation services in the region [16-20]. Kenya is no exception to these trends. The demand for anticoagulation management is increasing, yet structured systems to support safe and effective anticoagulant use are still developing [21,22]. Moi Teaching and Referral Hospital (MTRH), Kenya's second-largest referral hospital and academic medical center, serves a catchment population exceeding 24 million people across Western Kenya. Since 2009, MTRH has operated a contextualized anticoagulation clinic through a collaborative initiative involving local pharmacists and faculty from Purdue University College of Pharmacy [3,23]. The clinic has enrolled over 5,000 patients, with about 2,300 currently on active follow-up. Of these, 60% are cardiac patients, of whom 70% have valvular heart disease, while the remaining 40% are being managed for VTE [16-19].

Despite more than a decade of experience, challenges persist in optimizing anticoagulation outcomes at MTRH. These include suboptimal time in therapeutic range, lack of routine use of DOACs, and variable provider familiarity with anticoagulation guidelines [21,22,24]. Inadequate patient education on the risks, interactions, and monitoring requirements of anticoagulants further compounds these challenges. Therefore, the study aimed to examine factors influencing anticoagulation therapy among patients receiving care at the Moi Teaching and Referral Hospital

(MTRH) anticoagulation clinic. It explored patient-related and institutional factors affecting the uptake of anticoagulation therapy, evaluated the level of knowledge among clients, assessed adherence and monitoring practices, and examined patient satisfaction with the anticoagulation services provided.

Methods

Study design and setting: this was a cross-sectional study of individuals attending a clinic for anticoagulation therapy at Moi Teaching and Referral Hospital (MTRH) in Eldoret, Kenya. MTRH is the second-largest referral hospital in the country, serving the western region and offering a broad range of healthcare services. The research specifically focused on the anticoagulation clinic, which operates under the cardiology department. The clinic provides INR monitoring services for patients on anticoagulation therapy and has over 2,500 active patients. The setting was selected due to the availability of structured anticoagulation monitoring services, making it an ideal site for the study.

Eligibility criteria: participants aged 18 years and older were included to comply with legal consent requirements. Only patients who had been on anticoagulation therapy for at least 3 months between January and April 2024 were included. Additionally, patients with at least two INR readings were included to ensure familiarity with the monitoring process. Access to a phone for follow-up communication was also a requirement. Exclusion criteria included patients under 18 years of age due to the need for parental or guardian consent, patients with no record of anticoagulation therapy or fewer than two INR readings, and inactive patients who could not be contacted or whose follow-up was incomplete.

Sampling: the study used a non-probability consecutive sampling method chosen to minimize bias by including all eligible patients who met the inclusion criteria during the recruitment period. The consecutive sampling method allowed for a

clearer representation of the entire population attending the anticoagulation clinic. Data was collected over a 3-month period, with patients recruited during routine clinic visits. After obtaining written consent, the participants were included in the study.

Sample size: the required sample size was calculated using Slovin's formula at a 95% confidence level, where 282 patients were recruited for the study. Participants were identified through patient records at the anticoagulation clinic. Each patient received an introductory letter explaining the purpose of the study, the voluntary nature of participation, and the consent process. Written informed consent was obtained from all participants before data collection.

Data collection: data was collected through a pre-tested, researcher-administered questionnaire. The questionnaire was semi-structured to ensure clarity, accuracy, and completeness. It addressed the study's objectives, including patient demographics, anticoagulation therapy awareness, adherence to treatment, INR monitoring, and satisfaction with the anticoagulation services. To reduce bias, leading questions were avoided, and the questions were simple and clear to accommodate varying literacy levels among participants.

Data analysis: data was analyzed using R version 4.5.0 for both quantitative and qualitative data. The analysis process involved the first step, where descriptive statistics were calculated, including the mean, mode, and standard deviation, to summarize patient demographics, anticoagulation awareness, adherence, and satisfaction levels. Inferential statistics were then applied, using chi-square tests for categorical variables (gender, education level) and t-tests for continuous variables (age), with statistical significance set at $p < 0.05$. A stratified analysis was conducted to explore variations in satisfaction and adherence across different demographic groups. Age was categorized into predefined groups based on

clinical relevance to anticoagulation therapy outcomes and comparability with previous studies, allowing for meaningful subgroup analysis. Missing data were managed through deletion, where incomplete interviews were excluded from the analysis. Categorical variables were presented as frequencies and percentages, while continuous variables were analyzed using mean and standard deviation.

