




Warfarin Adherence and Its Associated Factors in Thai Older Adults with Atrial Fibrillation

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Introduction: Older people mostly found unable to adhere with warfarin treatment guidelines. The health service system is challenged in order to improve medication adherence in older population under limited health resources. The purpose of this study was to explore health systems factors on warfarin adherence in older population, particularly in resources constraint setting.

Methods: This study was a cross-sectional predictive study that enrolled older people who experienced atrial fibrillation (AF) and treated by warfarin, aged 60 years and over, and followed up at the warfarin clinic.

Results: A total of 197 participants with the mean age of 72.03 years (SD = 8.84) was recruited. Almost of them (85.8%) reported adhered to warfarin prescription. More than a half (60.5%) were able to report their targeted INR. Participants who stayed with the family had 5.54 times (95% CI 1.79–19.33), took regular daily dose warfarin had 5.07 times (95% CI 1.05–24.49), perceived targeted INR had 2.94 times (95% CI 1.04–8.29), and received family support had 1.33 times (95% CI 1.11–1.60) increased odds of warfarin adherence than those who did not. Participants who perceived a barrier to taking medication had 0.93 times decreased odds of warfarin adherence than those who did not (95% CI 0.86–0.99).

Conclusion: Healthcare system should encourage family to support the older population with AF in order to increase warfarin adherence. Future research should develop intervention combining family support to promote warfarin adherence.

Keywords: adherence, atrial fibrillation, INR, older population, warfarin

Introduction

Warfarin is an oral anticoagulant that prevents embolism by inhibiting Vitamin K. Warfarin is commonly used in both Valvular atrial fibrillation (VAF) and non-valvular atrial fibrillation (NVAF) patients such as postoperative heart valve replacement, arterial occlusion, venous thromboembolism, and atrial fibrillation.¹ The underlying hypertension, diabetes and coronary artery disease are the main risk factors NVAF. Risk factor control is essential to improve outcomes amongst NVAF patients. Hence, patient education and awareness are not only INR monitoring but also the risk factor control.^{2–4} The advancement of age increased the stroke risk in non-valvular atrial fibrillation (NVAF) patients. Therefore, long-term anticoagulant management in patients over 65 years has been recommended.⁵ The efficiency and safety of warfarin depend on blood coagulation known as International Normalized Ratio (INR). The targeted INR generally ranged between 2 and 3.

Warfarin adherence in Thai older population with atrial fibrillation (AF) was reported at 68.1%.^{6,7} The inability to control INR was related with the increasing risk for complications such as stroke (3%) and abnormal bleeding (4.4%).⁸ Uncontrolled INR in people aged ≥ 65 years are 2.37 times greater risk for bleeding than people under 65 years old.⁹ Warfarin is important for preventing cardiovascular diseases and complications, however healthcare providers have to actively monitor and manage INR level by promoting warfarin adherence in older population.

Factors associated with warfarin adherence was reviewed based on Multidimensional Adherence Model composed of 5 multidimensional factors including patient-related factors, condition-related factors, social/economic factors, therapy-related factors, and health system/healthcare team factors.¹⁰ Patient-related factors included cognitive limitations such as the impairment of vision, memory, decision-making, and problem-solving. Older population with cognitive impairment usually forget to take medications, or take medications at the wrong time and dosages.^{11,12} Moreover, the lack of knowledge about taking medication and the interactions between warfarin and foods/beverages/certain herbs, and air pollution were also associated with poor warfarin adherence.^{13,14}

Social/economic contexts, the benefits from family members help support older adults on warfarin in gaining the capacity to engage in medication adherence, which should be a strength in Thai society.¹⁵ Therapy related factors, previous evidences found that the administration and management of warfarin regimen are complex. For example, the difference dose of warfarin prescribed increased the chance of taking the wrong dosage on the wrong day and time.^{13,16}

Health System Factors, access to medication management and monitoring of warfarin use were related with medication adherence.^{14,17,18} Therefore, national healthcare service plans by the Ministry of Public Health prescribe the establishment of warfarin clinics covering 13 health zones nationwide in large community hospitals in Thailand. Multidisciplinary teams composed of cardiologists, nurses, and pharmacists work together to improve the warfarin adherence using case managers and coordinators model.¹⁹

The demand in actual health service situations above found gaps caused health inequality. Therefore, it is a challenge for the health service system on how to ensure that the older population would be able to receive the benefit equally under limited health resources. The aims of this study were to 1) determine the INR levels in older people with atrial fibrillation taking warfarin and 2) examine the predictors of warfarin adherence, including types of clinics receiving services, income, electronic health information literacy, family support, perceived benefits of using warfarin, perceived barriers to warfarin, knowledge, comorbidity, and time of warfarin used.

