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Barriers and facilitators to the implementation of guidelines for venous thromboembolism prevention and management: A mixed-methods systematic review

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ABSTRACT

Background: Evidence-based venous thromboembolism prevention and management is a priority for global health services. Low adoption of venous thromboembolism guidelines can result in compromised patient outcomes. Understanding clinicians' and patients' perceptions of barriers to and facilitators for guideline implementation and mapping identified barriers and facilitators to the Consolidated Framework for Implementation Research may inform theoretical interventions to improve guideline adoption rates.

Objective: To synthesize quantitative and qualitative evidence on both 1) perceptions and experiences of hospital clinicians and patients regarding venous thromboembolism practices and 2) barriers to and facilitators for guideline implementation.

Data source: English-language studies from MEDLINE, EMBASE, CINAHL, PsycINFO, and Cochrane published between 2012 and 2023.

Methods: The included studies primarily focused on two aspects: firstly, elucidating the perceptions and experiences of healthcare providers and patients concerning venous thromboembolism management practices, and secondly, identifying the barriers and facilitators that influence the implementation of venous thromboembolism guidelines. The Mixed Methods Appraisal Tool was used for critical appraisal. Quantitative data were transformed into qualitized data and then thematically synthesized with qualitative data to compare the perspectives of clinicians and patients. Barriers and facilitators related to each topic were mapped to the Consolidated Framework for Implementation Research, and the barriers were entered into its implementation strategy matching tool to obtain implementation strategies.

Results: Of 8262 studies of varying quality, 26 (20 quantitative, five qualitative, and one mixed-methods) met the inclusion criteria. Four themes represented factors influencing guideline implementation: 1) healthcare-led multidisciplinary prevention and management, 2) feasibility of guideline implementation, 3) patient involvement in prevention and management, and 4) government and hospital environments and related systems. The majority of barriers identified by healthcare providers were related to the second and fourth themes, while for patients, there were multiple barriers under the third theme. Barriers were mainly mapped into four domains: intervention characteristics, outer setting, inner setting, and characteristics of individuals. Most facilitators mentioned by healthcare providers and patients were related to themes 1, 3, and 4 and

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mapped to three domains: outer setting, inner setting, and characteristics of individuals. Seven optimal implementation strategies were obtained through the Consolidated Framework for Implementation Research-Expert Recommendations for Implementing Change matching tool.
Conclusions: We highlighted the most influential factors associated with implementing venous thromboembolism guidelines from the perspectives of both clinicians and patients, and mapping these factors to the Consolidated Framework for Implementation Research can help to develop stakeholder-appropriate implementation interventions.
Registration: This study's protocol has been registered at PROSPERO under the registration number CRD42024518184.

What is already known about the topic

- Low adoption of venous thromboembolism guidelines is common and can result in compromised patient outcomes.
- The first step in developing interventions to promote guideline implementation is to identify clinical staff and patient perceptions of barriers and facilitators.

What this paper adds

- Clinical staff and patients supported healthcare-led multidisciplinary, patient-centered interventions to encourage patient engagement in venous thromboembolism prevention and address organizational and individual barriers to venous thromboembolism prevention.
- The Consolidated Framework for Implementation Research-Expert Recommendations for Implementing Change implementation strategy matching tool was used to obtain the best implementation strategy for organizations and individuals.
- Mapping barriers to the Consolidated Framework for Implementation Research showed the necessity for different implementation strategies to improve multidisciplinary prevention and patient engagement.

1. Background

Venous thromboembolism, which includes deep vein thrombosis and pulmonary embolism, is a disorder of impaired venous return in which blood coagulates abnormally in the veins, causing complete or incomplete obstruction of the vessels (Kearon et al., 2016). It is one of the most common complications and the most common preventable cause of death in post-surgical patients (Granziera and Cohen, 2015; O'Donnell and Weitz, 2003). It not only adds to the financial burden of patients but also leads to a significant increase in costs to the healthcare system (Ruppert et al., 2011). Reported venous thromboembolism costs vary, with hospital costs in the United States increasing from $7.8 billion in 2003 to $12.1 billion in 2013 (Brahmandam et al., 2017). The costs amount to €13 billion annually in the European Union (Barco et al., 2016).

The harms of venous thromboembolism on patients include pain and discomfort, diminished standard of living, chronic complications, and potential fatality, resulting in death, poor mental health, and increased financial burdens associated with treatment costs and time away from work (Di Nisio et al., 2016). Maintaining blood circulation and intervening early when venous thromboembolism develops to prevent further vessel obstruction can significantly improve patient outcomes and reduce hospital costs (Torrejon Torres et al., 2019). Therefore, it is a top priority for policymakers and healthcare providers to implement evidence-based guidelines for the prevention and management of venous thromboembolism (Afshari et al., 2018; Ortel et al., 2020).

Although national and international venous thromboembolism clinical guidelines have long existed (Afshari et al., 2018; Falck--Ytter et al., 2012; Hill and Treasure, 2010; Kearon et al., 2016; Ortel et al., 2020), low uptake of guidelines is an ongoing health service problem (Onwuzo et al., 2023). The backing of healthcare providers for guidelines and the enhancement of their understanding regarding the prevention and management of venous thromboembolism do not consistently result in changes in practice (Gao et al., 2021). Even when plans and protocols are in place, the implementation of guidelines can still be challenging in the complex, resource-constrained, and emergency-priority hospital environment (Figueroa et al., 2019). Challenges to thromboembolism prevention and management include the widespread lack of education about prevention (Halboup et al., 2022), little involvement of managers (Zhou, Dai et al., 2023), the difficulty of accurately identifying its risk (Bhandari et al., 2022), and the absence of a comprehensive multidisciplinary approach (Wang et al., 2021). The current status of knowledge suggests that a multifaceted approach is needed to address barriers at the individual, societal, and organizational levels of stakeholders and to facilitate increased guideline implementation by administrators and accelerated clinical practice change (Burton et al., 2021; Mitchell et al., 2021; van Dulmen et al., 2020).

Interventions guided by theory have been demonstrated to be more effective and sustainable compared to those developed without utilizing frameworks or theories (Celis-Morales et al., 2015; Teggart et al., 2022). A common approach is to map barriers and facilitators that are identified as having the potential to influence guideline uptake from to the Consolidated Framework for Implementation Research (Damschroder et al., 2009). This framework includes five domains: intervention characteristics, inner setting, outer setting, characteristics of individuals, and process. It is used to guide researchers to explore the barriers and facilitators that affect

evidence transformation in clinical practice and then propose implementation strategies and construct implementation plans. The Consolidated Framework for Implementation Research has been used to examine barriers and facilitators to guideline implementation by stakeholders in the cancer hospital setting (Pearson et al., 2023). In the general hospital setting, as clinical healthcare providers are the main drivers of practice change, identifying their perceptions of guideline implementation may help to understand barriers and develop effective strategies to enhance guideline implementation (Baker et al., 2015). Similarly, identifying patients' views and experiences with venous thromboembolism prevention will help develop strategies to improve patient-centered care (Hohmann et al., 2012).