Ethical considerations and dissemination: the study adhered to ethical guidelines to ensure participant confidentiality and informed consent. Approvals were obtained from the National Commission for Science, Technology, and Innovation (NACOSTI), Ref No: 576180, AMREF University, and the MTRH Institutional Research Ethics Committee (IREC). Informed consent was obtained from all participants, ensuring they were aware of their right to withdraw from the study at any time. All data was kept confidential, with no personally identifiable information included in the analysis. Data is available on request.

Results

Demographics and clinical characteristics: the demographic profile of the study participants revealed a predominance of females, accounting for 71.7% ($n=205$), compared to 28.3% males ($n=81$), a statistically significant difference ($p < 0.001$). Participants spanned a broad age range, with the highest representation in the 30-39-year group (26.7%) and those aged above 50 years (29.9%). The 20-29-year age group had the lowest representation at 18.8%. Educational attainment varied widely, with tertiary-level education being most common (28.8%), followed closely by no formal education (27.1%). Participants received warfarin therapy for thromboembolic events, often alongside hypertension management (92.9%), with one participant (3.6%) treated for hypertension alone. Most underwent regular INR testing (88.2%), while some only at initiation (20.6%) and a few seldom (11.8%). When INR values were above the therapeutic range, 53.6% recognised the risk of bleeding, 28.6% reported

fatigue, and 17.9% experienced both; when below the range, 42.9% identified increased clotting risk, 21.4% reported skin rash, and 35.7% experienced both. Table 1 and Table 2 summarize the frequencies and percentages for gender, age, and education level.

Knowledge of anticoagulation: participants exhibited varying degrees of knowledge regarding anticoagulation therapy, assessed through both self-reported ratings and objective measures. Half of the participants, 47.8% of females and 48.2% of males, rated their knowledge as very good, with no statistically significant difference observed between genders ($p=0.5$). Most participants (89.7%) correctly identified the primary indication for anticoagulation therapy as the prevention of blood clot formation. Additionally, as represented in Table 3, 85.2% demonstrated an understanding of the role of the International Normalized Ratio (INR) test in monitoring therapy. Awareness of medication-related risks was also high, with 80% acknowledging the risk of bleeding when INR values are elevated, and 84.8% recognizing the increased risk of clot formation when INR values are low.

Adherence to anticoagulation therapy: adherence to anticoagulation therapy was assessed by exploring medication uptake, missed doses, and interactions with healthcare providers. Table 3 presents participant behaviors and attitudes related to medication adherence. A large majority (89.7%) reported taking their anticoagulation medication twice daily. However, 77.9% acknowledged that they missed at least one dose within the past month. Of those, most (73.5%) resumed with the next scheduled dose without consulting a healthcare provider.

While 63.8% of participants reported experiencing side effects, trust in healthcare providers remained high, with 88.3% expressing confidence in the information provided.

Warfarin management and dosage: medication preparation and administration practices varied

among participants. Most patients (26.1%) reported relying on healthcare professionals to prepare their anticoagulation medication, while a smaller proportion (4.4%) depended on relatives. The majority (69.5%) prepared and administered their own medication, demonstrating a degree of self-management but also exposing patients to potential dosing errors and safety risks without adequate guidance. A considerable number (77.9%) admitted to missing doses, and a notable portion reported taking excess doses of anticoagulants, raising concerns about the potential for complications such as bleeding. Additionally, 26.1% of participants expressed difficulty in adjusting their warfarin doses, indicating a need for more structured support and patient education in dose management.

Perspectives on accessibility, education, and service improvement: in addition to the quantitative findings, qualitative interviews with patients and healthcare providers highlighted three key areas influencing anticoagulation care that included accessibility, education, and service improvement. Accessibility challenges included long travel distances, limited clinic hours, and irregular service availability. As one patient explained, *“I travel more than three hours to reach the clinic, and I waited for more than 2 hours to get my INR results from the laboratory”* (female, 48 years), while another added, *“I waited the whole morning before being seen”* (female, 52 years). Gaps in education were also evident, with patients often struggling to understand warfarin dosing, side effects, and the importance of INR monitoring. A patient reflected, *“I don’t really know why they keep changing my dose, no one explained it to me”* (male, 60 years), and a provider observed, *“Most patients do not understand why INR is important, so adherence becomes a challenge”* (clinical officer). To address these issues, participants suggested service improvements such as extending clinic hours, enhancing community outreach, and providing patient-friendly educational materials. One patient recommended, *“If they could open the clinic on weekends, it would help people who work during*

the week” (male, 55 years), while a nurse emphasized, “We need leaflets in simple language so patients can remember what to do at home”.

