A GLOBAL VIEW

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Challenges in venous thromboembolism prophylaxis: a narrative review of East and Southeast Asian perspectives

Thita Chiasakul,[1,2] Noppacharn Uaprasert,[1,2] and Ponlapat Rojnuckarin[1,2]

[1]Center of Excellence in Translational Hematology, Department of Medicine, Faculty of Medicine, Chulalongkorn University, Bangkok, Thailand; and [2]King Chulalongkorn Memorial Hospital, Bangkok, Thailand

Anticoagulant prophylaxis for high-risk patients is strongly recommended in standard clinical practice guidelines worldwide. However, there is a recognized gap between these international mandates and actual practice in East and Southeast Asia. This narrative review summarizes the underlying factors contributing to this underutilization of venous thromboembolism (VTE) thromboprophylaxis among countries in this region. First, the baseline VTE incidence in the general Asian population is lower than that in Western populations. Although historic VTE rates after major orthopedic surgery in Asia aligned with those reported in the West, recent data demonstrate that the absolute event rates have decreased significantly following the adoption of modern surgical techniques, early ambulation, and mechanical prophylaxis. Similarly, in general surgery, the VTE disease burden is notably lower in Asian cohorts at equivalent Caprini scores than in Western demographics. Furthermore, although Western VTE risk assessment models are available, they lack rigorous validation and calibration specifically for Asian medical patients. Regarding the safety concern, Asian patients show a higher baseline incidence of spontaneous intracranial hemorrhage and carry a greater risk of major bleeding after warfarin administration at the same intensity. Overall, these data shift the risk-benefit ratio of routine pharmacologic thromboprophylaxis in Asian patients. Finally, the economic burden of routine anticoagulants for all patients at risk remains high in developing countries. We propose that, as an initial effort, institutions should establish their own consensus-based VTE prevention protocols, prioritizing at least the universal implementation of nonpharmacologic prophylaxis. Ultimately, more large-scale research specifically targeting Asian populations is needed to formulate robust, evidence-based regional recommendations.

Introduction

Venous thromboembolism (VTE) is a leading cause of preventable hospital-associated morbidity and mortality worldwide.[1] Because over half of VTE events occur during or shortly after hospitalization for medical illnesses or surgical procedures, pharmacologic prophylaxis for high-risk patients has become the standard of care in various international guidelines.[2,3] These recommendations have been incorporated into the hospital quality assurance and insurance reimbursement systems, endorsing the

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Table 1. Comparative summary of thrombotic risks in Western vs Asian populations

Clinical settings	Western populations	Asian populations	Clinical implications
Baseline VTE incidence	100-183 per 100 000 person-years[5,14] 8 per 1000 inpatients[11]	Asian population in native countries: 13-70 per 100 000 person-years[7-10] Asian population residing in North America: 21 per 100 000 person-years[5] 4 per 1000 inpatients[11]	Baseline VTE risk in the general Asian population is roughly one-third to one-fifth that of Western demographics, driven by genetic and environmental differences.
Major orthopedic surgery without pharmacologic thromboprophylaxis	Screening venography, 40%-50%[15]	Conventional data: screening venography, 36%-41%[16,17]; symptomatic VTE, 2.3%[18] Modern studies: symptomatic VTE, 1.1%-1.2%[19,20]	The rate of VTE without thromboprophylaxis after major orthopedic surgery is substantial; however, modern surgical techniques, mechanical prophylaxis, and early rehabilitation may offer a more favorable risk-benefit ratio than anticoagulants.
Cancer-related surgery	Thromboprophylaxis recommended as standard of care due to high VTE risk[21,22] With prophylaxis 1.3%-2.1%[23-26]	Without prophylaxis Gynecologic: DVT, 5.9%-8.8%[27-29]; PE, 36%[30] Colorectal, 3%-11.2%[31,32] Gastric: VTE, 3.6%[33]	Asian guidelines suggest that LMWH should be considered in surgery for cancers with a high risk of VTE[34]; however, implementation varies because bleeding remains a major concern.

concept that prevention is better than cure. Nevertheless, prevention of VTE may require anticoagulants, which incur costs and carry potential side effects. Consequently, VTE prophylaxis in high-risk hospitalized patients in Asia, particularly Thailand, has been inadequately implemented.[4] This narrative review explores the reasons behind this implementation gap and suggests strategies to improve patient care.

