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Knowledge, Attitude, Practice, and Clinical Outcomes Regarding Oral Anticoagulants among Patients with Atrial Fibrillation: A Scoping Review

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Research Article

Keywords: atrial fibrillation, oral anticoagulant, patients' knowledge, health literacy, medication adherence, stroke prevention

Posted Date: February 27th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-8730688/v1

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Additional Declarations: No competing interests reported.

Abstract

Background: Atrial fibrillation (AF), the most common sustained arrhythmia, has an estimated prevalence of 2% to 4% in the global population and increases stroke risk fivefold. Oral anticoagulants (OACs), which include vitamin K antagonists (VKAs) and direct OACs (DOACs), are critical for thromboembolic prevention. Nevertheless, patient knowledge, attitudes, and practices (KAP) deficits perpetuate a lack of compliance. Underutilization and unsatisfactory outcomes disproportionately affect socioeconomically disadvantaged groups.

Aim: To map the existing literature evaluating KAP and associated clinical outcomes among adults with AF receiving OACs.

Methods: Guided by Arksey and O'Malley's framework and Preferred reporting items for systematic review and meta-analysis extension for scoping reviews (PRISMA-ScR), this scoping review included results of a comprehensive search of PubMed/MEDLINE, Scopus, ScienceDirect, and CINAHL (1 January 2020–20 October 2025) for the above English-language studies with quantitative, qualitative, and mixed-methods designs. Search strategy was based on the PCC framework (population, concept, context) with keywords. Finally, 13 relevant studies underwent narrative synthesis and inductive thematic analysis to identify patterns, predictors, and intervention effects, following the Joanna Briggs Institute (JBI) approach.

Results: The predominant knowledge gaps (62-66% inadequate comprehension of adverse effects, monitoring, and interactions) were more prevalent in DOAC than VKA users, with knowledge affecting attitudes and adherence. While deficient KAP was associated with an increased risk of stroke, adequate knowledge was associated with a significant reduction in risk (adjusted hazard ratios 0.03–0.46 for knowledge-attenuated events). Sociodemographic imbalances (low education, advanced age, deprivation) exacerbated disparities; tailored treatments (e.g., pharmacist-led counselling, digital platforms) minimized gaps by 34-66%, increasing satisfaction and self-management.

Conclusions: KAP deficits are modifiable predictors of AF morbidity, highlighting systemic disparities in OACs therapy. Equity-oriented, multipronged methods that combine organized education, digital innovations, and provider training show potential for increasing adherence and reducing problems. Prospective, multicenter trials are necessary to clarify causal processes, scale interventions, and incorporate novel medicines (e.g., factor XI inhibitors), thus easing the escalating worldwide burden.

Introduction

Atrial fibrillation (AF) is the most prevalent sustained cardiac arrhythmia globally, affecting approximately 37 million people worldwide with a 33% increase in incidence over the past two decades [1-3]. The global prevalence is estimated at 2-4% in the general population, though the true burden is likely underestimated due to frequently undiagnosed cases, particularly in aging population and region with limited health infrastructure[4]. Regional projection indicates substantial disease burden; >15 million cases are expected in the United States by 2025 and ~17 million in Europe by 2026 [5-8].

AF clinically significant extends beyond prevalence estimates. The condition is associated with a five–fold increase in stroke risk contributing to 15 – 20 % of ischemic strokes globally and represents a major cause of long-term disability and death [2, 9, 10] . Current management guidelines prioritize three key goals: stroke prevention, symptoms control, and improvement of quality of life in AF management. oral anticoagulants (OACs),

including vitamin K antagonists (VKAs) such as warfarin and direct oral anticoagulation (DOACs; apixaban, dabigatran, edoxaban, and rivaroxaban), remain central to thromboembolic prevention [11-14]. Despite their proven efficacy, appropriate OAC utilization is complicated by factors such as under-prescription, non-adherence, lack of health literacy, and clinical complexities including bleeding risk and medication interactions [15-18]. Additionally, patients face significant challenges in understanding their condition, the risk and benefits of OAC therapy, and the impact on daily life, which can lead to distress and lower quality of life [18-21] .

In clinical practice, substantial gaps persist in patients' knowledge, attitudes, and practices (KAP) regarding oral anticoagulation, Studies consistently demonstrate that patients have inadequate knowledge about OACs, suboptimal attitude toward medication adherence, non- proactive self-management behaviors. These deficits correlate with poor clinical outcomes, particularly elevated stroke risk [4,7,12,21,22]. Conversely, evidence indicates that enhancing health literacy and patient education-especially among those with lower socioeconomic status or limited formal education- has demonstrated improvement in medication adherence, patient satisfaction and clinical outcomes [21,23,24].

The growing global burden of AF necessitates comprehensive synthesis of current evidence on patients KAP regrading OAC and associated clinical consequences [25-27]. Understanding these patterns is essential for identifying intervention opportunities and reducing preventable complication, Therefore, this scoping review aims to map the current evidence on knowledge, attitudes, and practices regarding oral anticoagulant use among patients with atrial fibrillation, identify barriers to optimal therapy, highlight knowledge gaps, and explore how KAP influences clinical outcomes such as stroke, bleeding, and mortality.

Methods

This study was conducted as a scoping review to systematically map existing evidence on knowledge, attitudes, and practices (KAP) regarding oral anticoagulants among patients with atrial fibrillation and their association with clinical outcomes. The methodology followed the five-stage framework developed by Arksey and O'Malley [28]. The primary objective is to map the existing literature evaluating KAP and associated clinical outcomes among adults with AF receiving OACs.

