

## ORIGINAL ARTICLE

# Venous thromboembolism prophylaxis for hospitalized adult patients: a survey of US health care providers on attitudes and practices

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## Abstract

**Background:** Venous thromboembolism (VTE) is a leading cause of preventable mortality among hospitalized patients, but appropriate risk assessment and thromboprophylaxis remain underutilized or misapplied.

**Objectives:** We conducted an electronic survey of US health care providers to explore attitudes, practices, and barriers related to thromboprophylaxis in adult hospitalized patients and at discharge.

**Results:** A total of 607 US respondents completed the survey: 63.1% reported working in an academic hospital, 70.7% identified as physicians, and hospital medicine was the most frequent specialty (52.1%). The majority of respondents agreed that VTE prophylaxis is important (98.8%; 95% CI: 97.6%-99.5%) and that current measures are safe (92.6%; 95% CI: 90.2%-94.5%) and effective (93.8%; 95% CI: 91.6%-95.6%), but only half (52.0%; 95% CI: 47.9%-56.0%) believed that hospitalized patients at their institution are on appropriate VTE prophylaxis almost all the time. One-third (35.4%) reported using a risk assessment model (RAM) to determine VTE prophylaxis need; 44.9% reported unfamiliarity with RAMs. The most common recommendation for improving rates of appropriate thromboprophylaxis was to leverage technology. A majority of respondents (84.5%) do not reassess a patient's need for VTE prophylaxis at discharge, and a minority educates patients about the risk (16.2%) or symptoms (18.9%) of VTE at discharge.

**Conclusion:** Despite guideline recommendations to use RAMs, the majority of providers in our survey do not use them. A majority of respondents believed that technology could help improve VTE prophylaxis rates. A majority of respondents do not reassess the risk of VTE at discharge or educate patients about this risk of VTE at discharge.

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**KEYWORDS**

health care surveys, hospitalization, patient discharge, risk assessment, venous thromboembolism

**Essentials**

- Appropriate thromboprophylaxis in adult hospitalized patients remains misapplied.
- We conducted an electronic survey of US health care providers to understand its use.
- A majority of providers do not use risk assessment models.
- A majority of providers do not reassess the risk of venous thromboembolism at discharge.

## 1 | INTRODUCTION

Venous thromboembolism (VTE) affects an estimated 300,000 to 600,000 individuals in the US annually and is a major public health challenge [1–3]. More than half of the VTE burden in the US is related to hospitalization [4,5], with a majority of cases occurring within 90 days of discharge. VTE is the leading cause of in-hospital mortality and contributes significantly to morbidity and health care utilization [6,7].

Despite consensus guidelines recommending thromboprophylaxis for at-risk patients in the hospital [8–10], appropriate thromboprophylaxis remains underutilized or misapplied. Studies suggest that those at the highest risk are inadequately covered and the majority of patients receiving thromboprophylaxis may not truly be at sufficient risk [11–13]. Multiple risk assessment models (RAMs) have been created and validated to help providers assess the risk of individual patients and determine appropriate thromboprophylaxis on an individualized basis [14]. There is no single universally recommended RAM, but some guidelines do recommend that providers choose one to integrate into their clinical decision-making process [9].

Though there are 2 direct oral anticoagulants approved for extended prophylaxis after hospital discharge, guidelines do not generally recommend VTE prophylaxis at discharge [9,15]. The benefits of VTE prophylaxis at discharge are less widely accepted. However, studies suggest that certain individuals may benefit [16,17], highlighting the need for individualized risk assessment of patients at discharge.

Overall, population-based studies report that hospital-associated VTE incidence rates and VTE-associated mortality have remained relatively unchanged over time [18–21]. Preventing VTE in hospitalized patients is an important focus of research on safe, effective health care [22,23]. It is also a key quality metric linked to reimbursement in the United States and internationally [24]. Understanding current practices and attitudes among health care providers can inform quality improvement initiatives to improve appropriate thromboprophylaxis rates. We conducted a survey of health care providers in the United States to explore attitudes, practices, and barriers related to thromboprophylaxis in hospitalized adult medical patients and at discharge.