Discussion

The study aimed to explore factors associated with the uptake of anticoagulation services at Moi Teaching and Referral Hospital (MTRH) in Eldoret, Kenya, with a specific focus on patient demographics, knowledge levels, medication adherence, and access to INR monitoring. A notable gender disparity was observed, with 71.7% of respondents being female. This suggests that women are more likely to seek healthcare services, a finding consistent with global patterns that indicate higher health-seeking behavior among women [25,26]. Additionally, the majority of participants were aged over 50, which corresponds with the increased risk of cardiovascular disease typically associated with advancing age [27]. Education level emerged as a significant predictor of both health literacy and engagement with care. Participants who had attained tertiary-level education demonstrated a better understanding of anticoagulation therapy and showed higher levels of engagement with the healthcare system [28].

With regard to knowledge levels related to anticoagulation, the study revealed a high awareness of the purpose of anticoagulant therapy, primarily its role in preventing blood clots. However, important gaps were identified. Some participants incorrectly believed that hypertension requires anticoagulation, indicating a need for better patient education on appropriate indications, findings that are consistent with Hoffmann's reporting of intervention [29]. There was also a limited understanding of bleeding risks and the importance of regular INR monitoring. Notably, participants with higher education levels had better knowledge scores, reinforcing the link between educational attainment and health literacy, consistent with findings from Nundy *et al.* on the practice of academic medicine in developing countries [30].

In terms of medication adherence and monitoring practices, the findings highlighted challenges in consistent use and comprehension of therapy. Approximately 78% of patients reported missing at least one dose of their medication, and many were unsure of their adherence patterns, indicating poor medication management consistent with global trends, notable from Seguin *et al.* strong structuration analysis of patterns of adherence to hypertension medication [31]. While general awareness of the need for INR testing was good, a significant number of participants lacked clarity on how frequently the test should be done and its clinical purpose. This limited understanding could undermine the safety and effectiveness of warfarin therapy, emphasizing the need for ongoing patient education and support to ensure proper adherence and monitoring. This is consistent with patterns observed on direct oral anticoagulants versus warfarin in the treatment of cerebral venous thrombosis [32].

The study offers several strengths that enhance the robustness and relevance of its findings. First, it provides focused, context-specific insights into the challenges and opportunities associated with anticoagulation care in a low-resource setting, conducted at Moi Teaching and Referral Hospital (MTRH), a major referral hospital in Kenya. This makes the findings highly relevant to similar institutions in Kenya and other sub-Saharan African countries. The study's comprehensive assessment of multiple factors, including patient demographics, knowledge levels, medication adherence, and access to INR monitoring, provides a holistic view of the complex barriers patients face in accessing anticoagulation services. Additionally, the use of real-world data from actual patients bridges the gap between theory and practice, offering practical insights that can inform future interventions in similar healthcare settings. The study is further strengthened by its alignment with established theoretical frameworks such as the Health Belief Model and Diffusion of Innovation Theory, providing a solid conceptual foundation for interpreting the factors influencing service uptake and patient behavior. Moreover, by

identifying critical gaps in patient knowledge, adherence, and misconceptions about anticoagulation therapy, the study underscores the need for patient-centered education and targeted interventions, making it a valuable contribution to improving healthcare practices and policies. Finally, the study's findings are particularly relevant to low- and middle-income countries (LMICs), contributing to the growing body of literature on health systems and patient care in resource-limited-constrained environments.

This study contributes to the growing body of literature that underscores the critical role of education, access, and patient-provider communication in the effective delivery of anticoagulation care, particularly in low- and middle-income countries (LMICs). The finding of low uptake of specialized anticoagulation services, despite the existence of an anticoagulation clinic, highlights the need for health system innovations to be complemented by robust community engagement and awareness campaigns. Similar findings were observed in other LMIC settings, where inadequate community awareness and health system barriers contributed to suboptimal utilization of anticoagulation services [15]. Drawing on the diffusion of innovation theory, which emphasizes the importance of awareness, persuasion, and perceived advantage in the adoption of new health services [33]. The study suggests that improving patient knowledge and perceptions about anticoagulation therapy is essential for increasing service uptake. In line with this, research from India and South Africa has demonstrated that enhancing patient education and outreach programs can significantly improve service uptake and adherence to anticoagulation therapy [5,31,32,34].