Seemingly lower disease burden in Asia

Various epidemiologic studies have indicated a lower incidence of VTE in general Asian populations compared to the West (Table 1). Although the VTE incidence rates in Western countries are ~100 per 100 000, Asian populations report rates that are less than one-fifth of this figure.[5,6] Incidence rates of 13.8, 16.9, 21.0, and 57 per 100 000 have been reported in Korea,[7] Taiwan,[8] Hong Kong,[9] and Singapore,[10] respectively. Furthermore, the VTE incidence among Asian and Pacific Islander populations residing in the United States is approximately one-third to one-half of that in White populations.[11,6,12] Because the disparity is more pronounced among Asian populations living in their native countries than among those in the United States, both genetic and environmental factors likely contribute.[6,13]

Although differences in genetic predisposition may partially explain the relatively lower reported incidence, limited clinical awareness and systemic underdiagnoses likely lead to an underestimation of the true VTE burden in East and Southeast Asian populations. The reported incidence rates are heavily impacted by variations in study designs, detection methods (such as routine screening vs symptomatic presentation), differences in reporting systems, and access to diagnostic procedures. A recent nationwide study in China underscored this evolving landscape, demonstrating a continuous temporal increase in the incidence of pulmonary embolism (PE), which reached 14.19 per 100 000 population in 2021. This escalation is largely attributed to improved diagnostic awareness among physicians and the widespread availability of diagnostic techniques. Furthermore, health care infrastructure plays a critical role in mitigating this burden; the study revealed that regions with a higher geographical density of VTE-related facilities and mature prevention systems experienced a marked decrease in both the overall PE incidence and mortality rates.[35]

In contrast to the general population, VTE incidence is not low among Asian patients exposed to major VTE risk factors, particularly those undergoing high-risk surgical procedures. Landmark studies conducted in major orthopedic surgeries (hip fractures, hip arthroplasty, and knee arthroplasty) illustrate this. Without thromboprophylaxis, the AIDA (Assessment of the Incidence of Deep Vein Thrombosis in Asia) study investigators revealed a deep vein thrombosis (DVT) rate of 41% (121/295) by venography across 19 hospitals in Asia. Among these, 30 (10.2%) were proximal DVT and 2 (0.5%) were confirmed PE.[16] The figures align with rates reported in White populations (40%-60%).[16] One criticism was that most of the VTE events were asymptomatic. The prospective SMART (Surgical Multinational Asian Registry in Thrombosis) study cohort of 2420 Asian patients who underwent major orthopedic surgery reported a symptomatic VTE or sudden death rate of 2.3% (n = 55) with a 95% confidence interval of 1.6 to 3.2. After adjudication, this rate was reduced to 1.2% (n = 28) and consisted of 24 VTE events and 4 sudden deaths.[18] These foundational data established prophylactic anticoagulation as a standard of care for hip or knee surgery in many centers across Asia. Although these studies provide a crucial, unconfounded baseline of untreated VTE risk in Asian populations, their execution over 2 decades ago invites valid scrutiny regarding their direct applicability to modern clinical practice.

Since then, orthopedic practice has evolved significantly. Modern arthroplasty techniques involve shorter surgical time and minimal tissue trauma. Nowadays, the fast-track protocol for hip fractures have minimized immobilization periods. All postoperative patients are encouraged to ambulate early, with or without pneumatic calf compression and supervised calf exercises. A recent, prospective, single-center investigation that applied these nonpharmaceutic strategies in 896 patients found no symptomatic DVT after major orthopedic surgery despite the absence of anticoagulant therapy.[36] Similarly, a recent study evaluating a fast-track rehabilitation protocol using mechanical prophylaxis alone (intermittent pneumatic compression and graduated compression stockings) in a cohort of 542 Hong Kong Chinese patients undergoing primary total hip arthroplasty found a proximal DVT incidence of only 1.1%, with 0 cases of symptomatic or fatal PE.[19] Broadening this perspective, a systematic review and network meta-analysis of 11 769 Asian patients undergoing total joint arthroplasty

