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Venous Thromboembolism Retrospective Longitudinal Study: The Impact of Active Monitoring on VTE Management Practices of Healthcare Provider's Towards Patient Outcomes

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Abstract

Venous thromboembolism (VTE) is a relatively common disease that stands as the leading cause of preventable deaths in developed nations. VTE encompasses deep vein thrombosis (DVT) and pulmonary embolism (PE) and affects both hospitalized and non-hospitalized patients. Because VTE is associated with substantial morbidity and mortality when untreated, accurate risk assessment and appropriate prophylaxis programs are vital, as overlooked risk factors of these processes can potentially result in misdiagnosis and inappropriate treatment of the condition, with associated complications.

This study aims to assess the impact of active monitoring on VTE management practices among healthcare providers towards patient outcomes at Imam Abdulrahman Al Faisal Hospital in Riyadh, Saudi Arabia, from April 2018 to July 2023. This study uses a longitudinal retrospective study design and data from 33,237 admitted patients were analyzed using a Statistical Process Control (SPC) chart to evaluate the relationship between VTE risk assessment, active monitoring and patient outcomes. Findings identified 11 cases of hospital-acquired VTE, with patients aged 18–40 years developed most cases (7 of 11 cases) and a male predominance of 54.5%. The overall VTE incidence rate during the study period was 0.31%, or one case per 11,000 admissions, having four cases of PE and seven DVT. The results of this study indicate that active monitoring through continuous education and regular patient rounds, significantly improves adherence to VTE risk assessment and prophylaxis at IAFH.

The researchers attributed the increased identification and timely reporting of VTE cases to vigilance by healthcare providers and not to a decline in care quality. A comprehensive, multidisciplinary strategy to VTE management and continuous quality improvement can help reduce VTE-related morbidity and improve patient outcomes. Lastly, addressing risk factors involved in the occurrence of hospital-acquired VTE and post-discharge follow-up of patients were recommended.

Keywords: Venous Thromboembolism, Deep Vein Thrombosis, Pulmonary Embolism, Active Monitoring, VTE Management Practices.

Introduction

Background of the Study

Venous thromboembolism (VTE) is a relatively common disease and the leading cause of preventable deaths in developed countries [1]. VTE refers to both deep vein thrombosis (DVT) and pulmonary embolism (PE), affecting hospitalized and non-hospitalized patients, with around 100 cases per 100,000 people each year [2, 3]. Similarly, Al-Hameed et al. (2015) stat-

ed that an estimated 25,000 people are affected by VTE annually in Saudi Arabia.

The primary risk factors for VTE include age, surgery, immobility, hospitalization, cancer, trauma, pregnancy, the postpartum period, hormone use, obesity, and both inherited and acquired conditions that increase blood clotting [4]. According to Kearon et al. (2012), VTE contributes to significant morbidity and mortality, especially when not treated properly. Once diagnosed, managing VTE presents significant challenges for healthcare providers. Using the wrong treatment or treating it in an inappropriate setting can lead to serious complications and even life-threatening consequences [5].

According to Clapham et al. (2023), many hospitalized patients do not receive adequate VTE prophylaxis, with 40% and 60% of all VTE cases occurring during or within three months after hospitalization. In addition, Bruno et al. (2022) stated that hospitalization increases the risk of VTE by about 100 times. VTE can be clinically silent, making diagnosing many hospitalized patients difficult. Thus, researchers and healthcare providers suggest that a systematic approach to VTE prevention, including risk assessments upon hospital admission, can help reduce morbidity and mortality. Onwuzo et al. (2023) urge healthcare professionals to follow VTE guidelines closely and call on policymakers to develop an easy-to-use algorithm. Furthermore, previous studies have shown that VTE risk assessment and electronic alerts can enhance prevention efforts and reduce hospital-associated thrombosis [6]. Similarly, Pandor et al. (2021) emphasize that accurate risk assessment and personalized pharmacological thromboprophylaxis can help lower the incidence of hospital-acquired VTE.

In a study by Al-Hameed et al. (2011) conducted at a hospital in Saudi Arabia, 500 patients were diagnosed with VTE over a year, with a fatality rate of 20.8%. Two-thirds of these patients were in surgical wards, and the remaining third were in medical wards. The study found that the VTE prophylaxis guidelines were poorly implemented and severely underused. Patients who didn't receive VTE prophylaxis had much higher death rates, which shows how important it is for health authorities to make sure these guidelines are followed in healthcare settings.

