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Full Length Article

Rate and predictors of thromboprophylaxis in internal medicine wards: Results from the AURELIO study

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ABSTRACT

Background: Randomized controlled trials suggest that prophylactic doses of anticoagulants effectively prevent venous thromboembolism (VTE) in hospitalized medical patients with high thromboembolic risk. However, no prospective studies exist regarding the real-world prevalence of prophylactic anticoagulant use. This prospective study aimed to determine the rate and predictors of thromboprophylaxis in an unselected population of patients hospitalized in medical departments.

Methods: We conducted a multicenter prospective observational study (AURELIO – rAte of venous thrombosis in acutely iLl patIents hOspitalized) to assess the rate of deep vein thrombosis (DVT) in unselected acutely ill patients hospitalized in medical wards using compression ultrasound (CUS) at admission and discharge. Additionally, we evaluated the rate of pharmacological thromboprophylaxis administration in this population and analyzed the thrombotic risk by assessing RAMs (Risk Assessment Models) such as the IMPROVE-VTE and PADUA scores following the clinician's decision to administer thromboprophylaxis. Patients with IMPROVE-VTE scores $\geq$3 and/or PADUA scores $\geq$4 were classified as high thrombotic risk; those with IMPROVE-VTE scores $<$3 and/or PADUA scores $<$4 were classified as low risk.

Results: We recruited 2371 patients (1233 males [52 %] and 1138 females [48 %]; mean age 72 $\pm$ 16 years). The median length of hospitalization was 13 $\pm$ 12 days. Overall, 442/2371 (18.6 %) patients received prophylactic parenteral anticoagulants (subcutaneous low weight molecular heparin or fondaparinux once daily) at admission. Assessing the thrombotic risk of the population recruited 1016 (42.9 %) patients were classified as high risk and 1354 (57.1 %) were low risk. Among high-risk patients, 339/1016 (33.4 %) received anticoagulant prophylaxis compared to 103/1354 (7.6 %) low-risk patients. During hospitalization, 9 patients developed DVT, comprising 7 asymptomatic and 2 symptomatic cases of proximal DVT. Of these, 3 patients were on anticoagulant prophylaxis, while 6 were not. Among the high-risk population, 7 out of 1016 patients (0.7 %) experienced

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proximal DVT during hospitalization, with 2 out of these 7 (28 %) receiving anticoagulant thromboprophylaxis. In the low-risk population, 2 out of 1354 patients (0.2 %) developed DVT, with 1 out of these 2 (50 %) receiving anticoagulant thromboprophylaxis. Age, heart or respiratory failure, pneumonia, active neoplasia, previous VTE, reduced mobility, and absence of kidney failure were more frequent in patients receiving prophylaxis. Multivariable logistic regression identified age (RR 1.010; CI 95 % 1002–1019; $p = 0.015$), heart/respiratory failure (RR 1.609; CI 95 % 1248–2075; $p < 0.0001$), active neoplasia (RR 2.041; CI 95 % 1222–2141; $p < 0.0001$), pneumonia (RR 1.618; CI 95 % 1557–2676; $p < 0.0001$), previous VTE (RR 1.954; CI 95 % 1222–3125; $p < 0.0001$), and reduced mobility (RR 4.674; CI 95 % 3700–5905; $p < 0.0001$) as independent predictors of thromboprophylaxis.

Conclusions: This study, conducted without pre-established thromboembolic risk scores, offers a comprehensive view of venous thromboembolism prophylaxis in medical patients with acute conditions hospitalized in internal medicine departments. It reveals that advanced age, heart or respiratory failure, active cancer, pneumonia, previous VTE, and reduced mobility are predictors that may influence the decision to administer thromboprophylaxis in these patients.

1. Introduction

Venous thromboembolism (VTE), comprising deep-vein thrombosis (DVT) and pulmonary embolism (PE), is a serious and multifactorial disease, representing a leading cause of cardiovascular morbidity and mortality [1,2]. Accounting for 5–10 % of deaths in hospitalized patients, pulmonary embolism stands as the most common preventable cause of in-hospital death [3–6].

In Europe, the estimated number of VTE-related deaths in hospitalized medical patients per annum was more than double the sum of deaths due to AIDS, breast cancer, prostate cancer, and transport-related fatalities [7]. Furthermore, VTE is also associated with long-term complications such as post-thrombotic syndrome and chronic thromboembolic pulmonary hypertension [8]. Therefore, VTE poses a major health problem, leading to worse prognosis, longer hospitalization durations, and increased healthcare costs [9–11].

