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# Education on Warfarin therapy through social media: A facilitator of INR control in patients with prosthetic heart valves

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## Abstract

Heart valve replacement surgery requires long-term care due to its chronic nature. Warfarin, as the primary post-operative medication, can lead to complications such as bleeding or embolism if there is poor adherence to the treatment. This study aimed to investigate the effect of social media-based education on the control of the International Normalized Ratio (INR) index in heart valve replacement patients.

This experimental study was conducted on 104 patients under warfarin treatment who underwent heart valve replacement surgery between August 2022 and May 2023. Patients were divided into control and intervention groups. The intervention group, in addition to routine discharge education, received warfarin-related training via social media for two months and was followed up for an additional two months. The INR index was evaluated before and after the intervention, and data were analyzed using independent T-tests, paired T-tests, and Chi-square tests.

The results showed that there was no significant difference in demographic variables between the two groups. The mean change in INR in the intervention group significantly decreased by -1.27 ± 0.35 after the intervention (P-value < 0.001), whereas this change was not significant in the control group (P-value = 0.18).

Utilizing social media-based education can help improve quality of life and reduce warfarin complications by increasing patient awareness and treatment adherence.

**Keywords:** Warfarin, Social Media, Heart Valve Replacement, Patient Education

## Introduction

Cardiovascular diseases are the leading cause of mortality worldwide, and valvular heart diseases hold particular significance due to their chronic and progressive nature (1). These diseases cause hemodynamic changes in the body that eventually lead to heart failure, arrhythmia, embolism, and other complications (2). With advancements in medical technologies and surgical skills, heart valve replacement has improved significantly (3). Heart valve replacement is a common treatment for valvular heart diseases, but long-term anticoagulant therapy is necessary after surgery (4). In this condition, there is a risk of thromboembolism due to ineffective anticoagulation or bleeding due to excessive drug effect (5). In the last five decades, more than 4 million valve replacement surgeries have been performed, and the use of anticoagulant drugs is considered the only definitive treatment for most patients with advanced heart valve disease (6).

The increase in mortality caused by thromboembolic diseases has made the use of anticoagulant drugs essential (7, 8). Warfarin, as an oral anticoagulant, is prescribed lifelong for patients with prosthetic heart valves (7). Warfarin dose adjustment is performed based on the International Normalized Ratio (INR), and the target value for patients is usually between 2-3 (9, 10). For this reason, monitoring and supporting patient adherence to warfarin play a key role in determining the appropriate dose and promoting the efficacy and safety of the treatment (11).

One of the main challenges in warfarin therapy is patient non-adherence to treatment. Research has shown that more than 92% of patients whose INR is outside the control range have poor treatment adherence (12). Low adherence to treatment, in addition to physical risks, leads to psychological consequences such as anxiety, depression, decreased self-esteem, and low quality of life (13).

Patient awareness of the reasons for and the importance of warfarin consumption and its continuous monitoring plays a vital role in improving treatment outcomes (14). Patient knowledge about the correct dose, side effects, and drug interactions can have a significant impact on achieving the target INR. In a study by Çınar et al. (2022), it was found that patients who had sufficient information about warfarin were significantly closer to their therapeutic goals (15). This issue highlights the vital role of nurses in providing comprehensive education for these patients (10). Using social media as an educational tool can assist in greater interaction between patients and medical staff (16). However, initial education alone is not sufficient, and continuous follow-up is also necessary (17). Telenursing, as a modern method, provides the possibility of providing individualized and continuous care to patients with chronic diseases. Telenursing, using modern technologies, helps improve patient adherence to treatment and INR control. This method can improve their quality of life and reduce the risk of complications from warfarin by increasing patient awareness about the importance of warfarin therapy, potential side effects, and drug interactions (18, 19).

By reviewing studies and research conducted in the field of education for patients treated with warfarin, no study has investigated the effect of warfarin therapy education using social media on INR control. Also, in this study, we intend to use the social media-based education method and examine its effect on the treatment of patients under warfarin therapy. Therefore, this study was conducted with the aim of teaching warfarin therapy through social media as a facilitator in the INR control of heart valve replacement patients.

## Methods

### *Study Design*

In this experimental study conducted from August 2022 to May 2023, a total of 104 heart valve replacement patients and warfarin users at Afshar Hospital, Yazd.

