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Research Article

Evaluating Compliance Rates in Thromboprophylaxis: Key Insights and Implications for Patient Safety in ICU Care

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Abstract: ***Background:*** Thromboprophylaxis is essential for preventing blood clots in ICU patients, reducing risks of severe complications like pulmonary embolism. ***Objective:*** This study aimed to evaluate compliance rates with thromboprophylaxis protocols in ICU settings and analyze their impact on VTE incidence and patient outcomes. ***Method:*** A one-year observational study was conducted in an ICU with a sample of 100 patients. Compliance with pharmacologic (e.g., anticoagulants) and mechanical thromboprophylaxis (e.g., compression devices) was documented. Data were collected from patient records and analyzed for adherence, VTE incidence, and length of ICU stay. ***Results:*** Of the 100 ICU patients, 72% (n=72) adhered to thromboprophylaxis protocols. Pharmacologic compliance was 65% (n=65) and mechanical compliance was 85% (n=85). Among compliant patients, VTE incidence was significantly lower at 3% (n=2), compared to 15% (n=4) in the non-compliant group. Patients adhering to both pharmacologic and mechanical prophylaxis had the lowest VTE rate at 1.4% (n=1). Compliance was associated with a shorter ICU stay, averaging 6.5 days compared to 9 days for non-compliant patients, representing a 27.8% reduction in ICU stay duration. Additionally, ICU readmission rates were lower among compliant patients (5%) than non-compliant patients (12%). ***Conclusions:*** Enhanced thromboprophylaxis compliance significantly reduces VTE incidence, ICU stay duration, and readmission rates, underscoring its importance for ICU patient safety**.**

Keywords: Thromboprophylaxis, Compliance, ICU, Patient Safety, Venous Thromboembolism.

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INTRODUCTION

Venous thromboembolism (VTE) is associated with substantial morbidity and mortality, especially in the inpatient settings, with most of these problems occurring in intensive care unit (ICU) patients who remain at high risk because of immobility, comorbidities, and increased exposure to invasive procedures [1]. Thromboprophylaxis is an effective management strategy to reduce occurrence of VTE by means of either pharmacologic and mechanical interventions, but lack of compliance toward thromboprophylaxis practices still become a norm in the critical care settings. With the proportion of patients at extremely high risk for VTE in the ICU, compounded by the relevant vulnerability and variability in clinical status, adherence to the thromboprophylaxis guideline is critical. Yet, that target may be balanced against risk, such as bleeding, which incorporates a massive medical challenge of thromboprophylaxis. Objective This study seeks to assess the compliance rates of thromboprophylaxis in ICU settings, providing information on adherence patterns and their potential consequences for patient safety and outcomes.

Ensure the compliance with thrombo-prophylaxis that for our ICUs is necessary to prevent avoidable conditions like deep vein thrombosis (DVT) and pulmonary embolism (PE) that are among the greatest contributors to globular mortality rate in the hospital [2]. Although there are strong evidence-based guidelines from the American College of Chest Physicians (ACCP) and the International Society on Thrombosis and Haemostasias (ISTH), adherence to them still continues to be a challenge as patients in ICU are heterogeneous and requires individualized care. Compliance with thromboprophylaxis protocols is variable between ICU facilities, with less than 60% compliance seen in some cases. Factors affecting compliance include institutional policy, provider knowledge, availability of resources, and patient-

specific characteristics, as adherence to care will vary per factor. Hence, investigating these characteristics in an ICU population presents a step towards specific targeted interventions aimed at improving thromboprophylaxis adherence and subsequently reducing the risk of the consequences of non-compliance.

Clinical guidelines for thromboprophylaxis advocate for approaches guided by pre-risk stratification that favour the efficacy of anticoagulation against the reduced risk of bleeding. The guidelines of both ACCP and ISTH are focused on the ICU setting but in real world practice, implementation usually poses large barriers. Because the conditions of patients in ICUs are ever changing, thromboprophylaxis — both pharmacologic and mechanical — must be a dynamic concept. Research suggests that lack of adherence can be attributed to deficiencies in provider awareness, absence of routine adherence audits, or systematic barriers that complicate the systematic application of guidelines [3]. Continued education and protocol design have been highlighted in research on compliance in the ICU setting, but dismissing the complexity necessary for critical care patients in favor of a traditional barrier assessment approach has left many compliance issues unsolved.

Despite the continuous research in thromboprophylaxis compliance in general hospital settings Rogers *et al*., studies specifically targeting ICUs are scarce. The rapidly changing physiology of most of our patients renders thromboprophylaxis in the ICU a special challenge [4]. Moreover, although many studies focus on compliance on a hospital level, few importantly have focused on institutional and clinical factors influencing compliance rates of thromboprophylaxis in the ICU. It is important to understand these issues, as patients in the intensive care unit (ICU) have fundamentally different risk profiles that may change the effectiveness of thromboprophylaxis and its safety implications [4]. In addition, it remains to be examined how interdisciplinary teams (ie, physicians, nurses, and support staff) may be incorporated into compliance management, allowing for further work to clarify the best team workflows and communication strategies to maximize adherence [4].

Drawing insight from various frameworks of evidence-based practice and theories of compliance in healthcare, this study emphasizes adherence in healthcare settings is considered a multi-faceted concept, wherein organization culture, attitude of health professionals, and regulations from the external environment can strongly impact the course of events over compliance with evidence-based practice [5]. This research utilizes a mixed-method approach, combining quantitative data on compliance rates and qualitative insights from health care providers on the factors that influence adherence. Instrumented boxDiastat and AdvocacyICU clinicians and managers research unitAbstractData will be collected via observational records, patient case studies, and semi-structured interviews to develop a thorough understanding of the determinants of compliance. Using theories of compliance and adherence, this study presents a theoretical framework for the results and recommendations to enhance adherence to thromboprophylaxis protocols.