## 2 | METHODS

### 2.1 | Survey development

We developed an electronic survey exploring current attitudes and practices around VTE prophylaxis in adult hospitalized patients (Supplementary Methods). The study instrument was vetted by a multidisciplinary study team and a survey expert and piloted with a representative sample of 10 respondents for clarity, length, and relevance prior to dissemination. We defined VTE as both deep vein thrombosis (DVT) and/or pulmonary embolism. We defined prophylaxis as including pharmacologic and/or mechanical measures for VTE prevention and did not specify what type of thromboprophylaxis is considered “appropriate” given that this can vary with each patient’s individual risks of VTE and bleeding.

The survey included questions on 1) attitudes and practices regarding VTE prophylaxis in hospitalized adult medical patients (10 questions), including at discharge (6 questions), and 2) perceived rates of appropriate prophylaxis at respondent hospitals and perceived barriers to/suggestions for improving rates of appropriate prophylaxis (4 questions). Answers to the questions were either Likert-scale responses (strongly agree to strongly disagree), multiple choice (with an option to select only one or all that apply), or free text for written responses. The survey also gave all respondents the option to share their age, sex, ethnicity, clinical role, specialty, training status, and practice setting (academic, community, or federal institution).

### 2.2 | Respondents

Health care providers targeted for the survey included physicians, nurses, advanced practice providers, and pharmacists. The survey was distributed electronically to a targeted convenience sample during a 1-year study period, August 2021 to August 2022. Respondents were recruited through social media posts; professional health care organizations including the Haemostasis and Thrombosis Research Society,

**TABLE 1** Demographics and characteristics of respondents.

Demographic	N = 607 n (%)
Age	
21-30 y	163 (26.9%)
31-40 y	260 (43.0%)
41-50 y	92 (15.2%)
51-60 y	53 (8.8%)
≥61 y	37 (6.1%)
Gender	
Female	335 (55.7%)
Race/ethnicity <sup>a</sup>	
Asian	124 (20.4%)
Black or African American	22 (3.6%)
White	414 (68.2%)
Other	45 (7.4%)
Hispanic or Latino	45 (7.4%)
Clinical role	
MD or DO	429 (70.7%)
Pharmacist	125 (20.6%)
Registered nurse	25 (4.1%)
APP specified as nurse practitioner or physician assistant	27 (4.4%)
MD, DO, or APP time in clinical practice (n = 456)	
In training	207 (45.4%)
Not in training	237 (52.0%)
Completed training, practicing ≤5 y	82 (34.6%)
Completed training, practicing 6-10 y	39 (16.5%)
Completed training, practicing ≥10 y	116 (49.0%)
Unknown training status	12 (2.6%)
Clinical focus <sup>a</sup>	
Hospital medicine	316 (52.1%)
Hematology	126 (20.8%)
Primary care	89 (14.7%)
Critical care	76 (12.5%)
Cardiology or vascular medicine	55 (9.1%)
Other	141 (23.2%)
Primary practice setting	
Academic hospital	383 (63.1%)
Community hospital	211 (34.8%)
VA hospital or other	13 (2.1%)
How often do you decide whether a patient needs VTE prophylaxis?	
Every day	397 (65.8%)

(Continues)

**TABLE 1** (Continued)

Demographic	N = 607 n (%)
A few times a week	109 (18.1%)
A few times a month	60 (10.0%)
A few times a year or less	37 (6.2%)

APP, advanced practice provider; DO, doctor of osteopathic medicine; MD, medical doctor.

<sup>a</sup>Respondents could select more than one, and thus, totals may sum to >100%.

Venous thromboembolism Network US (VENUS), ISTH, and Society of Hospital Medicine; and via email to 250 internal medicine program directors across the United States. Trainees invited to participate in the study could opt to enter a raffle drawing for 1 of 100 \$10 gift cards. There was no incentive for other groups. Due to these methods of distribution, a response rate could not be accurately calculated. Given the heterogeneity of VTE prophylaxis guidelines and options across the world, only US-based respondents were included in this analysis. As a descriptive survey utilizing a sample of convenience, we did not perform any a priori sample size calculations.

