

# BMJ Open Factors influencing medication adherence for deep vein thrombosis prevention in post-discharge patients after joint replacement surgery: a qualitative study based on Protection Motivation Theory

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## ABSTRACT

**Objectives** This study aims to identify factors influencing medication adherence for deep vein thrombosis (DVT) prophylaxis in post-discharge patients after joint replacement surgery using Protection Motivation Theory (PMT).

**Design** This study employed qualitative semi-structured interviews with patients discharged after hip or knee replacement surgery.

**Setting** Using purposive sampling to ensure a diverse representation of patient profiles, participants were recruited from patients who underwent total knee replacement surgery from April 2024 to May 2024 and were discharged 1-month prior.

**Participants** 12 patients who had undergone total knee replacement surgery participated in the study. The median (IQR) age of participants was 57.5 (55–67.25) years.

**Analysis** Semi-structured interviews were conducted via online video calls. These interviews were audio recorded and transcribed verbatim. Data were analysed using Colaizzi's seven-step method. Themes were identified based on the dimensions of the PMT: susceptibility, severity, internal rewards, external rewards, response efficacy, self-efficacy and response costs. Two researchers independently coded and extracted themes, with discrepancies resolved through team discussions and verification with respondents.

**Results** Participants acknowledged the importance of adhering to anticoagulant medication to prevent DVT and its complications, understanding the severe consequences, such as the life-threatening nature of pulmonary embolism and the impact on daily activities. Perceived health status influenced adherence, with some participants feeling their good health negated the need for anticoagulants. External factors, including the desire to avoid side effects and financial constraints, also played significant roles in adherence decisions. Belief in the effectiveness of anticoagulants motivated adherence, but confidence in managing medication varied among participants. Practical barriers such as physical limitations and psychological burdens significantly impacted adherence.

## STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ The study used Protection Motivation Theory (PMT) as a comprehensive framework to understand factors influencing medication adherence for deep vein thrombosis (DVT) prevention in post-discharge patients after joint replacement surgery.
- ⇒ The use of qualitative semi-structured interviews allowed for in-depth exploration of patients' perceptions and experiences, providing rich, detailed data.
- ⇒ Participants were recruited using purposive sampling to ensure a diverse representation of patient profiles, including variations in age, ethnicity and health status.
- ⇒ The qualitative nature of the study relies heavily on self-reported data, which can be subject to recall bias and social desirability bias.

**Conclusions** Improving medication adherence requires a multifaceted approach addressing cognitive, motivational and practical barriers. Continuous education, financial assistance, support systems and tailored interventions are crucial. PMT provides a robust framework for understanding and enhancing adherence behaviours, ultimately improving health outcomes in post-discharge joint replacement patients.

## INTRODUCTION

Total hip arthroplasty (THA) and total knee arthroplasty (TKA) are among the most common orthopaedic surgeries globally, effectively alleviating joint pain, restoring function and improving patients' quality of life.<sup>1–3</sup> The volume of these surgeries has surged significantly in recent years, both domestically and internationally.<sup>4,5</sup> While THA and TKA, types of total joint arthroplasty, offer substantial therapeutic benefits, they also involve extensive surgical procedures that pose a high risk

of postoperative complications, particularly deep vein thrombosis (DVT) and pulmonary embolism (PE).<sup>6 7</sup> These conditions, collectively known as venous thromboembolism (VTE), are significant causes of morbidity and mortality following joint replacement surgery.<sup>8–10</sup> DVT can progress rapidly, leading to severe venous return obstruction, limb swelling and intense pain, with the potential for life-threatening complications such as shock and venous gangrene. In acute phases, embolus dislodgement can trigger PE, with a fatality rate of up to 30% if untreated.<sup>11–13</sup>