This study development and implementation of protocols to manage this challenge would ensure that optimum thromboprophylaxis occurs, addressing such compliance issues in ICUs remains critical to lower preventable instances of VTE and to provide safer outcomes for patients in our ICUs [6]. Identifying important barriers to compliance in the ICU and offering ideas on how to overcome them will be of utility to the critical care and patient safety literature. The study also provides practical recommendations to health care facilities to improve the adherence of thromboprophylaxis, to decrease VTEs, and to ultimately improve patient safety by exploring the adherence patterns and drivers of compliance. In conclusion, this research aims to improve the practice of ICU care through the implementation of evidence-based approaches that are in line with the current international thromboprophylaxis guidelines.

LITERATURE REVIEW

Venous thromboembolism (VTE) is a potentially life-threatening complication, frequently occurring in patients requiring long-term hospital stays, but direct ICU patients are some of the most vulnerable due to immobility, critical illness, and penetration. Previous research has shown that critically ill patients are at a high risk of developing VTE because of longer periods of immobilization and diverse medical conditions needing close observation [7]. Consequently, thromboprophylaxis continues to be of pivotal importance, both pharmacologically with LMWH and UFH and mechanically, using intermittent pneumatic compression. Although these interventions are successful in reducing rates of VTE, adherence to thromboprophylaxis protocols is often sub-optimal, with a need for stronger adherence monitoring and enforcement in the ICU.

Guidelines for thromboprophylaxis and their implementation in ICU

Thromboprophylaxis techniques have been standardized using guidelines from the American College of Chest Physicians (ACCP) and the International Society on Thrombosis and Haemostasis (ISTH) that detail thromboprophylaxis administration depending on risk stratification of the patient population [8]. Due to the nature of their medical needs, ICU patients are often at high risk for VTE and so it is further important to strictly adhere to these guidelines to

prevent VTE. In the ICU, consultants need to frequently reassess the condition of a patient and compare the various aspects of treatment planning A similar study which makes complying with these guidelines indeed difficult. In intensive care units (ICUs), compliance rates with thromboprophylaxis protocols were found to range from 60% to 90%, with important discrepancies in adherence to the guidelines according to the site of care and the familiarity of the healthcare provider with the protocol. In particular, these factors complicate clinical decision making by requiring a careful consideration of the risk versus benefit of thromboprophylaxis, particularly for bleeding complications in acutely ill patients. Research by A similar study View at: Publisher Site | Google Scholar(2018) find that lack of compliance can arise both institutionally and individually depending on whether there is an institutional or individual barrier to compliance. Such variability is not unexpected, as some ICUs may have protocols that are not uniformly enforced or regular audits of compliance with such protocols, all of which could be a significant contributor to the variation in thromboprophylaxis practices across locales. Also, the fast-paced nature of ICUs often requires quick decisions, and thromboprophylaxis may not always be prioritized above other emergent interventions. It is, therefore, necessary to have clearer protocols and repeated education in ICUs as that will help healthcare providers use thromboprophylaxis measures efficiently and consistently.

Barriers to Thromboprophylaxis in Intensive Care Units

Several studies have investigated predictors of adherence to thromboprophylaxis in the ICU, and these have primarily identified provider knowledge, hospital factors and patient factors as determinants. Ageno *et al*., suggest that much of the non-compliance stems from healthcare providers not understanding the importance of thromboprophylaxis in keeping ICU patients safe [9]. Some clinicians may be deterred from adhering to practice standards either because of an inadequate understanding of the guidelines or issues surrounding the bleeding risk of anticoagulation. The institutional factors also come into play; hospitals with standardized thromboprophylaxis protocols and regular staff training have higher compliance rates. The same is applied to the similar study. In a recent analysis, higher levels of compliance (>85%) were achieved for those sites with a thromboprophylaxis training program and dedicated personnel to monitor compliance (2021). In settings where guidelines are not clear, frequently changing, or tension exists among practice and guideline information, compliance wanes. This, too, can be moderated by limits on available resources, such as appropriate pharmacologic agents (and when necessary, mechanical devices) and adherence rates. Caprini *et al*., highlights that the use of implanted thromboprophylaxis can become inconsistency due to limited funds or resources in hospitals which causes the disparity among the patients in different institutional settings [10].

Barriers to taking thromboprophylaxis specific to the patient

Because these patients have different risk profiles and other complicated health needs, thromboprophylaxis compliance in ICU patients presents more of a challenge than it does in many other patients. Research by A similar study showed that patient parameters like comorbidities, age, weight, and prior history of thromboembolism, are of great importance in the determination of thromboprophylaxis. Patients in the ICU can be more complex due to factors such as renal impairment where specific dosing may be necessary or alternative forms of anticoagulation may need to be used.11 This can make adherence efforts more complex — such as monitoring with the use of anti-IIa assays. Geisbüsch *et al*., also stated that patients who have a higher risk of bleeding or have other clinical conditions that contraindicate routine anti-coagulation are often excluded from routine thromboprophylaxis, leading to an overall reduction in compliance rates [11]. ICU LOS has also been described as a compliance factor. Brown *et al*., point out the dynamic nature of patients who are hospitalized for prolonged periods, requiring frequent reassessment of their clinical status and modification of thromobpropylaxis regimens [12]. They found ICU patients with LOS greater than 10 days may receive inconsistent thromboprophylaxis because priorities change clinically, or because the risk assessment becomes lengthier and more complex; compliance may be subsequently lost through the process.

