Patient Preference and Adherence

Dovepress
Taylor & Francis Group

Open Access Full Text Article

REVIEW

Strategies for Enhancing Anticoagulation Adherence in Adult Patients After Cardiac Valve Replacement: An Evidence-Based Summary

Yangyao Peng[1,*], Jingjing Huang[2,*], Shuwen Qin[1], Bangyu Guo[1], Qian Hu[1], Dandan Xu[3], Caixia Gao[1], Fen Hu[1,4,5]

[1]Department of Cardiovascular Surgery, Zhongnan Hospital of Wuhan University, Wuhan, Hubei, 430071, People's Republic of China; [2]Department of Plastic Surgery, Zhongnan Hospital of Wuhan University, Wuhan, Hubei, 430071, People's Republic of China; [3]Department of Critical Care Medicine, Zhongnan Hospital of Wuhan University, Wuhan, Hubei, 430071, People's Republic of China; [4]Nursing Department, Zhongnan Hospital of Wuhan University, Wuhan, Hubei, 430071, People's Republic of China; [5]Center for Critical Care and Anesthesia Nursing Research, Wuhan, Hubei, 430071, People's Republic of China

*These authors contributed equally to this work

Correspondence: Caixia Gao; Fen Hu, Department of Cardiovascular Surgery, Zhongnan Hospital of Wuhan University, 169 Donghu Road, Wuhan, Hubei, People's Republic of China, Email gcx689655@163.com; hufen@znhospital.cn

Background: Heart valve replacement is one of the primary treatments for valvular heart disease. Postoperatively, patients require long-term anticoagulation therapy to prevent life-threatening thromboembolic events. However, poor patient adherence to anticoagulation can lead to complications such as thrombosis and embolism, adversely impacting patient prognosis. This study aimed to systematically search for the best available evidence on anticoagulation adherence management to provide evidence-based guidance for the clinical practice concerning adult patients after heart valve replacement.

Methods: Following the "6S" evidence resource model, evidence retrieval was conducted in a top-down manner, collecting relevant guidelines, best practices, evidence summaries, systematic reviews, and expert consensuses. The search period was limited to databases from January 1, 2015, to May 31, 2025. Two evidence-trained researchers independently appraised the quality of the included literature. Evidence was then extracted and summarized according to the JBI evidence grading and recommendation system.

Results: A total of 13 articles were finally included, comprising 5 clinical decisions, 1 evidence summary, 3 guidelines, 2 systematic reviews, 1 expert consensus, and 1 randomized controlled trial. Eighteen best evidence statements were summarized from four dimensions: symptom assessment, monitoring modalities and methods, quality control and management, and patient education.

Conclusion: This study summarized the best evidence for anticoagulation adherence management after heart valve replacement across four dimensions. This can provide guidance for clinical or community healthcare professionals in developing and implementing interventions and practice programs to improve patient adherence to anticoagulation, thereby improving clinical outcomes and quality of life for patients post-heart valve replacement.

Keywords: evidence summary, evidence-based nursing, medication compliance, valvular heart disease

Introduction

Valvular Heart Disease (VHD) is a group of organic disorders characterized by structural or functional abnormalities of the heart valves, leading to valvular stenosis or regurgitation, which subsequently affects intracardiac hemodynamics.[1] Cardiac Valve Replacement (CVR), as a primary therapeutic modality for VHD, typically involves a standard approach via median sternotomy to gain surgical access, followed by opening the pericardium to expose the heart under cardiopulmonary bypass support, and replacing the diseased valve with either a mechanical valve (fabricated from synthetic materials) or a bioprosthetic valve (derived from homologous or heterologous biological tissues).[2] Mechanical valves constitute 70% of valve replacement procedures[3] Due to the inherent material properties of mechanical valves and

Received: 24 June 2025
Accepted: 9 October 2025
Published: 23 October 2025

the patient's unique hemodynamic profile, their implantation is prone to trigger host coagulation cascades post-replacement, leading to severe complications such as thrombosis and embolism. Consequently, patients undergoing Mechanical Heart Valve Replacement (MHVR) require lifelong anticoagulation therapy and regular monitoring of the International Normalized Ratio (INR)[4] (Internal Normalized Ratio). INR steadiness is a direct determinant of anticoagulation outcome and safety, and it is predicated on patients' long-standing, meticulous compliance with their anticoagulant therapy. The World Health Organization (WHO) defines medication adherence as the extent to which a patient's behavior in taking medication aligns with the recommendations provided by healthcare professionals, encompassing aspects such as timing, dosage, and frequency of administration during treatment.[5] Both domestic and international studies indicate that patient adherence to anticoagulants following MHVR is a significant challenge. International research has reported that approximately 25% of patients undergoing valve replacement exhibit suboptimal medication adherence,[6] which further declines markedly after six months of anticoagulant therapy.[7]

Patient medication adherence is influenced by a multitude of factors, including individual responses to treatment (eg, genetics, ethnicity, pathological conditions, pregnancy) and drug interactions, all of which can potentially compromise anticoagulation efficacy. The complexity of INR monitoring, due to factors such as economic burden, time cost, and geographical limitations, often prevents patients from attending timely follow-up appointments, further exacerbating the risk of variability in anticoagulation efficacy. Furthermore, studies indicate that illness perception is a predictor of adherence behavior in patients with cardiovascular disease,[8] with those holding negative illness perceptions being more likely to be non-adherent to prescribed anticoagulants.[9] Moreover, limited educational attainment exacerbates communication barriers between clinicians and patients, leading to diminished patient engagement in medical decision-making.[10] Patients may exhibit skepticism towards oral anticoagulants, leading to deviations in medication duration, self-modification of dosage, or even unauthorized discontinuation.[11] Additionally, comorbidities and age-related factors, including cognitive impairment, frailty, and fear of falling, are also associated with adherence to anticoagulant therapy[12,13] Therefore, long-term postoperative management of VHD patients faces multiple challenges, including inter-individual variability in treatment response, monitoring complexity, patient cognitive limitations, and comorbidities. This consequently leads to a concerning state of clinical adherence, significantly compromising the efficacy of anticoagulant therapy.