Review question

This scoping review was guided by the following research question: What is known from the existing literature about the knowledge, attitudes, and practices of patients with atrial fibrillation using oral anticoagulants, and how do these factors relate to clinical outcomes?

Search Strategy and Data Sources

A comprehensive search was conducted across four major electronic databases: PubMed/MEDLINE, Scopus, ScienceDirect, and CINAHL (Cumulative Index to Nursing and Allied Health Literature). The search covered publications from 1 January 2020 to 20 October 2025 with this time frame selected to capture contemporary evidence in this rapidly evolving field.

Search terms were combined using Boolean operators (AND, OR) and included the following keywords: ("atrial fibrillation" OR "AF") AND ("anticoagulants" OR "warfarin" OR "DOAC" OR "direct oral anticoagulants" OR "novel oral anticoagulants" OR "NOAC" OR "vitamin K antagonists" OR "VKA") AND ("knowledge" OR "attitude" OR "practice"

OR "KAP" OR "awareness" OR "adherence" OR "compliance") AND ("clinical outcomes" OR "stroke" OR "bleeding" OR "mortality" OR "thromboembolic events").

The final electronic database search was completed on October 20, 2025. A total of 576 records were initially identified. In addition to electronic database searching, hand-searching of reference lists from all included studies and relevant systematic reviews was performed to identify additional eligible studies.

Eligibility Criteria

Studies were selected according to the Population-Concept-Context (PCC) framework:

Population:

• Adult patients (≥18 years) diagnosed with atrial fibrillation and prescribed oral anticoagulants

Concept:

• Knowledge, attitudes, and practices (KAP) regarding OAC therapy

• Clinical outcomes (stroke, bleeding, mortality, quality of life)

Context:

• Any healthcare setting

• Published 1 January 2020 to 20 October 2025

• English-language peer-reviewed studies

• All study designs

Exclusion Criteria:

• Studies focusing solely on healthcare providers without patient involvement

• Animal studies or in vitro research

• Studies not addressing KAP aspects of oral anticoagulation

Study Selection and Screening Process

The study selection process followed a two-stage approach. In the first stage, two independent reviewers (O.A. and Y.A.) screened titles and abstracts of all retrieved records against the predefined eligibility criteria. Studies that clearly did not meet the inclusion criteria were excluded at this stage.

In the second stage, full-text articles of potentially eligible studies were independently assessed for final inclusion. Before formal screening commenced, 110 records were removed for the following reasons: 10 duplicate records were identified through deduplication processes, 78 records were marked as ineligible by automation tools based on publication type or language, and 22 records were removed for other reasons,

including retracted articles or unavailable full texts. This resulted in 466 unique records for title and abstract screening.

Any discrepancies or disagreements between the two reviewers regarding study eligibility were resolved through careful discussion and re-examination of the study. A third senior researcher (S.A.) was available to arbitrate if consensus could not be reached, although this was not required. The complete study selection process is illustrated in the Preferred reporting items for systematic review and meta-analysis extension for scoping reviews (PRISMA-ScR) flow diagram **(Figure 1),** which details the number of records at each stage. PRISMA-ScR does not require study protocols to be prospectively registered. A completed PRISMA-ScR reporting checklist and search strings are provided as a supplementary file to demonstrate compliance with all recommended reporting items.

Data extraction

Data extraction was conducted independently by two reviewers (O.A. and Y.A.) using a standardized data extraction form that was piloted on three randomly selected studies to ensure clarity and consistency. The following data elements were systematically extracted from each included study: author and publication year, study purpose, study design, setting and geographic location, sample size, population characteristics, KAP components assessed (including measurement instruments or custom questionnaires), clinical outcomes reported, and main findings. The measuring instruments included anticoagulation knowledge test (AKT), Jessa atrial fibrillation knowledge questionnaire (JAKQ) and Morisky medication adherence scale (MMAS). Extracted data were compiled and organized in **Table 1** to provide a comprehensive summary of all included studies.

Table 1: Summary of 13 studies included in this review.

Author / year	Purpose	Settings	Sample size	Study design	Main findings
Zahid (2020) [29]	Assess knowledge of OAC and side effects among patients	Civil hosp Karachi & National Institute of Cardio-vascular Disease, Pakistan	207	Quantitative, multicenter-cross sectional using AKT	Poor overall knowledge (66.7% unaware of side effects; >75% unaware of warfarin target INR) Higher education associated with better knowledge scores
Elkerdaw (2022) [30]	Assess knowledge and adherence to OAC in AF patients	Outpatient cardiac clinics, Elmery hosp, Alexanderia U., Egypt	55	Descriptive exploratory cross sectional; MMAS for adherence	63.6% had unsatisfactory knowledge; adherence: high 50.9%, medium 29.1%, low 20%; knowledge correlated positively with adherence; age, education, regimen linked to knowledge/adherence.
Alajami (2021) [31]	Evaluate anticoagulation knowledge among Saudi AF patients on OAC	Tertiary care, king Saudi U. medical city, Riyadh, Saudi Arabia	290	Cross sectional survey using AKT	67.2% had adequate overall knowledge by ≥50% cut-off; warfarin users scored higher than DOAC users; increasing age predicted lower knowledge (-0.08/year)
Konieczynska (2022) [32]	Examine association between AF/OAC knowledge and clinical outcomes	Outpatients' clinic, john Paul II hosp, Krakow, Poland	174	Prospective cohort; baseline JAKQ; median 42 months FU	Lower JAKQ associated with composite endpoint (thromboembolism, bleeding, death); specific knowledge items predicted fewer events; worse knowledge, longer OAC use, higher CHA2DS2-VASc predicted events.
Li (2023) [7]	Assess KAP toward OACs among AF patients	China-Japan union hosp, Changchun China (web-based)	491	Cross sectional KAP questionnaire	Inadequate knowledge (mean 4.64/20), suboptimal attitude, inactive practice; higher education/income & longer AF duration associated with better knowledge; knowledge associated with better attitude/practice
Ye (2025) [33]	Explore KAP toward AF among patients	Lishui central hosp, China	486	Online cross sectional; KAP with	Poor knowledge, positive attitude, proactive practices; knowledge directly