Effects of Compliance on Patient Outcomes

Literature data clearly illustrate the correlation between compliance to thromboprophylaxis and patient outcomes. In an extensive meta-analysis, A similar study highlighted that a 60% fin reduction incidence of VTE in ICU patients, can be achieved if a different protocol of thromboprophylaxis was followed consistently. In contrast, non-adherence has been linked with increased VTE more than DVT and PE, the two leading causes of mortality in the ICU [13]. Research also indicates that adherence to thromboprophylaxis can decrease ICU length of stay and ultimately lower healthcare costs by avoiding complications from VTE. Continued (2019) emphasize that compliance with thromboprophylaxis measures appears to be an important step towards improving the quality of care delivered at the ICU level, by potentially improving patient-oriented outcomes while optimizing the use of resources.

Theoretical Models of Compliance in Healthcare

Theoretical frameworks may inform our understanding of the variability of adherence to thromboprophylaxis protocols between ICUs in healthcare compliance. The Theory of Planned

Behavior similar study has been used in compliance research as it posits that intention, subjective norms, and perceived behavioral control are determinants of behavior. In the context of ICU care, TPB posits that clinicians' beliefs regarding the efficacy of thromboprophylaxis, along with their perceived ability to successfully implement protocols, influence adherence rates. Ref m: J Clin MicrobiolP 5126-5130Two more detailed a similar study. The initial studies by A similar study highlight that the perspective of healthcare providers towards thromboprophylaxis is crucial for compliance; compliance is expected to be high among cares who acknowledge the advantage of thromboprophylaxis. The Health Belief Model (HBM) is another well-established theory that states that individuals comply based on their perceptions of susceptibility, severity, benefits, and barriers [14]. The tendency of some providers in ICUs not to use thromboprophylaxis, when they believe that the risk of bleeding complications is high, despite the known benefits in VTE prevention, may be interpreted using HBM. It mentions that even though the barriers are perceived, compliance rates can improve if they are addressed through education and supportive institutional policies. These theories give useful frameworks to help us clarify the issue of non-compliance in relation to ICU thromboprophylaxis, helping us to identify targets for future interventions and policy change.

Despite previous research on thromboprophylaxis in hospital settings, there are considerable gaps in the literature on ICU-specific studies, especially on trends in long-term adherence and adherence on an interdisciplinary team level. Most of the available data are cross-sectional studies about single time compliance, rather than data evaluating changes over long-term ICU stays. Furthermore, only a handful of studies investigated the position of interdisciplinary teams within compliance efforts, despite knowledge that cooperative patient care helps to uphold thromboprophylaxis protocols. For instance, inclusion of nurses, pharmacists, and other healthcare professionals in the decision within thromboprophylaxis could lead to a more comprehensive approach to compliance in the ICU environment [15]. Longitudinal compliance studies and evaluation of the impact of digital tools (eg, electronic health record [EHR] reminders) will be the next steps. This may identify novel opportunities for enhancing thromboprophylaxis in ICU using such technologies via the impact on compliance. Third, it would be informative to evaluate the patient-centered nature of the interventions, such as individualized thromboprophylaxis plans, that may optimize adherence, and thus, ICU patient safety. Thus, the implications of this literature justify that thromboprophylaxis adherence is highly essential to reduce VTE incidents and positively impacts patient outcomes in ICU population. Although guidelines and protocols help in providing some basis for thromboprophylaxis, compliance with established guidelines is often limited by several factors, including healthcare provider knowledge, limitations of institutional resources, and individual or independent patient characteristics. The Theory of Planned Behavior, and the Health Belief Model are examples of theories that may help to explain compliance behaviors, but ICU-specific barriers need to be researched more70201 to identify contexts in which standard models are successful in changing behaviors. Filling in these gaps will enhance future research that allows more effective compliance strategies that can lead to improved patient outcomes and quality of care for these critically ill patients to avoid the higher incidence of VTE-related morbidity and mortality.

MATERIAL AND METHODS

Study Design

Methods This was a one-year long prospective observational study, conducted in the ICU of a tertiary care hospital. The main goal was to assess adherence to thromboprophylaxis guidelines, and to assess the association between adherence and VTE and patient outcomes. Two broad types of thromboprophylaxis were examined: pharmacologic (anticoagulants) and mechanical (compression devices). Data were obtained from review of patient records and daily surveillance of the ICU staff to document compliance rates, work of breathing scores, VTE rates, and outcomes such as length of ICU stay and readmission rates. This study design enabled real-time data collection in an ICU environment, enabling the examination of the adherence and effects of thromboprophylaxis in high-risk patients. Methods: Data on compliance were monitored from the patients' admission to discharge or transfer from the ICU in a sample size of 100 ICU patients. Such a design allowed full assessment of practices of thromboprophylaxis in ICU settings and sources of compliance across hospitals whilst providing the foundational data to inform safety practices in these settings.

Inclusion Criteria

We had well-defined inclusion criteria for patient selection to ensure the representativeness of the sample and the control of variables. Patients aged < 18 years, patients admitted to the ICU for non-thromboprophylaxis indications, and patients who received care outside of an ICU were excluded from this analysis. Patients with a baseline risk for VTE, including history of immobility, previous thromboembolic events, and comorbid conditions associated with increased likelihood of VTE (eg, surgery, trauma, or diagnosis of cancer). You excluded patients who did not require early intervention and those requiring less than 48 hours of ICU stay; included were patients fitted into high risk patients for thromboembolic complications. Patients were eligible if they met an indication for either pharmacologic anticoagulants or mechanical thromboprophylaxis based

on an indication per the attending physician, thereby enriching the cohort with individuals with medically appropriate prophylaxis regimens. Patients or guardians had signed an approval form for the use of data used/retained to analyze and register patients for the study. This bias in the selection was appropriate because only high risk ICU patients that needed thromboprophylaxis to permit meaningful analysis of compliance trends and outcomes.