Variations in medication adherence not only correlate with patient characteristics but are also significantly influenced by factors such as healthcare service quality, patient education, clinician-patient communication, and continuity of care. Current healthcare systems and interactive factors exhibit substantial deficiencies in supporting postoperative anticoagulation adherence among MHVR patients, forming a critical knowledge gap that demands urgent resolution. Specifically, patient education and information delivery are generally inadequate, often featuring obscure content lacking personalized design. These materials fail to adequately account for patients' diverse health literacy levels and cultural backgrounds, resulting in poor disease understanding, frequent misconceptions, and weak self-management capabilities. Concurrently, effective clinician-patient communication models remain unestablished, with recurring issues like ambiguous information delivery, insufficient patient listening, and disregard for patient preferences. Particularly when addressing communication challenges such as educational disparities, clear guidelines for healthcare providers to proactively adjust communication strategies are notably absent, directly exacerbating patient distrust and confusion. Furthermore, healthcare accessibility and continuity suffer severe shortcomings, manifested through uneven distribution of anticoagulation clinic resources, appointment difficulties, irregular follow-up scheduling, and inefficient or absent inter-institutional information-sharing and coordination mechanisms. These deficiencies substantially increase objective barriers for patients to maintain treatment monitoring. Finally, continuity-of-care support systems remain particularly weak. Seamless transitions from hospital to home/community settings prove challenging, discharge planning often becomes superficial, convenient long-term follow-up and consultation channels remain underdeveloped, and timely INR feedback, dosage adjustment guidance, and psychosocial support for addressing treatment fatigue are universally lacking.

Therefore, to enhance medication adherence in patients post-cardiac valve replacement, alongside addressing individual patient factors, significant attention should be directed towards optimizing care processes, reinforcing patient education, and improving the overall quality of healthcare services. Evidence-based nursing (EBN) is an emerging and rapidly developing methodology in recent years. It entails nursing professionals judiciously, wisely, and accurately applying existing research findings, integrating patient needs and preferences with their own clinical expertise, to select

and deliver the most effective nursing interventions for optimal patient care. However, a systematic and comprehensive body of evidence concerning the management of oral anticoagulant adherence has yet to be fully established, which consequently impedes the standardized post-operative care for VHD patients. Therefore, this study aims to synthesize the best available evidence for oral anticoagulant adherence management in VHD patients post-surgery, thereby providing a robust foundation for the development of scientific VHD anticoagulation adherence management protocols.

Materials and Methods

Establishment of the Problem

The evidence-based question was constructed using the PIPOST framework, namely: P (Population): patients undergoing cardiac valve replacement who are on oral anticoagulants; I (Intervention): adherence management; P (Professional/Performer): healthcare professionals in cardiovascular surgery; O (Outcome): medication adherence, INR monitoring status, incidence of postoperative complications, and patient satisfaction; S (Setting): postoperative rehabilitation wards and follow-up outpatient clinics; and T (Type of Evidence): guidelines, expert consensuses, systematic reviews, evidence summaries, recommended practices, and randomized controlled trials. This study has been registered with the Fudan University Evidence-Based Nursing Center, registration number ES20257742.

Literature Search Strategy

Evidence retrieval followed a top-down approach according to the "6S" Pyramid of Evidence model. The following databases were searched: Up To Date, BMJ Best Practice, UK National Institute for Health and Care Excellence (NICE), Registered Nurses' Association of Ontario (RNAO), National Guideline Clearinghouse (NGC), Scottish Intercollegiate Guidelines Network (SIGN), Guidelines International Network (GIN), Cochrane Library, JBI Evidence Synthesis Database, PubMed, Web of Science, China Biology Medicine Disc (CBMdisc), China National Knowledge Infrastructure (CNKI), Wanfang Data, and Medlive Guidelines Network. The databases were searched using a combination of Medical Subject Headings (MeSH) and free-text keywords. The search period was limited from January 1, 2015, to May 31, 2025. The detailed steps for searching English databases, using PubMed as an example, can be found in Figure 1.

#1 Heart Valve Disease[Mesh]

#2 Heart Valve Disease[Title/Abstract] OR Cardiac Valve Disease[Title/Abstract] OR Valvular Heart Disease[Title/Abstract] OR Cardiac Valve Dysfunction[Title/Abstract] OR Cardiac Valve Replacement[Title/Abstract] OR Valve Surgery[Title/Abstract] OR Valve Insufficiency[Title/Abstract] OR Heart Valvular Disease[Title/Abstract]

#3 #1 OR #2

#4 Medication Adherence[Mesh]

#5 Adherence[Title/Abstract] OR Drug Adherence[Title/Abstract] OR Prescription Adherence[Title/Abstract] OR Prescription Adherences[Title/Abstract] OR Medication Persistence[Title/Abstract] OR Medication Nonadherence[Title/Abstract] OR Medication Non-Adherence[Title/Abstract] OR Medication Non Adherence[Title/Abstract] OR Medication Noncompliance[Title/Abstract] OR Medication Compliance[Title/Abstract] OR Drug Compliance[Title/Abstract] OR Medication Non-Compliance[Title/Abstract] OR Medication Persistence[Title/Abstract]

#6 #4 OR #5

#7 #3 AND #6

Figure 1 Literature search strategy of PubMed.

Inclusion and Exclusion Criteria

Inclusion Criteria

① Studies involving adult patients receiving mechanical ventilation in intensive care units (ICUs); ② Interventions focused on nebulized inhalation therapy and related management measures; ③ Literature types included guidelines, systematic reviews, evidence summaries, randomized controlled trials (RCTs), and expert consensuses; ④ Published in Chinese or English.

Exclusion Criteria

① Duplicate publications; ② Literature with incomplete information or unavailable full text; ③ Literature with a quality appraisal rating of C; ④ Documents solely interpreting existing guidelines.