## 2.3 | Analysis

We used descriptive statistics to analyze responses and respondent characteristics, summarizing data as proportions with binomial 95% CIs. Because VTE prophylaxis is typically directed by hospital medicine providers, we presented key findings separately for this subgroup. Two researchers (B.L. and S.P.) conducted a qualitative thematic analysis of the free text responses to the question "Do you have suggestions for how to improve VTE prophylaxis in hospitalized medical patients?" by first reviewing all responses and independently creating a list of themes to reflect the data. The researchers then discussed their themes and iteratively developed a final codebook by consensus. The researchers used this codebook to independently code the responses, assigning up to 3 codes per response. The researchers compared their coding assignments and reached consensus for every response.

## 2.4 | Ethics statement

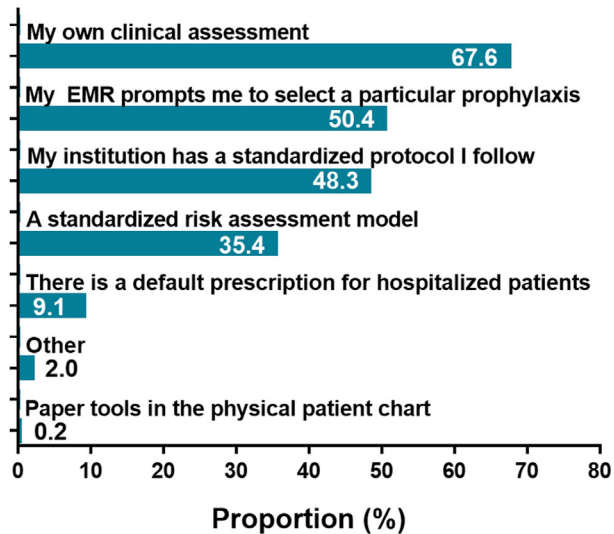
This study was approved by the Beth Israel Deaconess Medical Center IRB.

## 3 | RESULTS

### 3.1 | Respondents

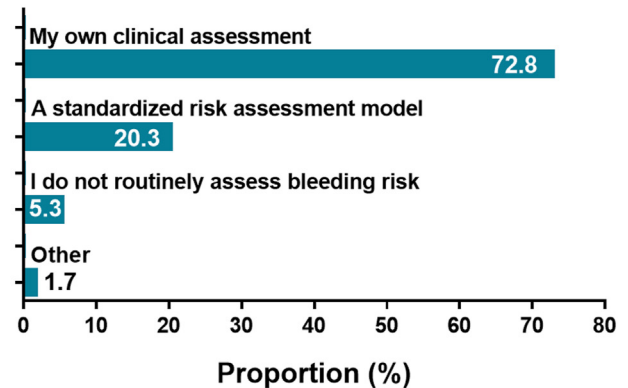
Of 607 respondents from the United States, most were recruited through professional medical societies (77.3%), followed by surveys forwarded by residency program directors (20.8%) and a minority

## A What tools do you use to determine who needs VTE prophylaxis?\*



\*May choose more than one response

## B How do you determine bleeding risk in patients who need VTE prophylaxis?



**FIGURE 1** Tools used to determine who needs VTE prophylaxis. A, Tools used to determine need for VTE prophylaxis. B, Tools used to determine bleeding risk. VTE, venous thromboembolism.

through social media dissemination (1.8%). The majority of respondents were <40 years old (69.9%), female (55.7%), and White (68.2%; [Table 1](#)). A majority reported working at an academic medical center (63.1%), and 70.7% were MDs or DOs, of whom 45.4% identified as trainees. The most common specialty was hospital medicine (52.1%), followed by hematology (20.8%), and 65.8% of respondents reported making a decision about VTE prophylaxis every day.