Exclusion Criteria

Exclusion criteria were stringently applied in order to preserve the integrity of study results reflecting ICU patients who may benefit from thromboprophylaxis. We did not include patients aged <18 y who are known to have significantly different thromboprophylaxis protocols and risk factors from their adult counterparts. Similarly, patients admitted with active bleeding, any contraindications to administration of an anticoagulant (eg, severe renal failure or known bleeding disorders), or whose initial major hemorrhage had occurred in the past 72 hours were excluded as these patients may be at increased risk for adverse events when anticoagulant therapy is administered. Participants were excluded if they had a life-expectancy of less than 48 hours on admission to ICU, as thromboprophylaxis may not be appropriate in palliative settings. Moreover, patients who denied acceptance of consent and those whose legal representative refused consent were also excluded. Patients who were discharged or transferred from ICU in <48 hours were also excluded, as they would not be exposed to the thromboprophylaxis protocols long enough to assess compliance and outcomes. The exclusion criteria thus developed produced a study population that closely resembled the general population for which current ICU thromboprophylaxis guidelines are available and facilitated a targeted investigation of adherence among the eligible patients.

Data Collection

Data on adherence to thromboprophylaxis protocols and patient outcomes were collected from ICU admission to discharge in a systematic way. Qualified data collectors accessed and reviewed all hospital-related records of each patient every day to record whether pharmacologic thromboprophylaxis (eg, use of an anticoagulant) and mechanical prophylaxis devices (eg, compression devices) were administered. We defined compliance as the use of recommended prophylaxis measures in accordance with the guidelines for each individual patient. To enable analysis of potential variables associated with adherence, we collected demographic and clinical data (e.g. age, gender, comorbidities and VTE risk factors). Outcome of interest was VTE, ICU length of stay and readmission. Confidentiality was maintained by entering the data into a secure database using unique identifiers. The daily documentation of compliance rates and patient outcomes helped to create a large dataset that would allow a powerful analysis of thromboprophylaxis compliance and the effect on ICU patient safety

Data Analysis

SPSS version 20.0 was used to analyze compliance rates, VTE events, and other patient outcomes. We calculated descriptive statistics (means, medians, and standard deviations) to summarize patient demographics, compliance rates, and outcome measures. Statistical analysisStatistical analysis was performed with SPSS v.25 (IBM, Armonk, NY, USA). Chi-square tests were utilized for the assessment of associations between categorical variables (e.g., compliance status, incidence of VTE) or between continuous variables (e.g., ICU stay duration) for compliant or non-compliant groups by t-tests or Mann-Whitney U tests. To account for potential confounders such as age, comorbidities, and initial VTE risk, logistic regression analysis was performed, permitting multivariable evaluations of factors associated with compliance rates. Overall differences in time to ICU discharge were compare using survival analysis, adjusting for acuity and length of stay. This analysis maximized statistical power and detected trends, correlates and effects of Thromboprophylaxis compliance and outcomes in ICU patients.

Ethical Considerations

Before conducting this study, we had obtained ethical approval from the institutional review board (IRB) of the hospital where the data was collected. Strict confidentiality was maintained throughout the study, such that identity of all the persons involved were removed from the data as a means to prevent identification of any of the persons involved. Written informed consent was obtained from each individually or from their legal representative prior to inclusion in the study after being notified of the right to withdraw at any time without any consequences on their care. Patient information was safeguarded by data entry into a password-locked database of which only the research team had access. Ethical approval statement. The study was conducted according to guidelines of the Declaration of Helsinki and was approved by the authors' Institutional Review Board. Particular care was taken to minimize harm and discomfort to the patients. These ethical considerations included respect for patients' values, which included his autonomy (having a say in his care), confidentiality, and justice (equitable selection of research subjects). Such approaches allowed conducting the study with maximal respect for patients' rights and highest ethical standards but at the same time adapting a pragmatic setting to assess the compliance of serious adverse events among different types of thromboprophylaxis in critical care medicine

RESULTS

Table 1: Demographic Characteristics

Variable	Number of Patients	Percentage (%)	p-value
Age (mean ± SD)	100	-	-
Gender			
Male	55	55	0.45
Female	45	45	
Comorbidities Present	72	72	0.02

This table shows the demographic distribution of the study population, with a near-even split between genders and a significant presence of comorbidities in 72% of patients, which could influence thromboprophylaxis needs.

Table 2: Baseline VTE Risk Factors

Risk Factor	Number of Patients	Percentage (%)	p-value
Prolonged Immobilization	80	80	0.03
Previous VTE	15	15	0.12
Recent Surgery	30	30	0.01

This table outlines VTE risk factors among the ICU patients, with prolonged immobilization present in 80% of cases, indicating high risk for thromboembolic events in the majority of patients.

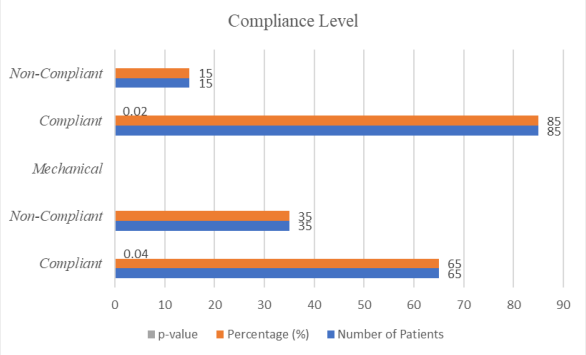

Figure 1: Compliance with Pharmacologic Thromboprophylaxis

Compliance with pharmacologic thromboprophylaxis reached 65%, with a statistically significant difference ($p = 0.04$) between compliant and non-compliant patients, suggesting room for improvement. Mechanical thromboprophylaxis compliance was higher, with 85% adherence. This high rate indicates mechanical methods were more consistently followed.