To date, a systematic review examining facilitators and barriers to implementation of venous thromboembolism clinical practice guidelines by healthcare providers identified nine barriers and nine facilitators(Gaston et al., 2012). The main barriers were 'lack of attention and lack of awareness', with the main facilitator being 'education'. While the previous review explored specific aspects of barriers and facilitators, we added new content to the existing knowledge base by mapping the identified barriers and facilitators to the Consolidated Framework for Implementation Research and examining which implementation strategies align with the Consolidated Framework for Implementation Research determinants, providing a deeper understanding of how these factors can be addressed to improve guideline implementation. As barriers and facilitators can be expressed in a qualitative or quantitative form, the purpose of this mixed-methods systematic review was to synthesize both types of evidence on 1) clinical healthcare providers' and patients' perceptions of barriers and facilitators to implementing guidelines for venous thromboembolism prevention and management, and 2) mapping barriers and facilitators to the Consolidated Framework for Implementation Research. Results should contribute to develop theoretically patient-centered interventions to improve the application of guidelines in hospital settings.

2. Methods

2.1. Design

In this mixed-methods systematic review, we focused on identifying, assessing, and synthesizing evidence related to the perceptions of clinical providers and patients regarding venous thromboembolism prevention and management. The review protocol has been registered on the International Prospective Register of Systematic Reviews (PROSPERO 2024 CRD42024518184). We utilized the convergent integrated approach, with information on data transformation provided in the JBI Manual for Evidence Synthesis Handbook (Stern et al., 2020). The review is reported according to the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) statement 2020 (Page et al., 2021).

2.2. Eligibility criteria

We included qualitative, quantitative, and mixed-methods studies if they 1) reported on the perceptions and experiences of clinical healthcare providers and patients regarding venous thromboembolism prevention and management, 2) included barriers and facilitators to implementation of venous thromboembolism guidelines or policies, and 3) were published in English from 2012 to 2023. We also included studies focusing on deep vein thrombosis or pulmonary embolism. Clinical healthcare providers were defined as health professionals directly engaged in providing patient care.

2.3. Search strategy

Two researchers (HMB and YJ) and an experienced evidence-based expert (HJY) worked together to develop the search strategy. The PICo (Population, phenomenon of Interest and the Context) framework guided the development of the eligibility criteria and search strategy (Lockwood et al., 2015). The eligibility criteria for the PICo structures are shown in Supplementary Material Table 1. Terms used in the search strategy were related to 1) perceptions or experiences of prevention or management, and 2) venous thromboembolism. Depending on the database, medical subject headings and keywords were utilized for each search term. A comprehensive literature search was meticulously crafted and initially executed on MEDLINE, which was then extended and applied to four additional reputable databases: EMBASE, CINAHL, PsycINFO, and the Cochrane Library, ensuring a broad and inclusive examination of the literature. The search strategies for all databases are provided in Supplementary Material Table 2. Due to the publication of a systematic review on the same topic in 2012, we searched for literature published between 2012 and 2023.

The literature was imported into Endnote X9 software for deduplication, initial screening, and re-screening of the full text. Two investigators (HMB and CJJ) independently screened the literature according to eligibility criteria, and a third investigator (HJY) was sought in case of disagreement.

2.4. Data extraction

Relevant data from the included studies were extracted using a customized version of the JBI data extraction forms tailored for this review. The data extraction process encompassed various aspects, including the first author, publication years, and study and participant characteristics, as well as qualitative, quantitative, and mixed methods findings. Qualitative studies provided insights into themes, perceptions, experiences, barriers, facilitators, and participant quotes. During data extraction, barriers and facilitators related to venous thromboembolism prevention and management, such as risk assessment and mechanical prophylaxis, were specifically identified. Qualitative data from open-ended survey responses were extracted separately, while outcome measure descriptions, tables,

and narrative summaries were derived from quantitative studies. The narrative summaries are mainly from the discussion section of quantitative studies. Mixed methods studies had their qualitative and quantitative data extracted individually.

2.5. Critical appraisal

The Mixed Methods Appraisal Tool was applied to evaluate the methodological quality of the included studies, including the following designs: qualitative studies, quantitative randomized controlled trials, quantitative non-randomized studies, quantitative descriptive studies, and mixed methods studies.

Two researchers (HMB and YJ) independently performed data extraction and quality assessment. We engaged in discussions whenever disagreements arose in this process, and further differences were resolved by a third researcher with expertise (HJY).

2.6. Data transformation

Data were transformed using the convergent integrated approach, following the methodological guidance for mixed-methods systematic reviews (Stern et al., 2020). Qualitization is the process of extracting data from quantitative studies and transforming them into qualitized information, such as topics, categories, or descriptions, for the integration with qualitative information. Following JBI recommendations, we transformed quantitative data into qualitized data, which were directly integrated with qualitative data with similar meanings to form themes.

One researcher (HMB) was tasked with qualitizing the data, and the original authors' descriptive summaries of quantitative findings were utilized to validate the accuracy of the data transformation during the cross-checking process.

2.7. Data analysis

Our qualitative data analysis employed a combination of inductive and deductive approach to facilitate the identification of themes, patterns, and new findings. The analysis began by using an inductive approach to identify key themes. Following this, a deductive approach was used to theorize the themes; that is, to relate the identified themes to the domain and construct of the Consolidated Framework for Implementation Research.

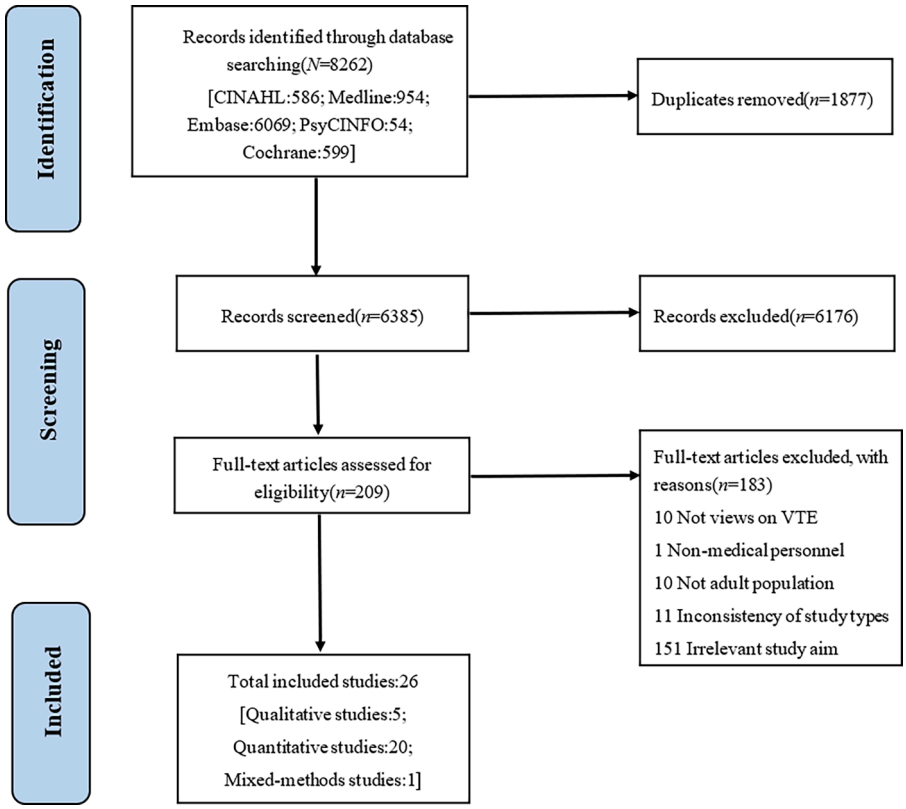

Fig. 1. PRISMA flow diagram.