Literature Quality Appraisal

Literature Appraisal Criteria

Guidelines were appraised using the Appraisal of Guidelines for Research and Evaluation II (AGREE II).[14] Randomized controlled trials and expert consensuses were appraised using the corresponding criteria from the JBI Evidence-based Healthcare Center (2016 edition) critical appraisal tools. Systematic reviews were appraised using AMSTAR 2.[15] Clinical decisions from authoritative databases such as UpToDate and JBI were considered high-quality evidence and directly included.

Literature Quality Appraisal Process

The included literature underwent independent appraisal by two researchers proficient in evidence-based medicine, followed by a rigorous cross-verification process. Any discrepancies that emerged were meticulously resolved by a third reviewer.

Evidence Integration and Grading

The principal investigators, who are also the first and second authors, conducted an exhaustive review of the articles that were finally incorporated into our research. The original literature underlying the included evidence was graded according to the JBI Levels of Evidence and Grades of Recommendation (2014), ranging from Level 1 to 5, with Level 1a being the highest and Level 5c being the lowest.

Results

Literature Inclusion Results

A total of 1807 articles were retrieved. After removing duplicates and studies that did not meet the inclusion criteria, 13 articles were finally included, comprising 5 clinical decisions, 1 evidence summary, 3 guidelines, 2 systematic reviews, 1 expert consensus, and 1 randomized controlled trial. The article screening flowchart is presented in Figure 2. General information about the articles included in our review can be found in Table 1.

Results of Literature Quality Appraisal

Quality Appraisal of Guidelines

A total of 3 guidelines were included in this study. The results of their quality appraisal are presented in Table 2. All included guidelines demonstrated good appraisal consistency and were approved for inclusion.

Quality Appraisal of Expert Consensuses

One expert consensus was included in this study. All items scored "Yes", indicating high quality, and thus it was included.

Quality Appraisal of Systematic Reviews

Two systematic reviews were included in this study. The systematic review conducted by Anderson, et al scored "Yes" on all appraisal items. For the systematic review by Yuan et al, Item 1 ("Is a preliminary plan provided?") was "unclear" and Item 4 ("Is the publication status considered in the inclusion criteria, such as grey articles?") was "no", while all other items scored "Yes". All systematic reviews were included.

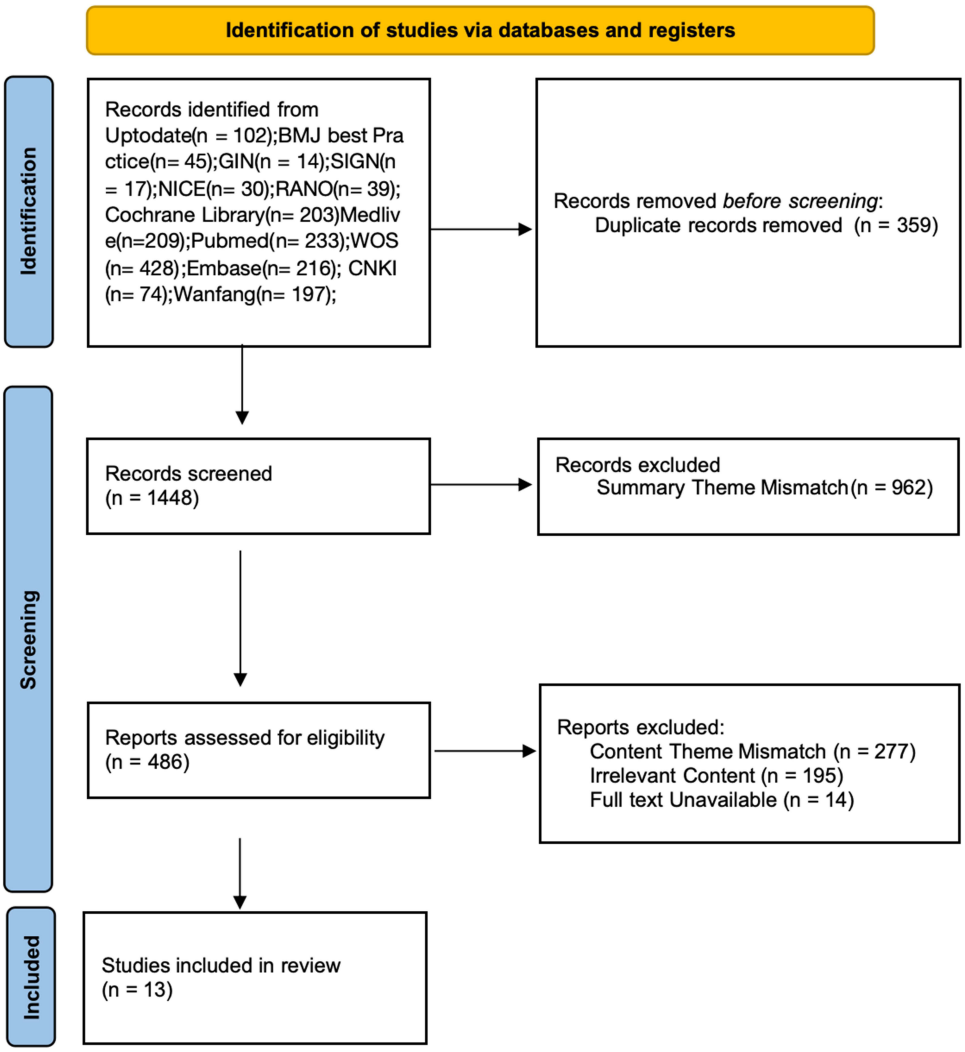

Figure 2 PRISMA flow chart of literature search and screening.

Quality Appraisal of Randomized Controlled Trials

One randomized controlled trial was included in this study. In the study by A et al, Item 4 ("Blinding of outcome assessment") scored "No", while all other items scored "Yes".