				SEM mediation	improved attitude/practice; age (-), education (+), marital status (+) influenced KAP; drinking negatively impacted practice.
Li, Liu & Zhu (2024) [34]	KAP of AF in high altitude general population	High-altitude regions (China), online survey	786	Cross sectional; KAP with SEM	Adequate knowledge, positive attitude, proactive practices; knowledge and attitude independently predicted proactive practice; never smoking associated with better practice.
Chen (2025) [35]	KAP of geriatricians re; OAC for elderly AF	China; online survey of geriatricians	210 physicians	Cross sectional KAP survey	Knowledge average 9.84/14; younger (≤40), outside Beijing, non-public tertiary hospitals had lower knowledge; knowledge correlated with positive attitudes; 5-10 years experiences and knowledge associated with practices
Moudallel (2022) [36]	Assess DOAC adherence, satisfaction, knowledge over time.	UZ Brussel, Belgium; tertiary hosp	164 at baseline, 128 at 3 mos, 101 at 6 mos	Prospective longitudinal; MARS-5 adherence; SAFUCA satisfaction; JAKQ subset	Suboptimal adherence ~41-43% at 3-6 months; satisfaction high; knowledge and satisfaction not associated with adherence over 6 mos; strong correlation between satisfaction & knowledge
Metaxas (2020) [37]	Assess OAC knowledge during pharmacy medication review and 2 week FU	Swiss community pharmacies; PMC service	81	Cross sectional with FU (2 weeks)	Knowledge gaps decreased from 66% to 31.3% after counseling; NOAC users had more gaps than VKA; high patient satisfaction with pharmacist counseling.
Abdul-hameed (2022) [38]	Assess AF and anticoagulant knowledge and sociodemographic association	Al-Nasiriya heart center, Thi-Qar. Iraq	90	Descriptive cross sectional JAKQ (adapted)	62.2% poor knowledge; better knowledge in younger, higher education, employed; no gender/residence effect.
Ionnidis (2021) [39]	Assess AF/DOAC knowledge (JAKQ) in Greek AF patients on DOACs	Outpatient clinics, city hosp Thessaloniki, Greece	285	Cross sectional; JAKQ (Greek validation)	Mean JAKO 57.2% (medium); more schooling and longer AF duration associated with higher scores; major gaps on

					painkiller choice and missed dose; patients desired more information.
Khanal (2024) [4]	Evaluate anticoagulation knowledge and adherence in Nepalese AF patients on OAC	Dhulikhel hosp, Nepal	114 (93 on OAC)	Descriptive cross sectional; AKT and ACDS	Only 48% had adequate AKT knowledge;83.9% high adherence; OAC duration associated with adequate knowledge

ACDS: adherence to compliance drug scale, **AF:** atrial fibrillation, **AKT**: anticoagulation knowledge test, **FU**: follow-up, **Hosp:** hospital, **INR:** international normalized ratio, **JAKQ:** Jessa atrial fibrillation knowledge questionnaire**, KAP:** knowledge, attitude, and practice**, MMAS:** Morisky medication adherence scale,MARS-5:medication adherence report scale, **mos**: months, **NOAC/DOAC**: Novel/directed oral anticoagulant, **OAC**: oral anticoagulant, **PMC:** pharmacy medication check, **SAFUCA:** satisfaction with anticoagulant care questionnaire, **SEM:** structural equation modeling, **U**: university, **VKA:** vitamins K antagonists.

Quality assessment

Scoping reviews do not formally assess study quality, consistent with scoping methodology. Hence, no formal critical appraisal or risk of bias assessment was conducted. However, source credibility and potential bias were considered in data extraction and interpretation of findings to ensure the reliability of reported evidence.

Results

This scoping review synthesized findings from 13 studies (published 2020–2025) that looked at KAP regarding OACs in AF patients and the related clinical outcomes. Thematic analysis was employed inductively to derive patterns from the main findings using four main themes as follows [40]. These themes highlight enduring gaps in patient knowledge, dynamic connections among KAP categories, multidimensional predictors, and practical ramifications for managing AF. Study-specific examples of transparency are included in the theme presentation of narrative synthesis.