Materials and Methods

Sample

Older people with AF were treated with warfarin, aged 60 years and over, received services at the warfarin clinic, internal medicine clinic, or outpatient department of one tertiary hospital in Thailand. Inclusion criteria consisted of: 1) treated with warfarin for at least six months; 2) had at least two INR results report; 3) took warfarin by themselves; and 4) communicated in Thai. Researchers excluded samples who had a history of heart valve replacement surgery or artificial heart valve implantation and presented with cognitive impairment.

Power Analysis

Calculation of the sample size to study factors predicting warfarin adherence among the older population. Power analysis was performed using the G*power program, version 3.1.9.2, based on Cohen's power analysis. We defined statistical power (P) at 0.85, and a significant level (α) at 0.05, and the odds ratio of 2.67 based on previous study found that age was independently associated with adherence to warfarin therapy (OR 2.67, 95% CI 1.29–5.52).²⁰ The minimal requirement sample size was 189.

Instruments

The questionnaire used to ask for information from the research participants was 65 items, taking about 30–45 minutes to answer the questionnaire. The details are as follows:

1. The Personal Information and Illness Questionnaire was created by the researcher. The questionnaire consisted of income, obtaining information on the target INR level, sex, age, marital status, education level, health insurance, receiving health assistance from family members or caregivers, internet use experience, warfarin tracking patterns, and alternative medicine.

2. The eHealth Literacy Scale was developed by Norman and Skinner (2006),²¹ with Cronbach's Alpha Coefficient of 0.88. Division of Health Awareness Promotion and Communication, Department of Health, Ministry of Public Health was translated into Thai using the back translation process.
3. The Oral Anticoagulation Knowledge Test (OAK) was developed by Zeolla et al²² with a KR-20 of 0.76. Researchers performed a back translation and sent back the translation tool kit to the owner of the original tool to determine the correctness of the language.
4. The Family APGAR Questionnaire was developed by Smilkstein et al²² with a Cronbach's Alpha of 0.78. Malathum (2001)²³ translated into Thai and used the back translation process to adjust the language to match the Thai context. The questionnaire quality was tested on 211 Thai elderly subjects with the Cronbach's Alpha Coefficient of 0.91.
5. A Beliefs About Anticoagulation Survey was developed by Orensky and Holdford (2005)²⁴ with a Cronbach's alpha of 0.82. Panichpathom et al²⁵ translated into Thai by translating back into English to assess perceived benefits and perceived barriers to warfarin intake in Thai patients with arrhythmias. The Cronbach's Alpha Coefficient was 0.90 and 0.62, respectively.
6. The Oral Anticoagulation Measurement of Treatment Adherence was developed by Da Silva Carvalho et al²⁶ to assess medication adherence. Measurement of Treatment Adherence was translated into Thai by reverse translation method by Panichpathom et al²⁵ and used to assess anticoagulant adherence in Thai patients with atrial fibrillation. Answers were obtained using a six-point scale varying from always (1) to never (6). The summed scores obtained ranged from one to six. A total summed score of less than 5 defines poor medication adherence, and the total summed score 5 to 6 determines good medication adherence. The Thai version of the anticoagulant cooperation questionnaire had a Cronbach coefficient of 0.70.
7. The Charlson Comorbidity Index (CCI) was developed by Charlson et al,²⁷ and it was used to assess the severity of comorbidity in patients with cardiovascular disease. It is widely used in foreign countries, including Thailand.²⁸ The Thai version of the CCI had a Cronbach coefficient of 0.70.

Statistical Analysis

Descriptive statistics were used to divide frequency (Frequency Distributions), percentage, mean, median, standard deviation (SD), range and the range between the values. The predictors of warfarin adherence among types of clinics receiving services, income, electronic health information literacy, family support, perceived benefits of using warfarin, perceived barriers to warfarin, knowledge, comorbidity, and time of warfarin used were analyzed using logistic regression analysis.

Results

Demographic Data

This study recruited 197 participants, including 169 samples (85.8%) who adhered to the warfarin and 28 samples (14.2%) who have not adhered to the warfarin. The average age of the participants was 72.03 years (SD = 8.84). More than half of the samples (67%) were married, and most of them (79.2%) had an elementary school level of educational attainment. Almost half of the participants (88.7%) lived with a family with an average income of 87.3 US\$ (SD = 229.2), so almost all of them (91.8%) reported they received support from the family. Most of them (81.4%) used Universal Health Care coverage insurance. When comparing adhere versus non-adhere to warfarin groups, the results found that participants who stayed with the family (92.3%) had a higher percentage of warfarin adherence than participants who did not stay with the family (66.7%) with a statistical significance ($p < 0.001$). Moreover, participants who received support from the family (94.0%) had a higher percentage of warfarin adherence than those without (78.6%) with a statistical significance ($p = 0.014$) as shown in Table 1.