2.7.1. Thematic synthesis approach

In the convergent integrated approach, the extracted qualitative and qualitized quantitative data are given equal weight (Harden and Thomas, 2010). A thematic synthesis approach (Thomas and Harden, 2008) was utilized for analyzing and synthesizing all the research results. Research results were first coded line by line and then grouped by relevant codes to define descriptive topics (Thomas and Harden, 2008). These descriptive topics were presented as barriers and facilitators to implementation of the guidelines and were further synthesized to produce analytical topics (Thomas and Harden, 2008). These were the main analytical topics, and barriers and facilitators were listed under each topic in the results section. Throughout the thematic synthesis process, NVivo 12 was utilized as a tool to facilitate data management.

To begin, one researcher (HMB) independently analyzed the study data. The studies were numbered, and a second researcher (YJ or CJJ) randomly selected half of the studies for independent analysis through a lottery. Any discrepancies that arose were debated until a consensus was achieved, with a senior researcher mediating to resolve any remaining differences. (HJY).

2.7.2. Mapping barriers and facilitators to the consolidated framework for implementation research

The barriers and facilitators recognized within each topic preserved the results closest to the initial findings of the inclusion studies (Thomas and Harden, 2008) and were categorized into the related Consolidated Framework for Implementation Research domains (Damschroder et al., 2009). This process was carried out by one researcher (HMB) and then debated and cross-checked with one senior researcher (HJY) who was well versed in implementing scientific knowledge. The targeted implementation strategies can be obtained by inputting the barriers into the Consolidated Framework for Implementation Research-Expert Recommendations for Implementing Change implementation strategy matching tool. It ranks implementation strategies that solve each barrier based on the percentage of expert acceptance shown by the strategy to provide the best implementation strategy for each. Only Level 1 strategies (expert approval >50 %) were included in the implementation strategy. The specific implementation strategies were detailed descriptions of the Consolidated Framework for Implementation Research-Expert Recommendations for Implementing Change implementation strategies, which was strictly deliberated and formulated by the expert group in combination with the included studies.

3. Results

The database search produced a total of 8262 studies. Following the elimination of duplicates and a thorough review of titles and abstracts, 209 studies were selected for a detailed full-text evaluation. Ultimately, 26 studies were deemed suitable for inclusion in the final analysis (Fig. 1). It is noteworthy that, despite some participants in Basey's study (Basey et al., 2012) not meeting the age criteria, this study was still included after careful consideration. Firstly, this study was the only mixed-methods study among the included studies, integrating the perspectives of healthcare providers and patients. Secondly, the average age of the patients in this study was 64 years. Although a minority of participants were under 18, they did not significantly alter the results of this study.

3.1. Study characteristics

Tables 1 and 2 show the characteristics of participants in the studies and included studies involving clinical healthcare providers and patients, respectively (20 quantitative, 5 qualitative, and 1 mixed method). Studies reported on clinicians' or patients' perspectives exclusively, except for a mixed methods study that included both clinicians' and patients' views on venous thromboembolism prevention (Basey et al., 2012). Studies were conducted in 14 countries. The sample sizes for quantitative studies ranged from 48 to 5218 participants and for qualitative studies from 8 to 91 participants. Of the 21 clinical care provider perspective studies, 17 quantitative studies utilized validated venous thromboembolism knowledge, attitudes, and practice questionnaires or self-developed questionnaires to survey knowledge, attitudes, practices, or barriers to preventing venous thromboembolism. Two qualitative studies of relevance to clinical healthcare professionals used semi-structured interviews, and one of them also used a think-aloud protocol to explore perceptions of venous thromboembolism management barriers (Johnson et al., 2012). Three studies were designed to specifically investigate knowledge and practice of venous thromboembolism risk assessment among clinical healthcare providers (Lee et al., 2014; Oh et al., 2017; Sousa da Silva et al., 2020). Among the five studies that examined hospital patients' views, three qualitative studies all employed semi-structured interviews as their primary data collection method, two of which explored their perceptions of venous thromboembolism prevention, and one investigated patients' knowledge and attitudes about venous thromboembolism risks. Two patient-relevant quantitative studies utilized validated questionnaires or self-developed surveys to explore patient-reported outcomes, awareness, and perceptions of thrombosis prevention.

3.2. Participant characteristics

Data on 12,708 clinical healthcare providers and 1495 patients were reported. Of the 21 studies about clinical healthcare providers, 10 recruited only nurses; five recruited a variety of clinical healthcare providers, including nurses and physicians or allied health professionals. Six others recruited only physicians. Thirteen studies provided information on the duration of clinical practice, which varied from under one year to 45 years (Lee et al., 2014). Within the six studies involving patients, all participants were hospitalized individuals with reported ages ranging from 16 to 98 years (Basey et al., 2012). Five studies reported on venous thromboembolism prevention and management strategies accepted by patients, all using heparin or low-molecular-weight heparin or anticoagulants, and one study also used compression stockings (Apenteng et al., 2016).

Table 1
Studies involving clinical healthcare providers and participant characteristics.