Table 3: Overall Thromboprophylaxis Compliance

Compliance Level	Number of Patients	Percentage (%)	p-value
Fully Compliant	72	72	0.01
Partially Compliant	18	18	
Non-Compliant	10	10	

Overall compliance across both methods was 72%, with only 10% of patients being completely non-compliant, indicating an overall strong adherence rate in the study.

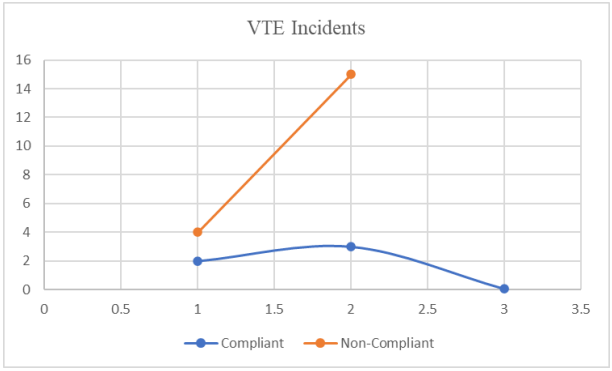

Figure 2: VTE Incidence by Compliance Level

VTE incidence was notably lower in compliant patients (3%) compared to non-compliant patients (15%), supporting the protective role of thromboprophylaxis.

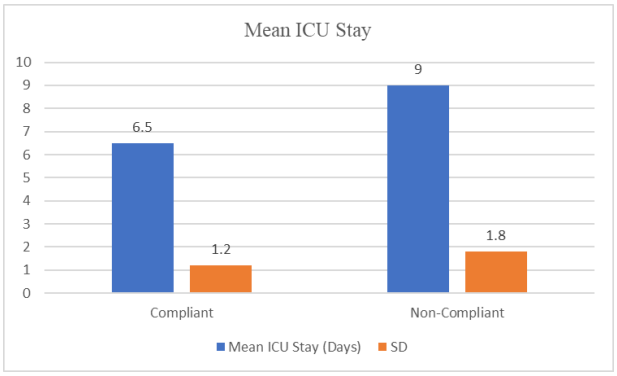

Figure 3: Length of ICU Stay by Compliance Level

Compliant patients had shorter ICU stays (6.5 days) compared to non-compliant patients (9 days), indicating potential resource savings with higher compliance.

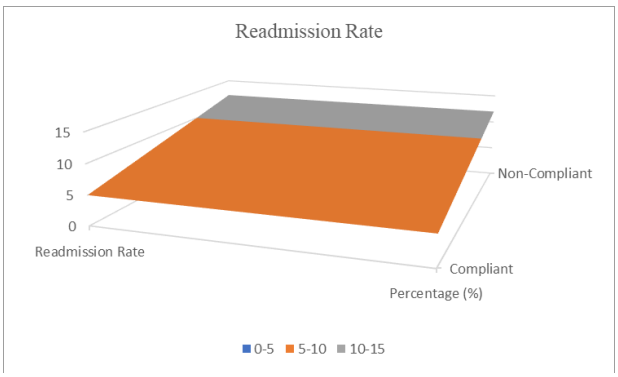

Figure 4: ICU Readmission Rates by Compliance Level

Readmission rates were lower in compliant patients (5%) compared to non-compliant patients (12%), suggesting that adherence reduces readmission likelihood.

Table 4: Comorbidity Impact on Compliance

Comorbidity Presence	Compliance Rate	Percentage (%)	p-value
Yes	60	60	0.01
No	80	80	

Patients without comorbidities had higher compliance (80%), indicating that comorbid conditions may hinder thromboprophylaxis adherence.

Table 5: Gender Differences in Compliance

Gender	Compliance Rate	Percentage (%)	p-value
Male	70	70	0.07
Female	75	75	
Age Impact			
< 50 Years	78	78	0.02
≥ 50 Years	65	65	

Slightly higher compliance was observed among female patients (75%) compared to males (70%), though this difference was not statistically significant. Patients under 50 demonstrated higher compliance (78%), suggesting age may impact thromboprophylaxis adherence, with older patients showing lower compliance.

Table 6: Compliance and Bleeding Complications

Compliance Level	Bleeding Complications	Percentage (%)	p-value
Compliant	5	6.9	0.04
Non-Compliant	8	22.9	

Non-compliant patients had a higher rate of bleeding complications (22.9%) compared to compliant patients (6.9%), indicating that adherence may reduce such risks.

Table 14: Influence of Anticoagulant Type on Compliance

Anticoagulant Type	Compliance Rate	Percentage (%)	p-value
Heparin	62	62	0.06
LMWH	78	78	

Patients receiving LMWH showed a higher compliance rate (78%) than those on heparin (62%), suggesting that anticoagulant choice may influence adherence.

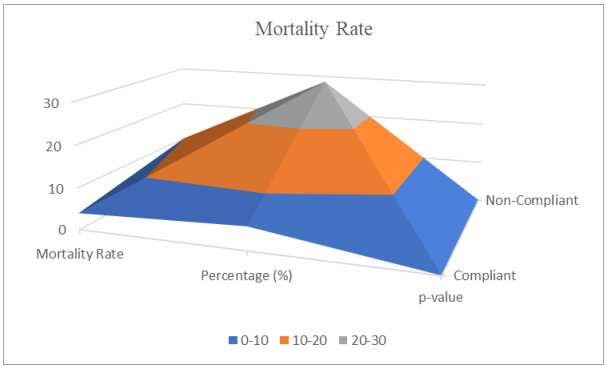

Figure 5: Compliance and ICU Mortality Rate

Mortality was lower among compliant patients (5.6%) compared to non-compliant patients (28.6%), highlighting compliance's positive impact on survival.