More than half of the participants (60.5%) reported that they knew the targeted INR. Only a few of them (17.8%) used the Internet to search for information by using the LINE application (13.2%) and Facebook (7.1%). The average

Table I Demographic Data of the Sample (N = 197)

	Total	Good Warfarin Adherence	Poor Warfarin Adherence	P value
	n (%) 197 (100)	n (%) 169 (85.8)	n (%) 28 (14.2)	
Gender				
Male	94 (47.7)	81 (41.9)	13 (46.4)	0.883 ^c
Female	103 (52.3)	88 (52.1)	15 (53.6)	
Age (year) (Mean ± SD)	72.03±8.84	72.43±7.30	73.11±8.18	0.656 ^c
< 80 yrs.	163 (82.7)	140 (82.8)	23 (82.1)	0.928 ^f
≥ 80 yrs.	34 (17.3)	29 (17.2)	5 (17.9)	
Marital status				
Single	12 (6.3)	9 (5.5)	3 (11.1)	0.496 ^c
Married	128 (67.0)	110 (67.1)	18 (66.7)	
Divorced/ Widowed/Separated	51 (26.7)	45 (27.4)	6 (22.2)	
Education				
None	10 (5.1)	7 (4.1)	3 (10.7)	0.173 ^f
Elementary	156 (79.2)	136 (80.5)	20 (71.4)	
High school	23 (11.7)	18 (10.7)	5 (17.9)	
Bachelor's degree or higher	8 (4.1)	8 (4.7)	–	
Income				
Sufficient savings	30 (15.3)	24 (14.3)	6 (21.4)	0.262 ^f
Live without savings	83 (42.3)	75 (44.6)	8 (28.6)	
Insufficient without dept	50 (25.5)	44 (26.2)	6 (21.4)	
Live in dept	33 (16.8)	25 (14.9)	8 (28.6)	
Income (Mean ± SD) US\$	87.3±229.2	90.4±235.1	68.3±86.7	0.673 ^c
Medical Benefit Scheme				
Universal Coverage Scheme	144 (81.4)	126 (82.9)	18 (72.0)	0.264 ^f
Others	33 (18.6)	26 (17.1)	7 (28.0)	
Living conditions				
Living with family	173 (88.7)	155 (92.3)	18 (66.7)	0.001 ^{f*}
Living alone	22 (11.3)	13 (7.7)	9 (33.3)	
Family support				
Not received	16 (8.2)	10 (6.0)	6 (21.4)	0.014 ^{f*}
Received	180 (91.8)	158 (94.0)	22 (78.6)	

Notes: ^cChi-Square Test, ^fFisher's Exact Test, ^tIndependent T-test.

Abbreviations: SD, standard deviation; US\$, United States dollar.

media literacy score was 8.48 (SD = 14.44). Almost all of them (90.9%) have never used supplement medication such as herbs. When comparing adhere versus non-adhere to warfarin groups, the results found that participants who perceived targeted INR (64.7%) had a higher percentage of warfarin adherence than participants who did not perceive (35.7%) with a statistical significance ($p = 0.004$) as shown in [Table 2](#).

Knowledge, Family Support, and Beliefs

Most participants (87.3%) had a low level of knowledge, with an average score of 13.10 (SD = 2.99). The average family support score was 18.75 (SD = 2.41), perceived benefits with an average score of 22.13 (SD = 2.64), and perceived barrier with an average score of 18.64 (SD = 5.78). When comparing adhere versus non-adhere to warfarin groups, the results found that participants who adhered to warfarin (19.05 ± 2.16) had higher average scores of family support than participants who did not adhere to warfarin (16.89 ± 2.99) with statistical significance ($p < 0.001$) as shown in [Table 3](#).

Table 2 Perceived General Information Data the Sample (N = 197)

	Total	Good Warfarin Adherence	Poor Warfarin Adherence	P value
	n (%) 197 (100)	n (%) 169 (85.8)	n (%) 28 (14.2)	
Obtaining information on the target INR level				
No	77 (39.5)	59 (35.3)	18 (64.3)	0.004 ^{c*}
Yes	118 (60.5)	108 (64.7)	10 (35.7)	
Internet usage experienced				
No	162 (82.2)	136 (80.5)	26 (92.9)	0.179 ^f
Yes	35 (17.8)	33 (19.5)	2 (7.1)	
Using Line Application	26 (13.2)	25 (14.8)	1 (3.6)	0.136 ^f
Using Facebook	14 (7.1)	14 (8.3)	–	0.226 ^f
History of Herbal or Dietary Supplement Usage				
No	179 (90.9)	155 (91.7)	24 (85.7)	0.295 ^f
Yes	18 (9.1)	14 (8.3)	4 (14.3)	
Electronic health information literacy score				
Mean ± SD	8.48±14.44	8.65±14.61	7.46±13.63	0.688 ^c

Notes: ^cChi-Square Test, ^fFisher's Exact Test, ⁱIndependent T-test, *P value < 0.05.

Abbreviations: SD, standard deviation; INR, International normalized ratio.