### 3.2 | Attitudes and practices related to VTE prophylaxis in hospitalized patients

Almost all respondents agreed that VTE prophylaxis is important for patient care (98.8%; 95% CI: 97.6%-99.5%) and that current measures are safe (92.6%; 95% CI: 90.2%-94.5%) and effective (93.8%; 95% CI: 91.6%-95.6%). Similarly, of the 316 hospital medicine providers, the majority agreed that VTE prophylaxis is important (97.4%; 95% CI: 94.1%-99.2%), safe (94.0%; 95% CI: 90.3%-97.2%), and effective (93.3%; 95% CI: 88.8%-96.4%). Respondents were able to select multiple answers for how they determine who needs VTE prophylaxis; 67.6% reported using their own clinical assessment and 50.4% reported using an electronic health record (EHR) prompt as part of their decision process ([Figure 1A](#)). A small proportion (13.2%) reported that they use clinical assessment only. Nearly half of the total respondents (48.3%) reported that they utilize their institution's standardized protocol. Only 35.4% of total respondents reported using a standardized RAM, while 46.4% of hospital medicine respondents reported using one. Of the 215 respondents who reported using a RAM,

the Padua score was most commonly used (58.6%), followed by the Caprini score (27.4%), 4-ELEMENT RAM (14.4%), IMPROVE (7.9%), and Geneva (6.1%; [Supplementary Table S1A](#)). Of the 392 respondents who reported that they do not use a RAM, the 2 most common reasons were being unfamiliar with them (44.9%) and lack of integration into the EHR (41.3%; [Supplementary Table S1B](#)).

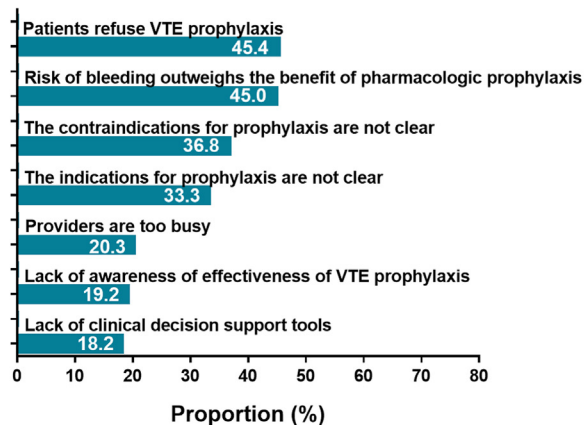
A majority of respondents (72.8% of all respondents, 71.8% of hospitalists) reported using their own clinical assessment to determine a patient's bleeding risk, and 20.3% of all respondents and 22.5% of hospitalists reported using a standardized RAM ([Figure 1B](#)). Of the 123 respondents who reported using a RAM, the HAS-BLED score was most commonly used (81.3%), followed by the VTE-BLEED score (17.9%; [Supplementary Table S2](#)).

Approximately half of the respondents (47.0%) reported reassessing a patient's need for VTE prophylaxis every day, and another half (51.4%) reported reassessing when there is a clinical change. These rates were similar among hospital medicine providers (48.1% and 53.5%, respectively). Only 15.7% reported reassessing the need for VTE prophylaxis at the time of transfer to another floor or facility, and 9.6% reported that they do not routinely reassess the need for VTE prophylaxis.

### 3.3 | Attitudes, practices, and barriers related to VTE prevention at discharge

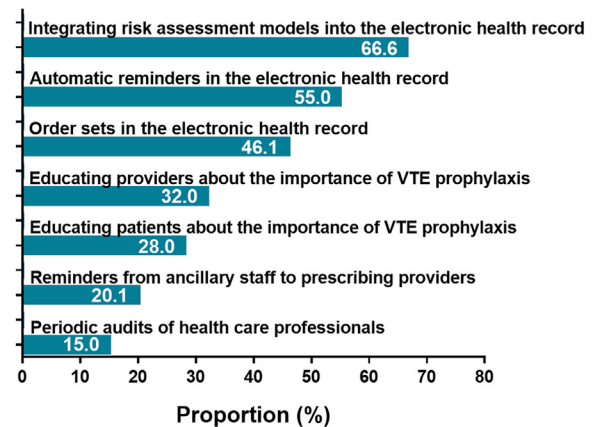
Less than one-fifth of respondents reported reassessing a patient's need for VTE prophylaxis at the time of discharge (15.5%) and routinely educating hospitalized patients about the risk of VTE