Numerous VTE risk factors have been suggested, including predisposing factors (such as age, family history, obesity, former VTE events, and thrombophilia) and exposing factors (such as trauma, immobilization, surgery, and acute medical illness) [12]. Patients hospitalized in medical departments have been reported to have an eight-fold increase in VTE risk compared to the general population, often carrying multiple VTE risk factors [6].

However, the incidence of VTE in medically hospitalized patients varies greatly among different studies. Autopsy studies found an incidence of VTE of >10 % in medical hospitalized patients [4,13,14]; clinical trials on selected medical populations observed an incidence of 4.4 % of asymptomatic DVT and 0.75 % of symptomatic DVT [15]; studies on unselected patients showed a lower incidence, ranging between 0.5 % (according to a registry study) and 2 % (in clinical trials) [7,16–18]. Considering the burden of VTE in hospitalized medical patients, multiple randomized controlled trials with anticoagulants have been conducted, demonstrating the efficacy of VTE prophylaxis in reducing the incidence of VTE and VTE-related mortality [19–21]. Based on these results, international and nationwide guidelines recommend thromboprophylaxis in medically hospitalized patients at increased thrombotic risk in the absence of any contraindications for such treatment with a moderate/low grade of evidence [3,22–25].

Several risk assessment scores have been developed to promote appropriate utilization of thromboprophylaxis in medically ill patients by evaluating the main VTE risk factors (such as decreased mobility, previous VTE, thrombophilia, previous trauma or surgery, advanced age $\geq$ 70, heart or respiratory failure, ischemic stroke or acute myocardial infarction, acute infections, active cancer, obesity, and hormonal therapy). The most studied of these scores are the Padua and the IMPROVE-VTE risk assessment models (RAM); however, their predictive value still needs to be confirmed in large prospective studies [26,27]. Nonetheless, in everyday practice, despite guideline recommendations, thromboprophylaxis prescription rates are low among hospitalized medically ill patients, ranging from 13 % to 64 %, depending on the type of studies and populations, institutions or country protocols, and different RAMs used to detect high-risk patients [28–34]. However, few clinical studies have been conducted about thromboprophylaxis on unselected medically hospitalized populations [7,16,17]. Furthermore, to the best of our knowledge, no prospective study analyzes the rate of thromboprophylaxis in unselected hospitalized acute medical patients.

Based on these premises, the main aim of the present study was to determine the rate of DVT occurred during hospitalization and the rate of patients eligible for and treated with thromboprophylaxis in a population of unselected patients hospitalized in internal medicine wards and analyze their predictors.

2. Materials and methods

2.1. Study design and population

This is a multicenter, observational, prospective study performed in Italian non-intensive care unit (non-ICU) medical wards [35]. Ten centers associated to the ultrasound Study Group of the Italian Society of Internal Medicine participated in this study. We enrolled two thousand three hundred seventy-one consecutive non-selected adult patients with acute medical conditions requiring hospitalization in internal medicine departments from February 2015 to May 2024. Furthermore, as previously reported [7,35], to be enrolled, medical patients had to be hospitalized at least 5 days. Reasons for exclusion were treatment with anticoagulant therapy at admission, in-hospital treatment with vitamin k inhibitors or direct oral anticoagulants, acute symptomatic deep venous thrombosis and acute pulmonary embolism at admission, patients without CUS at discharge, presence of acute major bleeding or high risk for mayor bleeding (a decline in hemoglobin concentration of at least 20 g/l, need for transfusion of 2 units or more), surgical procedures 4 weeks before or during hospitalization, patients admitted in internal medicine wards from the intensive care units, or COVID-19 infection (assessed by nasopharyngeal swab). A COVID-19 case was defined as a person with laboratory confirmation of COVID-19 infection, irrespective of clinical signs and symptoms. We routinely used both antigen and molecular test after a nasopharyngeal swab, and the analysis are performed at admission, in case of positivity of another patient in the same room and in case of presence of signs and symptoms. Each center was advised to follow the local standard anticoagulant prophylactic management of acutely ill medical patients. Biographic data and comorbidities of patient were collected. During the study hospitalization: reduced mobility was defined as requiring total bed rest or being sedentary with bathroom privileges for at least 3 days [36], heart failure was defined according to the 2013 ACCF/AHA Guideline for the Management of Heart Failure; syncope, myocardial infarction and stroke were defined as previously reported [37–39]; respiratory failure was defined as a syndrome in which the respiratory system fails with hypoxemic or hypercapnic conditions; COPD was defined according to the