Knowledge deficits and variability about OACs drug

It is crucial to understand patients' existing knowledge regarding OACs to prevent adverse effect. Therefore, assessing current patient knowledge is the foundational step in developing interventions aimed at enhancing the quality of OAC use. The majority of studies in this scoping review consistently recorded widespread inconsistencies in OAC knowledge, characterized by frequent deficits in core aspects such as side effects, monitoring parameters like INR, and effective dosing management [7, 29, 30, 33, 38]. This variability demonstrates a primary lack of comprehension, with pockets of sufficiency emerging in certain contexts. Specifically, although there was typically a general understanding of AF symptoms, many patients still lacked thorough knowledge about the condition's effects, recurring risks, and specific treatment options [41]

For instance, Zahid et al. found that "knowledge generally poor," with 65.7% of participants unaware of important OAC side effects and more than 75% unaware of warfarin target INR levels [29]. Similarly, Elkerdaw et al. discovered 63.6% unsatisfactory knowledge [30], while Li et al. measured inadequacy with a mean score of

4.64/20 on the JAKQ [7]. Ye et al. [33] and Abdul-Hameed et al. [38] confirmed this, describing " inadequate knowledge" in 62.2% of cases, which was frequently associated with gaps in interaction management (e.g., painkiller choices or missed doses, as observed by Ioannidis et al. [39]. Metaxas et al. [37] discovered additional treatment-specific vulnerabilities, with DOAC users having greater knowledge gaps than VKA users (66% initial gaps reduced post-intervention). This indicates a crucial need for structural education to address these differences and increase patient knowledge of anticoagulant treatments, particularly for DOACs, which are commonly considered as easy to sustain [42].

Conversely, a subgroup of studies found that over 50% of participants had appropriate knowledge, especially when thresholds (e.g., ≥50% correct responses) were applied. Alajami et al. [31] found that 67.2% of respondents had adequate general knowledge, with warfarin users surpassing DOAC users. Li, Liu, and Zhu [34] described a "adequate knowledge" profile in high-altitude people, while Ioannidis et al. [39] reported a medium mean JAKQ score of 57.2%, and Khanal et al. [4] discovered 48% adequacy via the AKT. This variability shows that contextual factors, such as regional healthcare availability or evaluation techniques, may influence knowledge levels, necessitating personalized instructional programs.

KAP interconnections and patterns

Evidence reveals that there is a significant association between patients' KAP and outcome. Also, investigating patients' KAP regarding AF and OACs is critical for identifying influencing factors and providing data to attain positive outcomes. Li et al. and Ye et al. showed that "knowledge directly improved attitude/practice “using structural equation modeling to confirm mediation effects [7,33]. Chen et al. corroborated this via correlations between knowledge scores (mean 9.84/14) and favorable attitudes among geriatricians, extending to practice behaviors [35]. Adherence linkages were similarly difficult to interpret. Elkerdaw et al. [30] reported a positive correlation between knowledge and adherence (50.9% high, 20% low), whereas Khanal et al. [4] found that 83.9% of participants with adequate knowledge demonstrated high adherence. Li, Liu, and Zhu highlighted independent predictive effects, with knowledge and attitudes separately estimating “proactive practices” [34]. In contrast, Li et al. described “suboptimal attitude” and “inactive practice” [7], while Ye et al. identified proactive attitude despite limited knowledge as a potential resilience factor [33]. Moudallel et al. discovered a gap over time, with "knowledge and satisfaction not associated with adherence over 6 months," despite high baseline satisfaction (41-43% inadequate adherence remained) [36]. These relationships highlight knowledge as a leverage point for comprehensive KAP improvement, but longitudinal monitoring is required to maintain improvements.

Clinical outcomes, risks, and interventions

Inadequate knowledge directly tied to negative outcomes, as Konieczynska et al. found that lower JAKQ scores were associated with composite endpoints (stroke, bleeding, and death) over 42 months, which was aggravated by longer OAC use and higher CHA2DS2-VASc scores [32]. Specific knowledge items predicted fewer occurrences, emphasizing the need of focused education in prevention. Interventions showed promise in mitigating risks. as Metaxas et al. observed that knowledge gaps decreased from 66% to 31.3% during chemist counselling, resulting in great satisfaction [37]. Ioannidis et al. agreed with patients' need for "more information," and Konieczynska et al. suggested knowledge gains could prevent events [32,39]. Satisfaction positivity reinforced this; Moudallel et al. reported high treatment satisfaction, which was substantially linked with knowledge despite suboptimal adherence [36]. Collectively, these findings support for scalable, patient-centered interventions, such as pharmacy-led reviews, to optimize outcomes and eliminate discrimination.in AF care.

Socio-demographic and contextual influences

The majority of studies identify socio-demographic and experience characteristics as knowledge influences, with education and duration as enhancers and age as a barrier, resulting in targeted risk stratification. Education consistently improved outcomes, as marked "education as positive knowledge predictor" in Zahid et al. [29], Elkerdaw et al. [30], Li et al. [7], and Abdul-Hameed et al. Income, employment, and a longer AF/treatment duration all contributed to this (Alajami et al. [31]; Ioannidis et al. [39]; Khanal et al. [4]; Li et al.[7]). Age has a negative impact, with increases suggesting -0.08 annual reductions (Alajami et al. [31]). Younger cohorts (≤40) demonstrate deficits concomitant institutional impediments such as non-public settings (Chen et al.[35], Abdul-Hameed et al. [38]). No gender or residence impacts were found (Abdul-Hameed et al., [38]). These indicators reveal disparities, highlighting the importance of personalized education for vulnerable populations.