### A Why are patients at your institution not on appropriate VTE prophylaxis almost all the time?\*



\*May choose more than one response

### B What would help increase rates of appropriate VTE prophylaxis?\*



\*May choose more than one response

**FIGURE 2** Areas for improving VTE prophylaxis. A, Reasons why patients are not on appropriate VTE prophylaxis; this question was asked of 48.0% of respondents who did not perceive that hospitalized patients at their institution were on appropriate prophylaxis almost all of the time. B, Suggestions to improve rates of appropriate VTE prophylaxis. VTE, venous thromboembolism.

(16.2%) and symptoms of VTE (18.9%) at discharge. Among the 316 hospital medicine provider respondents, only 16.3% reassessed a patient's need for VTE prophylaxis at discharge and very few routinely educate hospitalized patients about the risks (5.8%) or symptoms (5.2%) of VTE at discharge. Of the 51 total respondents who reported routinely (>75% of the time) prescribing VTE prophylaxis at discharge, the majority (82.4%) reported prescribing it for some or all high-risk patients. Of the remaining 544 respondents who reported not routinely prescribing VTE prophylaxis at discharge, the most common reasons were that the indications were not clear (51.5%), being unaware of the need for postdischarge prophylaxis (32.4%), and that guidelines do not recommend postdischarge prophylaxis (31.8%). Respondents felt that the 3 most effective methods for reducing postdischarge VTE events were the use of standardized RAMs at the time of discharge (60.0%), provision of educational materials for patients (51.2%), and inclusion of postdischarge VTE prophylaxis in discharge checklists (45.5%; [Supplementary Table S3](#)).

### 3.4 | Perceived barriers to appropriate VTE prophylaxis in hospitalized patients

Approximately half of the respondents (315/607, 52.0%) reported that they believe that hospitalized patients at their institution are on appropriate VTE prophylaxis almost all the time. Of the remaining 291 (47.9%) respondents, the 3 most common reasons reported for patients likely not being on appropriate prophylaxis were patient refusal (45.4%), risk of bleeding outweighing potential benefit (45.0%), and unclear contraindications (36.8%). One-third also reported that the indications for VTE prophylaxis are not clear (33.3%; [Figure 2A](#)).

Respondents felt that the 3 most effective methods for increasing rates of appropriate VTE prophylaxis were integrating of RAMs into the EHR (66.6%), adding automatic reminders into the EHR (55.0%), and creating order sets in the EHR (46.1%; [Figure 2B](#)). One hundred one respondents offered free text responses about what would help improve rates of appropriate VTE prophylaxis in general. Seven themes emerged from these qualitative responses, with the most common recommendation being leveraging the EHR with interventions such as order sets and automated reminders and exploring novel technology such as artificial intelligence (AI; [Table 2](#)).

## 4 | DISCUSSION

Our study is, to our knowledge, the largest survey of health care providers in the United States to date evaluating attitudes and practices around VTE prophylaxis in adult hospitalized medical patients. The vast majority of respondents agreed that VTE prophylaxis is important, safe, and effective, yet only half perceived that hospitalized patients at their institution are on appropriate thromboprophylaxis almost all the time. Respondents reported that the most common reason why patients are not on appropriate VTE prophylaxis could be because they refuse them. Prior studies have shown that patient refusal accounts for ~40% of missed doses and is indeed the most common reason why thromboprophylaxis is not administered as prescribed [25–27]. The majority of refused doses may come from a small but vocal sample of patients [28], and targeted educational interventions have proven effective [29,30]. However, in this survey, respondents generally recommended systems-based interventions as the most effective method for improving VTE prophylaxis.