Prophylactic anticoagulant therapy is a proven, cost-effective method for significantly reducing the risk of venous thrombosis in surgical patients.<sup>14</sup> Patients undergoing joint replacement are at extremely high risk for DVT and require routine prophylaxis. According to multiple evidence-based guidelines, it is recommended that post-discharge patients continue prophylactic anticoagulant therapy for at least 7–14 days, with some recommendations extending up to 35 days to further reduce the risk of DVT, alleviate patient suffering and lower healthcare costs.<sup>15 16</sup> However, a major barrier to effective DVT prophylaxis is patient adherence to the prescribed anticoagulant regimen.<sup>17 18</sup> Factors such as patient understanding and acceptance of prophylactic measures, daily medication regimens, anticoagulant costs and potential side effects significantly impact adherence.<sup>19 20</sup> While adherence is relatively high during hospitalisation due to direct supervision by healthcare providers, it decreases notably after discharge.<sup>21</sup> It has been reported that the medication adherence rate among patients discharged after joint replacement surgery is only 44–83%, and 30% of these patients have little knowledge of DVT-related complications.<sup>19 22 23</sup>

Protection Motivation Theory (PMT) provides a framework for understanding and enhancing adherence behaviours by explaining behaviour change through cognitive mediating processes, including threat appraisal and coping appraisal.<sup>24</sup> PMT has been widely applied in health behaviour research, demonstrating that protection motivation is crucial in promoting adherence to health behaviours.<sup>25</sup>

Given the current gaps in research, our study aims to explore factors influencing DVT prophylactic medication adherence in post-discharge joint replacement patients using PMT as a theoretical framework. By conducting qualitative interviews and analysing factors such as susceptibility, severity, internal rewards, external rewards, response efficacy, self-efficacy and response costs, we hope to provide new insights into improving adherence and preventing DVT in this high-risk population.

## MATERIALS AND METHODS

### Design and participants

This study employed qualitative semi-structured interviews with patients discharged from two large public healthcare institutions in Xinjiang Uygur Autonomous

Region of China after hip or knee replacement surgery. The patients use rivaroxaban for anticoagulation after discharge and emphasise regular follow-up with ultrasound to monitor for DVT. Purposive sampling was used to select patients who underwent total knee replacement surgery from April 2024 to May 2024 and were discharged 1-month prior. Inclusion criteria for this study were: first-time hip or knee replacement surgery; ability to read and understand written materials; and informed consent to participate in this survey. Exclusion criteria included: DVT before or after surgery; combined liver or kidney dysfunction or other organic diseases; communication barriers, mental illness or other severe chronic diseases (including bleeding disorders or a tendency to bleed, such as cerebral haemorrhage, haemorrhagic cerebral infarction, active peptic ulcer disease and active pulmonary tuberculosis; severe liver, kidney or heart dysfunction; cachexia; malignant hypertension; and other conditions such as severe trauma, vascular tumours, severe infections and drug allergies). The surgical history in the inclusion criteria was confirmed based on the patient's surgical record, which determined the history of hip or knee replacement surgery and the exact time of re-examination. The exclusion criterion for DVT was diagnosed based on the ultrasound examination records of deep veins in both lower limbs. Other diseases were excluded based on the doctor's diagnosis certificate. The sample size was determined to reach data saturation, and a total of 12 patients were selected for interviews.

### Data collection

Based on a review of relevant literature, an initial interview outline was developed, focusing on seven aspects of the cognitive mediation process of the PMT theory: susceptibility, severity, internal rewards, external rewards, response efficacy, self-efficacy and response costs. This outline was then refined through expert consultation and pre-interviews with two joint replacement patients. The final interview outline, based on the PMT theory, included the following questions: (1) Do you think the consequences of not taking anticoagulant medication on time are serious? What are the serious consequences? (2) How do you manage to take anticoagulant medication on time? Do you find this method reliable? (3) Do you think adhering to the timely intake of anticoagulant medication affects your psychological state? If so, in what ways? (4) How does adhering to the timely intake of anticoagulant medication affect your daily life? If so, in what ways? (5) What benefits do you think you gain from taking anticoagulant medication on time? If so, what are they? (6) What difficulties do you encounter in adhering to the timely intake of anticoagulant medication? Do you think you can overcome them? The original interview protocol was shown in online supplemental table 1.