### *Setting and Participants*

This experimental study was conducted at Afshar Hospital in Yazd, Iran, between August 2022 and May 2023. A total of 104 heart valve

replacement patients receiving warfarin therapy were selected using convenience sampling and then randomly assigned into two groups: intervention (n=52) and control (n=52). The inclusion criteria required participants to be at least 18 years old, demonstrate willingness and motivation to follow educational programs, have access to social media, and hold a warfarin prescription from a cardiologist. Exclusion criteria included having cognitive or physical disorders that hindered understanding, incurable diseases, a history of bleeding in the past three months, sensory impairments (visual or hearing), dementia, or changing phone numbers during the study.

*Sample Size*

Based on the calculated formula and considering $\alpha = 0.05$, $\beta = 0.2$, and a minimum difference of 7 scores between the two groups, and accounting for a 10% attrition rate, 104 people were determined and randomly divided into two groups of 52 intervention and control participants who entered the study using the convenience sampling method. It should be noted that no blinding was performed in this study.

$$n = \frac{\left(z_{1-\frac{\alpha}{2}} + z_{1-\beta}\right)^2 [\sigma_1^2 + \sigma_2^2]}{d^2}$$

$$\sigma_1 = \sigma_2 \approx \frac{\mathrm{R}}{6} = \frac{90 - 18}{6} = 12$$

*Measurements and Validity and Reliability*

This prospective experimental study was conducted over a four-month period to evaluate the efficacy of a digital educational intervention. Initially, baseline International Normalized Ratio (INR) levels were established for all 104 participants (randomized into intervention and control groups, n=52 each). For this purpose, 2cc venous blood samples were collected and analyzed using the Succeeder SF8100 automated coagulation analyzer to ensure standardized laboratory results.

The intervention group received a structured 8-week digital educational program delivered via social media platforms. This educational program, which was validated by a panel of expert cardiologists, utilized multimodal teaching modalities, including text-based instructions, recorded audio, infographics, and instructional videos to enhance patient engagement. The program encompassed eight critical domains:

1. Warfarin rationale and indications.
2. Dosage management and self-monitoring protocols.
3. Interpretation of PT and INR values.
4. Pregnancy and breastfeeding considerations.
5. Management of complications, specifically hemorrhage.
6. Pharmacological interactions (chemical and herbal).
7. Nutritional guidelines and Vitamin K consistency.
8. Identification of "red-flag" symptoms requiring urgent medical intervention.

Full technical details regarding the weekly modules and specific teaching modalities are delineated in Table 1.

Following the educational phase, the intervention group underwent an intensive two-month tele-nursing follow-up. This consisted of weekly telephone consultations designed to address patient-specific inquiries, reinforce educational material, and bolster treatment adherence. Conversely, the control group received only the standard hospital discharge counseling. At the conclusion of the four-month study period, follow-up INR levels were measured for the 100 participants who remained in the study (Intervention: n=51; Control: n=49), due to lost contact (changes in phone numbers).

**Table 1. Warfarin therapy education content**

| Session | Topic / Description | Teaching Method |
|---|---|---|
| **1** | **Introduction to Warfarin:** Explaining the application of Warfarin and the reasons for its use in these patients. | Text, recorded audio, and images |
| **2** | **Warfarin Control and Consumption:** Education on therapeutic doses of Warfarin, and how to check, monitor, and adjust the dosage. | Text, recorded audio, and images |
| **3** | **Familiarity with PT and INR Tests:** Understanding normal and abnormal values, as well as medications that affect these levels. | Text, recorded audio, and slides |
| **4** | **Warfarin and Pregnancy:** Effects of Warfarin on pregnancy and the fetus, and guidance for breastfeeding mothers. | Educational videos and slides |
| **5** | **Warfarin Side Effects and Care:** Familiarity with the primary side effect of Warfarin (bleeding) and related self-care. | Text, recorded audio, images, and educational videos |
| **6** | **Drug Interaction Recommendations:** Familiarity with the interactions of chemical and herbal medications with Warfarin. | Educational videos and slides |
| **7** | **Nutrition in Warfarin Therapy:** Familiarity with food interactions and maintaining a proper diet while using Warfarin. | Educational videos and slides |
| **8** | **Danger and Warning Signs:** Identifying signs and symptoms that require immediate contact with medical centers. | Educational videos and slides |

*Statistical and Data Analysis*

Data were analyzed using SPSS (Version 20.0, IBM Corp., Armonk, NY, USA). The characteristics of the participants were presented in the form of a table using descriptive statistical methods including frequency and ratio indices, mean, and standard deviation. To compare quantitative variables between the two groups, due to the normal distribution of data, the independent T-test was used, and the Chi-square test was used to compare qualitative variables between the two groups. Also, to examine intra-group changes, the paired T-test was used. The significance level in this study was considered $p < 0.05$.