**TABLE 2** Recommendations for improving rates of appropriate VTE prophylaxis in hospitalized adult medical patients.

Themes	Quotes
Leveraging technology Using electronic order sets, artificial intelligence, or automated reminders	“Order set linked with a risk assessment method that (is) easy and quick.” “Artificial intelligence to detect the probability (of VTE) in patients.”
Provider education Increasing education of providers, improving guidelines, or furthering research into specific populations	“Give physicians in different specialties more targeted guidelines about their specific situations for VTE prophylaxis...” “...it would be helpful to (see) more high-quality data showing the benefit (of chemical VTE prophylaxis).”
Workflow changes Mandating assessments and reassessments during hospitalization	“Require (it) as part of (the) admission order set.” “Reminders that prophylaxis needs should be assessed, perhaps with a tool, would be valuable.”
Risk assessment tool Creating, validating, or standardizing risk assessment tools	“We need improved risk assessment models that integrate into the medical record.” “Use one standard score so there isn’t a change back and forth between different providers.”
Improving options for VTE prophylaxis Expanding use of oral anticoagulants, improving mobility, and other options	“Use of more DOACs as many (patients) refuse due to shots.” “Get patients up and walking about, especially after surgery.”
Including other staff Utilizing other members of the care team, coordinating surveillance with other providers	“Reminders from nursing or pharmacist to prescribing providers.” “Hospitals should financially support anticoagulation stewardship programs to do surveillance.”
Patient-centered approaches Involving patients in decision-making, advocating for mobility, and algorithms for managing refusal	“We need a standardized education method for patients who refuse DVT prophylaxis...” “On admission have (the) MD and RN explain the process and the necessity. I find most MDs order it but do not discuss (it) with (the) patient.”

DOAC, direct oral anticoagulant; DVT, deep vein thrombosis; MD, medical doctor; RN, registered nurse; VTE, venous thromboembolism.

The most commonly suggested strategies for improving VTE prophylaxis involved leveraging technology, whether it was to integrate RAMs into the EHR, automate reminders in the EHR, or create electronic order sets. A Cochrane review did show that computer alerts for VTE prophylaxis are associated with increased prescription of appropriate prophylaxis and a reduction in symptomatic VTE at 3 months [13], but these types of her-based changes must be implemented carefully given the risk of alert fatigue and provider burnout [31]. Several free text responses also suggested exploring AI as a tool to better predict a patient’s clotting and bleeding risk and identify patients who are not prescribed appropriate VTE prophylaxis. AI is particularly appealing because of its potential to reduce documentation burden on providers while improving patient care [32]. A recent systematic review [33] found that AI models for VTE prediction and diagnosis have good performance metrics, but the studies are few and heterogenous in their computer science approach, suggesting that further research and standardization are needed before real-world implementation.

Our survey also revealed several gaps from the provider’s perspective. A majority of respondents reported using their own clinical assessment to determine who needs VTE prophylaxis (67.6%) and patients’ bleeding risks (72.8%), whereas a minority reported using a standardized RAM to determine VTE risk (35.4%) and bleeding risk (20.3%). This suggests that integration of RAMs into clinical decision-making is uncommon despite the availability of multiple RAMs [34] and guideline recommendations to use them [9]. While respondents believed that the most effective method of improving VTE prophylaxis rates is incorporation of RAMs into the EHR, there is

the initial challenge of determining which RAM to use and when to use. There is no single RAM that is universally endorsed by national guidelines and RAMs are limited by their heterogeneity [35]. Few RAMs are externally validated and may be validated only in specific subpopulations [14]. RAMs vary widely in what factors they choose to include, with commonly used RAMs listing anywhere from 10 to 40 variables [36]. Recognizing these limitations, work is being done to review the literature and identify the most predictive risk factors in order to create better RAMs [37]. Experts also emphasize the importance of reassessing how a patient’s risk changes throughout the hospitalization [37]. A majority of respondents in our survey reported that they do not reassess the need for VTE prophylaxis at transitions of care such as at transfer (84.3%) or discharge (84.5%), and a significant portion of respondents who do not use RAMs reported that they are not familiar with them (44.9%), highlighting opportunities for provider education. There was also a large portion of respondents who do not use RAMs because they are not integrated into the EHR (41.3%), again emphasizing the potential technology has for educating providers, enforcing workflows, and influencing change.