Data were collected using semi-structured interviews. Interview appointments were scheduled 1-month post-surgery by phone, with interviews conducted 1 day after the scheduled follow-up, lasting 30–45 min each. The

interviews were conducted via an online video app in a quiet, comfortable environment without interruptions. Before the interviews, patients were informed about the study's purpose, assured of the confidentiality of their information and asked for consent to record the interviews. During the interviews, non-verbal behaviours such as tone, expression and movements were recorded to assess the authenticity of the interviewees' statements. The interviewer actively listened, asked follow-up questions and encouraged the patients to express their true opinions and feelings. All interviews were conducted by the first author, who had received training in qualitative research and had experience in VTE research.

### Data analysis

Conversion of recordings and notes was completed within 24 hours after each interview by two researchers independently, who then cross-checked and verified the conversions to ensure accuracy. Subsequently, the same two researchers used Colaizzi's seven-step analysis method to organise and analyse the data, independently coding and extracting themes. The research team discussed differing viewpoints until consensus was reached. Finally, the extracted themes were verified with the respondents to enhance the credibility of the findings.

### Ethical considerations

This study was approved by the Ethics Committee (XJYKDXR20240314062), and all subjects voluntarily participated in this study and signed an informed consent form.

### Patient and public involvement

Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

## RESULTS

### General information about the interviewees

In this study, after interviewing 12 subjects, no new interview information was found, indicating that the data had reached saturation. Therefore, the sample size of the qualitative study was 12. During the interviews, the non-verbal cues of the interviewees, such as tone, expression and movements, were consistent with the information conveyed through their verbal communication. These 12 subjects were numbered H1 through H12 and came from various regions across Xinjiang Uygur Autonomous Region. The general demographic and clinical information of the participants are shown in [table 1](#).

### Interview results

The interview data were sorted and relevant themes were extracted and summarised according to the seven dimensions of the PMT: susceptibility, severity, internal rewards, external rewards, response efficacy, self-efficacy and response costs. Notably, the study explored the factors influencing medication adherence among three

**Table 1** Demographic and clinical characteristics of patients in the study

Name	Gender	Age	Anticoagulation treatment
H1	Male	50s	Rivaroxaban
H2	Male	60s	Rivaroxaban
H3	Male	80s	Rivaroxaban
H4	Male	70s	Rivaroxaban
H5	Female	70s	Rivaroxaban
H6	Female	50s	None
H7	Female	60s	Rivaroxaban
H8	Male	50s	Rivaroxaban
H9	Female	60s	Rivaroxaban
H10	Female	30s	Rivaroxaban
H11	Male	30s	None
H12	Male	50s	None

minority patients: H9 (Uyghur), H10 (Kazakh) and H12 (Hui). All three patients recognised the importance of adhering to their anticoagulant regimens to prevent DVT and its severe complications, such as PE. H9 and H10 were particularly aware of the severe consequences, while H12 had a moderate understanding and believed more in self-management. Family support and reminders were significant factors in H9's adherence. H10 was motivated by healthcare providers' consistent reminders and her desire to remain independent. In contrast, H12 perceived himself as young and healthy, which reduced his perceived need for medication. Additionally, external factors such as the cost of medication and the inconvenience of obtaining it negatively impacted his adherence. These findings highlight the importance of addressing both internal beliefs and external barriers through tailored interventions to improve medication adherence among minority patients. The details of factors influencing DVT prophylactic medication adherence are as follows:

### Susceptibility (A)

Participants generally acknowledged the importance of adhering to anticoagulant medication to prevent DVT and its complications.

A1. Dependence on anticoagulants: many participants, like H6, recognised that not taking anticoagulants could lead to serious outcomes, as confirmed by follow-up checks showing no thrombosis. (H6: "I took the medication as prescribed and during the follow-up, no thrombosis was found.")

A2. Risk of altering dosage: patients like H1 emphasised strict adherence to prescribed dosages, understanding that altering medication could increase the risk of thrombosis or adverse drug reactions. (H1: "I followed the nurse's instructions exactly to avoid any risk.")