Similarly, Ambra et al. (2022) found that while VTE is relatively low in hospitalized patients, healthcare providers need further education on VTE assessment and prophylaxis to ensure they follow the guidelines for all patients at admission. Additionally, they stated that patient education is important to ensure adherence to VTE prevention strategies and recommended performing VTE risk assessments for all patients at discharge to determine if post-discharge prophylaxis is needed, which could help reduce the risk of VTE after leaving the hospital.

Moreover, in their study, Gray and Rasmuz (2012) discussed the importance of taking all possible measures to prevent VTE in hospitalized patients. Implementing a standardized VTE risk assessment and prophylaxis program helped reduce hospital-acquired VTE rates. Along with educational efforts and awareness initiatives, introducing a standardized order set during patient admission, which listed VTE risk factors, also helped raise awareness about VTE prevention. Similarly, Taha et al. (2015) reported that, through performance improvement interventions, their hospitals increased compliance with general medicine VTE risk assessment from 4% in April 2014 to 98% in August 2015.

In 2018, the Performance Improvement Project to enhance VTE management was launched at Imam Abdulrahman Al Faisal Hospital, along with the formation of the Venous Thromboembolism Taskforce Committee. The committee aims to assess patients appropriately for VTE risk and receive the proper prophylaxis according to quality and safety standards. The hospital has implemented policies following CBAHI guidelines for VTE and bleeding risk assessments in adult and pregnant patients. It has also developed specific protocols for groups like postnatal women, stroke patients, and long-distance travelers, covering treatments like antithrombotic therapy and pneumatic compression devices.

Even though the hospital has evidence-based measures and treatments in place, timely and appropriate VTE prophylaxis delivery is still not ideal. This can lead to higher readmissions, more complications, and additional costs. As a result, the hospital is exploring more effective solutions.

Aim of the Study

This study aims to assess the impact of active monitoring on VTE management practices among healthcare providers towards patient outcomes at Imam Abdulrahman Al Faisal Hospital in Riyadh, Saudi Arabia, from April 2018 to July 2023. It also aims to examine the critical role of active monitoring, such as ongoing education and regular rounds, in improving adherence, accuracy and timeliness of VTE risk assessments and prophylaxis to evidence-based guidelines and practice. Lastly, the study seeks to reduce hospital-acquired VTE cases and improve patient outcomes, aiming to refine and optimize the entire care process.

Conceptual Framework

The study is anchored in the Health Belief Model (HBM) by Becker (1974), which looks into individuals' perceptions and behaviors related to health actions and preventive measures. HBM is one of the most commonly used and applied theories in health behavior, which suggests that a person's health-related actions are influenced by six constructs - seriousness of a health condition or risk severity, their susceptibility to it, the benefits of acting, barriers that might prevent their action, self-efficacy to act, and cues that prompt action (Becker, 1974; Champion & Skinner, 2008; Glanz & Bishop, 2010).

In this study, the HBM is used to examine how healthcare providers' perceptions affect their management of VTE through active monitoring and its subsequent impact on patient outcomes. According to Jones et al. (2014), HBM can lead to the best behavior changes when messages effectively address perceived barriers, benefits, self-efficacy, and threats. In the case of venous thromboembolism (VTE) risk assessment and prophylaxis, the HBM helps to understand the beliefs, attitudes, and perceptions of both patients and healthcare providers regarding VTE prevention strategies.

However, according to Xiao et al. (2008), one challenge with the HBM is its assumption that everyone has equal access to health information and services or a similar level of health literacy. On

contrary some researchers argue that health knowledge, beliefs, and behavior are closely tied to overall health literacy.

Additionally, this model suggests that people are rational and more likely to take health-supporting actions if they believe they can address a health issue, expect effective outcomes, and perceive action feasibility. Effective interventions include how people view the risk of VTE, the challenges or barriers they may face, the benefits of their actions, and their confidence in managing the situation. Patients and healthcare providers must consider the benefits of acting against perceived challenges to improve adherence to VTE prevention guidelines. Consistent training on VTE and health education programs that address these factors can also help promote healthier behaviors for healthcare providers and patients.