Author(s), year	Country	Methodology			Participants			Study focus
		Setting	Recruitment date	Data collection method	Total number	Number in each health discipline	Years of practice (years)	
Qualitative								
Johnson et al., (2012)	United Kingdom	Two strategic Health Authority regions in the North of England and Wales	3/2010–1/2011	Think aloud protocols and individual semi-structured interviews.	91	91 physicians	Not reported	Barriers to VTE diagnosis and management
Abboud et al., (2022)	United Kingdom	Acute hospital medical ward	1/2019–6/2019	semi-structured face to-face interviews	16	16 physicians	1~20	Barriers and facilitators to VTE guideline practice
Quantitative								
Alyousef et al., (2022)	Saudi Arabia	In 6 medical and surgical units	Not reported	Self-developed survey	67	67 nurses	<5:28.4 %;5–10:35.8 %;>10:35.8 %	Knowledge and practice of preventing DVT
Vardi et al., (2012)	>30 countries	Medical ward	11/2010–1/2011	Self-developed survey	226	226 physicians	Not reported	Attitudes and practices to prevent VTE
Lam et al., (2023)	United States	academic, community, or federal institution	8/2021–8/2022	Self-developed survey	607	429 physicians,125 pharmacists,25 registered nurses,27 nurse practitioners or physician assistants	Not reported	Attitudes, practices and barriers to thrombosis prevention
Kumari et al., (2023)	India	hospitals	Not reported	Self-developed survey	140	20 physicians,88 nurses,12 pharmacists,4 lab technicians,13 OT technicians,3 physiotherapists	<5:70 %;5–10:27.2 %;10–15:1.4 %;>15:1.4 %	Knowledge of VTE and its prevention
Yohannes et al., (2022)	Ethiopia	Medical, surgical, emergency, intensive care and maternity wards in 5 hospitals	1/4/2021–30/4/2021	Self-developed survey	412	412 nurses	≤5:43 %;6–10:43.7 %; ≥11:13.3 %	Knowledge, practice and related factors for the prevention of DVT
Wang et al., (2021)	China	Neurology, neurosurgery, general surgery, general medicine, orthopedics, geriatrics and intensive care units in 25 hospitals	9/2015–10/2015; 11/2015–3/2016	Self-developed survey and CRF	485	485 nurses	Not reported	Knowledge, attitude and prevention of VTE
Yan et al., (2021)	China	Hospital medicine, surgery, obstetrics and gynecology and pediatrics	12/2019	Self-developed survey	1121	1121 nurses	<5:30.3 %;5–9:32.6 %;10–20:25.2 %;21–30:9.5 %;>30:2.3 %	Knowledge, attitudes and behaviors to prevent VTE
Bhandari et al., (2022)	Nepal	Hospital internal medicine, surgery, ICU, orthopedics, obstetrics and gynecology and other departments	14/7/2019–13/8/2019	Survey Monkey	328	328 physicians	Not reported	Knowledge and practice of VTE prevention measures
Zhou et al., (2023)	China	Ophthalmology	10/3/2021–30/4/2021	Sojump and Self-developed survey	610	610 nurses	≤5:22.5 %;6–10:29.8 %;11–15:25.2 %;≥16:22.5 %	Knowledge, attitudes and practices for VTE prevention
Ma et al., (2018)	China	106 hospitals	Not reported	Self-developed survey	5218	5218 nurses	8.96±7.37	Knowledge of VTE prevention
Feng et al., (2021)	China	1 university hospital	1/9/2019–15/10/2019	Self-developed survey	2042	921 physicians,1121 nurses	<5:25.9 %;5–9:29.4 %;10–20:28.4 %;21–30:13.4 %;≥31:2.9 %	Knowledge, attitudes and practices for VTE prevention
Mendoza and Christie	Canada	Hospital internal medicine	6/2012–10/2012	Self-developed survey	58	35 physicians, 23 researchers	Not reported	Knowledge, attitudes and practices for VTE prevention

(*continued on next page*)

Table 1 (*continued*)

Author(s), year	Country	Methodology			Participants			Study focus
		Setting	Recruitment date	Data collection method	Total number	Number in each health discipline	Years of practice (years)	
Visperas (2012)								
Oh et al., (2017)	South Korea	Internal medicine, surgery, orthopedics, oncology, rehabilitation, obstetrics/ gynecology, or ICU in 2 hospitals	7/2015	Questionnaire developed by Lee et al	452	452 nurses	5.8 ± 4.8	Knowledge and practice of VTE risk assessment and prevention
Suker et al., (2021)	Iraq	Maternity wards in 6 hospitals	Not reported	Self-developed survey	57	57 physicians	10.7 ± 7.5	Barriers to knowledge and practice and implementation guidelines for preventing VTE
Sousa et al., (2020)	Brazil	Medical or surgical ward of 1 hospital	1/2019–5/2019	Questionnaire developed by Lee et al	81	81 nurses	Median: 7	VTE risk assessment of knowledge, practice, cognitive impairment, and self-efficacy in VTE prevention
Khan et al., (2012)	Pakistan	General surgery and orthopedics in 4 hospitals	Not reported	Self-developed survey	48	48 physicians	Not reported	The understanding and practice of preventing thrombosis
Kiflie et al., (2022)	Ethiopia	1 hospital in orthopedics, surgery, trauma, ICU and obstetrics and Gynecology	10/5/2021–20/ 6/2021	Self-developed survey	404	156 physicians, 152 nurses, 75 midwives, 21 physiotherapists	≤5:67.1 %;6–10:30 %;>10:3 %	Awareness, attitude, practice and related factors in the prevention of VTE
Lee et al., (2014)	United States	2 acute care hospitals	Not reported	Self-developed survey	221	221 nurses	Median (range): 13 (0.25–45)	Knowledge and practical barriers to VTE risk assessment
Mixed-methods								
Basey et al., (2012)	United Kingdom	Hospital emergency department	11/2009;1/ 2010;4/2010; 4/2011	Review the case records, observe the admission process and interview	24	24 nurses	Not reported	Barriers to the implementation of VTE guidelines

VTE: venous thromboembolism; DVT: deep vein thrombosis; OT: occupational therapists; ICU: intensive care unit; CRF: case report forms.

Table 2
Studies involving patients and participant characteristics.

Author(s), year	Country	Methodology			Participants			Study focus
		Setting	Recruitment date	Data collection method	Total number	Age, year	VTE prevention/ management strategies	
Qualitative								
Apenteng et al., (2016)	United Kingdom	4 hospitals in Birmingham and Oxford.	Not reported	Semi-structured interview	31	Average:63; range:38–81	Compression stockings and heparin injections	Knowledge and experience in preventing hospital-acquired thrombosis
Xu et al., (2018)	China	The orthopedic department of a level-three, class-A hospital in Beijing, China	3–7/2017	Semi-structured interview	8	Average:65; range:44–92	Not reported	Views on VTE and prevention
Haxaire et al., (2015)	France	A university hospital	Not reported	interview	10	24–60	Use anticoagulants	Perceptions, knowledge and attitudes towards VTE risk
Quantitative								
Halboup et al., (2022)	Yemen	Medical wards in 7 hospitals	6/2020–11/ 2020	Questionnaire survey	396	18–40:41 %;41–64:33 %;>65:26 %	Receive a DVT prophylactic dose of LMWH or regular heparin	Understanding and views on thromboembolism and thrombosis prevention
Almodaimegh et al., (2017)	Saudi Arabia	medical wards at the KAMC	12/2015–3/ 2016	Questionnaire survey	174	18–30:18.4 %; 31–50:25.9 %; 51–70:37.9 %;71+:17.8 %	Heparin injection	Understanding of VTE and thrombosis prevention
Mixed-methods								
Basey et al., (2012)	United Kingdom	Hospital emergency department	11/2009;1/ 2010; 4/2010; 4/ 2011	Review the case records, observe the admission process and interview	876	Average:64; range:16–98	Inject LMWH	Barriers to the implementation of VTE guidelines

VTE: venous thromboembolism; DVT: deep vein thrombosis; LMWH: Low Molecular Weight Heparin; KAMC: King Abdulaziz Medical City.

3.3. Methodological quality of included studies

The results of the critical appraisal are detailed in Supplementary Material Table 3. In summary, all five qualitative studies demonstrated consistency across data sources, collection methods, analysis, and interpretation, offering specific information about data collection and results interpretation. Of the 20 quantitative studies, most used validated measurement instruments and appropriate statistical analysis methods to address the research questions. Moreover, 15 studies proved the representativeness of the sample, and 14 exhibited minimal risk of non-response bias. The sampling methods of 10 studies were suitable to answer the research questions. One mixed-method study did not effectively integrate qualitative and quantitative findings.