demonstrated that the baseline incidences of symptomatic and proximal DVT in control/placebo groups were inherently low at 2.92% and 3.11%, respectively. Because of this much lower baseline incidence, the overall benefit-to-risk ratio of routine pharmaceutic thromboprophylaxis is significantly lower in Asian populations than in Western demographics.[37] Broad extrapolation of the findings from single-center studies should be cautioned because of inherent variations in surgical practices and patient demographics across different regions. However, these data suggest that nonpharmacologic VTE prophylaxis may serve as a reasonable and safe alternative for carefully selected Asian patients with standard VTE risk, provided that they are managed within optimized, fast-track protocols with rigorous clinical surveillance. Clinical observation in high-volume centers (performing over a thousand arthroplasties) further supports the rarity of postoperative symptomatic VTE or sudden death even in the absence of anticoagulation.[38-40] The recent Asia-Pacific Venous Thromboembolism Consensus Group emphasized that protocols should be individualized via risk stratification rather than adopting blanket pharmacologic mandates. For Asian patients with a standard VTE risk, mechanical prophylaxis alone is strongly recommended if there is a concurrent elevated risk of bleeding. If bleeding concerns are absent, mechanical prophylaxis alone or in combination with safe, cost-effective agents such as low-dose aspirin (81-162 mg/d) is deemed highly appropriate.[41] Ultimately, large-scale, multicenter randomized controlled trials are required to validate the safety and efficacy of this approach before broad implementation can be confidently recommended.

Among surgical Asian patients, perioperative VTEs are frequently associated with active malignancies. Symptomatic and/or proximal DVT rates among patients who underwent surgeries for gynecologic malignancy have been reported to be as high as 5.9% to 8.8%.[27-29] Recognizing this elevated risk, the Thai Gynecologic Cancer Society explicitly recommends routine prophylactic anticoagulation in their guidelines.[42] The critical necessity of this pharmacologic approach in Asian cohorts was further explored in a randomized controlled trial of Japanese patients undergoing surgery for gynecologic malignancies. This study was terminated early because of safety concerns after the cohort receiving only intermittent pneumatic compression demonstrated an alarmingly high VTE incidence of 35.7%, including a 21.4% rate of PE, compared to rates of 6.7% and 0%, respectively, in the enoxaparin group.[30] To mitigate surgical bleeding risks, the initiation of enoxaparin in this trial was delayed until 24 to 36 hours after the surgical procedure, a stark departure from standard Western guidelines, which often recommend initiating therapy preoperatively or within 6 hours of surgery. Similarly, in colorectal cancer surgeries, a recent multicenter study of 1836 Chinese patients with colorectal cancer found a high, short-term postoperative VTE incidence of 11.2%. Strikingly, none of the patients who developed VTE had received adequate thromboprophylaxis, which was frequently omitted, delayed, or truncated because of prevailing concerns for bleeding.[31] This underscores that withholding prophylaxis in high-risk Asian oncology cohorts directly results in significant thromboembolic harm.

Despite its preventive efficacy, the bleeding risk inherent to pharmacologic prophylaxis must be strictly weighed against its benefits. This clinical dilemma is illustrated in the PROTECTOR randomized clinical trial, which evaluated 666 Korean patients who underwent a gastrectomy for gastric adenocarcinoma.[33] Although the addition of low molecular weight heparin (LMWH) to mechanical prophylaxis successfully reduced the overall VTE incidence compared to intermittent pneumatic compression (IPC) alone (0.6% vs 3.6%), it simultaneously triggered a nearly eightfold increase in postoperative bleeding complications (9.1% vs 1.2%). Because the vast majority of detected VTEs were completely asymptomatic and no VTE-related mortalities occurred, the investigators concluded that routine pharmacologic prophylaxis is not recommended for this population due to the highly unfavorable risk-benefit ratio.[33]

Beyond specific malignancies, routine pharmacologic prophylaxis is also not universally adopted as standard practice for other major general and benign surgeries. This hesitation stems from prevailing concerns among surgeons regarding intraoperative bleeding, coupled with a very low VTE risk in these specific procedures. For example, a nationwide, population-based epidemiologic study using the Korean Health Insurance Review and Assessment Service database evaluated the incidence of VTE after major surgery.[20] Reflecting local standard clinical practice in which pharmacologic prophylaxis was rarely used for nonmalignant patients, the study found that the overall rate of postoperative VTE for benign surgeries was exceptionally low at just 0.05%. Although the study noted that major orthopedic and cancer surgeries carried a greater than 20-fold higher risk of VTE than benign procedures, the overall baseline VTE incidence across Asian surgical populations remains markedly lower than the rates reported in Western cohorts. Consequently, clinicians often conclude that the baseline VTE incidence in general surgery among Asian population is low enough that routine, blanket pharmacologic thromboprophylaxis may not be clinically justified.