Table 1 General Information of Included Studies

Rank	Author/s	Publication Year	Article Source	Title of the Article	Type of Articles
1	Zoghbi, W.A[16]	2025	Up to date	Overview of the management of patients with prosthetic heart valves	Clinical decision
2	Nkomo, V.T.[17]	2023	Up to date	Anticoagulation for prosthetic heart valves: Management of bleeding and invasive procedures	Clinical decision
3	Konkle, A.B.[18]	2024	Up to date	Antithrombotic therapy for mechanical heart valves	Clinical decision
4	Hull, D.R.[19]	2025	Up to date	Biology of warfarin and modulators of INR control	Clinical decision

(*Continued*)

https://doi.org/10.2147/PPA.S549299

Table 1 (Continued).

Rank	Author/s	Publication Year	Article Source	Title of the Article	Type of Articles
5	Hull, D.R.[20]	2025	Up to date	Warfarin and other VKAs: Dosing and adverse effects	Clinical decision
6	Gebremichael, L.G.[21]	2022	JBI	Medication Self-Administration: Interventions to Improve Adherence	Evidence summary
7	Beijing Hypertension Prevention and Control Association[22]	2024	Medlive	Comprehensive Management Practice Guidelines for Cardiovascular Diseases at the Primary Level 2024	Guideline
8	Otto, C.M.[23]	2020	Pubmed	2020 ACC/AHA Guideline for the Management of Patients With Valvular Heart Disease: A Report of the American College of Cardiology/American Heart Association Joint Committee on Clinical Practice Guidelines	Guideline
9	SIGN[24]	2017	SIGN	Cardiac rehabilitation	Guideline
10	Yuan Xia[25]	2021	Pubmed	Effect of continuity of care on anticoagulant therapy and quality of life after heart valve replacement: a systematic review and meta-analysis	Systematic review
11	Anderson, L.J.[26]	2020	Pubmed	A systematic overview of systematic reviews evaluating medication adherence interventions	Systematic review
12	The Group of Valve Surgery, Chinese Society for Thoracic and Cardiovascular Surgery[27]	2022	WanFang	Consensus of Chinese experts on anticoagulant therapy in cardiac valve surgery	Expert consensus
13	Nana Ding[28]	2024	WOS	Intervention Effect of the Mobile Phone APP Based Continuous Care on Patients after Mechanical Heart Valve Replacement: A Randomised Controlled Trials	RCT

Table 2 Results of the Evaluation of Guidelines

Literature		Beijing Hypertension Prevention and Control Association[22]	Otto, C.M.[23]	SIGN[24]
Standardized percentages of scores in each field (%)	Scope and objective	100	94.44	100
	Participants	86.11	72.22	94.44
	Rigor of development	31.25	79.17	86.46
	Clarity of presentation	80.56	97.22	88.89
	Applicability	77.08	66.67	83.33
	Independence	41.67	37.5	70.83
Domain scores≥60%		4	5	6
Domain scores≥30%		6	6	6
Recommendation level		A	A	A

Summary of Best Evidence

Ultimately, 23 pieces of evidence were extracted from 16 articles. Through extraction and synthesis, all evidence was categorized into four dimensions: symptom assessment, monitoring modalities and methods, quality control and management, and patient education. The evidence is shown in Table 3.

Discussion

Enhancing Postoperative Anticoagulation Adherence: Early Identification and Risk Assessment

CVR stands out as a safe and efficacious clinical intervention, capable of markedly enhancing both cardiac hemodynamics and the overall quality of life.[23] However, the interaction between prosthetic valve materials and blood can readily lead to thrombus formation on the valve surface, potentially resulting in severe complications such as stroke or even death.[29,30] Anticoagulation therapy plays a crucial role in preventing post-replacement thrombus formation. By administering anticoagulant medications, the blood coagulation process can be inhibited, reducing the risk of thrombosis and ensuring the normal function of the heart valve. While warfarin is a highly effective and affordable vitamin K antagonist (VKA) for preventing thrombosis after heart valve surgery, its impact on blood coagulation exhibits significant inter-individual variability.[30] Patient sex, age, living arrangement, educational level, and clinical follow-up adherence can influence warfarin efficacy to varying degrees.[31] Therefore, the consolidation of therapeutic efficacy highly depends on postoperative medication management, and enhancing patient medication adherence after surgery has become a critical factor for long-term surgical success. However, patients often exhibit knowledge deficits regarding oral anticoagulation therapy and INR monitoring, which can lead to suboptimal therapeutic outcomes.[32] Equally concerning is the risk of excessive anticoagulation, evidenced by an annual intracranial hemorrhage incidence of 0.1–0.9% and major extracranial bleeding rates of 0.4–2.0%, which significantly complicates clinical management.[32]

Currently, diverse direct and indirect methods are employed for assessing patient medication adherence.[22] Among these approaches, patient self-reporting remains the most direct and clinically practical assessment method. Validated medication adherence scales have demonstrated efficacy in characterizing medication utilization patterns across diverse disease states. While these tools enable rapid adherence evaluation, it should be noted that all methodologies exhibit inherent limitations. For instance, direct assessment methods such as electronic pillbox monitors can record medication intake in real-time but are costly, and patients may decline their use due to privacy concerns; indirect methods, like self-report questionnaires, are susceptible to social desirability bias.[33] These methodological constraints compromise the accuracy of current adherence assessments, hindering timely identification of high-risk populations. Given the accelerated integration of artificial intelligence in contemporary healthcare, we propose conducting large-scale, multi-center cohort studies to address these limitations. These studies could leverage machine learning to precisely identify high-risk postoperative valve replacement patients with poor medication adherence and their individual risk factors, thereby constructing high-quality predictive models for medication adherence. Such models could provide a basis for healthcare teams to develop more effective intervention strategies.