3.4. Topics

Four main topics emerged, supplemented by illustrative quotes and related barriers and facilitators. The main topics were: 1) healthcare-led multidisciplinary prevention and management, 2) feasibility of guideline implementation, 3) patient involvement in prevention and management, and 4) government and hospital environments and related systems.

3.4.1. Healthcare-led multidisciplinary prevention and management

This topic underscores the critical role of healthcare leadership in initiating, guiding, and supporting multidisciplinary efforts for venous thromboembolism prevention. One qualitative study and two quantitative studies emphasized the importance of multidisciplinary teamwork for evidence-based decision-making (Abboud et al., 2022; Feng et al., 2021; Wang et al., 2021) .

> *"The majority of participants indicated that they discussed the venous thromboembolism recommendations with their team members: 'we take multidisciplinary decisions to make better care'."*

(Abboud et al. page 6, 2022)

Across qualitative and quantitative studies, commonly reported facilitators to enhance healthcare-led multidisciplinary care included recognition of the importance of venous thromboembolism prevention and management and communication across health disciplines to foster a multidisciplinary approach. Other facilitators included appointing a venous thromboembolism coordinator to assist with risk assessment and nominating specialist nurses to provide venous thromboembolism testing services to minimize disruption to patients.

> *"Another professional or nurse could do the risk assessment, and we just need to verify it then it would be easier for us."*
>
> (Abboud et al. page 6, 2022)

> *"I do a clinic on a Thursday over in the main department at [hospital] and there is a little laminated sheet stuck on the x-ray box and it says, Suspect a DVT [Deep Vein Thrombosis]? Call this number and they do one straight away. Basically, if somebody comes in to your clinic with a swollen painful leg, you ring that number, you whizz them round to x-ray and you get a Doppler there and then, I mean it's a 9 to 5 service it's not out of hours, but yeah, it's easy …."*
>
> (Johnson et al. page 7, 2012)

Commonly reported barriers included inadequate knowledge and practice of venous thromboembolism prevention among healthcare providers and unclear roles and scope of practice among nurses. Only one study reported patients' perceptions of multidisciplinary prevention. The patient received conflicting advice from various disciplines and was unclear about the role of compression stockings in prevention.

> *"The nurse said wear them for a fortnight which is what I did and then reading the leaflet afterwards it said keep wearing the stockings for after six weeks but I only wore them for a fortnight."*
>
> (Apenteng et al. page 4, 2016)

3.4.2. Feasibility of guideline implementation

This topic discusses the practical challenges associated with implementing guidelines for venous thromboembolism prevention and management from the perspective of clinical providers. Clinical healthcare professionals from qualitative, quantitative, and mixed methods studies reported that their ability to fully comply with venous thromboembolism guidelines was limited due to the heavy workload and time constraints in clinical settings. Practical difficulties in implementing the guidelines included limited or missing information about patients' medical conditions and language barriers.

> *"Inadequate information, if the patient comes unconscious, we know nothing. It is difficult to start the patient on antibiotic prophylaxis without knowing the risk assessment."*
>
> (Abboud et al. page 5, 2022)

Two studies reported organizational barriers to guideline implementation; venous thromboembolism guidelines did not clearly guide the practice of healthcare providers in some clinical settings (Abboud et al., 2022; Vardi et al., 2012). In one qualitative study, facilitators of guideline implementation at the organizational level were stakeholders' perceptions that adherence to guidelines can enhance patient safety and well-being, reduce the financial burden of hospitals and patients, and protect hospitals' reputation.

> *"It will protect patients from developing DVT [Deep Vein Thrombosis] or PE [Pulmonary Embolism], it will reduce the mortality & morbidity rate. A waste of resources and then you have to do more advanced management for these patients. It is a very good thing for our hospitals' reputation."*
>
> (Abboud et al. page 5, 2022)

In addition, healthcare professionals from both quantitative and qualitative studies reported barriers to guideline implementation at the individual level, mainly including physicians following their own clinical judgment and patients with complex conditions.

> *"……When you say restrictive and make it mandatory physicians feel like you are taking away their autonomy.…in complicated cases in which the bleeding risk is high, it becomes difficult to decide should or should not prescribe prophylaxis."*
>
> (Abboud et al. page 6, 2022)

3.4.3. Patient involvement in prevention and management

This topic represents how patients feel about participating in hospital venous thromboembolism care. Four quantitative and qualitative studies of patient opinions showed that patients' unclear understanding of the prevention measures and importance of venous thromboembolism affected patients' participation in prevention.

> *"I mean, I know there is a risk but I wouldn't know how to assess whether or Not* I *was having a blood clot. …Anti-embolism stockings are too tight and uncomfortable. I often take them off."*
>
> (Apenteng et al. page 5, 2016; Xu et al. page 3, 2018)

Other commonly reported barriers included poor compliance among patients due to physical discomfort, fear of bleeding, and underestimation of potentially life-threatening events following emergency treatment.

"Sometimes there are patients who refuse, that affects your decision for ordering prophylaxis." "My father had a cerebral thrombosis. It is not fatal, and I don't think it's too dangerous."

(Abboud et al. page 6, 2022; Xu et al. page 3, 2018)

In three quantitative and qualitative studies, facilitators for patient involvement in prevention and management included patient awareness of the potentially serious consequences of thrombosis and confidence in the safety and effectiveness of thrombosis prophylaxis.

"My sister suffered from serious varicose veins in her lower limbs. After having an operation, her doctor told us it was important to prevent DVT [Deep Vein Thrombosis], which could lead to PE [Pulmonary Embolism] and death…Following the doctor's advice is always correct."

(Xu et al. page 3, 2018)

Patients' different experiences of venous thromboembolism influenced their preference for participation levels. For example, in a qualitative study, patients who had experienced venous thromboembolism and understood that it was preventable were more willing to actively participate in venous thromboembolism care, had a venous thromboembolism prevention attitude, and tended to maintain healthy lifestyle habits.

"Patients emphasis on advices in the event of long travels and on the interest of practicing physical activities. In some patients, regular walking was mentioned as a proxy for contention stockings. Other preventive measures applicable at the population level have been endorsed by patients, such as avoidance of smoking and drinking and being on a healthy diet—five fruits and/or vegetable a day"

(Haxaire et al. page 7, 2015)

3.4.4. Government and hospital environments and related systems

This topic mainly described the impact of the organizational level on the implementation of venous thromboembolism guidelines. Researchers in four studies showed that government policies to promote venous thromboembolism prevention and managers to participate in venous thromboembolism prevention and supervise compliance with guidelines were beneficial to guideline implementation. However, the relevant institutional policies did not take into account the important role of nurses in venous thromboembolism prevention, resulting in poor implementation.

In the implementation of the guidelines, the organization's incentives and rewards were particularly important. Emphasizing top performance and continuous reminders and inspirations in the implementation process promoted guidelines implementation, and financial penalties improved the compliance of medical staff to guidelines implementation.

"We can highlight the best performance…. continuous reminders during the rounds … encourages us."