Table 3 Knowledge, Family Support, and Beliefs of the Sample (N=197)

	Total		Good Warfarin Adherence	Poor Warfarin Adherence	P value
	Mean±SD	Range	Mean±SD	Mean±SD	
Anticoagulant Knowledge score	13.10±2.99	4–20	13.10±2.97	13.08±3.16	0.962 ^c
Inadequate knowledge (score < 17)	172 (87.3)		148 (87.6)	24 (85.7)	0.762 ^f
Adequate knowledge (score ≥ 17)	25 (12.7)		21 (12.4)	4 (14.3)	
Family support score	18.75±2.41	8–20	19.05±2.16	16.89±2.99	0.001 ^{c*}
Perceived benefits score	22.13±2.64	11–25	22.24±2.58	21.46±2.91	0.152 ^c
Perceived barriers score	18.64±5.78	7–35	18.40±5.31	20.11±8.03	0.286 ^c

Notes: ^cFisher's Exact Test, ⁱIndependent T-test, *P value < 0.05.

Abbreviation: SD, standard deviation.

Clinical data

The average duration of warfarin use was 70.06 days (SD = 54.43), the average dose of warfarin used was 17.80 mg/week (SD = 8.10), and the average number of pills was 6.93 tablets/week (SD = 2.93). Almost half of the participants (41.1%) had the targeted INR between 2.00 and 3.00. Almost all (91.3%) received service at a warfarin clinic. More than half of the participants (62.9%) had one or two comorbidities. Almost all of them (94.9%) took regular daily dose warfarin prescriptions. Three-quarters of them (75.9%) took two regimens of warfarin prescriptions per week. A few of the participants report reported adverse events related to warfarin, including scurvy (2.7%), and upper gastrointestinal bleeding (0.5%). When comparing adhere versus non-adhere to warfarin groups, the results found that participants who took regular daily dose warfarin prescriptions (96.4%) had better warfarin adherence than participants who took non-regular daily dose warfarin prescriptions (85.7%), with a statistical significance ($p = 0.039$) as shown in Table 4.

Finally, using the logistic regression to examine the predictors of warfarin adherence, the results found that perceived targeted INR, staying with the family, taking regular daily dose warfarin, receiving family support, and perceived barriers to taking medication were the significant predictors. For instance, participants who perceived targeted INR had 2.94 times higher odds of warfarin adherence than those who did not (95% CI 1.04–8.29). Participants who stayed with the family had 5.54 times higher odds of warfarin adherence than those who did not (95% CI 1.79–19.33). Participants who took regular

Table 4 Clinical Data of the Sample (N = 197)

	Total	Good Medication Adherence	Poor Medication Adherence	P value
	n (%)	n (%)	n (%)	
Duration of warfarin taking (Day)	70.06±54.43	68.26±50.91	80.59±71.98	0.278 ^c
Dose of Warfarin (mg.)/week	17.80±8.10	17.89±8.33	17.27±6.62	0.707 ^c
Oral medications (tablets/week)	6.93±2.93	6.99±2.87	6.57±3.26	0.487 ^c
INR levels				
Below therapeutic target (0–1.99)	72 (36.5)	62 (36.7)	10 (35.7)	0.917 ^c
Therapeutic target (2.00–3.00)	81 (41.1)	69 (40.8)	12 (42.9)	
Above therapeutic target (≥ 3.01)	44 (22.3)	38 (22.5)	6 (21.4)	
Type of clinics				
Warfarin Clinic	179 (91.3)	154 (91.1)	25 (92.6)	1.000 ^f
Gen Med	17 (8.7)	15 (8.9)	2 (7.4)	
CCI Score	1.51±1.21	1.51±1.16	1.50±1.53	0.971 ^c
None (score = 0)	42 (21.3)	34 (20.1)	8 (28.6)	0.309 ^c
Mild (score = 1–2)	124 (62.9)	110 (65.1)	14 (50.0)	
Moderate and severe (score = 3+)	31 (15.7)	25 (14.8)	6 (21.4)	
Warfarin prescriptions				
Non-regular daily dose	10 (5.1)	6 (3.6)	4 (14.3)	0.039 ^{*f}
Regular daily dose	185 (94.9)	161 (96.4)	24 (85.7)	
Dose of warfarin in a week				
The same dose	45 (23.1)	40 (24.0)	5 (17.9)	0.281 ^f
Two different doses	148 (75.9)	126 (75.4)	22 (78.6)	
Three different doses	2 (1.0)	1 (0.6)	1 (3.6)	
Adverse Event (yes)	6 (3.0)	12 (7.5)	2 (7.4)	1.000 ^f
Scurvy (yes)	5 (2.5)	5 (2.5)	-	0.100 ^f
UGIB (yes)	1 (0.5)	1 (0.5)	-	1.000 ^f

Notes: ^cChi-Square Test, ^fFisher's Exact Test, ^tIndependent T-test, ^{*P} value < 0.05.