Optimized Anticoagulation Monitoring Models: Precision Management and Strategic Practices

In contrast to bioprosthetic valves, mechanical valves demonstrate superior durability but require indefinite anticoagulation therapy - a therapeutic imperative that intrinsically elevates thromboembolic and hemorrhagic risks. Consequently, proactive prevention of postoperative complications and timely identification of high-risk determinants become paramount, as these measures directly influence long-term clinical outcomes and healthcare resource utilization.

As traditional anticoagulants, Vitamin K Antagonists (VKAs) such as warfarin, have their efficacy influenced by various physiological factors.[34] Moreover, insufficient knowledge regarding oral anticoagulants contributes to a narrow therapeutic window, thus demanding precise dose adjustment and frequent INR monitoring to avert complications arising from sub-therapeutic or supra-therapeutic states.[35] Although INR monitoring has become standard practice, clinical data indicate that approximately 75% of complications in patients after mechanical valve replacement are still related to thromboembolic or hemorrhagic events.[36] The persistent issue of insufficient warfarin adherence annually exposes millions of patients to the risk of preventable severe complications, such as hemorrhagic or ischemic strokes, thereby imposing additional strain on healthcare costs and resource allocation.[37]

Currently, the monitoring of anticoagulant therapy can be accomplished via a multitude of approaches. These encompass the comprehensive management provided at specialized anticoagulation clinics, the in - depth laboratory -

Table 3 Summary of Best Evidence for Anticoagulation Adherence Management in Adults After Heart Valve Replacement

Category	Evidence Summary	Evidence Grade
Symptom Assessment	1. Factors influencing patient adherence include: limited access to healthcare, lack of continuity of care, poor clinician-patient relationships, extremes of age, physical impairments, psychological and behavioral health issues, and relatively complex and time-consuming diagnostic procedures[22,27]	2b
	2. Direct measures of adherence include: biomarker assays and directly observed therapy. Indirect measures include: self-report, electronic medication event monitoring systems, pill counts, and pharmacy claims data[22]	2c
	3. Symptoms or signs related to valvular complications necessitate prompt medical attention, such as a significant change in mechanical valve click, persistent or recurrent fever, reduced exercise tolerance, cerebral ischemic events, or palpitations[16,23]	5b
	4. Interruption of effective anticoagulation in mechanical valve patients, or changes in clinical symptoms/signs of prosthetic valve dysfunction, warrant re-evaluation with clinical assessment and transthoracic echocardiography (TTE). Transesophageal echocardiography (TEE) may be performed if necessary[16,23]	1b
	5. Asymptomatic patients with mechanical heart valves and without evidence of left ventricular or prosthetic valve dysfunction do not require routine annual echocardiographic surveillance of the valve[16,23]	3c
Monitoring Modalities and Methods	6. A scheduling approach should be utilized – providing patients and clinicians with a clear timetable or schedule outlining changes in anticoagulant therapy and INR testing times[17]	3c
	7. For INR targets and monitoring, patients can carry a card specifying their implanted valve information, which physicians can then record as a key entry in the medical record's problem list[18]	1c
	8. Patients can improve adherence through INR self-monitoring combined with warfarin self-management methods, such as pill boxes, dose calendars, smartphone applications, and dosing algorithms[19,20]	1b
	9. If patients are capable of self-testing and can afford the associated costs, small portable devices, such as Point-of-Care (POC) devices, can be used for self-monitoring of anticoagulation levels and corresponding dose adjustments[20]	4b
	10. Anticoagulation management provided by specialized anticoagulation clinics is at least comparable to, and slightly superior to, management guided by general practitioners or regular hospital follow-ups[20]	1c
	11. Utilizing anticoagulation clinics allows for routine reminders of upcoming and missed appointments, as well as documentation of PT/INR values and dose adjustments[20]	1c
	12. Such anticoagulation clinics facilitate continuous communication between patients and healthcare providers, offering opportunities to assess patient medication use, dietary changes, clinical status, and to provide ongoing patient education[20]	1b
	13. Providing continuous care for patients post-discharge can effectively improve their adherence to anticoagulant therapy, enhance their understanding of medications, reduce the incidence of complications and adverse events, and thus improve their quality of life[25]	1a
	14. The use of mobile applications by patients is advisable as it can enhance warfarin adherence, INR adherence rates, and self-care abilities following mechanical heart valve replacement surgery[28]	1c
Quality Control and Management	15. If safely feasible, reducing the number of prescribed medications or simplifying the dosing regimen can contribute to improved adherence[19,21,26]	1b
	16. T/INR values measured by small portable testing devices typically demonstrate high concordance with laboratory-measured values[20]	1b
	17. Once patients initiate standard anticoagulation therapy with warfarin, regular monitoring is recommended. Increasing the frequency of INR monitoring can, to some extent, reduce the incidence of anticoagulation-related complications[27]	1c
	18. If multiple INR values are consistently within the therapeutic range and stable, the monitoring frequency may be reduced[20]	1c
	19. Patients with consistently stable INR may be monitored as infrequently as every 12 weeks. However, this is typically reserved for the most stable patients whose clinical characteristics closely resemble those in clinical trials; for other patients, the monitoring frequency should be increased[20]	1c

(*Continued*)

Table 3 (Continued).