(Abboud et al. page 5, 2022)

In quantitative studies, barriers to guideline implementation included increasing medical costs, longer hospital stays, increased medical staff-patient conflicts, and irrational admission procedures, as well as lack of new resources, facilities, and adequate venous thromboembolism prevention education in hospitals. Facilitators included adding risk assessment tools for electronic medical records and setting up automatic reminders.

In the qualitative studies, facilitators affecting guideline implementation involved an emphasis on the importance of venous thromboembolism guideline implementation, and implementing venous thromboembolism risk assessment in the hospital admission process. The barriers included the investigation burden caused by hospital logistical and organizational factors.

"Sometimes admitting doctors are very busy and they are not able to do the risk assessment."

(Abboud et al. page 6, 2022)

"The involvement of multiple staff in individual admissions, interruptions, lack of awareness, time pressures and the lack of user-friendliness of the tools provided may contribute to failure to conduct the assessment."

(Basey et al. page 6, 2012)

3.5. Mapping barriers and facilitators to the consolidated framework for implementation research

The majority of barriers identified by healthcare providers were related to the second and fourth themes, while for patients, there were multiple barriers under theme three. Barriers were mainly mapped into four domains: intervention characteristics, outer setting, inner setting, and characteristics of individuals. Most facilitators mentioned by healthcare providers and patients were related to themes one, three, and four and mapped to three domains: outer setting, inner setting, and characteristics of individuals. The specific mapping results are shown in Table 3. The table that does not contain the theme to fully present the Consolidated Framework for Implementation Research framework is Supplementary Material Table 4. The Consolidated Framework for Implementation Research-Expert Recommendations for Implementing Change matching tool obtained seven best implementation strategies: accessing new funding, obtaining and using patients/consumers and family feedback, involving patients/consumers and family members, conducting local needs assessment, identifying and preparing champions, conducting educational meetings, and adapting each strategy to the context of the study and practice site, as shown in Table 4.

Table 3
Barriers and facilitators to implementing venous thromboembolism prevention and management guidelines mapped to the Consolidated Framework for Implementation Research domains.

Main themes	CFIR domain	Construct	Barriers	Facilitators
Healthcare-led multidisciplinary prevention and management	Inner setting	Networks & Communications		Multidisciplinary decision making delivers better care
		Culture		Physicians are responsible for VTE risk assessment
		Relative Priority		Healthcare providers recognize the importance of VTE prevention for patients
		Available Resources		Nurses are empowered to provide continuing education with appropriate resources
	Characteristics of individuals	Knowledge & Beliefs about the Intervention	Physicians ignore alerts that the VTE risk assessment has not been completed	Physicians are proficiency in tools related to VTE guideline practice
			Healthcare providers have insufficient understanding of clinical guidelines for VTE	Healthcare providers are happy and satisfied with the implementation of the VTE guidelines and have a positive attitude.
			Nurses lack awareness, knowledge and practice of VTE prevention	
		Self-efficacy	Nurses have unclear roles and responsibilities in VTE prevention	Healthcare providers are confident in performing VTE preventive measures
	Process	Formally Appointed Internal Implementation Leaders		VTE coordinators assist in risk assessment and specialized nurses perform VTE testing services
Feasibility of guideline implementation	Intervention characteristics	Evidence Strength & Quality	VTE guidelines in some clinical situations are not clear in guiding their practice	
		Relative Advantage		Stakeholders perceive that following the VTE guidelines offers significant advantages, such as reducing the incidence of DVT and PE, decreasing morbidity and mortality cases, lowering the financial burden on hospitals and patients, protecting hospital's reputation and shortening hospital stay.
		Complexity	VTE guidelines are difficult to implement in cases with a high risk of bleeding	
	Outer setting	Patient Needs & Resources	Limited or missing information about the patient's medical status Language barrier	
	Inner setting	Structural Characteristics	The workload is heavy and time is tight in a clinical setting.	
		Culture	Variations in physicians' interpretations and adherence to VTE assessment constitute a barrier, as they lead to inconsistent application of the guideline.	
Patient involvement in prevention and management	Outer setting	Patient Needs & Resources	Patient preference, concern about bleeding, physical discomfort, poor compliance Patients lack understanding explanation and information about VTE thrombosis prevention, lack understanding of risk factors, severity, and necessary strategies for VTE prevention	Patients recognize the serious consequences of blood clots
	Characteristics of individuals	Knowledge & Beliefs about the Intervention		Patients have confidence in physicians' expertise and believe in the safety and effectiveness of thromboprophylaxis Patients have a VTE prevention attitude and tend to maintain healthy lifestyle habits
Government and hospital	Intervention characteristics	Complexity	Contradictions between medical staff and patients intensified	

(*continued on next page*)

Table 3 (*continued*)

Main themes	CFIR domain	Construct	Barriers	Facilitators
environments and related systems				
		Cost	Increased medical costs and longer hospital stays The burden of investigation caused by hospital logistics and organizational factors	
	Outer setting	External Policy & Incentives	The relevant institutional policy does not take into account the prevention of VTE in nurses	Governments develop policies to promote VTE prevention
	Inner setting	Structural Characteristics	Improper admission process: multiple staff members involved in patient admission led to disruption of VTE assessment	VTE risk assessment is included in the hospital admission process
		Organizational Incentives & Rewards		Managers highlight best performance and continuous reminders and encouragement Economic penalty
		Leadership Engagement	The VTE risk assessment model has not been incorporated into clinical work in less developed countries.	Hospitals add a risk assessment tool to the electronic medical record, with automatic reminders Managers involve in VTE prevention and monitor compliance with VTE guidelines
		Available Resources	Hospitals lack new resources, facilities and adequate VTE prevention education. The contents, methods and emphasis of VTE training in different departments are not uniform Hospitals lack decision support systems and information technology-based tools (such as electronic medical records) in less developed countries.	
		Access to Knowledge & Information		Hospitals provide information on the importance and health consequences of VTE guidelines

VTE: venous thromboembolism; DVT: deep vein thrombosis; PE: pulmonary embolism; CFIR: Consolidated Framework for Implementation Research.

4. Discussion

The previously published systematic review on the same topic focused on barriers and facilitators to implementation of venous thromboembolism guidelines by healthcare providers and was not conducted with patients (Gaston et al., 2012). Additionally, the review did not systematically propose specific implementation strategies. However, the previous review found that passive dissemination or a single intervention model was not sufficient to affect and sustain practice change, which provided the basis for implementation strategies developed in our study that involved multidisciplinary and patient engagement. We used an innovative approach to synthesize the views of clinical healthcare providers and patients on the implementation of venous thromboembolism guidelines and to explore the factors influencing evidence-based venous thromboembolism prevention from the perspective of healthcare providers and patients. These factors have been mapped to the Consolidated Framework for Implementation Research, and the Consolidated Framework for Implementation Research-Expert Recommendations for Implementing Change matching tool targets barriers to obtaining optimal implementation strategies, which provides a rationale for promoting evidence-based practice to improve guideline implementation.