This review explores facilitators and obstacles to attitudes and practices, extending beyond knowledge to lifestyle and experience, with dual predictors emphasizing holistic influences. Education extended as a "dual attitude and practice predictor" (Elkerdaw et al.[30]), while marital status and non-smoking improved outcomes [33,34]. Barriers included lifestyle factors like drinking negatively impacting practice (Ye et al.) [33]. Professional experience (5–10 years) influenced practices via knowledge (Chen et al., [35]). These elements highlight modifiable levers, such as lifestyle counseling, to foster positive attitudes and proactive behaviors in OAC adherence. In conclusion, this thematic synthesis identifies knowledge as a critical but underutilized domain that is interconnected with attitudes/practices and controlled by socio-contextual factors, ultimately determining clinical risk (Fig. 2). These findings suggest focused strategies for improving OAC adherence and stroke prevention in various AF groups. Nevertheless, challenges remain in ensuring consistent patient participation and resolving varied knowledge gaps, which frequently come from varying educational levels and socioeconomic circumstances [43]. Overall, knowledge deficits persist across settings; education and socioeconomic status are consistent predictors; few studies have longitudinal or interventional designs

Discussion

Knowledge deficit as modifiable risk factors for adverse outcomes

Accumulating evidence demonstrates that inadequate patient knowledge regarding OAC therapy constitutes clinically significant and modifiable risk factors that are independently associated with adverse cardiovascular outcomes, including ischemic stroke, major bleeding, and all-cause mortality [32,44]. The pervasive nature of these knowledge gaps—spanning understanding of medication purpose, monitoring requirements, drug–drug and drug–food interactions, appropriate management of missed doses, and recognition of warning signs necessitating urgent medical attention—has been consistently documented across international cohorts from low-, middle-, and high-income countries [7,35, 44,45]. Critically, these deficits are not merely indicators of suboptimal health literacy but represented actionable targets for intervention, given robust evidence that structured education significantly improves patients understanding, medication adherence, and treatment satisfaction [45,46].

The paradoxical findings that patients prescribed DOACs demonstrate greater knowledge gaps compared to those receiving VKAs despite the former superior safety profile and reduced monitoring requirements warrants particular attention [4,37]. This counterintuitive observation likely reflects healthcare delivery system structures that prioritize intensive patient counseling and frequent professional interactions for VKA users necessitated by

INR monitoring, while mistakenly assuming that DOACs' pharmacokinetic predictability obviates the need for comprehensive patient education [45,48]. This systemic oversight may inadvertently compromise patient safety and treatment outcomes, particularly given evidence that DOAC users with inadequate knowledge exhibit higher rates of non-adherence and breakthrough thromboembolic events [44].

Recent prospective cohort studies have elucidated specific knowledge domains that independently predict clinical outcomes. Patients who understand the rationale for continuous anticoagulation despite absence of symptoms, recognize appropriate analgesic choices compatible with anticoagulant therapy, and comprehend proper management strategies for missed doses demonstrate substantially reduced risks of ischemic stroke (hazard ratio 0.03-0.46) and major bleeding (hazard ratio 0.13-0.37) compared to those lacking such knowledge [32]. These effect magnitudes rival those of pharmacological interventions, suggesting that optimizing patient education could yield clinical benefits comparable to medication selection or dosage optimization [44; 58]

Educational interventions: efficacy, modalities, and implementation strategies

Randomized controlled trials conducted over the past two years have provided Level 1 evidence supporting the efficacy of structured educational interventions in improving patient knowledge, treatment adherence, and selected clinical outcomes [45,46]. The multinational AF-EduCare trial, enrolling 1,359 participants across 10 European countries, demonstrated that targeted patient education—delivered through either in-person counseling or digital platforms—significantly improved disease-specific knowledge scores, medication adherence assessed via validated instruments, and patient-reported quality of life compared to usual care [45]. Notably, educational benefits persisted at 12-month follow-up, suggesting sustained impact beyond transient knowledge gains. However, the trial did not demonstrate statistically significant reductions in the primary composite endpoint of unplanned cardiovascular hospitalizations or emergency department visits, highlighting the complexity of translating improved knowledge into hard clinical outcomes and underscoring the influence of factors beyond patient understanding, including healthcare access, medication costs, and social determinants of health [45].

Digital health innovations have emerged as promising scalable strategies for extending educational reach while enabling personalization and continuous engagement. The 48App multicenter randomized trial demonstrated that smartphone-based anticoagulation management—incorporating medication reminders, interactive educational modules, symptom tracking, and bidirectional communication with healthcare providers—significantly improved medication adherence (mean difference 12.3%, 95% CI 8.7-15.9%, $p<0.001$) and treatment satisfaction compared to standard care among 628 atrial fibrillation patients prescribed DOACs [46]. Similarly, the AF-EduApp intervention demonstrated sustained knowledge gains and improved self-management capabilities through gamified learning modules and algorithm-driven personalized feedback [45,47]. These digital platforms may partially address equity concerns by reducing geographic and access barriers, though digital literacy limitations, connectivity disparities, and differential engagement across age and socioeconomic strata warrant consideration in implementation planning [46, 49]

Emerging evidence suggests that clinician-targeted education yields complementary benefits. The EVICOAG digital education program for nurses demonstrated improved provider confidence in anticoagulation risk assessment, enhanced utilization of validated decision support tools (CHA_2DS_2-VASc, HAS-BLED), and superior quality of patient counseling as assessed through standardized patient encounters [48]. Similarly, targeted email-based educational interventions directed at primary care physicians with suboptimal anticoagulation prescribing rates resulted in statistically significant increases in oral anticoagulant initiation among high-risk AF patients

(adjusted odds ratio 1.67, 95% CI 1.34-2.08, p<0.001) [50]. These findings underscore the importance of multipronged educational strategies addressing both patient and provider knowledge gaps within integrated care delivery models.