The observed high rates of missed doses and misconceptions about medication indications point to a critical need for patient-centered education, especially regarding the narrow therapeutic index of warfarin and the vital role of regular INR testing in ensuring effective and safe

treatment. These findings are consistent with previous studies that emphasize the importance of personalized education in managing patients on anticoagulation therapy [35]. For example, a study in Ethiopia found that a significant proportion of patients had limited understanding of their medication and its potential risks, leading to poor adherence and increased health risk [36]. Similarly, a study from Uganda noted that patient education and follow-up interventions significantly improved anticoagulation control and reduced medication errors [37]. These findings reinforce the importance of tailoring educational interventions to address common gaps in patient understanding, which could significantly improve adherence and clinical outcomes. This knowledge gap may be partly attributed to low literacy levels within the patient group, underscoring the need for simplified and easily understandable Information, Education, and Communication (IEC) materials tailored to the local context.

The findings from this study have moderate generalizability. Population-level factors such as age distribution and gender-related healthcare behavior are likely to reflect trends observed across Kenya and other similar low- and middle-income countries (LMICs), making the demographic insights applicable beyond MTRH. However, health system structures can vary significantly, and MTRH, being a referral hospital, offers more specialized services than other Kenyan facilities. As such, results related to service access and monitoring may not fully apply to lower-tier health centers that lack INR testing or trained anticoagulation staff [38]. Furthermore, findings related to patient knowledge and adherence behaviors, particularly those influenced by education level and geographic access, are likely to mirror conditions in other low-resource settings. While caution is necessary when applying institutional findings universally, the core patient-centered insights on knowledge, adherence, and barriers are widely relevant to anticoagulation programs across sub-Saharan Africa and similar healthcare contexts [39].

Several limitations should be considered when interpreting the results of this study. First, the study's single-center design, conducted solely at Moi Teaching and Referral Hospital (MTRH), limits the generalizability of the findings to broader Kenyan or regional patient populations. As the study was based on a single hospital setting, it may not accurately reflect the diversity of patient experiences or healthcare infrastructures across other regions. This limitation could result in either an overestimation or an underestimation of service uptake in areas with differing healthcare resources or patient demographics.

Second, the study relied on self-reported data for both knowledge levels and medication adherence. This introduces the possibility of recall bias, where patients may not accurately remember or report their behaviors, and social desirability bias, where participants may overstate their adherence to prescribed treatments or their understanding of anticoagulation therapy. As a result, there may be an inflation of knowledge scores and an underreporting of non-adherence, which could skew the findings. Third, the cross-sectional nature of the study design limits the ability to draw causal inferences or assess changes over time. This snapshot approach provides valuable information about the current state of anticoagulation service uptake, but it does not allow for an analysis of how patient knowledge, adherence, or access to monitoring may evolve. Longitudinal studies would be necessary to track changes in patient behaviors and attitudes over an extended period.

Lastly, potentially influential factors such as socioeconomic status, cultural practices, or provider-level factors, like the quality of counseling provided to patients, were outside the scope of this study. These variables could play a significant role in shaping patients' understanding of anticoagulation therapy and their adherence to prescribed treatments. The absence of these variables in the analysis may obscure key barriers to effective care and limit the depth of the findings.

Despite these limitations, the internal consistency of the findings with global literature and their alignment with established theoretical models, such as the health belief model and the diffusion of innovation theory, lend confidence to the observed trends. These frameworks support the study's conclusions and suggest that the observed patterns in knowledge, adherence, and healthcare utilization are likely reflective of broader trends in similar settings. Similarly, the alignment of the results with previous research from other LMICs and established frameworks, such as the WHO's patient safety model [23]. Strengthens the credibility of the study's conclusions.

Conclusion

This study provides valuable insights into the factors influencing the uptake of anticoagulation services at Moi Teaching and Referral Hospital (MTRH) in Eldoret, Kenya. A significant gender disparity was found, with more women seeking anticoagulation services, which aligns with global trends of higher health-seeking behavior among women. Older individuals, particularly those over 50, were more likely to access these services, likely due to the increased risk of cardiovascular disease with age. Education level also played a role in understanding anticoagulation therapy, with those with higher education showing better knowledge. Despite the presence of a specialized anticoagulation clinic, many patients preferred MTRH for its perceived accessibility and trust. While most participants understood the purpose of anticoagulation, misconceptions about its use and the need for INR monitoring were common. Medication adherence was moderate, with many patients missing doses, but there was a high level of trust in healthcare providers. Overall satisfaction with the service was high, but the study highlighted the need for better education and support to improve adherence and address knowledge gaps.