However, because intraoperative PE carries a grave prognosis, some institutions have adopted localized preventive strategies. For instance, high-risk patients (such as those with active cancer or prolonged immobilization) may undergo preoperative ultrasound screening for DVT. If a DVT is detected, an inferior vena cava filter may be temporarily placed to prevent embolization, followed by postoperative anticoagulation and subsequent filter removal.[43,44] It is important to emphasize that this preoperative screening and inferior vena cava filter protocol is an institution- or surgeon-based practice driven by local clinical apprehension, rather than a standard recommendation reflected in national or international VTE guidelines.

Recent local data suggest that standardized protocols can be safely implemented. In a single-center, retrospective cohort study (N = 4579), implementing a multidisciplinary protocol based on Caprini scores significantly reduced symptomatic VTE (1.20%-0.37%) and 30-day VTE-related mortality (0.11%-0.02%).[45] Pharmacologic prophylaxis was administered in 8% of the entire cohort, and 16% of those were classified as high risk. Crucially, the study highlighted a distinct disparity in disease burden; although Western validation studies indicate VTE rates exceeding 2% to 6% for patients with high-risk scores (Caprini $\geq$5),[46] the incidence in this high-risk Thai cohort was markedly lower at 1.08%. This phenomenon of lower absolute event rates despite equivalent risk stratification warrants careful interpretation. First, it likely reflects true baseline risk differences, driven by the unique genetic and environmental factors present in Southeast Asian

populations. Second, the potential for systemic underdetection must be critically considered. The investigation by Kittitirapong et al primarily captured symptomatic VTE events; because routine postoperative duplex ultrasonography was not universally applied across the cohort, a substantial proportion of asymptomatic DVTs likely went undetected, artificially lowering the reported absolute incidence. Nonetheless, these favorable outcomes were achieved with a conservative approach in which only 16% of high-risk patients received pharmacologic agents and the majority were managed with mechanical prophylaxis and early ambulation. Furthermore, no major bleeding events were recorded. This suggests that although the Caprini model effectively identifies relative risk in Asian patients, the absolute event rates remain lower than in Western populations, validating a more conservative pharmacologic strategy.

Regarding hospitalized medical patients, the rate of symptomatic VTE without prophylaxis was found to be 0.59% (42/4126). Although the overall prevalence is not high, the mortality impact was significant. There were 10 (0.14%) fatal PEs and 2 deaths related to bleeding after therapeutic anticoagulant during the study period.[47] This led to follow-up studies that aimed to develop a VTE risk assessment model (RAM) for the identification of high-risk patients who require prophylaxis. Notably, known VTE-RAMs developed in White populations, such as Padua, Arcelus, and Kucher scores, have shown poor predictive performance for Asian medical patients.[48,49] A prospective single-center study (N = 1290) showed that autoimmune diseases, solid tumors, family history of VTE, varicose veins, and estrogen use were significant risk factors,[48] whereas another single-center study (N = 1192) revealed that diabetic ketoacidosis, previous DVT, central venous catheter placement, and a length of hospital stay of >10 days (n = 10) were significantly associated with an increased risk of VTE.[49] Future multicenter investigations may be helpful to formulate a validated VTE-RAM for Asian populations. Thus far, medical patient subgroups who are suitable candidates for VTE prophylaxis in this region remain to be established. Recent data demonstrated the value of localized, risk-adapted protocols. A prospective trial in Thai medical intensive care units showed that implementing targeted prophylaxis based on Caprini and HAS-BLED scores significantly reduced VTE incidence from 6.06% to 2.16%. Furthermore, this approach did not increase hemorrhagic complications; in fact, major bleeding trended lower after implementation (8.22% vs 11.26%). This confirms that tailored risk stratification is both safe and effective for critically ill Southeast Asian cohorts.[50]

Higher bleeding risks in Asian patients

Anticoagulants, even when used for VTE prophylaxis, have been known to be associated with an increased risk of hemorrhagic complications.[51] When assessing this risk in East and Southeast Asian individuals, it is crucial to distinguish between 2 compounding factors, namely an underlying population-level vulnerability to spontaneous bleeding and a distinct pharmacologic sensitivity to antithrombotic agents.