In this study, the barriers identified by healthcare providers and patients corresponded to different themes, which may be related to differences in the focus of different groups. Healthcare providers were more concerned with barriers related to the organizational level (Abboud et al., 2022), whereas patients were more concerned with barriers related to their personal experience or access to information (Apenteng et al., 2016). Healthcare-led multidisciplinary prevention and management was highlighted by healthcare providers as necessary to facilitate guideline implementation. A multidisciplinary team approach means that professionals from different disciplines determine effective strategies for interdisciplinary communication and cooperation, which is crucial to achieve the best venous thromboembolism prevention and management. As the front line of health service delivery, healthcare providers can effectively implement venous thromboembolism prevention guidelines and play an important role in applying evidence-based recommendations to enhance clinical practice outcomes (Blann, 2014). Therefore, it is essential for policymakers and hospital managers to foster a practical multidisciplinary approach to venous thromboembolism prevention and support nurses in taking an active role in prevention efforts (Wang et al., 2021). In the current clinical environment, heavy workload and time constraints affect healthcare providers ability to conduct venous thromboembolism risk assessment in a timely manner. Multidisciplinary teams develop and implement mandatory clinical decision support tools to ensure that they are part of the normal workflow of clinicians, which can enhance risk stratification of patients and risk-appropriate venous thromboembolism prophylaxis and improve compliance with risk

Table 4
Results of CFIR-ERIC matching tool to identify optimal implementation strategy.

CFIR domain	Construct	CFIR-ERIC implementation strategy	Expert approval rate	Specific implementation strategies
Intervention characteristics	Cost	Access new funding	72 %	1. Medical institutions select appropriate application channels and formulate funding application plans, elaborating on the importance of VTE prevention, current issues, expected goals, funding needs, and specific usage plans, in order to secure support from the government, charities, or social capital; 2. Establish close cooperative relationships with government agencies such as financial departments and health departments to jointly promote the application and implementation of funding for VTE prevention; 3. Raise public awareness and support for VTE prevention through media publicity and public welfare activities, attracting more social capital investment.
Outer setting	Patient Needs & Resources	Obtain and use patients/ consumers and family feedback	76 %	1. Establish an advisory committee of patients and their families to obtain feedback and gain a deeper understanding of their perceptions, experiences, and satisfaction with VTE prevention. 2. At the individual level, healthcare providers use feedback to develop VTE prevention education and communication strategies. For example, if patients are confused about medication adherence, more interactive or patient-centered educational materials should be developed. 3. At the organizational level, the feedback can guide strategic decisions related to VTE prevention. If multiple patients or family members mention a lack of clarity in communication about risk factors or preventive measures, hospitals should consider implementing a standardized staff training program. 4. Incorporate feedback into a continuous quality improvement framework, periodically review feedback, assess the impact of implemented changes, and make adjustments as needed to ensure continuous optimization of VTE prevention practices
		Involve patients/consumers and family members	71 %	1. Healthcare providers explain to patients and families the importance of VTE prevention measures (such as regular activity, adequate hydration, proper use of elastic socks, or medication). 2. Patients can actively prevent venous thromboembolism by exercising regularly, wearing anti-thrombotic elastic socks and maintaining adequate water intake, and self-monitor symptoms to improve self-management. 3. Family members assist patients with daily activities, supervise the implementation of preventive measures, and provide emotional support to jointly create a positive prevention atmosphere.
		Conduct local needs assessment	57 %	Local needs assessment can ensure that VTE prevention strategies are more relevant to local conditions to improve the effectiveness and sustainability of prevention measures. 1. Collect and analyze local epidemiological data of VTE, evaluate existing medical resources and the utilization and effectiveness of these resources in VTE prevention. 2. Collect patients' and families' views, needs and expectations for VTE prevention through surveys or interviews, etc. Understand the awareness, attitude and practice of healthcare personnel on VTE prevention and the challenges and barriers encountered in implementing preventive measures. 3. Assess the compliance of local healthcare institutions with the VTE prevention guidelines and the applicability and effectiveness of the guidelines in practical work.
Inner setting	Culture	Identify and prepare champions	52 %	1. Assemble multidisciplinary teams: Identify healthcare professionals from multiple disciplines, including internal medicine, surgery, vascular surgery, nursing, pharmacy, and rehabilitation, who have a high level of interest, expertise, and responsibility for VTE prevention as potential champions. These personnel should have the awareness and ability of interdisciplinary cooperation, and be able to build Bridges between different disciplines. 2. Develop champions: Provide champions with professional training on VTE prevention, including the latest research,

(*continued on next page*)

Table 4 (*continued*)

CFIR domain	Construct	CFIR-ERIC implementation strategy	Expert approval rate	Specific implementation strategies
				clinical guidelines, implementation techniques, etc. Organize interdisciplinary academic exchange activities to promote knowledge sharing and thinking collision and bring new ideas and methods for VTE prevention work; encourage champions to explore new methods and technologies for VTE prevention in clinical practice, and improve the awareness and skill level of the whole team for VTE prevention. 3. Under the guidance of the champions, develop multidisciplinary cooperation programs for VTE prevention. Programs should clarify the division of responsibilities, cooperation mechanisms, and work process of each discipline (e.g. VTE coordinators assist in risk assessment and specialized nurses perform VTE testing services) to ensure the systematization, coordination and effectiveness of VTE prevention.
	Available Resources	Access new funding	78 %	1. Identify funding requirements and project planning; according to current resource gaps (such as equipment purchase, education and training, software development, etc.), formulate a detailed budget plan and clarify the priorities of various expenditures. Develop an attractive project proposal detailing the importance of VTE prevention, current resource deficiencies, intended objectives, implementation plan, and expected outcomes to demonstrate the value of the project to potential funders. 2. Raise funds through multiple channels: actively apply for public health project funding from national and local governments, and make use of government policy guidance and financial support; Contact charitable foundations and public welfare organizations focused on healthcare and apply for funding; Explore cooperation opportunities with medical device manufacturers, pharmaceutical companies, health insurance companies, etc., and obtain support through sponsorship, collaborative research and development or donations.
Characteristics of individuals	Knowledge & Beliefs about the Intervention	Conduct educational meetings	56 %	1. Clarify the objectives and content of the meeting: to improve the understanding and practice of VTE prevention guidelines among medical staff. The content of the meeting should cover the latest guidelines and research results in the basic knowledge of VTE, the use of risk assessment tools, the selection and implementation of preventive measures, and the management and follow-up of patients. To help medical staff establish a comprehensive knowledge system of VTE prevention through systematic theoretical learning. 2. Adopt a variety of teaching methods, such as lectures, seminars, workshops, etc., to meet the learning needs of different healthcare professionals. Lectures can provide systematic knowledge explanation, seminars focus on in-depth discussion and exchange of issues, and workshops strengthen and enhance the skills of medical staff through practical operations. 3. After the meeting, the learning effect of medical staff will be evaluated through assessment, which could not only reflect the effectiveness of educational activities, but also provide a basis for improvement of subsequent educational activities. Establish a continuous follow-up mechanism to regularly understand the application of VTE prevention guidelines in clinical practice; Help healthcare professionals consolidate and update their knowledge and skills in VTE prevention through regular review sessions or training activities.