What is known about this topic

- Patient-level factors such as knowledge, health literacy, and perceptions about anticoagulation therapy influence adherence and service utilization;
- Health system challenges, including drug availability, provider communication, and facility accessibility, significantly impact the uptake of anticoagulation services in low-resource settings;
- Sociodemographic characteristics-age, gender, education, and income-affect health-seeking behaviors and chronic disease management.

What this study adds

- Identifies both patient- and institutional-level barriers to anticoagulation service uptake at Moi Teaching and Referral Hospital (MTRH), including knowledge gaps, medication adherence issues, and service accessibility concerns;
- Highlights a preference for general outpatient services over specialized anticoagulation clinics, suggesting the need to address awareness, trust, and access to specialized care;
- Reveals inconsistencies in patient understanding of anticoagulant use, underlining the importance of targeted education interventions to support informed and consistent care.

Competing interests

The authors declare no competing interests.

Authors' contributions

Samuel Khacheso Nyanje had full access to all the data in the study and took full responsibility for the integrity of the data and accuracy of the data analysis, and conceptualized and designed the study, with the guidance of Peter Suwirakwenda Nyasulu, Kefa Bosire, and Imran Manji; raw data were available to Samuel Khacheso Nyanje;

collection, analysis, and interpretation of data were carried out by Samuel Khacheso Nyanje; statistical analysis was performed by Dennis Njenga; the drafting of the manuscript was done by Samuel Khacheso Nyanje; critical review and appraisal of the manuscript were conducted by Samuel Khacheso Nyanje, Peter Suwirakwenda Nyasulu, Imran Manji, Kefa Bosire, Mercy Atieno Oduor, and Benson Milimo; administrative support and coordination were provided by Samuel Khacheso Nyanje and Imran Manji; supervision of study activities was carried out by Samuel Khacheso Nyanje. All the authors read and approved the final version of this manuscript.

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Tables

Table 1: demographic characteristics of individuals seeking anticoagulation services at Moi Teaching and Referral Hospital, from January 2024 to January 2025 (N=282)

Table 2: knowledge levels on anticoagulation therapy across different demographic groups among patients attending the clinic at Moi Teaching and Referral Hospital, from January 2024 to January 2025 (N=282)

Table 3: participant understanding of clinical indications for anticoagulation therapy among patients attending the clinic at Moi Teaching and Referral Hospital, from January 2024 to January 2025 (N=282)