Abbreviations: UGIB, Upper gastrointestinal bleeding; mg, milligram; INR, International normalized ratio.

daily dose warfarin had 5.07 times higher odds of warfarin adherence than those who did not (95% CI 1.05–24.49). Participants who received family support had 1.33 times higher odds of warfarin adherence than those who did not (95% CI 1.11–1.60). Participants who perceived a barrier to taking medication had 0.93 times lower odds of warfarin adherence than those who did not (95% CI 0.86–0.99) in Table 5.

Table 5 Logistic Regression Predicting Warfarin Adherence of the Sample (N = 197)

	Beta	Wald	P value	OR	95% CI
Constant	−5.49	6.818	0.009	0.01	–
Aged ≥ 80 years	1.11	1.860	0.173	3.05	0.62, 15.10
Obtaining information on the target INR level (Yes / No)	1.08	4.152	0.042*	2.94	1.04, 8.29
Living with family	1.71	7.202	0.007*	5.54	1.79, 19.33
Warfarin prescriptions (Regular daily dose) / Non-regular daily dose)	1.62	4.086	0.043*	5.07	1.05, 24.49
Dose of warfarin in a week					
The same dose (ref)	1				
Two different doses	−0.05	0.007	0.933	0.95	0.29, 3.16
Three different doses	−2.58	2.204	0.138	0.08	0.003, 2.28
Family support	0.29	9.420	0.002*	1.33	1.11, 1.60
Perceived barriers to medication taking	−0.08	4.128	0.042*	0.93	0.86, 0.997

Notes: *P value < 0.05, Nagelkerke R² = 0.318 Hosmer & Lemeshow Test P value = 0.230.

Abbreviations: OR, Odds ratio; INR, International normalized ratio; ref, reference; CI, confidence interval.

Discussion

Participants who obtained their INR target had a statistically significant association with warfarin adherence (OR 2.94, 95% CI 0.62–15.10, $p = 0.042$). Participants who know their targeted INR might be better engaged and taken into account in their treatment.²⁹ Patients commonly receive repeated information regarding the purpose of taking warfarin and the importance of achieving the therapeutic INR. These might help them improve adherence to warfarin. This result differs from the previous study, which found that participants who obtained their targeted INR were unrelated to warfarin adherence. INR testing and clinical appointments may make the participants concerned and have negative attitudes toward warfarin.³⁰

Taking regular daily dose of warfarin had a statistically significant association with warfarin adherence (OR 5.07, 95% CI 1.05–24.49, $p = 0.043$). Warfarin regimens are generally complex, with different doses and days of medication taking. Its complexity causes confusion and forgetting, leading to medication non-adherence, wrong medication dose, and undesired warfarin-related complications. This finding might be explained by the fact that taking warfarin every day at a similar time helps the patient easily remember a routine of medication taking. The finding is consistent with the study aimed to compare adherence and persistence of different daily doses of oral anticoagulants in patients with AF.³¹

Family support had a statistically significant association with warfarin adherence (OR 1.33, 95% CI 1.11–1.60, $p = 0.002$). The participants of this study were older population. They might have some difficulties in regular warfarin-taking, such as vision and cognitive impairment, as well as the complexity of the warfarin regimen. Therefore, family support or living with family, particularly in Asian cultures, plays a crucial role in helping the elders with self-care and medication taking. This finding is congruent with the study in China, which found that family functioning was related to the patient's medication adherence, particularly in patients with low medication literacy.³²

Perceived barriers to using warfarin showed a statistically significant association with warfarin adherence (OR 0.93, 95% CI 0.86–0.997, $p = 0.042$). Perceptions about barriers related to warfarin usage were identified, such as dose per day, unfavorable warfarin-related complications, warfarin-related knowledge deficit, and concern about forgetting to take warfarin. Perceived barriers to using warfarin are related to warfarin usage and adherence.^{30,33} Accordingly, info about barriers to using warfarin might be applied as one of the strategies for improving warfarin adherence.

Perceived benefits of using warfarin showed no statistically significant difference between warfarin adherence and non-adherence groups ($p = 0.262$). Perceptions about the benefits of using warfarin might not be apparent because they are mainly for preventing AF complications or hospitalization. Healthcare providers might not commonly use or repeat this beneficial information during hospital visits to increase medication adherence. This result is congruent with the previous study that the perceived benefits of using warfarin were not associated with medication adherence.³⁰