Global Initiative for Chronic Obstructive Lung Disease (GOLD); sepsis was defined according to the definition of ACCP [40]; inherited thrombophilia was defined as known diagnosis of factor V Leiden and prothrombin G20210A mutations, presence of protein S, C or antithrombin deficiencies and antiphospholipid syndrome (APS). APS was defined according to previously reported criteria (association of at least one clinical criterion (thrombosis or pregnancy morbidity) and one laboratory criterion (lupus anticoagulant (LAC), anticardiolipin antibodies (aCL) or beta2-glycoprotein I antibodies (aβ2GPI)). Compression ultrasonography (CUS) and color Doppler ultrasonography were performed within 48 h of hospitalization and before discharge (performed on the last day of hospitalization) of patients and interpreted by internists with adequate experience. Ultrasonography was routinely used to verify the diagnosis of venous thrombosis in all participating enters; no specific training for the study was necessary. The index test was a compression ultrasonography (CUS) performed by participating MD with ultrasound machine equipped with a 7.5–10 MHz linear-array transducer and a venous vascular software. For obese subjects, a 3.5 MHz curvilinear transducer was available. Color Doppler imaging assisted vessel identification. CUS was performed according to a standardized protocol as previously described [41]. After identification of the common femoral artery and vein located just inferior to inguinal ligament, pressure was applied until common femoral vein was completely compressed; superficial femoral vein and popliteal vein were identified and examined as a common femoral vein. Visualization of intraluminal thrombosis with incomplete compressibility of any target vein, despite adequate pressure, rendered an examination positive. Examinations demonstrating complete compressibility of all target veins were considered negative. CUS was performed at admission and discharge in all patients. IMPROVE-VTE and PADUA score were assessed after the choice of clinicians to administrate or not a thromboprophylaxis. The IMPROVE-VTE score includes previous VTE (3 points), known thrombophilia (2 points), current lower-limb paralysis (2 points), current cancer (2 points), age $>$ 60 years (1 point), immobilization $\geq$ 7 days (1 point) and ICU/CCU stay (1 point). The PADUA score includes active cancer (3 points), Previous VTE (3 points), reduced mobility (3 points), already known thrombophilia (3 points), recent ($\leq$1 month) trauma and/or surgery (2 points), age $\geq$ 70 years (1 point), heart and/or respiratory failure (1 point), acute MI and/or ischemic stroke (1 point), acute infection and/or rheumatologic disorder (1 point), BMI $\geq$30 (1 point) and hormonal treatment (1 point). The thromboprophylaxis is suggested with an IMPROVE-VTE score $\geq$ 3 and/or with a PADUA score $\geq$ 4 [24]. The outcomes of this study were to assess the rate of DVT during hospitalization in acutely ill medical patients, the frequency of the thromboprophylaxis administration and the variables associated with the clinical choice to administer thromboprophylaxis. All procedures performed in this study were in accordance with the ethical guidelines of the 1975 Declaration of Helsinki; the study was approved by the Ethical Committee of participating centers and was registered on ClinicalTrials.gov (identifier NCT03157843).

2.2. Statistical analysis

Data are expressed as mean and standard deviation for continuous variables and count and percentages for categorical ones. The Kolmogorov–Smirnov test was used to determine whether variables were normally distributed. Comparison between groups was performed by chi-square test, *t* Student's test, Mann–Whitney test or Kruskal–Wallis tests as appropriate. Multivariate logistic regression analysis was performed using a forward selection procedure. Stochastic level of entry into the model was set at a *p*-value = 0.05, and interaction terms were explored for all the variables in the final model. $P < 0.05$ was considered as statistically significant. All analyses were carried out with SPSS Statistics v. 27.0 (SPSS Inc. Chicago, USA).