References

1. World Health Organization. Cardiovascular diseases (CVDs). 2025. Accessed 4th June, 2025.

2. Hindricks G, Potpara T, Dagres N, Arbelo E, Bax JJ, Blomstrom-Lundqvist C *et al.* 2020 ESC Guidelines for the diagnosis and management of atrial fibrillation developed in collaboration with the European Association for Cardio-Thoracic Surgery (EACTS): The Task Force for the diagnosis and management of atrial fibrillation of the European Society of Cardiology (ESC) Developed with the special contribution of the European Heart Rhythm Association (EHRA) of the ESC. *Eur Heart J.* 2021 Feb 1;42(5):373-498. **PubMed** | **Google Scholar**
3. Obamiro KO, Chalmers L, Lee K, Bereznicki BJ, Bereznicki LRE. Anticoagulation knowledge in patients with atrial fibrillation: An Australian survey. *Int J Clin Pract.* 2018 Mar;72(3):e13072. **PubMed** | **Google Scholar**
4. Hohnloser SH, Basic E, Nabauer M. Changes in Oral Anticoagulation Therapy over One Year in 51,000 Atrial Fibrillation Patients at Risk for Stroke: A Practice-Derived Study. *Thromb Haemost.* 2019 Jun;119(6):882-893. **PubMed** | **Google Scholar**
5. Sanf elix-Gimeno G, Rodr iguez-Bernal CL, Hurtado I, Baix uli-P erez C, Librero J, Peir  S. Adherence to oral anticoagulants in patients with atrial fibrillation population-based retrospective cohort study linking health information systems in the Valencia region, Spain: a study protocol. *BMJ Open.* 2015 Oct 19;5(10):e007613. **PubMed** | **Google Scholar**
6. Ruff CT, Giugliano RP, Braunwald E, Hoffman EB, Deenadayalu N, Ezekowitz MD *et al.* Comparison of the efficacy and safety of new oral anticoagulants with warfarin in patients with atrial fibrillation: a meta-analysis of randomised trials. *Lancet.* 2014 Mar 15;383(9921):955-62. **PubMed** | **Google Scholar**
7. Pirmohamed M. Warfarin: almost 60 years old and still causing problems. *Br J Clin Pharmacol.* 2006 Nov;62(5):509-11. **PubMed** | **Google Scholar**
8. Barnes GD, Nallamotheu BK, Sales AE, Froehlich JB. Reimagining Anticoagulation Clinics in the Era of Direct Oral Anticoagulants. *Circ Cardiovasc Qual Outcomes.* 2016 Mar;9(2):182-5. **PubMed** | **Google Scholar**
9. Brais C, Laroche J, Turgeon MH, Blais L, Farand P, Perreault S *et al.* Predictors of Direct Oral Anticoagulants Utilization for Thromboembolism Prevention in Atrial Fibrillation. *J Pharm Pharm Sci.* 2017;20:8-14. **PubMed** | **Google Scholar**
10. Clarkesmith DE, Lip GYH, Lane DA. Patients' experiences of atrial fibrillation and non-vitamin K antagonist oral anticoagulants (NOACs), and their educational needs: A qualitative study. *Thromb Res.* 2017 May;153:19-27. **PubMed** | **Google Scholar**
11. Ebrahim I, Bryer A, Cohen K, Mouton JP, Msemburi W, Blockman M. Poor anticoagulation control in patients taking warfarin at a tertiary and district-level prothrombin clinic in Cape Town, South Africa. *S Afr Med J.* 2018 May 25;108(6):490-494. **PubMed** | **Google Scholar**
12. Jorgensen AL, Orrell C, Waitt C, Toh CH, Sekaggya-Wiltshire C, Hughes DA *et al.* A "Bundle of Care" to Improve Anticoagulation Control in Patients Receiving Warfarin in Uganda and South Africa: Protocol for an Implementation Study. *JMIR Res Protoc.* 2023;12:e46710. **PubMed** | **Google Scholar**
13. Elewa H, Jalali F, Khudair N, Hassaballah N, Abdelsamad O, Mohammed S. Evaluation of pharmacist-based compared to doctor-based anticoagulation management in Qatar. *J Eval Clin Pract.* 2016 Jun;22(3):433-8. **PubMed** | **Google Scholar**
14. Alghadeer S, Alzahrani AA, Alalayet WY, Alkharashi AA, Alarifi MN. Anticoagulation Control of Warfarin in Pharmacist-Led Clinics Versus Physician-Led Clinics: A Prospective Observational Study. *Risk Manag Healthc Policy.* 2020 Aug 17;13:1175-1179. **PubMed** | **Google Scholar**