Sociodemographic disparities and health equity implications

Profound and persistent sociodemographic disparities in oral anticoagulant knowledge, prescribing rates, and clinical outcomes represent a critical health equity challenge demanding urgent policy attention and targeted intervention [51,52]. Patients with lower educational attainment, reduced health literacy, limited English proficiency, advanced age, rural residence, and socioeconomic disadvantage consistently demonstrate inferior anticoagulation knowledge across international cohorts [7,31,35]. These knowledge disparities translate into tangible inequities in treatment access and outcomes: recent analyses of large United States healthcare databases demonstrate that Black patients are 23% less likely (adjusted OR 0.77, 95% CI 0.71-0.84) and Hispanic patients 13% less likely (adjusted OR 0.87, 95% CI 0.79-0.95) to initiate direct oral anticoagulants compared to White patients, even after rigorous adjustment for clinical risk factors, insurance status, and healthcare utilization [51].

Area deprivation index—a composite measure incorporating neighborhood-level income, educational attainment, housing quality, and employment—independently predicts oral anticoagulant use beyond individual patient characteristics and clinical stroke risk scores [53,54]. Patients residing in the most socioeconomically deprived quintile experience 34% lower anticoagulation rates and substantially elevated risks of ischemic stroke and mortality compared to those in the least deprived quintile [55,57]. These patterns persist across diverse healthcare systems with universal coverage, suggesting that financial barriers represent only one component of multifactorial access inequities encompassing health literacy, cultural beliefs, medical mistrust, language concordance, transportation access, and structural racism embedded within healthcare delivery [55,56].

Qualitative investigations have elucidated patient and clinician perspectives on barriers to equitable anticoagulation. The national "Barriers to and Facilitators of Equitable Oral Anticoagulation" study identified recurrent themes including patient concerns regarding bleeding risk amplified by poor prior experiences, mistrust of medical establishment rooted in historical exploitation, inadequate culturally tailored educational materials, competing health priorities and social needs, medication costs despite insurance coverage, and implicit provider biases influencing risk-benefit counseling [52]. These findings underscore that addressing knowledge disparities requires comprehensive, equity-focused interventions incorporating culturally adapted educational materials developed through community engagement, linguistically concordant communication, health literacy-optimized presentation formats utilizing plain language and visual aids, structural interventions addressing social determinants, and provider training in cultural humility and implicit bias mitigation [55,56].

Optimal timing of anticoagulation initiation following acute ischemic stroke

A critical knowledge gap with direct clinical implications concerns optimal timing of OACs initiation following acute ischemic stroke in patients with AF. Current guidelines recommend initiation within 4-14 days' post-stroke based on limited observational evidence, but precise timing balancing recurrent ischemic risk against hemorrhagic transformation remains uncertain [22,58]. The pragmatic randomized START trial, employing response-adaptive allocation across four initiation windows (days 3-4, 6, 10, or 14 post-stroke), demonstrated that early initiation (days 3-4) exhibited favorable posterior probability (41.1%) of representing the optimal

strategy, with no observed ischemic recurrences in this arm and acceptable hemorrhagic complication rates [22]. Complementary evidence from the ATTUNE observational cohort demonstrated that commencing anticoagulation within 4 days' post-stroke or transient ischemic attack was associated with fewer new ischemic lesions on 1-month follow-up magnetic resonance imaging compared to delayed initiation, particularly among patients with moderate-severity index events [59]

However, emerging data regarding left atrial appendage occlusion as an alternative stroke prevention strategy among patients experiencing recurrent ischemic events despite therapeutic anticoagulation complicates decision-making algorithms. Propensity-matched cohort analyses demonstrate that percutaneous left atrial appendage closure following breakthrough stroke on oral anticoagulants reduces subsequent ischemic stroke risk by approximately 60% (adjusted HR 0.42, 95% CI 0.26-0.68) compared to continuing anticoagulation alone [60,61] These findings suggest potential roles for mechanical stroke prevention strategies among selected high-risk populations, though randomized trial evidence remains limited [58].

Novel anticoagulant development and future directions

The anticoagulant therapeutic landscape continues evolving with investigation of factor XI/XIa inhibitors designed to uncouple hemostasis from thrombosis, potentially providing stroke prevention without proportional bleeding risk elevation characteristic of current agents [44]. The Phase 3 OCEANIC-AF trial comparing asundexian (oral factor XIa inhibitor) to apixaban for stroke prevention in atrial fibrillation was prematurely terminated for futility, highlighting challenges in achieving non-inferiority efficacy thresholds despite favorable bleeding profiles [60]. However, ongoing trials of alternative factor XI-directed agents with distinct pharmacological properties maintain optimism for this mechanistic approach [44]. Regardless of specific pharmacological agents ultimately proven effective, patient education regarding novel anticoagulants' mechanisms, monitoring requirements, and safety considerations will remain paramount for optimizing real-world effectiveness.

Limitations

This review acknowledges several limitations. The predominance of cross-sectional designs prevents causal inference regarding knowledge-practice-outcome relationships. Heterogenous assessment instruments complicate comparisons and meta-analysis, while convenience sampling from single centers limits generalizability. Language bias (English only databases) may exclude evidence from non-anglophone regions with rising AF burden. Additionally, few studies employed mechanistic analyses (mediation, SEM) to elucidate knowledge-outcome pathways.

Future research should employ longitudinal designs with repeated assessments, multicenter population- based sampling, standardized KAP instruments, implementations science frameworks, and qualitative methods to complement quantitative findings while reducing language bias through multilingual searches.

Conclusion

Addressing patient knowledge deficits through systematic, evidence-based, equity-focused educational interventions represents a critical, yet underutilized, strategy to optimize OACs, reduce preventable complications, minimize health disparities, and ultimately improve survival and quality of life for the millions of patients worldwide living with atrial fibrillation. The integration of structured patient education, pharmacist-led counseling, digital health innovations, and multidisciplinary care coordination into standard AF management protocols has

the potential to transform anticoagulation care and substantially reduce the global burden of AF-related stroke and bleeding complications.