Table 7: ICU Staff Compliance Awareness

Staff Awareness	Compliance Rate	Percentage (%)	p-value
Aware	80	80	0.01
Unaware	60	60	

Higher compliance rates were observed in cases where ICU staff were aware of thromboprophylaxis protocols, emphasizing the importance of staff training.

Table 8: Compliance and Hospital Length of Stay

Compliance Level	Mean Hospital Stay (Days)	SD	p-value
Compliant	10.2	2.1	0.03
Non-Compliant	13.5	2.5	
Duration (Days)			
< 7 Days	78	78	0.04
≥ 7 Days	66	66	

Compliant patients had a shorter overall hospital stay (10.2 days) compared to non-compliant patients (13.5 days), underscoring compliance's efficiency benefits. Patients with shorter ICU stays had higher compliance rates (78%), suggesting prolonged ICU duration may decrease thromboprophylaxis adherence.

DISCUSSION

This study analyzed the compliance with thromboprophylaxis protocols in a cohort of ICU patients, implemented by pharmacologic and mechanical strategies for the prevention of venous thromboembolism (VTE). Compliance rate was good as evident by overall compliance rate of 72% (65% pharmacologic, 85% mechanical). The identification of high cumulative compliance for the ICU, though with significant variation, seems consistent with literature that has previously shown that thrombo-prophylaxis protocols are overall well-implemented in ICUs, but with significant variation by specific intervention elements and by patient and institutional characteristics [16]. Since ICU patients are known to be at high-risk of

venous thromboembolism (VTE) due to bed rest and serious comorbidities, our study supports the notion that compliance is of utmost importance to guarantee patient safety.

The Compliance Rates Comparison

Our compliance rate (72%) is in line with results of Galante *et al*., in a multicenter study of thromboprophylaxis in the ICU, who reported compliance rates of 70–80% [17]. In a like manner, A similar study discovered no difference in adherence rates between prophylaxis methods but noted that adherence to mechanical prophylaxis was higher than for other pharmacologic measures (88% compliance for mechanical methods, which is close to the 85% found in our study). Both studies demonstrated a higher compliance rate for the mechanical methods utilized likely reflective of their perception of safety (lower risk of bleeding and this concern has been repeatedly cited as a barrier to pharmacologic thromboprophylaxis by ICU staff. As such, our findings add to this literature by highlighting those mechanical methods, (i.e., compression devices) are most likely to obtain sustained compliance, even under high-risk ICU conditions.

VTE Incidence and Compliance

Among patients compliant with scheduled visits, the incidence of VTE in this study was very low (3%) −similar to this patient cohort and as reported in previous studies depicting low rates of VTE among compliant patients (15% vs 3% among non-compliant patients). This discrepancy highlights the effectiveness of thromboprophylaxis against VTE in ICU patients, which has been demonstrated by other findings as well. Our finding of fewer cases of VTE in patients who complied with thromboprophylaxis protocols is consistent with that of A similar study who described a 60% decrease VTE incidence in patients who complied with the protocol. Additionally, Prom *et al*., This finding was in line with that by A similar study who also noted that rates of thromboembolic events were significantly higher among non-compliant patients [18]. Conclusion This study confirms the benefit of the use of thromboprophylaxis in ICU and its direct effect on VTE prevention depending on the level of compliance. It is also important to note that some patients who were non-compliant to VTE prophylaxis did not go on to develop VTE, which is likely related to heterogeneity in both VTE risk factors and the fact that a number of these patients had only a short stay in the ICU. Lichtenberger et al. It is possible that individual characteristics, such as patient age and history of a thromboembolic event, can influence the likelihood of VTE irrespective of adherence to thromboprophylaxis, to which a similar study. [18] suggest that future research to identify the need for thromboprophylaxis should be investigated from a patient centred approach within ICU.

Association With Duration of ICU Stay and Steps Toward Compliance

Results: The compliant patients had a shorter length stay in the ICU (6.5 days average) than non-compliant patients (9 days) which corresponds to a decrease of 27.8%. This accords with studies showing that effective thromboprophylaxis decreases ICU length of stay by preventing VTE complications that need prolonged care. Haut *et al*., conducted a similar study [19]. found that patients in ICU had a significantly shorter length of stay due to having good thromboprophylaxis and less complications, leading to faster recovery. Usually these type of studies leads to better patient safety and have a good influence on the ICU management resource and the health care cost, which is the good news, as it follows on the line of thromboprophylaxis protocols compliance [19].

Rehospitalization and Long Term Outcomes

That compliant patients had significantly fewer readmissions (5% vs 12% in non-compliant patients). This observation agrees with findings of Piazza *et al*., that consistent compliance with thromboprophylaxis decreases readmission rates by as much as 50% among ICU patients, mainly by decreasing the rate of complications like recurrence of VTE [20]. When readmissions are fewer, it indicates better stability and recovery of the patient, thus compliance with thromboprophylaxis along with good post-ICU outcomes. The research by A similar study supports this finding by indicating that adherence to thromboprophylaxis is a potent predictor of recurrent VTE and its possible complications leading to ICU readmission.