A3. Importance of timely medication: similar to A2, the emphasis was on taking medication exactly as

prescribed to avoid increased risks of DVT and its complications. (H1: “Taking it on time is crucial to prevent any complications.”)

A4. Risks of non-adherence: participants such as H4 and H2 highlighted that not following the anticoagulant regimen as advised by doctors significantly increased the risk of DVT and its serious consequences. (H2: “Skipping doses could lead to serious issues, like the doctor warned.”)

### Severity (B)

Participants expressed a clear understanding of the severe consequences associated with DVT and PE.

B1. Life-threatening nature of PE: the potential for PE to become life-threatening was recognised, with participants like H7 sharing anecdotal evidence of severe cases leading to death. (H7: “I know someone who died from a blood clot; it’s very dangerous.”)

B2. Impact on daily activities: the debilitating nature of DVT, leading to dependence on others for daily activities, was a common concern. Participants mentioned the inconvenience and the reluctance to burden family members. (H7: “I don’t want to rely on my family for everything; it’s a big inconvenience.”)

### Internal rewards (C)

The perception of current health status influenced participants’ adherence to medication.

C1. Perceived healthiness: some, like H11, felt that their youth and lack of symptoms negated the need for anticoagulants. (H11: “I’m young and healthy, so I don’t think I need it.”)

C2. Perceived recovery: H11 also believed that his good postoperative recovery made anticoagulants unnecessary. (H11: “I recovered well after surgery, so I didn’t see the need.”)

C3. Health impact scepticism: there was scepticism about the health benefits of anticoagulants among some participants. (H11: “I doubt it will make a difference.”)

C4. Adjusting dosage independently: some participants believed it was reasonable to adjust the dosage themselves, despite medical advice to the contrary. (H11: “I think I can manage the dosage myself.”)

C5. Acceptance of missed doses: participants like H11 accepted the risks of missing doses due to their perception of being at low risk. (H11: “Missing a dose now and then doesn’t seem risky to me.”)

### External rewards (D)

External influences and the desire to avoid negative experiences played a role in medication adherence.

D1. Avoidance of side effects: concerns about potential side effects led some, like H11, to avoid anticoagulants unless they felt unwell. (H11: “I’ll only take it if I feel bad; otherwise, it’s not worth the side effects.”)

D2. Cost and convenience: financial concerns and the inconvenience of acquiring medication influenced

adherence decisions. (H11: “The cost is too high and it’s hard to get.”)

D3. Alternative prevention methods: some participants, like H4, preferred alternative methods such as physical activity over medication. (H4: “I think staying active is enough to prevent clots.”)

### Response efficacy (E)

Belief in the effectiveness of anticoagulants was a significant motivator for adherence.

E1. Effectiveness in preventing DVT: participants like H6 understood and believed in the effectiveness of anticoagulants in preventing DVT, leading to better adherence. (H6: “I believe taking the medication prevents DVT, so I stick to it.”)

### Self-efficacy (F)

Participants demonstrated confidence in their ability to adhere to anticoagulant regimens to prevent DVT and its complications.

F1. Proactive use of anticoagulants: participants demonstrated varying levels of confidence in their ability to proactively use anticoagulants to prevent DVT. For example, H11, who almost faced life-threatening consequences, emphasised the importance of taking anticoagulants regularly. (H11: “Almost losing my life made me realize the importance of regular anticoagulant use.”)

F2. Understanding medication information: participants like H6 showed a proactive approach in understanding their medication regimen and its importance. (H6: “I know why I need to take this medication and follow the doctor’s instructions closely.”)

F3. Adherence to prescribed dosage: strict adherence to the prescribed dosage was highlighted by participants like H6, who ensured not to miss doses. (H6: “I always follow the schedule, and I never forget because it’s crucial.”)

F4. Avoiding self-modification of medication: participants understood the importance of not altering their medication dosage without medical advice. (H6: “I know better than to change my medication dose on my own; it’s too risky.”)