Materials and Methods

Study Design

This research used a retrospective longitudinal study design to identify and track patients over time to evaluate the relationship between VTE risk assessment, preventive measures, and patient outcomes. The study relied on an existing database that included records from all the OVRs raised regarding VTE incidents found in all patients' files, root cause analysis of hospital acquired-VTE cases, and all the records of patients who developed VTE during the hospitalization in IAFH from April 2018 to July 2023, which were reviewed retrospectively. The patients were assessed based on their age, sex, length of stay in IAFH, type of VTE acquired, prophylaxis received, and risk factors.

Study Setting

The study was conducted at Imam Abdulrahman Al Faisal Hospital in Riyadh, Saudi Arabia, to ensure that the research is situated in the healthcare setting where VTE risk assessment and prophylaxis protocols are implemented.

Study Participants

Inclusion criteria include patients aged >18 admitted to medical, surgical, and gynecological/obstetrical wards between April 2018 and July 2023 and who developed venous thromboembolism within 3 months of hospital admission.

Exclusion criteria were the patients aged <18 years, patients already on anticoagulants on admission, cancer-associated thrombosis, and patients whose admitting diagnosis was not hospital-acquired VTE. Patients with VTE at admission were also excluded from the study.

Statistical Analysis

Statistical Process Control (SPC) was used to analyze and interpret the data, combining time series analysis with a graphical presentation of data. This method often provides insights about the data in much easier and faster ways. Control limits were determined based on the capability of the process. In contrast, specification limits were determined according to the research requirements to enable easier identification of statistically significant changes in the data. The dotted lines (process limits) represented the expected range for data points, assuming variation would remain within expected parameters, specifically normal.

Diagnosis and Reporting of VTE

A radiologist diagnoses deep vein thrombosis (DVT) through Doppler venous ultrasound and identifies pulmonary embolism (PE) using a computerized tomography (CT) scan pulmonary angiogram. After making the diagnosis, the radiologist informs the IAFH VTE Coordinators. The coordinators then meet with the patients, examine their medical records, conduct interviews, and evaluate risk factors that may have led to the development of the VTE. If the patient is readmitted within 90 days, the case will be classified as hospital-acquired VTE.

Results

Imam Abdulrahman Al Faisal Hospital admitted about 33,237 patients from January 2018 to July 2023. During this time, high-risk individuals, including adults over 18 and pregnant women, were regularly reassessed. These reassessments were carried out every 24 hours to track progress and adjust treatment plans as required. The primary physician ensured that patients were informed about the benefits, risks, and potential complications of prophylactic measures.

Based on the assessment findings, the healthcare providers utilized the standardized VTE Risk Assessment Tool to evaluate each patient and tailor the prophylaxis decisions based on each patient's risk score. Among the admitted patients, 11 cases of hospital-acquired VTE were identified. Remarkably, no VTE cases were reported among OB-Gyne patients during the study period.

Table 1: Total number of patients admitted from January 2018 up to July 2023. (N=33,237)

Age/Gender	Without HA-VTE	Developed HA-VTE	Total Count
18-40	28946	7	28953
Female	15803	3	15806
Male	13143	4	13147
41-60	2440	2	2442
Female	1171	0	1171
Male	1269	2	1271
61-74	1180	0	1180
Female	541	0	541
Male	639	0	639
75 or more	660	2	662

Female	327	2	329
Male	333	0	333
Grand Total	33226	11	33237

Table 1 shows the total number of patients admitted to IAFH from January 2018 to July 2023. A total of 33,237 patients were admitted to the hospital during the study period. Of these, 11 patients developed VTE during their hospital stay, while 33,226 patients did not develop VTE. Among the patients who developed VTE, seven were between 18 and 40 years old (N=28,953), involving three females and four males.

Additionally, two male patients in the 41-60 age group (N=2,442) were affected. Similarly, two women developed VTE in the 75-and-older group (N=662).