Category	Evidence Summary	Evidence Grade
Patient Education	20. Anticoagulant stability must be maintained when switching anticoagulants. Therefore, when transitioning from another anticoagulant to a Vitamin K Antagonist (VKA), it should be noted that VKA may not achieve its full effect during the initial days, even if PT/INR is prolonged[20]	2d
	21. Artificial intelligence tools for guiding medication changes are not standard therapy and cannot replace management conducted by experienced humans using evidence-based dosing regimens[20]	2b
	22. With adequate education, training, and continuous quality control, the vast majority of patients, including the elderly, can safely and effectively self-adjust their anticoagulant dosage[20]	1b
	23. Overcoming adherence barriers for patients can be facilitated by tailored continuous support, such as intensive education or counseling from pharmacists (including motivational interviewing or cognitive behavioral therapy by professionals), daily treatment support, and additional support from family or peers[24]	1b

based specimen analysis conducted in hospital laboratories, and the patient - initiated self - monitoring utilizing portable coagulation devices. When juxtaposed with general outpatient clinics, specialized anticoagulation clinics exhibit significantly greater cost - effectiveness in both the monitoring and management of anticoagulation therapy. This cost-effectiveness can be further enhanced, particularly when Point-of-Care (POC) devices are integrated into patient management protocols.[38]

Especially for patients who have undergone valve replacement, the use of bedside POC devices for INR monitoring can improve monitoring convenience, support patient self-testing (PST) and patient self-management (PSM), and has proven to be safe and effective.[39] Self-monitoring includes self-management, where patients perform tests and adjust their treatment according to an algorithm; in self-testing, patients conduct the test but receive treatment advice after sending results to a clinician. In the UK, a retrospective review involving 8763 patients showed that self-monitoring appears to be safe and effective compared to standard monitoring, particularly for patients with prosthetic heart valves.[39] Concurrently, self-monitoring of anticoagulation status, especially self-management, appears to be cost-effective compared to routine care.[40] Furthermore, patient self-management with POC devices enhances adherence self-monitoring awareness, thereby improving overall adherence.[41]

Concurrently, with the rapid development of digital healthcare, through the dissemination of health services and information via electronic technologies, telemedicine has gradually emerged as an effective alternative to traditional healthcare models and is widely integrated into comprehensive technological platforms within hospitals and clinics. In recent years, studies have begun to explore the use of Internet-based remote patient monitoring (RPM) combined with portable INR monitoring for assessing anticoagulation efficacy in post-cardiac surgery patients, demonstrating significant positive effects on monitoring, treatment, and patient experience.[42]

Building Social Support and Enhancing Patient Education: Promoting Sustained Adherence

It is crucial to ensure continuous and comprehensive communication and education regarding treatment initiation, drug and dietary interactions, and temporary cessation during surgical or invasive procedures. Furthermore, continuous patient education is paramount for successful long-term treatment, requiring ongoing attention.[43] A cross-sectional study enrolling 383 participants revealed that patients' cognitive level regarding anticoagulation therapy influenced anticoagulation control[44] Healthcare professionals can provide knowledge education to patients initiating warfarin therapy to enhance their understanding. Concurrently, a range of diversified educational strategies should be implemented, including face-to-face counseling, the distribution of illustrated educational materials, and the dissemination of online science communication videos. These approaches are designed to address the heterogeneous learning preferences of patients,

thereby fostering accurate treatment understanding, enhancing self-management capabilities, and ultimately improving treatment adherence.

Moreover, standardizing follow-up frequency is a crucial component for ensuring treatment efficacy and reducing complication risks, making education on follow-up frequency indispensable for patients. Frequency (eg, regular INR testing) can optimize the dose adjustment of oral anticoagulants, thereby enhancing therapeutic effects and reducing the risk of complications such as bleeding and thromboembolism.[45] Healthcare professionals should, based on individual patient conditions, explain in detail the time points and frequency requirements for follow-up at different treatment stages. For instance, for patients with stable conditions, follow-up intervals can be appropriately extended; for those with significant fluctuations, the follow-up cycle should be shortened, emphasizing the importance of regular follow-ups in preventing severe complications such as bleeding and thromboembolism. However, traditional laboratory testing methods, where patients seek outpatient physicians to determine INR target values and receive dose adjustment plans after result reporting, result in complex procedures and prolonged patient waiting times, making regular patient monitoring challenging.[46] During patient education, active guidance should be provided to help patients learn how to use mobile devices. Mobile device-based monitoring, incorporating wearable technology or portable diagnostic tools, enables real-time and continuous tracking of key parameters such as INR. This approach overcomes temporal and spatial limitations, addressing the challenges associated with cumbersome traditional laboratory procedures and prolonged waiting times.

Limitations and Future Directions

Medication adherence is inherently multifactorial, with distinct determinants dominating across different populations. While this evidence summary synthesizes the highest-grade recommendations, its applicability requires contextual calibration. Crucially, the strategies were derived predominantly from studies involving adult MHVR recipients with formal education, potentially limiting generalizability to vulnerable subgroups such as: 1. Elderly patients with impaired cognitive function, reduced self-care capacity, and limited disease awareness; 2. Low-health-literacy populations facing comprehension barriers; 3. Rural communities with restricted healthcare access.These groups exhibit unique adherence determinants (eg, cognitive decline, transportation challenges) insufficiently addressed in current evidence.

Furthermore, real-world implementation gaps may arise from unvalidated feasibility in resource-constrained settings. To bridge this, we propose: conducting high-quality randomized controlled trials (RCTs) targeting specific populations—such as different age groups, genders, countries, and ethnicities—followed by optimizing the evidence through real-world applications. This approach enables dynamic evidence upgrading, ensuring continuous improvement when implementing interventions in actual clinical practice.

Conclusion

This study systematically integrates the best evidence for improving adherence to oral anticoagulation after mechanical valve replacement and provides practical measures directly applicable to clinical practice. It aims to offer actionable recommendations for clinical healthcare professionals and postoperative patients across four dimensions: symptom assessment, monitoring methods, quality control and management, and patient education, thereby reducing complication risks caused by poor adherence. Additionally, evaluating the clinical translation effects of these interventions across diverse cultural backgrounds, patient demographics, infrastructure, and healthcare environments is recommended. This will facilitate effective evidence implementation, help identify barriers to research evidence application, and ultimately maximize patient benefits.

Disclosure

The authors report no conflicts of interest in this work.