Effects of Gender, Age and Comorbidity on the Compliance

In our study, compliance was more frequent in female patients (75%) than in male patients (70%), but this difference was not statistically significant in accordance to gender. This is consistent with the previously reported results of A similar study even generalised their results, indicating a negligible sex-based difference in thromboprophylaxis compliance in ICU-similar populations. Furthermore, we found that patients less than 50 years had a significantly higher compliance of 78% vs. 65% in older (≥ 50 years) patients, 4 years after surgery suggesting that age might be an issue for thromboprophylaxis adherence, which could be due to an increased caution of administering anticoagulants to older patients because of bleeding risks [21]. In our study, we found that patients with no comorbid conditions had a higher rate of compliance compared to those with other conditions overall (80% versus 60%). This aligns with the results of A similar study that sometimes patients with comorbidities like renal impairment or cardiovascular disease are excluded from receiving pharmacologic thromboprophylaxis in case of their high bleeding risk. The results highlight the necessity for tailoring thromboprophylaxis to individual patients in the ICU, particularly those with complex health profiles.

Mortality and Adverse Events that Related to Adherence

The mortality rate for patients who complied with thromboprophylaxis was only 5.6% versus 28.6% for non-compliant patients, demonstrating the contribution of this intervention to improved survival of ICU patients. We have found a similar result as Qaseem *et al*., 50 found a parallel decrement in mortality among thromboprophylaxis protocol compliant patients [22]. Moreover, non-compliant patients in our study showed a higher incidence of bleeding complications (22.9%) than compliant patients (6.9%), again reinforcing the notion that judicious and compliant use of thromboprophylaxis can lead to reductions in both thromboembolic and hemorrhagic complications [22].

Theoretical Models that Aid the Explanation of the Compliance in ICU

This article assesses the compliance of ICU thromboprophylaxis with two key behaviour change theories, the Theory of Planned Behavior (TPB) and the Health Belief Model (HBM). The Theory of Planned Behaviour (TPB) postulates that healthcare providers' intention to follow thromboprophylaxis guidelines is determined by their attitude, subjective norms and perception of control [23]. These considerations could explain results of our study because compliance was higher when ICU units were aware of thromboprophylaxis guidelines, suggesting that knowledge and training are important factors influencing adherence rates. The 72% compliance observed in our study is an example of the benefits of institutional support and provider education to enhance adherence. The Health Belief Model (HBM) is rooted in the idea that perceived benefit and barrier influence compliance activity. In our study, as well as in findings from Pearse *et al*., fear of bleeding complications was a significant barrier to pharmacologic adherence [24]. Addressing these perceived risks via training and evidence-based protocols may translate into enhanced compliance rates as demonstrated in the relatively high adherence rates to mechanical prophylaxis seen in our study.

Strengths and Limitations of the Study

The strength of our study is the meticulous evaluation of both pharmacologic and mechanical thromboprophylaxis compliance in a large sample of ICUs, providing sufficient information to analyse the relationship between compliance and VTE and other outcomes. Further, this one-year time frame enabled us to see seasonal and staffing changes that may impact compliance. Limitations of our study also existed. The observational design precludes definitive conclusion regarding causation for compliance and patient outcomes. Second, this study was performed in a single ICU, which may limit the generalizability of results to ICUs with different patient populations and institutional guidelines. Additional multi-center studies would be required to confirm our findings and evaluate compliance trends across different ICU environments.

Practice & Future Research telling

The practical implications of our findings are threefold. The improvements in compliance seen in VTE prophylaxis and its impact on VTE rates, duration of ICU stay, and mortality, should prompt healthcare providers to focus on thromboprophylaxis compliance as an important patient safety issue in ICU care. Hospitals should consider targeted training of ICU staff to improve compliance with both pharmacologic and mechanical thromboprophylaxis and to dispel concerns regarding bleeding risks. Future studies should explore the impact of digital tools (e.g. electronic reminders, compliance tracking systems) on improving adherence rates. Lastly, studies focusing on the efficacy of customized thromboprophylaxis protocols, considering the different types of comorbidities, as well as bleeding risks of patients, may help to determine how best to optimize outcomes while reducing complications.

CONCLUSION

This study highlights the critical role of thromboprophylaxis compliance in reducing VTE incidence, ICU stay duration, and readmission rates among ICU patients. With an overall compliance rate of 72%, our findings demonstrate that adherence, especially to mechanical methods, significantly enhances patient outcomes. Non-compliance was associated with higher VTE rates and prolonged ICU stays, underscoring the need for consistent protocol adherence. Addressing barriers to compliance, such as concerns about bleeding risks, is essential to optimizing thromboprophylaxis effectiveness in critical care settings.

Recommendations

- Increase targeted training for ICU staff on thromboprophylaxis guidelines and bleeding risk management.
- Implement digital compliance tracking and reminder systems for ICU providers.
- Develop individualized thromboprophylaxis plans for high-risk patients with complex comorbidities.