The type of clinic services showed no statistically significant difference between warfarin adherence and non-adherence groups ($p = 1.000$). This result might be explained by the hospital implementing the standard protocol of warfarin therapy in all warfarin-related clinics. The relevant study found that establishing the standardized warfarin protocol showed positive effects on warfarin-related outcomes compared to before the standardized warfarin protocol implementation.^{34,35} Income showed no statistically significant difference between warfarin adherence and non-adherence groups ($p = 0.262$). This finding might be related to the participants' family support regarding financial support. Additionally, the majority had universal coverage schemes. They had no payment for warfarin prescriptions because the universal coverage schemes covered it. This finding differs from the study in patients with non-valvular atrial fibrillation. This study found that higher income was associated with high medication adherence. It was explained that the participants with high incomes could pay for the high price of anticoagulation medication. Therefore, they had better adherence to anticoagulation medication than the lower-income group.³⁶

eHealth information literacy showed no statistically significant difference between warfarin adherence and non-adherence groups ($p = 0.688$). This finding can be explained by the fact that most participants graduated from elementary school and had no experience with internet usage. The previous study found that eHealth information literacy was significantly correlated to education level.³⁷ eHealth literacy influenced the participants' health-related knowledge and behaviors.^{38,39}

Warfarin knowledge showed no statistically significant difference between warfarin adherence and non-adherence groups ($p = 0.962$). Warfarin knowledge is a cornerstone of medication safety and proper self-care,³⁵ however, it might

not directly affect warfarin adherence. This finding is consistent with the previous studies, which reported that anticoagulation-related knowledge was not significantly related to medication adherence.²⁸

Comorbidity showed no statistically significant difference between warfarin adherence and non-adherence groups ($p = 0.971$). Most of the participants, both good and poor warfarin adherence groups, reported a similar level of none and mild level of Charlson Comorbidity Index (CCI), which might not affect medication adherence. Moreover, most of them lived with their family, which could help them with medication taking. This finding differs from the previous study, which found that comorbidities were associated with oral anticoagulant non-adherence.⁴⁰

Patients who used non-vitamin K antagonist oral anticoagulants (NOACs) were found not inferior to warfarin for thromboembolic and bleeding events. NOACs should be considered to use in patients with NVAF. The retrospective study of NOACs in Thailand found patients who received warfarin had 3.17 times higher odds of complication such as thromboembolic or total bleeding than those who received NOACs.⁴¹ However, the future study should implement prospective cohort study or experimental study on the effectiveness of NOACs. The benefit of anticoagulants was not only preventing major stroke but also micro-emboli and dementia in the long term outcomes.^{42–44}

Conclusion

Living with family and receiving family support are significant elements for warfarin adherence in the Thai context. Healthcare provider should provide individual targeted INR levels and information regarding warfarin, such as the importance of warfarin adherence and warfarin-related complications, promotes older adults adhering to warfarin. The warfarin prescriptions should use daily dose method. Future studies should focus on the intervention to support older adults with AF and their families by combining a technology to remind the older population to take the warfarin and their targeted INR level.

Ethics Approval

This study complies with the Declaration of Helsinki and was performed according to ethics committee approval by the Human Research Ethics Committee. Eligible participants were fully informed the information related to this study asked for their willingness to participate in the study.

This study was approved by the Human Research Ethics Committee of Faculty of Nursing Mahidol University (IRB-NS2022/694.0306) and Sakon Nakhon hospital (SKNH REC No. 024/2565).

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References

1. Freedman B, Hindricks G, Banerjee A, et al. World heart federation roadmap on atrial fibrillation – a 2020 update. *Glob Heart*. 2021;16(1):41. doi:10.5334/gh.1023
2. O'Keefe EL, Sturges JE, O'Keefe JH, et al. Prevention and treatment of atrial fibrillation via risk factor modification. *Am J Cardiol*. 2021;160:46–52. doi:10.1016/j.amjcard.2021.08.042
3. Batta A, Hatwal J, Batta A, et al. Atrial fibrillation and coronary artery disease: an integrative review focusing on therapeutic implications of this relationship. *World J Cardiol*. 2023;15(5):229–243. doi:10.4330/wjc.v15.i5.229
4. Hiraya D, Sato A, Hoshi T, et al. Impact of coronary artery disease and revascularization on recurrence of atrial fibrillation after catheter ablation: importance of ischemia in managing atrial fibrillation. *J Cardiovas Electrophysiol*. 2019;30(9):1491–1498. doi:10.1111/jce.14029
5. January CT, Wann LS, Alpert JS, et al. AHA/ACC/HRS guideline for the management of patients with atrial fibrillation: executive summary: a report of the American College of Cardiology/American heart association task force on practice guidelines and the heart rhythm society. *Circulation*. 2014;130(23):2071–2104. doi:10.1161/CIR.0000000000000040