3. Results

The entire population consisted of 2688 patients, all of whom underwent CUS within 48 h of admission. Of these, 317 patients were excluded from the analysis for the following reasons: 1) hospitalization of <5 days ($n = 211$), 2) thrombosis at admission ($n = 58$; 2.2 %), and 3) patients requiring full anticoagulation for reasons other than DVT ($n = 48$; 1.8 %). Two thousand three hundred seventy-one patients (1233 males [52 %] and 1138 females [48 %]; age 72 ± 16 years) hospitalized in medicine wards were recruited. The median length of hospitalization was 13 ± 12 days. Considering the entire population, 442 (18.6 %) patients underwent prophylaxis with parenteral anticoagulants (Fondaparinux or subcutaneous LWMH once daily) at admission. Assessing IMPROVE-VTE and PADUA scores in a post hoc evaluation, 1016 (42.9 %) were classified with high thrombotic risk and 1354 (57.1 %) patients were classified with low thrombotic risk. Biographic characteristics of the patients hospitalized with low and high thrombotic risk profiles at admission are reported in Table 1. Compared with patients with a low-risk profile, those with a high thrombotic risk were older (Table 1). Furthermore, they had a higher rate of hypertension, ACS/Stroke, heart or respiratory failure, pneumonia, active neoplasia, previous VTE, reduced mobility, thrombophilia, kidney failure, and anticoagulant prophylaxis (Table 1). Evaluating the population stratified by thrombotic risk, 339 out of 1016 (33.4 %) high-risk patients and 103 out of 1354 (7.6 %) low-risk patients underwent anticoagulant prophylaxis.

During their hospital stay, 9 patients (0.4 %) with negative CUS at admission developed proximal DVT. This included 7 asymptomatic and 2 symptomatic cases, all occlusive, with no occurrences of symptomatic pulmonary embolism. Among these patients, 3 were on anticoagulant prophylaxis, while 6 were not (3/442 [0.68 %] vs. 6/1928 [0.3 %], $p = 0.259$). In the high-risk population, 7 out of 1016 patients (0.7 %) developed proximal DVT during hospitalization, with 2 of the 7 (28 %) receiving anticoagulant thromboprophylaxis. No significant difference was observed in the DVT rate between high-risk patients who received prophylaxis and those who did not (2/339 [0.59 %] vs. 5/677 [0.74 %], $p = 0.788$). In the low-risk population, 2 out of 1354 patients (0.2 %) developed DVT, with 1 (50 %) receiving anticoagulant thromboprophylaxis. A significant difference was observed in the DVT rate when comparing low-risk patients who received prophylaxis with those who did not (1/103 [0.97 %] vs. 1/1251 [0.1 %], $p = 0.02$).

Clinical characteristics of the patients treated or not treated with anticoagulant prophylaxis are depicted in Table 2. Patients under anticoagulant prophylaxis were older and had a longer length of stay. Furthermore, they had a higher incidence of heart or respiratory failure, pneumonia, active neoplasia, previous VTE, reduced mobility, and kidney failure (Table 2). A multivariable logistic regression model showed that age (RR: 1010; IC 95 % 1002–1019; p = 0,015), heart or respiratory failure (RR: 1609; IC 95 % 1248–2075; p < 0,0001), pneumonia (RR: 1618; IC 95 % 1222–2141; $p < 0,0001$), active neoplasia (RR: 2041; IC 95 % 1557–2676; p < 0,0001), previous VTE (RR: 1954; IC 95 % 1222–3125; p = 0,005), and reduced mobility (RR: 4674; IC 95 % 3700–5905; p < 0,0001) were independently associated with the choice to administer prophylactic therapy (Table 3).

The clinical characteristics of patients treated with prophylaxis versus those without prophylaxis, categorized by high and low risk, are reported in the Supplementary Data (Tables S1 and S2).

4. Discussion

Venous thromboembolism stands as a leading cause of cardiovascular morbidity and mortality, representing a major health issue that leads to a worse prognosis, longer hospitalization duration, and higher healthcare costs [1,2,9–11]. Randomized controlled trials have demonstrated the efficacy and safety of VTE thromboprophylaxis in reducing its incidence among hospitalized high risk medical patients [19–21]. Consequently, international and nationwide guidelines

Table 1
Clinical characteristics of patients with low thrombotic risk compared to those with high thrombotic risk.