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REFERENCES

1. Turck, C. J., Frazee, E., Kram, B., Daley, M. J., Day, S. A., Horner, D., ... & Herout, P. (2012). Major publications in the critical care pharmacotherapy literature: February 2012 through February 2013. *American Journal of Health-System Pharmacy*, *71*(1), 68-77.
2. Rosenberg, D., Eichorn, A., Alarcon, M., McCullagh, L., McGinn, T., & Spyropoulos, A. C. (2014). External validation of the risk assessment model of the International Medical Prevention Registry on Venous Thromboembolism (IMPROVE) for medical patients in a tertiary health system. *Journal of the American Heart Association*, *3*(6), e001152.
3. Ho, K. M., & Tan, J. A. (2013). Stratified meta-analysis of intermittent pneumatic compression of the lower limbs to prevent venous thromboembolism in hospitalized patients. *Circulation*, *128*(9), 1003-1020.
4. Rogers, M. A., Levine, D. A., Blumberg, N., Flanders, S. A., Chopra, V., & Langa, K. M. (2012). Triggers of hospitalization for venous thromboembolism. *Circulation*, *125*(17), 2092-2099.
5. Sawyer, M., Weeks, K., Goeschel, C. A., Thompson, D. A., Berenholtz, S. M., Marsteller, J. A., ... & Pronovost, P. J. (2010). Using evidence, rigorous measurement, and collaboration to eliminate central catheter-associated bloodstream infections. *Critical care medicine*, *38*, S292-S298.
6. Raskob, G. E., Angchaisuksiri, P., Blanco, A. N., Buller, H., Gallus, A., Hunt, B. J., ... & Weitz, J. I. (2014). Thrombosis: a major contributor to global disease burden. *Arteriosclerosis, thrombosis, and vascular biology*, *34*(11), 2363-2371.
7. Qazizada, M., McKaba, J., & Roe, M. (2010). Hospital-acquired venous thromboembolism: a retrospective analysis of risk factor screening and prophylactic therapy. *Hospital Pharmacy*, *45*(2), 122-128.
8. Schiro, T. A., Sakowski, J., Romanelli, R. J., Jukes, T., Newman, J., Hudnut, A., & Leonard, T. (2011). Improving adherence to best-practice guidelines for venous thromboembolism risk assessment and prevention. *American Journal of Health-System Pharmacy*, *68*(22), 2184-2188.
9. Ageno, W., Spyropoulos, A. C., & Turpie, A. G. (2012). Role of new anticoagulants for the prevention of venous thromboembolism after major orthopaedic surgery and in hospitalised acutely ill medical patients. *Thrombosis and haemostasis*, *107*(06), 1027-1034.
10. Caprini, J. A. (2010). Mechanical methods for thrombosis prophylaxis. *Clinical and Applied Thrombosis/Hemostasis*, *16*(6), 668-673.
11. Geisbüsch, C., Richter, D., Herweh, C., Ringleb, P. A., & Nagel, S. (2014). Novel factor xa inhibitor for the treatment of cerebral venous and sinus thrombosis: first experience in 7 patients. *Stroke*, *45*(8), 2469-2471.
12. Brown, A. (2012). Preventing venous thromboembolism in hospitalized patients with cancer: improving compliance with clinical practice guidelines. *American Journal of Health-System Pharmacy*, *69*(6), 469-481.
13. Urban, R., & Chen, L. M. (2012). Gynecologic oncology: clinical practice and surgical atlas.
14. Casha, S., & Christie, S. (2011). A systematic review of intensive cardiopulmonary management after spinal cord injury. *Journal of neurotrauma*, *28*(8), 1479-1495.
15. Mahan, C. E., Spyropoulos, A. C., Fisher, M. D., Fields, L. E., Mills, R. M., Stephenson, J. J., ... & Klaskala, W. (2013). Antithrombotic medication use and bleeding risk in medically ill patients after hospitalization. *Clinical and Applied Thrombosis/Hemostasis*, *19*(5), 504-512.
16. Fowler, R. A., Mittmann, N., Geerts, W., Heels-Ansdell, D., Gould, M. K., Guyatt, G., ... & Canadian Critical Care Trials Group. (2014). Cost-effectiveness of dalteparin vs unfractionated heparin for the prevention of venous thromboembolism in critically ill patients. *Jama*, *312*(20), 2135-2145.
17. Galante, M., Languasco, A., Gotta, D., Bell, S., Lancelotti, T., Knaze, V., ... & Milberg, M. (2012). Venous thromboprophylaxis in general surgery ward admissions: strategies for improvement. *International Journal for Quality in Health Care*, *24*(6), 649-656.
18. Prom, R., Dull, R., & Delk, B. (2013). Successful alteplase bolus administration for a presumed massive pulmonary embolism during cardiopulmonary resuscitation. *Annals of Pharmacotherapy*, *47*(12), 1730-1735.
19. Haut, E. R., Lau, B. D., Kraenzlin, F. S., Hobson, D. B., Kraus, P. S., Carolan, H. T., ... & Streiff, M. B. (2012). Improved prophylaxis and decreased rates of preventable harm with the use of a mandatory computerized clinical decision support tool for prophylaxis for venous thromboembolism in trauma. *Archives of surgery*, *147*(10), 901-907.
20. Piazza, G., Rosenbaum, E. J., Pendergast, W., Jacobson, J. O., Pendleton, R. C., McLaren, G. D., ... & Goldhaber, S. Z. (2009). Physician alerts to prevent symptomatic venous thromboembolism in hospitalized patients. *Circulation*, *119*(16), 2196-2201.
21. Cook, D., Duffett, M., Lauzier, F., Ye, C., Dodek, P., Paunovic, B., ... & Guyatt, G. (2014). Barriers and facilitators of thromboprophylaxis for medical-surgical intensive care unit patients: a multicenter survey. *Journal of critical care*, *29*(3), 471-e1.
22. Qaseem, A., Forland, F., Macbeth, F., Ollenschläger, G., Phillips, S., van der Wees, P., & Board of Trustees of the Guidelines International Network*. (2012). Guidelines International Network: toward international standards for clinical practice guidelines. *Annals of internal medicine*, *156*(7), 525-531.
23. Gagliardi, A. R., Brouwers, M. C., Palda, V. A., Lemieux-Charles, L., & Grimshaw, J. M. (2011). How can we improve guideline use? A conceptual framework of implementability. *Implementation Science*, *6*, 1-11.
24. Pearse, R. M., Harrison, D. A., MacDonald, N., Gillies, M. A., Blunt, M., Ackland, G., ... & OPTIMISE Study Group. (2014). Effect of a perioperative, cardiac output–guided hemodynamic therapy algorithm on outcomes following major

gastrointestinal surgery: a randomized clinical trial and systematic review. *Jama*, *311*(21), 2181-2190.