Abbreviations

AF	Atrial Fibrillation
AKT	Anticoagulation Knowledge Test
CI	Confidence Interval
DOACs	Direct Oral Anticoagulants (also referred to as NOACs)
HR	Hazard Ratio
INR	International Normalized Ratio
JAKQ	Jessa Atrial Fibrillation Knowledge Questionnaire
KAP	Knowledge, Attitude, and Practice
MARS-5	Medication Adherence Report Scale
MMAS	Morisky Medication Adherence Scale
NOAC/DOAC	Novel/Direct Oral Anticoagulant
OACs	Oral Anticoagulants
OR	Odds Ratio
PMC	Pharmacy Medication Check
PRISMA-ScR	Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews
SAFUCA	Satisfaction with Anticoagulant Care Questionnaire
SEM	Structural Equation Modeling
TIA	Transient Ischemic Attack
VKAs	Vitamin K Antagonists

Declarations

Author Contribution

S.A. (Suhair Al-Ghabeesh) conceived the study, designed the methodological framework, led the literature search strategy, supervised data extraction and screening processes, and critically revised the manuscript for intellectual content. Y.A. (Yara Alwaqfi) participated in the study design, conducted systematic literature searching across databases, independently screened titles and abstract, performed full-text articles assessment, extracted data, and drafted sections of the manuscript. O.A. (Omar Alqaisi) contributed to the study design, participated in study selection screening, extracted data, conducted quality assessment of included studies, performed data synthesis and thematic analysis, and contributed to manuscript preparation. A.D. and P.T. critically reviewed and revised the

drafts. All authors approved the final version of the manuscript and agree to be accountable for the accuracy and integrity of this work. S.A. serves as the guarantor of this work.

Funding

This scoping review received no specific grant from any funding agency in the public, commercial, or not-for profit sectors. The authors received no financial support for the conducted this research.

Data availability

No primary datasets were generated during this scoping review.

Ethical approval and consent to participate

Ethical approval was not required for this scoping review, as it is based entirely on analysis of previously published literature. No human participants were directly involved; therefore, informed consent was not applicable.

Clinical Trial Number: Not applicable

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests. No financial. professional, or personal interest influenced the conduct or reporting of this scoping review.