F5. Understanding medical guidance: participants like H10 fully understood and adhered to the medical guidance provided by healthcare professionals. (H10: “I trust my doctor’s instructions completely and follow them to the letter.”)

### Response costs (G)

The perceived costs and inconveniences of taking anticoagulants affected adherence.

G1. Physical and cognitive barriers: participants like H11 mentioned difficulties in obtaining and using medication due to physical or cognitive limitations. (H11: “It’s hard to get and remember to take the medication.”)

G2. Financial constraints: the cost of anticoagulants was a significant barrier for some participants. (H11: “It’s expensive, and I can’t afford it regularly.”)



G3. Psychological burden: the psychological burden of feeling like a patient led some participants to avoid medication. (H11: "Taking medication makes me feel like I'm sick all the time.")

## DISCUSSION

Using PMT as a guiding framework, this study aimed to explore the factors influencing medication adherence for DVT prophylaxis in patients discharged after joint replacement surgery. Through qualitative interviews, we gained comprehensive insights into the patients' perspectives, uncovering both the barriers and facilitators to their adherence behaviours. Our findings highlight the complexity of medication adherence in this context, emphasising the interplay of cognitive, emotional and practical factors. PMT, with its dimensions of susceptibility, severity, internal rewards, external rewards, response efficacy, self-efficacy and response costs, provided a robust framework for analysing these influences.

### Susceptibility and severity

Patients demonstrated a clear understanding of their susceptibility to DVT and the severe consequences of non-adherence to prophylactic medication. Participants like H6 acknowledged the critical role of anticoagulants in preventing serious outcomes, as evidenced by follow-up checks showing no thrombosis (H6). This aligns with the findings from González-Castro *et al* who reported that patients' awareness of severity and their vulnerability significantly influences adherence to protective measures.<sup>26</sup> Despite this awareness, knowledge alone was insufficient to ensure consistent adherence. Continuous education and reinforcement by healthcare providers are essential to maintain high adherence rates, as also suggested by Pedersen *et al* who demonstrated that a patient education strategy significantly improved adherence to rehabilitation programmes in primary healthcare settings.<sup>27</sup>

### Internal rewards and perceptions

Patients' perceptions of their health status significantly impacted their adherence behaviours. Younger patients like H11 felt that their good health and lack of symptoms negated the need for continued anticoagulant use. This perception led to scepticism about the benefits of medication, with some participants doubting whether anticoagulants significantly impacted their health. These findings are consistent with research by Leonhardt *et al*, which indicated that perceived invincibility and optimism bias can lead to lower adherence rates.<sup>28</sup>

### External rewards and influences

External factors, including the desire to avoid side effects, financial constraints and convenience, played crucial roles in adherence. Concerns about potential side effects led some patients to avoid taking anticoagulants unless they felt unwell, fearing that the medication might exacerbate

their condition (H11). Financial barriers were also significant; for example, H11 mentioned the high cost of drugs and the inconvenience of frequent purchases as reasons for non-adherence. These findings corroborate research by Mohammed *et al* who focused on hypertensive patients, identifying cost and fear of side effects as primary barriers to adherence.<sup>29</sup>

### Response efficacy and self-efficacy

Belief in the efficacy of anticoagulants was a significant motivator for adherence. Participants like H6 understood that consistent use of anticoagulants was crucial for DVT prevention, reinforcing their commitment to the medication regimen. This is supported by findings from De las Cuevas, who noted that patients with higher perceived health control, which relates to their belief in the efficacy of their treatment, show improved adherence rates.<sup>30</sup>

However, confidence in their ability to manage medication regimens varied among participants. Those who felt capable of adhering to their prescribed regimens were more likely to do so, indicating that self-efficacy plays a crucial role in adherence. For example, patients who had a structured routine or support from family members reported better adherence. This is consistent with the work of Gosak *et al*, who identified self-efficacy as a key antecedent to successful self-management, impacting clinical outcomes and quality of life.<sup>31</sup>