	LOW RISK	HIGH RISK	P
N.	1354 (57.1%)	1016 (42.9%)	-
Age (years)	67±18	77±13	**<0,0001**
Age ≥ 70 years n (%)	632 (46.7%)	786 (77.4%)	**<0,0001**
Male n (%)	728 (53.8%)	504 (49.6%)	**0,040**
Length of stay (days)	11±10	15±15	**<0,0001**
Smoke n (%)	336 (24.8%)	207 (20.4%)	**0,011**
Diabetes n (%)	337 (24.9%)	272 (26.8%)	0,314
Hypertension n (%)	788 (58.2%)	689 (67.8%)	**<0,0001**
Dyslipidemia n (%)	482 (35.6%)	338 (33.3%)	0,231
ACS or STROKE n (%)	157 (11.6%)	168 (16.5%)	**<0,0001**
Chronic ischemic heart disease n (%)	42 (3.1%)	38 (3.7%)	0,398
Heart or respiratory failure n (%)	233 (17.2%)	373 (36.7%)	**<0,0001**
Pneumonia n (%)	141 (10.4%)	247 (24.3%)	**<0,0001**
Active Neoplasia n (%)	22 (1.6%)	383 (37.7%)	**<0,0001**
Previous VTE n (%)	0 0 (0%)	102 (10.0%)	**<0,0001**
Reduced mobility n (%)	31 (2.3%)	657 (64.7%)	**<0,0001**
Thrombophilia n (%)	3 (0.2%)	23 (2.3%)	**<0,0001**
Kidney failure n (%)	199 (14.7%)	304 (29.9%)	**<0,0001**
IMPROVE-VTE Score ≥3 n (%)	0 (0%)	439 (43.2%)	**<0,0001**
PADUA score ≥4 n (%)	0 (0%)	982 (96.7%)	**<0,0001**
Anticoagulant Prophylaxis n (%)	103 (7.6%)	339 (33.4%)	**<0,0001**

Statistically significant comparisons ($p<0.05$) are reported in bold.

recommend thromboprophylaxis for medical patients hospitalized due to acute illness, who are at an increased thrombotic risk in the absence of contraindications [3,22–25]. However, in the real-world scenario, the prescription rate of thromboprophylaxis among hospitalized medically ill patients remains low [16,28,29]. Here, we present data from a multicenter observational prospective study involving a population of non-selected acutely ill patients hospitalized in medical departments, evaluating the rate of eligible patients receiving thromboprophylaxis treatment.

We enrolled 2371 patients hospitalized in internal medicine wards of various hospitals in Italy. Estimating VTE risk through post-hoc analysis using the PADUA and IMPROVE-VTE risk assessment models, we found that 1354 patients (57.1 %) were at low risk of VTE, while 1016 (42.9 %) were at high risk. Across the entire population, only 18.7 % of patients received prophylaxis with parenteral anticoagulants. When considering the population of patients who received thromboprophylaxis stratified by VTE risk using the RAMs, 339 patients were deemed high risk (33.3 %) and 103 were deemed low risk (7.6 %).

Previous studies have reported VTE prophylaxis rates ranging from 13 % to 64 % [30–34]. This variability is largely due to individual studies limiting their assessment to predefined populations, substantial differences between institutions, even within a country, and the use of different risk assessment models. The ENDORSE study [28], a large multinational cross-sectional survey including approximately 38,000 hospitalized medical patients from 32 countries, revealed that among the 42 % of medical inpatients classified as high risk for VTE, only 40 % of this subgroup received thromboprophylaxis or any form of anticoagulant treatment. A meta-analysis of studies published since then, which included >135,000 patients from 20 countries, showed that around 54 % of patients with high VTE risk received thromboprophylaxis [29].

In a recent retrospective "real-life" study on an unselected population of patients hospitalized in medical departments, Malhab-Guri et al. evaluated the rate of patients eligible for and treated with VTE prophylaxis, using the Padua score to identify high VTE risk patients [16]. According to this study, among patients eligible for thromboprophylaxis, only 46 % received it [16]. In another retrospective study, the FADOI-NOTEVOLE study [42], 40 % of hospitalized medical patients were treated with anticoagulant drugs for VTE prophylaxis. Of these, 66 % were considered high risk (PADUA score > 4) and 34 % low risk (PADUA score < 4). Furthermore, the REPOSI registry study [18], conducted in elderly subjects recruited from internal medicine wards in Italy, reported a prophylaxis rate of 15 % among hospitalized patients.

Compared to previous studies, ours stands out due to its prospective nature and the fact that CUS was performed on all patients both at the beginning and at the end of their hospital stay. Additionally, unlike the REPOSI study, we included all patients without any age limitations. The purpose of our study was to provide a "real-world" representation of the actual prescription of VTE prophylaxis in medical wards. Therefore, unlike the previous Mahlab study, our study did not advise physicians to use specific criteria to prescribe thromboprophylaxis in the participating medical departments [16].