## Results

Four people were excluded from the study due to a change in phone number; therefore, statistical analysis was performed on 100 people. Patients completed the questionnaires in a group before and after the intervention. Demographic information of the patients is given in Table 2. According to Table 2, we find that the average age of the participants in the study is 46.8 ± 13.07 years, of which 44 (44%) were men, 76 (76%) were married, 51 (51%) had university education, 59 (59%) had aortic valve replacement disease, 72 (72%) had hypertension, 73 (73%) had hyperlipidemia, and 44 (44%) had diabetes. According to the results obtained, no statistically significant difference was observed in terms of demographic variables between the two groups (P-value > 0.05).

The results of Table 3 show that the average INR score in the control group before the intervention was 2.82 ± 0.503 and after the intervention was 2.86 ± 0.495, which is not statistically significant (P-value = 0.180). The average INR score in the intervention group before the intervention was 3.57 ± 0.677 and after the intervention was 2.3 ± 0.641, which is statistically significant (P-value < 0.001).

**Table 2. Comparison of demographic characteristics between the intervention and control groups.**

| Variable | Measure | Control Group | Intervention Group | Total | p-value |
|---|---|---|---|---|---|
| **Age*** | Mean ± SD | 47.2 ± 13.2 | 46.4 ± 13.02 | 46.8 ± 13.07 | 0.764 |
| | Variables | Number (%) | Number (%) | Number (%) | |
| **Gender**** | Male | 25 (51%) | 19 (37.3%) | 44 (44%) | 0.166 |
| | Female | 24 (49%) | 32 (62.7%) | 56 (56%) | |
| **Education**** | Below Diploma | 10 (20.4%) | 6 (11.8%) | 16 (16%) | 0.477 |
| | Diploma | 16 (32.7%) | 17 (33.3%) | 33 (33%) | |
| | University | 23 (46.9%) | 28 (54.9%) | 51 (51%) | |
| **Marital Status**** | Single | 12 (24.5%) | 12 (23.5%) | 24 (24%) | 0.910 |
| | Married | 27 (93.1%) | 39 (76.5%) | 76 (76%) | |
| **Addiction**** | Smoking | 12 (18.4%) | 13 (25.5%) | 22 (22%) | 0.780 |
| | Alcohol | 7 (14.3%) | 5 (9.8%) | 12 (12%) | |
| | Narcotics | 11 (22.4%) | 12 (23.5%) | 23 (23%) | |
| | None | 22 (44.9%) | 21 (41.2%) | 43 (43%) | |
| **Type of Disease**** | Mitral Valve | 20 (40.8%) | 21 (41.2%) | 41 (41%) | 0.971 |
| | Aortic Valve | 29 (59.2%) | 30 (58.8%) | 59 (59%) | |
| **Duration of Warfarin Use**** | Less than 7 months | 17 (34.7%) | 16 (31.4%) | 33 (33%) | 0.935 |
| | 7-12 months | 17 (34.7%) | 19 (37.3%) | 36 (36%) | |
| | More than one year | 15 (30.6%) | 16 (31.4%) | 31 (31%) | |
| **Hypertension**** | Yes | 33 (67.3%) | 39 (76.5%) | 72 (72%) | 0.310 |
| | No | 16 (32.7%) | 12 (23.5%) | 28 (28%) | |
| **Diabetes**** | Yes | 20 (40.8%) | 24 (47.5%) | 44 (44%) | 0.530 |
| | No | 29 (59.2%) | 27 (52.9%) | 56 (56%) | |
| **Hyperlipidemia**** | Yes | 33 (67.3%) | 40 (78.4%) | 73 (73%) | 0.212 |
| | No | 16 (32.7%) | 11 (21.6%) | 27 (27%) | |

*Data are reported as Mean ± Standard Deviation (SD), and the significance level was calculated using the Independent T-test.
**Data are reported as Frequency (Percentage), and the significance level was calculated using the Chi-square test.