Regarding the baseline vulnerability to spontaneous bleeding, epidemiologic data indicate that there are significantly higher rates of spontaneous hemorrhagic stroke in East Asia. The ratios of ischemic to hemorrhagic stroke are 5 to 10:1 in North America and Europe, whereas the proportions are 0.8 to 4.6:1 in Japan, Korea, and China.[52] Recent, large-scale epidemiologic data comparing healthy individuals without comorbidities further underscored this site-specific vulnerability. In a study analyzing >112 000 East Asian people and 210 000 White people who were not taking antithrombotic medications, East Asian population demonstrated a 14% lower baseline incidence of overall major bleeding. However, the incidence rate of spontaneous intracranial hemorrhage (ICH) was > 3 times higher in the East Asian cohort (incidence rate ratio of 3.20). Strikingly, ICH accounted for 13.8% of all baseline bleeding events in East Asian patients, compared to just 2.8% in White patients. This disparity suggests that factors beyond medication use, such as intrinsic racial differences in hemostatic states and vascular properties, significantly contribute to ICH vulnerability. Asian individuals have more prevalence of cerebral microbleeds and arteriovenous malformation, which may partly explain the risk for ICH.[53] Furthermore, lifestyle factors, such as frequent alcohol consumption, were shown to disproportionately increase the incidence of major baseline bleeding in East Asian patients compared with their Western counterparts.[54] Although these spontaneous hemorrhagic events are pathophysiologically distinct from bleeding caused directly by anticoagulants, this high baseline risk creates a dangerous clinical environment; a spontaneous cerebral bleed in an Asian patient who is receiving anticoagulation is far more likely to expand, yielding a dismal and catastrophic outcome. Further large-scale studies to elucidate these underlying explanations for the ICH risk disparity are needed to help address and modify this vulnerability at a population level.

Independent of this baseline risk, East Asian populations demonstrate a distinct pharmacologic sensitivity to antithrombotic agents. For example, a large Japanese clinical trial of aspirin for the primary prevention of cardiovascular disease (N = 14 464) found a significantly higher risk of bleeding in the active group compared with controls (hazard ratio of 1.85).[55] This risk was not replicated in a similar study of aspirin primary prophylaxis in Western cohorts.[56] This distinct susceptibility, known as the East Asian Paradox, is driven by several compounding factors. First, high *Helicobacter pylori* prevalence exacerbates aspirin-induced gastrointestinal bleeding. Second, underlying cerebral vascular vulnerabilities (eg, microbleeds, intracranial atherosclerosis) lower the threshold for hemorrhagic stroke. Finally, lower body mass indices and coagulation profiles mean standard universal antiplatelet doses often overexpose these patients.[57]

The heightened vulnerability in East Asian patients is also illustrated by their response to warfarin, which is heavily driven by pharmacogenomics. Genetic polymorphisms, specifically in the VKORC1 and CYP2C9 genes, are highly prevalent in Asian cohorts. These variations significantly alter drug metabolism and render patients overly sensitive to standard warfarin dosing. In a post hoc analysis of randomized clinical trials for nonvalvular atrial fibrillation (AF) comparing warfarin vs direct oral anticoagulants (DOACs), Asian patients who were taking warfarin showed higher frequencies of both major and intracranial bleeding than non-Asian patients within the same trials.[58] This disparity is not attributable to the different intensity of coagulation because the bleeding rates were higher in Asian patients at similar international normalized ratio (INR) levels.[58,59] It is critical to note that a lot of the robust data demonstrating this antithrombotic sensitivity originate from trials for AF and primary cardiovascular prevention. Because the

dosing regimens, duration of therapy, and patient comorbidities in these scenarios differ significantly from short-term postoperative or in-hospital VTE prophylaxis, the absolute bleeding rates cannot be extrapolated directly across these distinct clinical indications.