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Figures

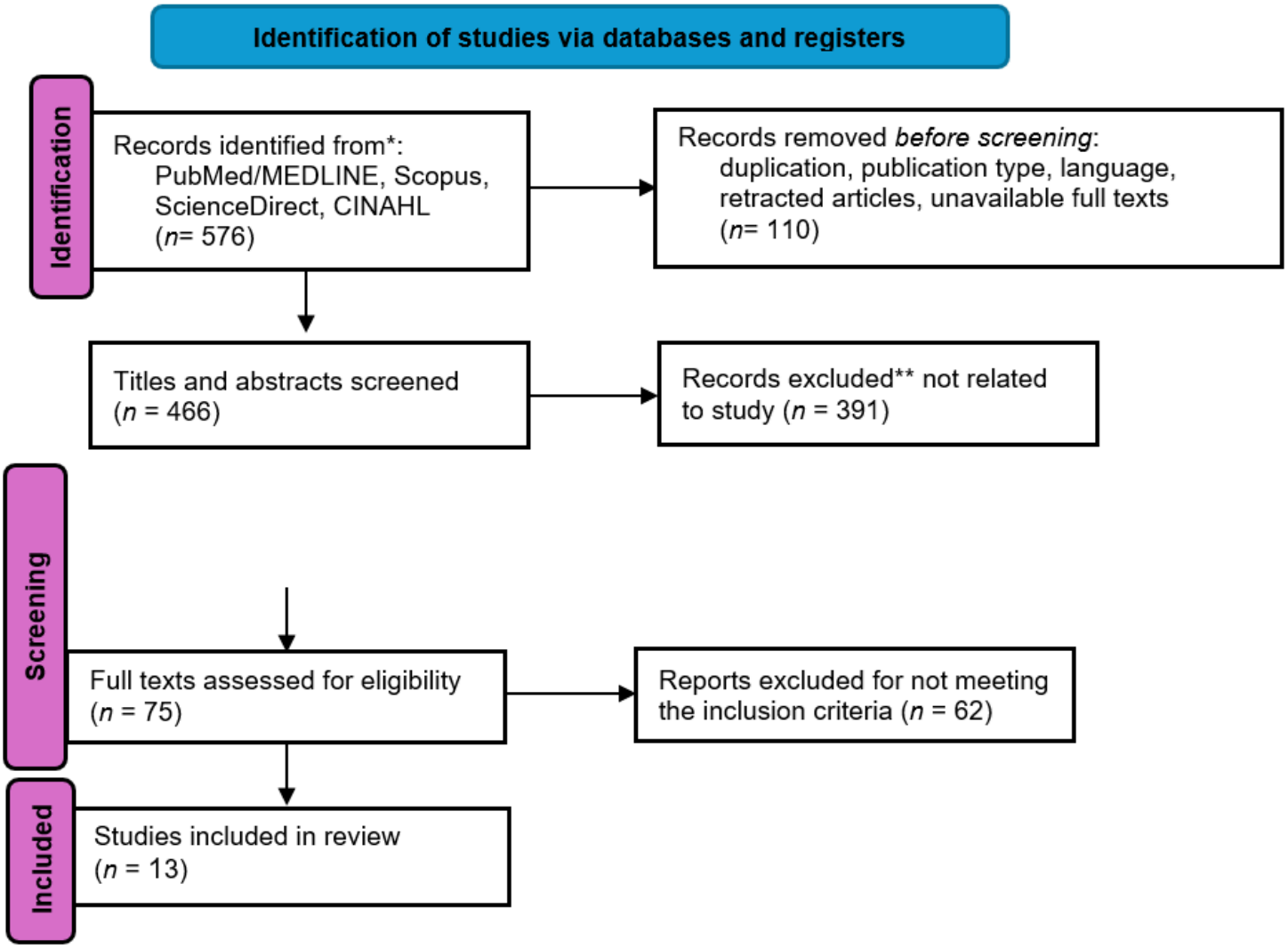


Figure 1

Preferred reporting items for systematic review and meta-analysis extension for scoping reviews (PRISMA-ScR) flow diagram of studies to include in this scoping review.

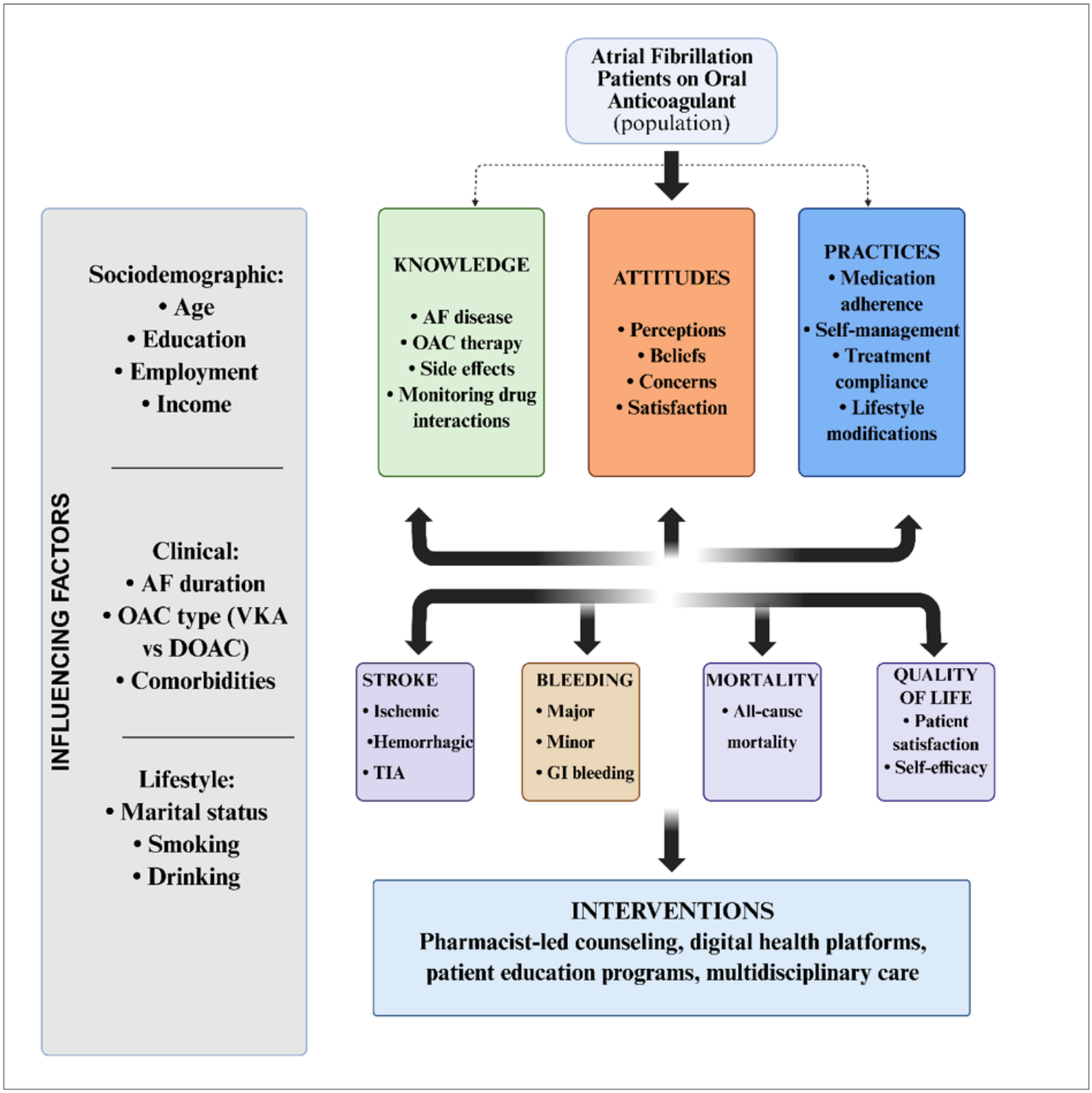


Figure 2

Conceptual framework illustrating the relationships among knowledge, attitudes, and practices (KAP) regarding oral anticoagulants and clinical outcomes in patients with atrial fibrillation. The framework demonstrates how sociodemographic, clinical, and lifestyle factors influence KAP components, which subsequently affect clinical outcomes. Bidirectional arrows between KAP components indicate their interconnected nature. AF: atrial

fibrillation; DOAC: direct oral anticoagulant; GI: gastrointestinal; OAC: oral anticoagulant; TIA: transient ischemic attack; VKA: vitamin K antagonist.