**Table 3. Comparison of INR Pre- and post-intervention in the intervention and control groups**

| Group | Pre-intervention | Post-intervention | p-value | Changes |
|---|---|---|---|---|
| | Mean ± SD | Mean ± SD | | Mean ± SD |
| **Control** | 2.82 ± 0.503 | 2.86 ± 0.495 | 0.180 | 0.22 ± 0.04 |
| **Intervention** | 3.57 ± 0.677 | 2.3 ± 0.641 | < 0.001 | -1.27 ± 0.351 |
| **p-value** | < 0.001 | < 0.001 | - | < 0.001 |

Data are reported based on Mean ± Standard Deviation. The significance level was calculated using Independent T-test and Paired T-test analyses.

## Discussion

The primary objective of this study was to evaluate the impact of a social media-based educational intervention and human-led telenursing on the stabilization of International Normalized Ratio (INR) levels in heart valve replacement (HVR) patients. Our findings demonstrated a statistically significant improvement, with the intervention group's mean INR shifting from a supratherapeutic baseline of 3.57 ± 0.67 to a stable therapeutic level of 2.3 ± 0.64 ($P < 0.001$), while the control group remained clinically unstable. Crucially, achieving a mean INR of 2.3 signifies that the intervention successfully transitioned patients into the internationally recommended target range for heart valve replacements (typically 2.0–3.0). This achievement demonstrates that the intervention did not merely change statistical values but effectively moved the patients from a high-risk "danger zone" of potential hemorrhage into a clinical "safe zone," optimizing their anticoagulation therapy. This outcome aligns with a massive retrospective study of over 33,000 patients, which confirmed that virtual training for warfarin management is not only effective but statistically superior to traditional in-person training, achieving higher Time in Therapeutic Range (TTR) values (66.78% vs. 64.19%, $p < 0.001$) (20). The similarity between our findings and these large-scale results underscores the clinical validity of remote educational platforms; however, the difference lies in our use of asynchronous social media (WhatsApp/Telegram) for holistic care, whereas the study by Price and Ansell utilized real-time video conferencing specifically for equipment mastery and self-testing.

The effectiveness of our 8-week multimodal curriculum, incorporating text, audio, and video, stands in stark contrast to the findings of Baysal et al. (2018). While their structured individual education using written and visual materials was effective in increasing the knowledge levels of patients, it failed to produce the same clinical impact, as INR values were not observed within the therapeutic range (10). This discrepancy suggests that while traditional materials may bridge a knowledge gap, digital and multimodal interventions are more effective at facilitating the actual clinical stabilization of INR. The similarity between our findings and the broader literature lies in the validated ability of structured curricula to enhance patient knowledge; however, the difference is that our multimodal digital approach successfully translated these knowledge gains into clinical INR stability, a goal that traditional written materials often fail to achieve.

Furthermore, Digital interventions, such as the tele-education program implemented by Souza-Silva et al. (2022) in Brazil, have proven effective in enhancing patient knowledge regarding complex drug-food interactions—specifically the impact of olive oil and green leafy vegetables on warfarin efficacy. While that study achieved significant dietary modifications among its cohort, it also highlighted a substantial challenge in long-term information retention, with nearly 40% of participants unable to recall specific educational content after seven months (21). Our study addressed this sustainability gap by utilizing a more intensive, 8-week multimodal curriculum combined with two months of human-led telenursing follow-up. This continuous reinforcement served as a critical safeguard against the 40% information decay observed in automated models, thereby ensuring the "sustainability" of the intervention's impact.

Moreover, it is important to recognize that without such ongoing clinical supervision, educational gains regarding nutritional consistency—particularly involving Vitamin K-rich vegetables and olive oil interactions—often remain vulnerable to patient non-adherence over time. The integration of human-led remote monitoring, such as telenursing, has demonstrated significant advantages over purely automated digital systems in anticoagulation therapy. Recent multicenter evidence from Zhu et al. (2021) indicates that internet-based management through mobile applications effectively increases the "Time in Therapeutic Range" (TTR) and minimizes the frequency of

emergency department visits compared to traditional offline care (22). Similarly, a pharmacist-led multidisciplinary model evaluated by Wang et al. (2026) in China showed high levels of efficacy and patient satisfaction, attributed to the provision of ongoing counseling and a convenient feedback loop (23). Our findings resonate with these results, particularly those of Guede-Fernández et al. (2024), who noted that patients feel "well looked after" and express high trust when digital instruments are coupled with professional clinical supervision (24). While the global trend reflects a shift toward internet-based management to alleviate healthcare resource maldistribution, our study remains distinct due to its human-centered approach. By prioritizing direct nurse-patient communication over automated notifications or chatbots, we foster a higher degree of trust and personalized care essential for high-risk postoperative populations.