Based on the idea that Asian patients may require lower doses of anticoagulation, clinical trials have been designed aiming to use lower DOAC doses rather than the recommended doses in White patients. These trials include the J-ROCKET AF trial,[60] which used a lower dose of rivaroxaban, and the ELDERCARE AF trial,[61] which used low-dose edoxaban in Japan. The data revealed a good efficacy and safety profile that supported the concept of increased anticoagulant sensitivity in Asia.

However, extrapolating these reduced-dose AF strategies directly to postoperative VTE prophylaxis requires careful distinction, because prophylactic DOAC regimens are already administered at globally reduced doses and shortened duration. When evaluating the evidence for DOAC prophylaxis specifically in Asian surgical cohorts, the efficacy and safety profiles seem to be highly dependent on the clinical indication. In a pooled analysis of the STARS E-3 and STARS J-V trials in Japanese and Taiwanese arthroplasty cohorts, edoxaban 30 mg daily reduced the VTE incidence by half compared with enoxaparin 20 mg twice daily (5.1% vs 10.7%) without increasing bleeding (4.6% vs 3.7%).[62] However, a more recent meta-analysis revealed that DOAC superiority was largely driven by a reduction in asymptomatic distal DVTs; there was no significant difference in the incidence of PE or proximal DVT, and the DOAC cohort trended toward a higher risk of major bleeding (odds ratio of 3.17).[63] Furthermore, in nonelective settings, such as major trauma, DOACs may be inferior to LMWH. A large-scale, retrospective cohort analysis of patients with major trauma revealed that DOAC use was associated with significantly higher VTE rates and in-hospital mortality compared with LMWH. Crucially, the study highlighted that Asian patients faced a disproportionately higher risk of these adverse thromboembolic events and mortality when receiving DOACs.[64] Ultimately, although DOACs offer convenience, the bleeding profile in Asian populations remains underinvestigated and not fully defined. Therefore, applying them for VTE prophylaxis in these cohorts demands indication- and population-specific evaluation rather than uniform adoption of Western guidelines.

The higher risk of bleeding potentially shifts the risk-benefit ratio of anticoagulant prophylaxis in Asian patients. Many physicians prefer safer modalities, such as aspirin or nonpharmacologic prophylaxis, despite their potentially lower effectiveness in VTE prevention. Clinical trials specific to Asian patients are required to determine the optimal balance between thrombosis and hemorrhage.

Cost-effectiveness and economic burden in Asian settings

Economic analyses are fundamentally based on the calculation of the incremental cost-effectiveness ratio (ICER), which represents the added cost require to gain 1 additional unit of health benefit, such as a quality-adjusted life year (QALY). Although health care payers in many resource-limited nations enforce strict reimbursement caps, economic capacities and health care systems vary significantly across regions. Therefore, any extrapolation of these findings should be carefully considered based on each region's specific economic setting. As a specific example, in Thailand, the current acceptable ICER is highly restrictive at only USD 5100 per QALY, leading to concerns regarding the economic value of thromboprophylaxis in resource-limited settings.

To accurately evaluate the utility and cost-effectiveness of anticoagulant prophylaxis, strict initial cost thresholds must be weighed against the downstream clinical and financial burden of unprevented VTE. Some analyses operate on the assumption that, because of the low reported incidence of hospital-acquired fatal PE, anticoagulant prophylaxis is unlikely to significantly reduce mortality or prolong survival.[65] However, this premise is debatable; the perceived rarity of these events may partially reflect clinical underdiagnosis rather than a genuine absence of fatal cases, which could lead to an underestimation of the drug's true life-saving value.

With a symptomatic VTE incidence of 2% to 3% in high-risk individuals, the number needed to treat is typically $>$ 50 patients to prevent 1 symptomatic VTE. The economic perception of a number needed to treat of this magnitude should take into account the high cost of treating postoperative VTE. Data from Asian cohorts demonstrate that developing a postoperative VTE severely multiplies health care use. In Vietnam, a VTE event in surgical patients increases the total 90-day costs 2.2-fold and the readmission rates by 5.4-fold with the 90-day costs reaching USD 2939.[66] Similarly, following major orthopedic surgery in Japan, a VTE occurrence led to a 1.5-fold increase in the length of hospital stay and a 1.7-fold increase in the total 90-day costs, driving an average cost difference of USD 10 538 between patients with VTE and those without VTE.[67] Although the absolute medical costs in Vietnam are lower than in developed nations such as Japan, the relative financial impact to the local health care system remains substantial.