15. Zühlke L, Engel ME, Karthikeyan G, Rangarajan S, Mackie P, Cupido B *et al.* Characteristics, complications, and gaps in evidence-based interventions in rheumatic heart disease: the Global Rheumatic Heart Disease Registry (the REMEDY study). *Eur Heart J.* 2015 May 7;36(18):1115-22a. **PubMed** | **Google Scholar**
16. Strandvik G, El-Menyar A, Asim M, Galwankar S, Al-Thani H. Clinical Characteristics, Management Practices, and In-hospital Outcomes among Trauma Patients with Venous Thromboembolism. *J Emerg Trauma Shock.* 2020 Apr-Jun;13(2):124-130. **PubMed** | **Google Scholar**
17. Tasamma AT, Bukate TA, Mehadi A, Handiso BT, Kassa BY, Hassen EO *et al.* Assessing the Comparative Efficacy and Safety of Warfarin and Rivaroxaban for Cancer Associated Thrombosis: Experience From a Resource Limited Setting. *Cancer Rep (Hoboken).* 2025 Jan;8(1):e70105. **PubMed** | **Google Scholar**
18. Cohen A, Keshishian A, Lee T, Wygant G, Rosenblatt L, Hlavacek P *et al.* Effectiveness and Safety of Apixaban, Low-Molecular-Weight Heparin, and Warfarin among Venous Thromboembolism Patients with Active Cancer: A U.S. Claims Data Analysis. *Thromb Haemost.* 2021 Mar;121(3):383-395. **PubMed** | **Google Scholar**
19. Danwang C, Temgoua MN, Agbor VN, Tankeu AT, Noubiap JJ. Epidemiology of venous thromboembolism in Africa: a systematic review. *J Thromb Haemost.* 2017 Sep;15(9):1770-1781. **PubMed** | **Google Scholar**
20. Hirsh J. Low-molecular-weight heparin: A review of the results of recent studies of the treatment of venous thromboembolism and unstable angina. *Circulation.* 1998;98(15):1575-82. **PubMed** | **Google Scholar**
21. Davis NJ, Billett HH, Cohen HW, Arnsten JH. Impact of adherence, knowledge, and quality of life on anticoagulation control. *Ann Pharmacother.* 2005 Apr;39(4):632-6. **PubMed** | **Google Scholar**
22. Mouton JP, Blockman M, Sekaggya-Wiltshire C, Semakula J, Waitt C, Pirmohamed M *et al.* Improving anticoagulation in sub-Saharan Africa: What are the challenges and how can we overcome them? *Br J Clin Pharmacol.* 2021 Aug;87(8):3056-3068. **PubMed** | **Google Scholar**
23. Scanlon ML. AMPATH Kenya Research Retreat Summary Report January 15-16 2024. Accessed 4th June, 2025.
24. Kagansky N, Knobler H, Rimon E, Ozer Z, Levy S. Safety of anticoagulation therapy in well-informed older patients. *Arch Intern Med.* 2004 Oct 11;164(18):2044-50. **PubMed** | **Google Scholar**
25. Galdas PM, Cheater F, Marshall P. Men and health help-seeking behaviour: literature review. *J Adv Nurs.* 2005 Mar;49(6):616-23. **PubMed** | **Google Scholar**
26. Tavares RM, Mendelsohn A, Grossman Y, Williams CH, Shapiro M, Trope Y *et al.* A Map for Social Navigation in the Human Brain. *Neuron.* 2015;87(1):231-43. **PubMed** | **Google Scholar**
27. Falkenreck C, Wagner R. The Internet of Things - Chance and challenge in industrial business relationships, Industrial Marketing Management. *Industrial Marketing Management.* 2017 Oct 1;66:181-95. **Google Scholar**
28. Semigran HL, Levine DM, Nundy S, Mehrotra A. Comparison of Physician and Computer Diagnostic Accuracy. *JAMA Intern Med.* 2016 Dec 1;176(12):1860-1861. **PubMed** | **Google Scholar**
29. Hoffmann TC, Glasziou PP, Boutron I, Milne R, Perera R, Moher D *et al.* Better reporting of interventions: template for intervention description and replication (TIDieR) checklist and guide. *BMJ.* 2014 Mar 7;348:g1687. **PubMed** | **Google Scholar**
30. Nundy S, Kakar A, Bhutta ZA. How to Practice Academic Medicine and Publish from Developing Countries?: a practical guide. Springer Nature. 2022. **Google Scholar**

31. Seguin M, Mendoza J, Lasco G, Palileo-Villanueva LM, Palafox B, Renedo A *et al.* Strong structuration analysis of patterns of adherence to hypertension medication. *SSM Qual Res Health.* 2022 Dec;2: None. **PubMed** | **Google Scholar**
32. Yaghi S, Shu L, Bakradze E, Salehi Omran S, Giles JA, Amar JY *et al.* Direct Oral Anticoagulants Versus Warfarin in the Treatment of Cerebral Venous Thrombosis (ACTION-CVT): A Multicenter International Study. *Stroke.* 2022 Mar;53(3):728-738. **PubMed** | **Google Scholar**
33. Roberts R, Edwards M. Overcoming Resistance to Service-Learning's Use in the Preparation of Teachers for Secondary Agricultural Education: A Reframing of the Method's Diffusion Challenges. *Journal of International Agricultural and Extension Education.* 2020;27(1):15-33. **Google Scholar**
34. Ageno W, Gallus AS, Wittkowsky A, Crowther M, Hylek EM, Palareti G. Oral anticoagulant therapy: Antithrombotic Therapy and Prevention of Thrombosis, 9th ed: American College of Chest Physicians Evidence-Based Clinical Practice Guidelines. *Chest.* 2012 Feb;141(2 Suppl):e44S-e88S. **PubMed** | **Google Scholar**
35. Albarqouni L, Glasziou P, Hoffmann T. Completeness of the reporting of evidence-based practice educational interventions: a review. *Med Educ.* 2017 Feb;52(2):161-170. **PubMed** | **Google Scholar**
36. Ayele AA, Emiru YK, Tiruneh SA, Ayele BA, Gebremariam AD, Tegegn HG. Level of adherence to dietary recommendations and barriers among type 2 diabetic patients: a cross-sectional study in an Ethiopian hospital. *Clin Diabetes Endocrinol.* 2018 Nov 29;4:21. **PubMed** | **Google Scholar**
37. Mwangi JM, Kariuki MI, Muturi PG. Influence of Strategic Planning on Performance of State Corporations In Kenya. *International Journal of Scientific and Research Publications (IJSRP).* 2020;10:457-62.
38. Dorje T, Zhao G, Tso K, Wang J, Chen Y, Tsokey L *et al.* Smartphone and social media-based cardiac rehabilitation and secondary prevention in China (SMART-CR/SP): a parallel-group, single-blind, randomised controlled trial. *Lancet Digit Health.* 2019 Nov;1(7):e363-e374. **PubMed** | **Google Scholar**
39. Chong KE, Shorey S. Barriers in adopting health-promoting behaviours among nurses: A qualitative systematic review and meta-synthesis. *Int J Nurs Practice.* 2022;28(1):e13030. **PubMed** | **Google Scholar**