### Response costs

Practical barriers such as physical limitations, cognitive difficulties and psychological burdens significantly impacted adherence. Physical barriers included difficulties in obtaining and using medication, particularly for older patients or those with mobility issues. For instance, H11 cited the inconvenience and effort required to obtain and take medication as deterrents. Cognitive barriers were also noted, where patients struggled to remember their medication schedules. Psychological burdens, such as the stigma of feeling like a patient, led some individuals to avoid medication. This emotional impact contributed to non-adherence, as highlighted by several participants who felt that taking medication was a constant reminder of their illness (H11). These findings are in line with research by Zanatta *et al*, who showed that psychosocial factors, such as physician communication and medication beliefs, play a significant role in treatment adherence among patients.<sup>32</sup>

### Comprehensive approach to improve adherence

The findings suggest that improving medication adherence among post-discharge joint replacement patients requires a multifaceted approach. Continuous education about the importance of anticoagulants and the risks of non-adherence is crucial. Healthcare providers should emphasise the severe consequences of DVT and PE to reinforce the necessity of strict adherence to prescribed regimens. This approach is supported by the work of Bukstein, who emphasised the role of patient-centred,

collaborative care and effective communication in improving adherence.<sup>33</sup>

Addressing external rewards and influences involves making medications more accessible and affordable. Financial assistance programmes and practical support for medication management, such as home delivery services or digital reminders, can alleviate some of these barriers. Additionally, healthcare providers should discuss potential side effects with patients and provide strategies to manage them, reducing the likelihood that concerns about adverse effects will lead to non-adherence. This is consistent with the recommendations of Zaildo *et al*, who emphasised the importance of financial and social support, effective communication and trust in authorities to enhance adherence to prevention measures.<sup>34</sup>

Enhancing response efficacy and self-efficacy can be achieved through educational interventions that build patients' confidence in their ability to manage their medication regimens. Support systems, including family involvement and peer-support groups, can provide the necessary encouragement and practical help. This is in line with findings by Okwuosa *et al*, who found that good perceived social support is significantly associated with high medication adherence, emphasising the involvement of families and friends in patient care.<sup>35</sup>

Finally, addressing response costs involves mitigating the practical and psychological barriers to adherence. This might include providing comprehensive discharge planning that ensures patients have a clear understanding of their medication regimen, follow-up appointments to monitor adherence and counselling services to address the psychological impacts of chronic medication use.

### Limitations and future directions

This study has several limitations. The sample size was small and limited to a specific geographical area, which may affect the generalisability of the findings. Additionally, the qualitative nature of the study relies on self-reported data, which can be subject to bias. Future research should include larger, more diverse populations and consider longitudinal studies to assess changes in adherence over time. Investigating the effectiveness of specific interventions based on PMT in improving medication adherence would also be valuable. Additionally, exploring the role of digital health tools, such as mobile apps for medication reminders and virtual support groups, could provide innovative solutions to enhance adherence. Understanding the long-term impact of improved adherence on clinical outcomes and healthcare costs is crucial for developing sustainable strategies.

### CONCLUSIONS

This study highlights the multifaceted nature of medication adherence for DVT prophylaxis in post-discharge joint replacement patients. Using PMT as a framework, we identified key factors influencing adherence and provided insights into potential interventions. Improving

adherence requires a comprehensive approach that addresses cognitive, motivational and practical barriers. Healthcare providers should focus on continuous education, support systems and tailored interventions to enhance adherence and prevent DVT in this high-risk population. In summary, the application of PMT in understanding medication adherence provides a robust framework for developing targeted interventions that can significantly improve health outcomes in patients undergoing joint replacement surgery. In addition, surgeons should focus on personalised education, support and practical solutions, including addressing financial barriers and involving family in care. A structured follow-up plan and digital reminders can further enhance adherence and reduce the risk of complications. Addressing both the cognitive and practical barriers to adherence can lead to better patient compliance, reduced incidence of DVT and overall improved postoperative recovery.

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