The seemingly low prescription rate of thromboprophylaxis found in high-risk patients could be explained by the lack of proven evidence regarding thromboprophylaxis in unselected populations of acutely ill medical patients. Current guidelines are based on randomized controlled trials conducted on selected populations that may not be representative enough of the real population of patients hospitalized in medical departments. Patients hospitalized in internal medicine departments are often elderly, have low weight, and are highly multimorbid, making them complicated to manage in terms of thrombotic and bleeding risk. Few RCT have been conducted on thromboprophylaxis in unselected medical hospitalized populations. For instance, a recent randomized placebo-controlled trial evaluated the use of enoxaparin versus placebo to prevent VTE in an unselected population of hospitalized medical patients [17]. Despite its limitations, this trial did not demonstrate the efficacy of enoxaparin in reducing the risk of symptomatic VTE in this population [17].

The results of this study demonstrate that the decision to treat a hospitalized patient in internal medicine wards is influenced by the following factors: advanced age, acute cardiac/respiratory failure,

Table 2
Clinical characteristics of patients treated with or without anticoagulant prophylaxis.

	NO Anticoagulant Prophylaxis	Anticoagulant Prophylaxis	P
N.	1928 (81.4%)	442 (18.6%)	-
Age (years)	70±17	77±14	**<0,0001**
Age > 70 years n (%)	1102 (57.2%)	316 (71.5%)	**<0,0001**
Male n (%)	1014 (52.6%)	213 (48.2%)	**<0,0001**
Length of stay (days)	12±12	16±13	**<0,0001**
Current Smoke n (%)	450 (23.3%)	93 (21.0%)	0,317
Diabetes n (%)	487 (25.3%)	122 (27.6%)	0,318
Hypertension n (%)	1188 (61.6%)	289 (65.4%)	0,147
Dyslipidemia n (%)	674 (35.0%)	146 (33.0%)	0,462
IMA or STROKE n (%)	262 (13.6%)	63 (14.3%)	0,468
Chronic ischemic heart disease n (%)	62 (3.2%)	18 (4.1%)	0,367
Heart or respiratory failure n (%)	431 (22.4%)	175 (39.6%)	**<0,0001**
Pneumonia n (%)	264 (13.7%)	125 (28.3%)	**<0,0001**
Active Neoplasia n (%)	290 (15.0%)	115 (26.0%)	**<0,0001**
Previous VTE n (%)	69 (3.6%)	33 (7.5%)	**<0,0001**
Reduced mobility n (%)	417 (21.6%)	271 (61.3%)	**<0,0001**
Thrombophilia n (%)	20 (1.0%)	6 (1.4%)	0,562
Kidney failure n (%)	386 (20.0%)	117 (26.5%)	**0,003**
IMPROVE-VTE Score ≥3 n (%)	314 (16.3%)	125 (28.3%)	**<0,0001**
PADUA score ≥4 n (%)	649 (33.7%)	333 (75.3%)	**<0,0001**
Enoxaparin n (%)	-	330 (74.7%)	
Parnaparin n (%)	-	3 (0.7%)	
Fondaparinux n (%)	-	63 (14.3%)	
Nadroparin n (%)	-	50 (11.3%)	

Statistically significant comparisons ($p<0.05$) are reported in bold.

pneumonia, previous deep vein thrombosis, active cancer, and reduced mobility. Regarding advanced age and acute cardiac and respiratory failure, these predictors of thromboprophylaxis align with those previously reported in the REPOSI registry retrospective study [18]. However, this result emphasizes the need for more studies on this topic in the geriatric population [43]. Active cancer, on the other hand, is recognized as a significant risk factor for venous thrombosis and is strongly recommended by international guidelines for thromboprophylaxis in hospitalized medical patients [44]. Compared to the underuse of thromboprophylaxis in hospitalized patients with active cancer described in previous years [45], the increased use of antithrombotic drugs reported in this study reflects greater awareness of the high thrombotic risk in this clinical condition. However, the current lack of reliable tools to assess their bleeding risk and the considerable heterogeneity in tumor types and chemotherapy treatments make proper management challenging [45].

Table 3
Multivariable logistic regression model for the administration of prophylactic therapy.