6. Dilokthornsakul P, Nathisuwan S, Krittayaphong R, et al. Cost-effectiveness analysis of non-vitamin K antagonist oral anticoagulants versus warfarin in Thai patients with non-valvular atrial fibrillation. *Heart Lung & Circulation*. 2020;29(3):390–400. doi:10.1016/j.hlc.2019.02.187
7. Ng SS, Nathisuwan S, Phrommintikul A, et al. Cost-effectiveness of warfarin care bundles and novel oral anticoagulants for stroke prevention in patients with atrial fibrillation in Thailand. *Thrombosis Res*. 2020;185:63–71. doi:10.1016/j.thromres.2019.11.012
8. Krittayaphong R, Winijkul A, Kunjara-Na-Ayudhya R, et al. Adherence to anticoagulant guideline for atrial fibrillation improves outcomes in asian population. *Stroke*. 2020;51(6):1772–1780. doi:10.1161/STROKEAHA.120.029295
9. Prikri W, Rattanavipanon W, Saejear W, et al. Incidence, risk factors, and outcomes of warfarin-associated major bleeding in Thai population. *Pharmacoepidemiol Drug Saf*. 2019;28(7):942–950. doi:10.1002/pds.4781
10. Chaudri N. Adherence to long-term therapies evidence for action. *Ann Saudi Med*. 2004;24(3):221–222. doi:10.5144/0256-4947.2004.221
11. Barbosa M, Menezes Falcão L. Oral anticoagulation in the elderly: new oral anticoagulants—innovative solution for an old problem? *Am J Therapeutics*. 2019;26(1):e133. doi:10.1097/MJT.0000000000000452
12. Lieneck C, Herzog B, Krips R. Analysis of facilitators and barriers to the delivery of routine care during the COVID-19 global pandemic: a systematic review. *Healthcare*. 2021;9(5):528. doi:10.3390/healthcare9050528
13. Tan CSS, Lee SWH. Warfarin and food, herbal or dietary supplement interactions: a systematic review. *Br J Clin Pharmacol*. 2021;87(2):352–374. doi:10.1111/bcp.14404
14. Kilic S, Çelik A, Seyis AS, et al. Potential factors affecting the anticoagulation control in patients treated with warfarin: results WARFARIN-TR study. *Int J Cardiovas Acad*. 2018;4(4):86. doi:10.4103/IJCA.IJCA_43_18
15. Woodham N, Taneepanichskul S, Somrongsong R, et al. Medication adherence and associated factors among elderly hypertension patients with uncontrolled blood pressure in rural area, Northeast Thailand. *J Health Res*. 2018;32(6):449–458. doi:10.1108/JHR-11-2018-085
16. Lip GYH, Brechin CM, Lane DA. The global burden of atrial fibrillation and stroke: a systematic review of the epidemiology of atrial fibrillation in regions outside North America and Europe. *Chest*. 2012;142(6):1489–1498. doi:10.1378/chest.11-2888
17. Jiang S, He Q, Yan J, et al. Evaluation of a pharmacist-led remote warfarin management model using a smartphone application (Yixing) in improving patients' knowledge and outcomes of anticoagulation therapy. *Front Pharmacol*. 2021;12. doi:10.3389/fphar.2021.677943
18. Lee JC, Horner KE, Krummel ML, et al. Clinical and financial outcomes evaluation of multimodal pharmacist warfarin management of a statewide urban and rural population. *J Pharm Pract*. 2018;31(2):150–156. doi:10.1177/0897190017703506
19. Phrommintikul A, Nathisuwan S, Gunaparn S, et al. Prospective randomised trial examining the impact of an educational intervention versus usual care on anticoagulation therapy control based on an SAME-TT2R2 score-guided strategy in anticoagulant-naïve Thai patients with atrial fibrillation (TREATS-AF): a study protocol. *BMJ Open*. 2021;11(10):e051987. doi:10.1136/bmjopen-2021-051987
20. Mayet AY. Patient adherence to warfarin therapy and its impact on anticoagulation control. *Saudi Pharm J*. 2016;24(1):29–34. doi:10.1016/j.jsps.2015.02.005
21. Norman CD, Skinner HA. eHealth literacy: essential skills for consumer health in a networked world. *J Med Internet Res*. 2006;8(2):e506. doi:10.2196/jmir.8.2.e9
22. Zeolla MM, Brodeur MR, Dominelli A, et al. Development and validation of an instrument to determine patient knowledge: the oral anticoagulation knowledge test. *Ann Pharmacother*. 2006;40(4):633–638. doi:10.1345/aph.1G562
23. Malathum P. *A Model of Factors Contributing to Perceived Abilities for Health -Promoting Self -Care of Community -Dwelling Thai Older Adults*. The University of Texas at Austin; 2001.
24. Orensky IA, Holdford DA. Predictors of noncompliance with warfarin therapy in an outpatient anticoagulation clinic. *Pharmacother J Human Pharmacol Drug Ther*. 2005;25(12):1801–1808. doi:10.1592/phco.2005.25.12.1801
25. Panichpathom V, Sriyuktasuth A, Wattanakitkrileart D, et al. Warfarin adherence and its associated factors among patients with atrial fibrillation. *Nursing Sci J Thailand*. 2019;37(1):73–85.
26. Carvalho AR, Dantas RAS, Pelegrino FM, et al. Adaptation and validation of an oral anticoagulation measurement of treatment adherence instrument. *Revista Latino Am Enfermagem*. 2010;18(3):301–308. doi:10.1590/s0104-11692010000300002
27. Charlson ME, Charlson RE, Peterson JC, et al. The Charlson comorbidity index is adapted to predict costs of chronic disease in primary care patients. *J Clin Epidemiol*. 2008;61(12):1234–1240. doi:10.1016/j.jclinepi.2008.01.006
28. Poungkaew A, Sindhu S, Pinyopasakul W, Tresukosol D, Viwatwongkasem, C, et al. Evaluation of A health service system for heart failure management in Thailand. *Suranaree J Sci Technol*. 2018;25(3):295–306.
29. Farinha JM, Jones ID, Lip GYH. Optimizing adherence and persistence to non-vitamin K antagonist oral anticoagulant therapy in atrial fibrillation. *Eur Heart J Suppl*. 2022;24(Supplement_A):A42–A55. doi:10.1093/eurheartj/suab152
30. Chen P-T, Wang T-J, Hsieh M-H, et al. Anticoagulation adherence and its associated factors in patients with atrial fibrillation: a cross-sectional study. *BMJ Open*. 2019;9(9):e029974. doi:10.1136/bmjopen-2019-029974
31. Smits E, Andreotti F, Houben E, et al. Adherence and Persistence with Once-Daily vs Twice-Daily Direct Oral Anticoagulants Among Patients with Atrial Fibrillation: real-World Analyses from the Netherlands, Italy and Germany. *Drugs Real World Outcome*. 2022;9(2):199–209. doi:10.1007/s40801-021-00289-w
32. Ni H, Lin Y, Peng Y, et al. Relationship between family functioning and medication adherence in Chinese patients with mechanical heart valve replacement: a moderated mediation model. *Front Pharmacol*. 2022;13. doi:10.3389/fphar.2022.817406
33. Holbrook A, Wang M, Swinton M, et al. Barriers and facilitators for optimizing oral anticoagulant management: perspectives of patients, caregivers, and providers. *PLoS One*. 2021;16(9):e0257798. doi:10.1371/journal.pone.0257798
34. Aidit S, Soh YC, Yap CS, et al. Effect of standardized warfarin treatment protocol on anticoagulant effect: comparison of a warfarin medication therapy adherence clinic with usual medical care. *Front Pharmacol*. 2017;8. doi:10.3389/fphar.2017.00637
35. Ababneh M, Nasser SA, Rababa'h A, et al. Warfarin adherence and anticoagulation control in atrial fibrillation patients: a systematic review. *Eur Rev Med Pharmacol Sci*. 2021;25(24). doi:10.26355/eurrev_202112_27642
36. Song T, Xin X, Cui P, et al. Factors associated with anticoagulation adherence in Chinese patients with non-valvular atrial fibrillation. *Patient Prefer Adherence*. 2021;15:493–500. doi:10.2147/PPA.S285020
37. Ghazi SN, Berner J, Anderberg P, et al. The prevalence of eHealth literacy and its relationship with perceived health status and psychological distress during Covid-19: a cross-sectional study of older adults in Blekinge, Sweden. *BMC Geriatr*. 2023;23(1):5. doi:10.1186/s12877-022-03723-y