Very few providers reported reassessing a patient’s need for VTE prophylaxis at discharge (15.5%). There is increasing evidence that the risk of hospital-associated VTE extends beyond the hospitalization period and that certain high-risk patients may benefit from continued thromboprophylaxis [38,39]. Even interventions such as educating patients about the risk and symptoms of VTE at discharge were low in uptake (15.1% and 17.9%, respectively). Overall, however, the survey results show that the majority of providers are not aware of the risks

of VTE at discharge and when a patient might warrant further thromboprophylaxis. Provider education is needed in this area so that they can, in turn, educate their patients.

Although this was a large multidisciplinary survey that targeted respondents from across the United States, we acknowledge that there are limitations inherent to the electronic survey design [40]. We utilized an online platform for survey distribution message boards and social media websites that permitted broader dissemination but did not allow for an accurate response rate estimation, which can underestimate or obscure sampling bias. Moreover, as participation was voluntary, the respondents who elected to participate may have introduced self-selection bias. For example, respondents who elected to participate may be more interested in thrombosis prevention, and thus, these results may overestimate the use of VTE prevention relative to all clinical providers. Nearly half of the respondents were in training and the majority reported working in an academic setting, perhaps because the majority of our respondents were recruited through training programs and professional societies. This limits the generalizability of our findings to other health care settings such as community-based hospitals and long-term care facilities. Practices for VTE prevention could differ considerably in such facilities and future iterations of survey studies should include more targeted sampling approaches. Although the target audience of the survey included all clinical providers, some questions may have been more relevant to prescribing roles than nonprescribing roles. The survey did not distinguish between types of medical patients, and providers may have different views on different subtypes, such as oncology patients. Incentives have been shown to be effective in boosting responses in survey studies [41], and while we were only able to offer incentives to trainees, we were able to get responses from a substantial number of non-trainees. Patient safety in general, including VTE prevention, requires interdisciplinary effort and partnerships. In this study, we included physicians as well as other health care providers but acknowledge that nurses and advanced practice providers may have been relatively under-represented in our sample. Although we present key findings among hospital medicine providers, the largest subgroup in this study, we plan to do future surveys of other subgroups to better understand differences in practices and attitudes by respondent specialty, training level, and years of clinical practice. Finally, in order to reduce respondent burden and maximize participation, we designed the instrument as predominantly multiple-choice, though this can limit the breadth of responses to the set options. In order to at least partially alleviate this shortcoming, we provided options for free text responses where possible and included an open-ended question that was subsequently analyzed using qualitative methodology. We also work to better understand our respondents' views with the second phase of our study, where we conduct focus groups with clinicians.

## 5 | CONCLUSION

In this large survey of US health care providers, the majority of respondents recognized the importance, efficacy, and safety of VTE prophylaxis in hospitalized adult medical patients, but perceived that

rates of appropriate prophylaxis are low. A minority of providers use RAMs to assess VTE and bleeding risk, and few providers educate patients about the risk and symptoms of VTE at discharge. We identified multiple areas for improvement including provider education on RAMs and use of technology to close gaps in prophylaxis.

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## AUTHOR CONTRIBUTIONS

B.L., R.R., N.R., A.A., K.A., I.V., J.Z., and R.P. contributed to the conception/design of the study. B.L., S.D., W.R., L.L., A.P., P.E., and R.P. were involved in data acquisition. B.L., L.D., S.P., and R.P. were involved in analysis/interpretation of the data. All authors were involved in manuscript writing and/or critically reviewing the manuscript and approving the final paper for submission.

## RELATIONSHIP DISCLOSURE

R.P.R. has received research funding from Bristol Myers Squibb and Janssen and provided consultancy/participated in the advisory board with Abbott, Bristol Myers Squibb, Janssen, Inari, and Penumbra. J.I.Z. has received research funding from Incyte, Quercegen, and the National Heart, Lung, and Blood Institute; provided consultancy services to Sanofi, CSL, and Parexel; and received honoraria from/participated in the advisory board with Pfizer/Bristol Myers Squibb, Portola, and Daiichi. All other authors have no competing interests to disclose.

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#### SUPPLEMENTARY MATERIAL

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