Age	RR: 1,010	CI 95% 1,002-1,019	**0,015**
Heart or respiratory failure	RR: 1,609	CI 95% 1,248-2,075	**<0,0001**
Pneumonia	RR: 1,618	CI 95% 1,222-2,141	**<0,0001**
Active Neoplasia	RR: 2,041	CI 95% 1,557-2,676	**<0,0001**
Previous VTE	RR: 1,954	CI 95% 1,222-3,125	**0,005**
Reduced mobility	RR: 4,674	CI 95% 3,700-5,905	**<0,0001**

VTE = Venous Thromboembolism; RR = Relative Risk; CI = Confidence Interval.

Interestingly, we found an association between pneumonia and thromboprophylaxis underscoring the need for more studies on thromboprophylaxis rates in infectious and inflammatory diseases [46–49].

Additionally, a history of previous deep vein thrombosis has emerged as a risk factor influencing thromboprophylaxis, consistent with previous studies documenting a higher risk in hospitalized medical patients [50]. Reduced mobility is still considered by physicians who prescribed thromboprophylaxis in this study an important risk factor, although the latest guidelines from the European Society of Cardiology now classify it as a minor risk factor for deep vein thrombosis [51].

This study offers a real-world snapshot of venous thromboembolism (VTE) prophylaxis in hospitalized medical patients with acute conditions in internal medicine departments. The absence of pre-established thromboembolic risk scores at admission did not significantly influence the physician's decision to administer prophylaxis. No significant difference in the rate of deep vein thrombosis (DVT) rate during hospitalization was found between high-risk patients treated with prophylactic anticoagulants and those who were not treated. However, this comparison may be affected by the low incidence of DVT events observed. Further research with a larger number of events is needed to evaluate these findings. Several limitations characterize this study. First, the study primarily included a Caucasian population from Italian centers, which may limit the generalizability of the findings to other ethnic groups or countries. Second, we did not assess distal DVTs as compression ultrasonography (CUS) was performed only up to the popliteal fossa. Additionally, this is a post-hoc analysis, which has its limitations as the non-randomized nature of the study and the lack of prespecified subgroups. Lastly, the low incidence of thromboembolic events during hospitalization limits our ability to draw conclusions about the effectiveness of anticoagulant prophylaxis in reducing thromboembolism.

In conclusion, this study highlights that age, heart or respiratory failure, active cancer, pneumonia, previous VTE, and reduced mobility are predictors that influenced the decision to use thromboprophylaxis in our hospitalized medical patient population.

CRediT authorship contribution statement

Arianna Magna: Investigation, Data curation. **Enrico Maggio:** Writing – original draft. **Gianpaolo Vidili:** Writing – review & editing, Visualization. **Angela Sciacqua:** Writing – review & editing, Supervision. **Chiara Cogliati:** Writing – review & editing, Supervision. **Rosella Di Giulio:** Writing – review & editing, Supervision. **Sciaila Bernardini:** Writing – review & editing, Supervision, Investigation. **Alessia Fallarino:** Investigation, Data curation. **Ilaria Maria Palumbo:** Investigation, Data curation. **Arianna Pannunzio:** Investigation, Data curation. **Chiara Bagnato:** Writing – review & editing, Supervision. **Carla Serra:** Writing – review & editing, Investigation. **Maria Boddi:** Writing – review & editing, Investigation. **Lorenzo Falsetti:** Writing – review & editing, Investigation. **Vincenzo Zaccone:** Writing – review & editing, Investigation. **Evaristo Ettorre:** Investigation, Conceptualization. **Giovambattista Desideri:** Writing – review & editing, Conceptualization. **Luca Santoro:** Writing – review & editing, Conceptualization. **Vito Cantisani:** Writing – review & editing. **Pasquale Pignatelli:** Writing – review & editing, Conceptualization. **Angelo Santoliquido:** Writing – review & editing, Conceptualization. **Francesco Violi:** Writing – review & editing, Investigation. **Lorenzo Loffredo:** Writing – review & editing, Formal analysis, Conceptualization. **Chiara Totè:** Writing – review & editing, Supervision. **Chiara Trivigno:** Writing – review & editing, Supervision. **Chiara Gioia:** Writing – review & editing, Supervision. **Lorenzo Baldini:** Writing – review & editing, Investigation. **Vincenzo Arienti:** Writing – review & editing, Investigation. **Maria Berria:** Writing – review & editing, Investigation. **Francesco Casella:** Writing – review & editing, Investigation.

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.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.thromres.2024.109148.

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