VTE: venous thromboembolism; CFIR: Consolidated Framework for Implementation Research; CFIR-ERIC: Consolidated Framework for Implementation Research-Expert Recommendations for Implementing Change.

assessment among healthcare providers (Streiff et al., 2012). For nurses to engage in tasks that may have traditionally fallen outside the scope of nursing practice, it is necessary for them to collaborate with other medical professionals (Carryer et al., 2007). One example of such collaboration could be delegating risk assessment tasks traditionally performed by physicians to nurses under the supervision or guidance of the physician. The involvement of nurses in venous thromboembolism risk assessment serves as a prime illustration of

multidisciplinary collaboration (Bonner et al., 2008). As important members of the healthcare team, nurses have frequent contact with patients and are able to observe many details that may not be noticed by physicians. The involvement of nurses can not only help physicians to more fully understand the risk status of patients but also can timely detect potential signs of venous thromboembolism through daily care and observation, allowing them to take necessary preventive measures (Al-Mugheed and Bayraktar, 2023).

The clinical role of individual members of the multidisciplinary team and the support and involvement of senior leadership in the implementation of venous thromboembolism prevention can advance prevention practice in the current clinical setting (Schleyer et al., 2016). The involvement of policymakers has a major impact on the promotion and implementation of venous thromboembolism prevention (Izcovich et al., 2020). The participation of managers can improve the atmosphere of venous thromboembolism prophylaxis, optimize the workflow of healthcare providers, and reduce the workload (Zhou et al., 2023). We found that healthcare providers had insufficient knowledge and practice of venous thromboembolism prevention and lacked sufficient understanding of related clinical guidelines. Therefore, hospital managers should regularly conduct venous thromboembolism prevention training to educate relevant healthcare providers, understand the latest prevention guidelines and strategies, enhance the awareness of prevention, and improve the knowledge and practice of prevention to promote the implementation of the guidelines (Bhandari et al., 2022).

Additionally, we suggest that clinical healthcare professionals and patients want patients to participate in venous thromboembolism prevention. Patient engagement refers to the process of empowering and enabling patients to actively participate in decision making (Duffett, 2017). Patient engagement is fundamental to developing patient-centered care and improved continuity of care (Kitson et al., 2013), which can lead to improved patient safety, self-efficacy, compliance with venous thromboembolism prevention, and satisfaction with quality of care (Delaney, 2017).

However, there are still many challenges to promoting patients' engagement in venous thromboembolism prevention (Tobiano et al., 2015). For example, patients may not understand the specific information about venous thromboembolism prevention, so they cannot implement preventive measures according to medical advice or guidance, resulting in poor compliance. In view of this, the implementation of patient-centered education can improve patient knowledge and compliance with venous thromboembolism prevention, and a patient-centered multidisciplinary approach is beneficial to enhance prevention and reduce its incidence (Torres et al., 2020). We advise establishing patient-physician counseling sessions prior to beginning thrombus prophylaxis to understand the patient's perceptions and experience of venous thromboembolism prevention, where appropriate interventions can be taken to increasing the patient's awareness. This approach could empower patients to play a more active role in minimizing venous thromboembolism risk and increasing their compliance with thromboprophylaxis.

Moreover, using different platforms to carry out venous thromboembolism awareness campaigns targeted at high-risk individuals can also have a positive influence on patients' health outcomes. Implementing clinical pharmacy services in both public and private sectors is essential, as clinical pharmacists play a critical role in reviewing patients' medications and providing face-to-face consultations, thereby helping to reduce drug-related problems (Halboup et al., 2022). Nurses should provide more systematic health education on risk factors and prevention strategies for venous thromboembolism to inspire patients to actively participate in and adhere to the treatment plan and to promote self-diagnosis and reporting of venous thromboembolism symptoms after discharge (Almodaimegh et al., 2017). This effort should also be extended to the general public, as the level of education is not associated with deep vein thrombosis awareness. Educational campaigns are helpful and have been shown to be effective in strengthening public awareness of venous thromboembolism (Noble et al., 2006).

5. Strengths and limitations

The strength of this study is the identification of the perceptions of clinical healthcare providers and patients regarding venous thromboembolism prevention, which facilitates the identification of barriers and facilitators to guideline implementation in the clinical setting. Mapping barriers and facilitators perceived by stakeholders to the Consolidated Framework for Implementation Research helps to identify and target barriers systematically. Using the Consolidated Framework for Implementation Research-Expert Recommendations for Implementing Change matching tool to identify the best implementation strategy can provide a reference for the development of effective interventions.

This review has several limitations. Most of the included quantitative studies were cross-sectional, with a single study type and lack of comprehensiveness. A mixed-methods study included did not fully meet the eligibility criteria, which may have affected the reliability of the findings. This review was also limited by the methodological rigor of some of the included quantitative studies, which had problems with sampling methods and a risk of non-response bias. The majority of studies with healthcare providers involved only nurses and lacked more comprehensive and detailed information on venous thromboembolism prevention. In addition to this, the included studies had little information about the patient's perception of multidisciplinary prevention. More research is needed to address patients' perceptions and experiences of multidisciplinary venous thromboembolism prophylaxis. The Consolidated Framework for Implementation Research-Expert Recommendations for Implementing Change matching tool is a new one that has played an important role in facilitating the adoption, implementation, and maintenance of research findings or evidence-based practices in daily healthcare practice, but more research is needed to confirm this. Only Level 1 strategies were selected as implementation strategies in this study and did not comprehensively cover the identified barriers. Additionally, due to the complex and changeable healthcare environment, the implementation strategy of this study may be difficult to fully adapt to the implementation needs in all situations. The implementation matching process in the Consolidated Framework for Implementation Research-Expert Recommendations for Implementing Change tool relies on expert consensus and empirical judgment and thus may be somewhat subjective. Different experts may propose different implementation strategies for the same barrier, which may affect the accuracy and reliability of the matching results.

6. Conclusions

We used a mixed methods systematic review to synthesize and compare the perceptions of clinical staff and patients on the implementation of venous thromboembolism guidelines. We found that to implement interventions effectively, it is important to develop strategies to enhance healthcare-led multidisciplinary prevention, promote patient participation, and address practical and organizational barriers. Each theme had specific barriers and facilitators that illustrated the necessity for different implementation strategies. Further research is needed to survey the effectiveness and sustainability of a patient-centered multicomponent implementation intervention consisting of these four topics that include healthcare-led multidisciplinary prevention and management, feasibility of guideline implementation, patient involvement in prevention and management, and government and hospital environments and related systems.

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CRediT authorship contribution statement

Mengbo Han: Writing – review & editing, Writing – original draft, Project administration, Methodology, Formal analysis, Data curation, Conceptualization. **Jingying Huang:** Writing – review & editing, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Jin Yang:** Writing – review & editing, Formal analysis, Data curation. **Jiaojiao Chen:** Writing – review & editing, Formal analysis, Data curation. **Haiou Qi:** Supervision, Resources.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.ijnsa.2024.100273.

Data availability

Due to the nature of extracting data from published studies in a systematic review, data has already been made available.

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