References

1. Bezuidenhout D, Williams DF, Zilla P. Polymeric heart valves for surgical implantation, catheter-based technologies and heart assist devices. *Biomaterials*. 2015;36:6–25. doi:10.1016/j.biomaterials.2014.09.013
2. Sengupta PP, Kluin J, Lee SP, et al. The future of valvular heart disease assessment and therapy. *Lancet*. 2024;403(10436):1590–1602. doi:10.1016/s0140-6736(23)02754-x
3. Nishimura RA, Otto CM, Bonow RO, et al. 2014 AHA/ACC guideline for the management of patients with valvular heart disease: executive summary: a report of the American college of cardiology/American heart association task force on practice guidelines. *Circulation*. 2014;129(23):2440–2492. doi:10.1161/CIR.0000000000000029
4. Heneghan C, Ward A, Perera R, et al. Self-monitoring of oral anticoagulation: systematic review and meta-analysis of individual patient data. *Lancet*. 2012;379(9813):322–334. doi:10.1016/S0140-6736(11)61294-4
5. Vrijens B, De Geest S, Hughes DA, et al. A new taxonomy for describing and defining adherence to medications. *Br J Clin Pharmacol*. 2012;73(5):691–705. doi:10.1111/j.1365-2125.2012.04167.x
6. Van Damme S, Van Deyk K, Budts W, et al. Patient knowledge of and adherence to oral anticoagulation therapy after mechanical heart-valve replacement for congenital or acquired valve defects. *Heart Lung*. 2011;40(2):139–146. doi:10.1016/j.hrtlng.2009.11.005
7. Osterberg L, Blaschke T. Adherence to medication. *New Engl J Med*. 2005;353(5):487–497. doi:10.1056/NEJMra050100
8. Mosleh SM, Almalik MM. Illness perception and adherence to healthy behaviour in Jordanian coronary heart disease patients. *Eur J Cardiovasc Nurs*. 2016;15(4):223–230. doi:10.1177/1474515114563885
9. Miyazaki M, Nakashima A, Nakamura Y, et al. Association between medication adherence and illness perceptions in atrial fibrillation patients treated with direct oral anticoagulants: an observational cross-sectional pilot study. *PLoS One*. 2018;13(9):e0204814. doi:10.1371/journal.pone.0204814
10. Cordina M, Hämeen-Anttila K, Lauri J, et al. Health and medication literacy and the desire to participate in pharmacotherapy decision making - comparison of two countries. *Res Social Adm Pharm*. 2018;14(9):817–823. doi:10.1016/j.sapharm.2018.06.009
11. Lee CH, Chang FC, Hsu SD, et al. Inappropriate self-medication among adolescents and its association with lower medication literacy and substance use. *PLoS One*. 2017;12(12):e0189199. doi:10.1371/journal.pone.0189199
12. Ferguson C, Inglis SC, Newton PJ, et al. Barriers and enablers to adherence to anticoagulation in heart failure with atrial fibrillation: patient and provider perspectives. *J Clin Nurs*. 2017;26(23–24):4325–4334. doi:10.1111/jocn.13759
13. Rouaud A, Hanon O, Boureau AS, et al. Comorbidities against quality control of VKA therapy in non-valvular atrial fibrillation: a French national cross-sectional study. *PLoS One*. 2015;10(3):e0119043. doi:10.1371/journal.pone.0119043
14. Brouwers MC, Kho ME, Browman GP, et al. AGREE II: advancing guideline development, reporting and evaluation in health care. *Cmaj*. 2010;182(18):E839–42. doi:10.1503/cmaj.090449
15. Shea BJ, Reeves BC, Wells G, et al. AMSTAR 2: a critical appraisal tool for systematic reviews that include randomised or non-randomised studies of healthcare interventions, or both. *BMJ*. 2017;358:j4008. doi:10.1136/bmj.j4008
16. Zoghbi WA. Overview of the management of patients with prosthetic heart valves. Available from: https://www.uptodate.cn/contents/zh-Hans/overview-of-the-management-of-patients-with-prosthetic-heart-valves. Accessed March 5, 2025.
17. Nkomo VT. Anticoagulation for prosthetic heart valves: management of bleeding and invasive procedures. Available from: https://www.uptodate.cn/contents/zh-Hans/anticoagulation-for-prosthetic-heart-valves-management-of-bleeding-and-invasive-procedures. Accessed April 20, 2023.
18. Konkle BA, Nkomo VT. Antithrombotic therapy for mechanical heart valves. Available from: https://www.uptodate.cn/contents/zh-Hans/antithrombotic-therapy-for-mechanical-heart-valves. Accessed October 31, 2024.
19. Hull RD, Garcia DA, Vazquez SR. Biology of warfarin and modulators of INR control. Available from: https://www.uptodate.cn/contents/zh-Hans/biology-of-warfarin-and-modulators-of-inr-control. Accessed February 27, 2025.
20. Garcia DA, Hull RD, Vazquez SR. Warfarin and other VKAs: dosing and adverse effects. Available from: https://www.uptodate.cn/contents/zh-Hans/warfarin-and-other-vkas-dosing-and-adverse-effects. Accessed May 22, 2024.
21. Ishaque S, Mbinji M. Medication self-administration: interventions to improve adherence. 2022. Available from: http://ovidsp.ovid.g.sjuku.top/ovidweb.cgi?T=JS&PAGE=reference&D=jbi&NEWS=N&AN=JBI146. Accessed June 24, 2025.
22. Beijing Hypertension Prevention and Control Association. *Practical Guideline for Comprehensive Management of Cardiovascular Diseases in Primary Care: 2024*. Beijing: Science and Technology Literature Press; 2024.
23. Otto CM, Nishimura RA, Bonow RO, et al. 2020 ACC/AHA guideline for the management of patients with valvular heart disease: executive summary: a report of the American college of cardiology/american heart association joint committee on clinical practice guidelines. *Circulation*. 2021;143(5):e35–e71. doi:10.1161/cir.0000000000000932
24. Scottish Intercollegiate Guidelines Network (SIGN). Cardiac rehabilitation. Available from: http://www.sign.ac.uk. Accessed May 22, 2024.
25. Yuan X, Chen Y, Zhuang Y, et al. Effect of continuity of care on anticoagulant therapy and quality of life after heart valve replacement: a systematic review and meta-analysis. *Ann Palliat Med*. 2021;10(5):5568–5579. doi:10.21037/apm-21-1167
26. Anderson LJ, Nuckols TK, Coles C, et al. A systematic overview of systematic reviews evaluating medication adherence interventions. *Am J Health Syst Pharm*. 2020;77(2):138–147. doi:10.1093/ajhp/zxz284
27. Valve Disease Surgery Group. Chinese society of thoracic and cardiovascular surgery, Chinese medical association. Chinese expert consensus on anticoagulation therapy in cardiac valve surgery. *Chin J Thorac Cardiovasc Surg*. 2022;38(3):164–174. doi:10.3760/cma.j.cn121779-20211208-009
28. Ding N, Luo X, Zhou J, et al. Intervention effect of the mobile phone APP based continuous care on patients after mechanical heart valve replacement: a randomised controlled trials. *Rev Cardiovasc Med*. 2024;25(9):314. doi:10.31083/j.rcm2509314
29. Tong Q, Cai J, Wang Z, et al. Recent advances in the modification and improvement of bioprosthetic heart valves. *Small*. 2024;20(23):e2309844. doi:10.1002/smll.202309844
30. Ibrahim DM, Fomina A, Bouten CVC, et al. Functional regeneration at the blood-biomaterial interface. *Adv Drug Deliv Rev*. 2023;201(115085). doi:10.1016/j.addr.2023.115085
31. Wang X, Xu B, Liang H, et al. Distribution characteristics and factors influencing oral warfarin adherence in patients after heart valve replacement. *Patient Prefer Adher*. 2018;12:1641–1648. doi:10.2147/ppa.S172223