Individualized anticoagulation management is paramount, as clinical parameters such as age, body mass index (BMI), and baseline INR significantly dictate dose requirements and the speed of achieving therapeutic targets. In a retrospective cohort study, Hou et al. (2025) utilized multivariable logistic regression to identify that patients with a BMI <24 kg/m² and those receiving a starting dose ≥3 mg/day achieved target stabilization significantly faster (25). Similarly, Mousavi Ganji et al. (2025) evaluated advanced machine learning algorithms, including Random Forest (RF) and Support Vector Machines (SVM), and identified that INR status, BMI, and clinical indications were the most influential predictors for accurate dose classification (26). The importance of the early postoperative phase was further highlighted by Oh et al. (2020), who demonstrated through stratified TTR analysis that maintaining high stability during the first 10 days post-surgery directly correlates with a reduced number of hospital visits and shorter time to reach consecutive therapeutic INR readings after discharge (27). The similarity between our work and these contemporary predictive models lies in the shared recognition of the multifactorial nature of INR stability; however, our study remains distinct in its practical application. While Hou et al. and Oh et al. focused on retrospective clinical factor analysis and Mousavi Ganji et al. proposed sophisticated mathematical algorithms, our study implemented a prospective, human-centered digital intervention. By utilizing widely accessible social media platforms combined with intensive nurse-led telenursing, we provide a low-cost and replicable solution for hospitals that lack the medical infrastructure or budget to implement genetic testing or advanced machine-learning dosing algorithms. This approach ensures that clinical knowledge is effectively translated into patient behavior, particularly in middle-income settings where digital literacy and accessibility are key barriers to care.

The primary strength of this study compared to others is the implementation of a structured, multimodal curriculum that was clinically validated and delivered via widely accessible social media platforms, making it highly replicable in middle-income settings. Unlike studies that rely solely on automated or expensive dedicated apps (Efficacy, Safety, and Cost-Effectiveness of “Internet + Pharmacy Care” Via the Alfalfa App...), our use of tele-nursing provided a human-centered approach that fostered trust. Furthermore, the use of simple digital tools avoids the high implementation costs and medical resource demands associated with complex machine-learning dosing algorithms (A Prediction Model of Stable Warfarin Doses...).

Limitations Despite the promising results, this study has several limitations that should be considered. First, it was conducted as a single-center study with a relatively small sample size, which may limit the generalizability of the findings to more diverse populations. Additionally, the study did not incorporate pharmacogenetic data—such as CYP2C9 and VKORC1 genotypes—which account for significant variability in warfarin dose requirements. Acknowledging these factors is essential for future research to refine individualized dosing protocols. Furthermore,

long-term follow-up beyond four months would be beneficial to evaluate the ultimate endurance of the clinical outcomes established during the intervention phase.

## Conclusion

Based on the results of this study, educating patients through social media significantly improved both their level of warfarin knowledge and their INR control. This indicates the effectiveness of using digital educational tools in patient treatment management, especially in patients who need careful monitoring. Modern educational methods can be used as an effective supplement to traditional education and play an important role in promoting the quality of medical care.

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## Conflict of Interest

The authors declare that there are no conflicts of interest.

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## Ethical Considerations

Ethical approval was obtained from the Ethics Committee of Shahid Sadoughi University of Medical Sciences, Yazd (Ethics Code: IR.SSU.REC.1400.176). Written informed consent was obtained from all participants before the study's commencement. The study was conducted in accordance with the Principles of the Declaration of Helsinki.

## Author Contributions

All authors participated in the study design, data collection, data analysis, interpretation, drafting of the manuscript, and its critical revision. All authors were accountable for every phase of the study and approved the final version of the article for publication.

## Data Availability Statement

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

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