Table 1: demographic characteristics of individuals seeking anticoagulation services at Moi Teaching and Referral Hospital, from January 2024 to January 2025 (N=282)

Category	Count N (%)	P-value
Gender		
Female	205 (71.7)	P<0.001
Male	81 (28.3)	
Age bracket		
20-29 years	54 (18.8)	P<0.04
30-39 years	77 (26.7)	
40-49 years	68 (23.6)	
Above 50 years	86 (29.9)	
Education Level		
High school	12 (4.2)	P<0.001
Primary school	29 (10.1)	
No formal education	78 (27.1)	
Tertiary/college	83 (28.8)	

Table 2: knowledge levels on anticoagulation therapy across different demographic groups among patients attending the clinic at Moi Teaching and Referral Hospital, from January 2024 to January 2025 (N=282)

Group	Very poor N (%)	Poor N(%)	Fair N(%)	Good N(%)	Very good N(%)	p
Gender						
Female	0 (0)	8 (3.9)	34 (16.6)	50 (24.5)	98 (47.8)	0.5
Male	1 (1.2)	3 (3.7)	11 (13.6)	24 (29.6)	39 (48.2)	
Education Level						
No education	0 (0)	4 (5.1)	21 (26.9)	21 (26.9)	27 (34.6)	0.06
Primary education	0 (0)	0 (0)	1 (3.5)	6 (20.7)	20 (68.9)	
High school	0 (0)	4 (4.8)	13 (15.5)	21 (25.0)	44 (52.4)	
University education	1 (1.20)	3 (3.6)	10 (12.1)	24 (28.9)	42 (50.6)	
Age bracket						
20-29	0 (0)	1 (1.5)	9 (13.3)	17 (25.0)	21 (40.4)	0.23
30-39	1 (1.5)	4 (5.9)	6 (8.9)	16 (23.9)	47 (70.2)	
40-49	0 (0)	3 (4.4)	11 (16.2)	15 (22.1)	34 (50.0)	
Above 50	0 (0)	3 (3.5)	18 (20.9)	26 (30.2)	35 (44.4)	

Table 3: participant understanding of clinical indications for anticoagulation therapy among patients attending the clinic at Moi Teaching and Referral Hospital, from January 2024 to January 2025 (N=282)

Category	Response	p-value
Indications for anticoagulation		
Those who have a blood clot or are a blood clot from forming	260(0.897)	P<0.001
Those who have hypertension (high blood pressure)	1(0.003)	
Purpose of the INR test		
That is used to monitor anticoagulation medicine like warfarin therapy	247(0.852)	P<0.001
That is seldom done while on warfarin	31(0.107)	
INR value impact		
He will be drowsy and fatigued from the medication	232(0.8)	P<0.001
He will be at risk of bleeding	37(0.128)	
Risks of INR value		
He will be at an increased risk of developing a blood clot	240(0.828)	P<0.001
He will be at an increased risk of bleeding	39(0.135)	
When to seek help		
When I experience nosebleeds that cannot be controlled	239(0.824)	P<0.001
When I bleed in my gums while brushing my teeth	46(0.159)	
Who to inform		
A doctor prescribing medication, a dentist who is set to do a tooth extraction, or a doctor stopping medication	167(0.576)	P<0.001
A dentist who is set to do a tooth extraction	29(0.1)	
Identifying medication		
Color, marking on the tablet	251(0.866)	
Interactions with warfarin		
Medication, alcohol, food, and herbal supplements	159(0.548)	
Preferred time for medication		
During lunchtime	1(0.003)	
Missed dose protocol		
Just skip the dose	158(0.545)	P<0.001
Inform the health care specialist at the anticoagulation clinic when going for INR	42(0.145)	
INR: International Normalized Ratio		