38. Green G. Seniors' eHealth literacy, health and education status and personal health knowledge. *DIG HEALTH*. 2022;8:20552076221089803. doi:10.1177/20552076221089803
39. Xie L, Zhang S, Xin M, et al. Electronic health literacy and health-related outcomes among older adults: a systematic review. *Preventive Med*. 2022;157:106997. doi:10.1016/j.ypmed.2022.106997
40. Ingason AB, Hreinsson JP, Lund SH, et al. Comparison of medication adherence to different oral anticoagulants: population-based cohort study. *BMJ Open*. 2023;13(1):e065700. doi:10.1136/bmjopen-2022-065700
41. Yamkasikorn J, Methavigul K. Safety and efficacy of non-vitamin K antagonist oral anticoagulants compared with well-controlled warfarin in Thai patients with atrial fibrillation. *Asian Biomed*. 2022;16(3):131–136. doi:10.2478/abm-2022-0016
42. Kalloo AE, Slouha E, Gallagher CP, et al. Anticoagulants and dementia: a systematic review. *Cureus*. 2023;15(5):e39693. doi:10.7759/cureus.39693
43. Batta A, Sharma YP, Hatwal J, et al. Predictors of dementia amongst newly diagnosed non-valvular atrial fibrillation patients. *Indian Heart J*. 2022;74(6):505–509. doi:10.1016/j.ihj.2022.11.009
44. Agarwal A, Mostafa MA, Ahmad MI, et al. Exploring the link between anticoagulation, cognitive impairment and dementia in atrial fibrillation: a systematic review. *J Clin Med*. 2024;13(8):2418. doi:10.3390/jcm13082418

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