Although some earlier cost-utility analyses suggested that high-cost drugs, such as LMWH and DOACs, are not cost-effective in major orthopedic surgery in Thailand,[68] recent data challenges this premise. A study evaluating the implementation of a comprehensive VTE prophylaxis protocol in a Thai public hospital demonstrated that it resulted in an incremental cost of Thai baht (THB) 726.46 per patient over a 1-year horizon while yielding an additional 0.30 QALYs. The overall ICER was THB 2453.21 per QALY. This falls well below the local willingness-to-pay threshold of THB 160 000, thereby proving the intervention to be highly cost-effective.[69]

Limitations

This narrative review has several limitations. First, East and Southeast Asia is a highly heterogeneous region with significant variations in health care infrastructure, genetics, lifestyle, and environmental factors. Therefore, broad extrapolations to all Asian demographics should be made with caution. Second, much of the foundational data establishing untreated VTE baselines in Asian surgical cohorts rely on historic studies. These older studies may not fully reflect modern clinical environments that emphasize modern arthroplasty techniques, fast-track protocols, and early ambulation. Finally, data from specific countries, such as Thailand, predominates discussion in certain sections, particularly those analyzing cost-effectiveness, economic burden, and localized RAMs. Further broad-scale regional economic and clinical

investigations are necessary to confirm these findings across diverse Asian health care systems.

Conclusions

The implementation of VTE prophylaxis in East and Southeast Asia presents a complex clinical challenge. Although international guidelines strongly advocate for pharmacologic prophylaxis in high-risk patients, the direct translation of these recommendations to this region is complicated by distinct patient risk profiles and economic considerations. A one-size-fits-all approach is clinically inappropriate for this vast and highly heterogeneous region, which varies significantly in health care infrastructure, genetics, lifestyle, and environmental factors.

Generally, East and Southeast Asian populations appear to have a relatively lower baseline VTE incidence, although this may be associated with an increased vulnerability to severe bleeding complications, especially ICH. Furthermore, a pronounced sensitivity to antithrombotic agents may narrow the safe therapeutic window for pharmacologic prophylaxis.

Optimized VTE prophylaxis for East and Southeast Asian populations should include population-tailored risk assessments and lower-risk prophylactic methods. The choice of specific prophylactic modality remains under debate, leading to wide variation in clinical practice. Although some centers strictly follow international anticoagulant guidelines, others consider mechanical prophylaxis or low-dose aspirin for specific subgroups. However, aspirin should not be viewed as an equal alternative to standard anticoagulant unless supported by robust regional evidence. Regardless of the pharmacologic strategy, universal mechanical prophylaxis and early rehabilitation are essential baseline measures. Ultimately, clinical awareness and targeted screening are crucial to ensure a prompt diagnosis of VTE and the prevention of fatal outcomes.

Future directions

To effectively prioritize VTE prevention without risking clinical fragmentation or inequity in patient care, coordinated multidisciplinary efforts are required to establish consensus-based institutional protocols and, ultimately, comprehensive regional frameworks.

Future progress relies heavily on targeted, region-specific research. Key priorities include multicenter studies to rigorously validate RAMs specifically tailored to Asian populations. Furthermore, adequately powered, large-scale randomized controlled trials are required to definitively establish the efficacy and safety of pharmacologic prophylaxis in these patient subgroups, thereby ensuring that protocols are anchored in solid clinical evidence rather than institutional preference. Economically, the increasing availability of generic LMWH and DOACs provides an opportunity to address regional budget constraints. To ensure sustainable implementation of these life-saving therapies, updated cost-utility analyses should be conducted, followed by active negotiations with health authorities to secure funding.

Authorship

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ORCID profiles: T.C., 0000-0002-0443-1751; N.U., 0000-0003-4562-9139; P.R., 0000-0001-7912-1996.

Correspondence: Ponlapat Rojnuckarin, Division of Hematology, Department of Medicine, Faculty of Medicine, Chulalongkorn University, Rama IV Rd, Pathumwan, Bangkok 10330, Thailand; email: rojnuckarinp@gmail.com.

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