32. Zahid I, Ul Hassan SW, Bhurya NS, et al. Are patients on oral anticoagulation therapy aware of its effects? A cross-sectional study from Karachi, Pakistan. *BMC Res Notes*. 2020;13(1):279. doi:10.1186/s13104-020-05119-w
33. Monnette A, Zhang Y, Shao H, et al. Concordance of adherence measurement using self-reported adherence questionnaires and medication monitoring devices: an updated review. *Pharmacoeconomics*. 2018;36(1):17–27. doi:10.1007/s40273-017-0570-9
34. Liu Z, Luo F, Zhao J, et al. Association between gene polymorphisms and initial warfarin therapy in patients after heart valve surgery. *Pharmacol Rep*. 2024;76(2):390–399. doi:10.1007/s43440-024-00575-8
35. Feldeisen D, Alexandris-Souphis C, Haymart B, et al. Higher OAK (Oral Anticoagulation Knowledge) score at baseline associated with better TTR (Time in Therapeutic Range) in patients taking warfarin. *J Thromb Thrombolysis*. 2023;55(1):141–148. doi:10.1007/s11239-022-02718-1
36. Montazeri N, Pourmehr S, Ziapour A, et al. Blood coagulation monitoring of patients with mechanical heart valve visiting Imam. *J Cardiothorac Surg*. 2025;20(1):68. doi:10.1186/s13019-024-03188-7
37. Demir N, Yucelen SY, Cetin EG, et al. Determining INR awareness of the patients who use warfarin and rates of achieving the target dosage. *Sisli Etfal Hastan Tip Bul*. 2020;54(3):357–363. doi:10.14744/semb.2019.76993
38. Garay OU, Guiñazú G, Adamczuk YP, et al. Cost-utility and budget impact analysis of implementing anticoagulation clinics and point-of-care monitoring devices in anticoagulated patients in argentina. *Pharmacoecon Open*. 2022;6(5):657–668. doi:10.1007/s41669-022-00352-4
39. Sharma P, Scotland G, Cruickshank M, et al. The clinical effectiveness and cost-effectiveness of point-of-care tests (CoaguChek system, INRatio2 PT/INR monitor and ProTime Microcoagulation system) for the self-monitoring of the coagulation status of people receiving long-term vitamin K antagonist therapy, compared with standard UK practice: systematic review and economic evaluation. *Health Technol Assess*. 2015;19 (48):1–172. doi:10.3310/hta19480
40. Kantito S, Saokaew S, Yamwong S, et al. Cost-effectiveness analysis of patient self-testing therapy of oral anticoagulation. *J Thromb Thrombolysis*. 2018;45(2):281–290. doi:10.1007/s11239-017-1588-8
41. Desteghe L, Vijgen J, Koopman P, et al. Telemonitoring-based feedback improves adherence to non-vitamin K antagonist oral anticoagulants intake in patients with atrial fibrillation. *Eur Heart J*. 2018;39(16):1394–1403. doi:10.1093/eurheartj/ehx762
42. Guede-Fernández F, Silva Pinto T, Semedo H, et al. Enhancing postoperative anticoagulation therapy with remote patient monitoring: a pilot crossover trial study to evaluate portable coagulometers and chatbots in cardiac surgery follow-up. *Digit Health*. 2024;10(20552076241269515). doi:10.1177/20552076241269515
43. Pengo V, Denas G. Optimizing quality care for the oral vitamin K antagonists (VKAs). *Hematology Am Soc Hematol Educ Program*. 2018;2018 (1):332–338. doi:10.1182/asheducation-2018.1.332
44. Cao H, Wu T, Chen W, et al. The effect of warfarin knowledge on anticoagulation control among patients with heart valve replacement. *Int J Clin Pharm*. 2020;42(3):861–870. doi:10.1007/s11096-020-01043-y
45. Poli D, Antonucci E, Pengo V, et al. Mechanical prosthetic heart valves: quality of anticoagulation and thromboembolic risk. The observational multicenter PLECTRUM study. *Int J Cardiol*. 2018;267:68–73. doi:10.1016/j.ijcard.2018.04.042
46. Huang Y, Huang L, Han Z. Combining portable coagulometers with the Internet: a new model of warfarin anticoagulation in patients following mechanical heart valve replacement. *Front Surg*. 2022;9(1016278). doi:10.3389/fsurg.2022.1016278