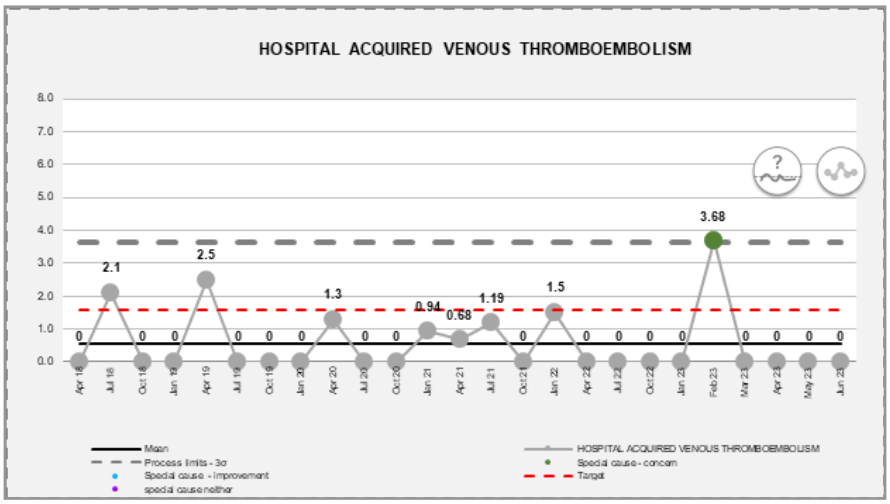
Lastly, there were no reported cases of VTE in the 61-74 age group (N=1,180).

Table 2: HA-VTE patient's diagnosis, demographics (Age, Sex), Length of Stay, type of VTE acquired, type of prophylaxis used during hospitalization, contraindications to pharmacological prophylaxis, and factors that lead to the development of VTE during hospital stay. (N=11)

Diagnosis	Age/ Sex/ LOS	PE/ DVT	Vte Prophylaxis	Contraindication	Risk Factor for VTE
DKA& ARF, and has acute psychotic episodes and delirium; on dialysis treatment; Readmitted	50 y/o, Female 30 days	DVT (2018)	Pharmacological prophylaxis (heparin 5000 IU TID SC)	Thrombocytopenia	- Obesity -Patient discharged without VTE prophylaxis
COPD, IHD, LVF, and gastritis; Readmitted	85 y/o, Male 47 days	PE (2019)	Enoxaparin 60 mg Q12H SC and SCD	None	- Patient discharged without VTE prophylaxis -Delayed prophylaxis for the patient (2 hours) - heart and lung disease - old age
Early Femur Fracture fixation within 24 hours reduces pulmonary complication	22 y/o, Male 36 days	PE (2020)	SCD	Active bleeding	- fracture, past surgery - ORIF operation
COVID-19, HTN, Bronchial asthma, and surgical history of right femur fracture and internal fixation	74 y/o, Female	DVT (2021)	Pharmacological prophylaxis	None	-limited mobilization of the patient - fracture, surgery - old age
COVID-19 with severe complications; bed-bound	48 y/o, Male 15 days	DVT (2021)	Heparin Infusion as per DVT protocol	None	-limited mobilization of the patient
COVID-19 with HTN, DM, Iron Deficiency Anemia and Asthma	58 y/o, Female 18 days	DVT, suspected PE (2021)	Pharmacological prophylaxis (heparin 5000 IU TID SC) and SCD	None	-limited mobilization of the patient - lung disease
ARDS and COVID-19 and mechanical ventilator, DM, HTN, bronchial asthma and hypothyroidism, MRSA (+)	78 y/o, Female 63 days	DVT (2022)	Pharmacological prophylaxis (Heparin infusion as per protocol) then switched to SCD	Active Bleeding	- old age -Bedridden; with pressure ulcer -limited mobilization of the patient - lung disease
Sepsis with respiratory symptoms, hypoxia, with a history of DM, HTN, Old CVA, and dementia	92 y/o, Female/ Obese 29 days	DVT (2023)	Pharmacological prophylaxis (Heparin 5000 TID IU SC)	None	-Delayed CT and administration of 1st heparin dose -bedridden patient; - old age -limited mobilization - lung disease
RTA- Multiple traumas, bilateral lung contusions, and fracture of left tibia	56 y/o, Male 15 days	PE (2023)	Enoxaparin 40 mg Q12h SC and Pneumatic compression device	Surgery	-Bed-bound due to multiple trauma; surgery -Compartment syndrome -delayed administration of VTE prophylaxis since the patient underwent an operation -S/p Fasciotomy and External fixation
Perforated Acute Appendicitis	40 y/o, Male 20 days	DVT (2023)	Enoxaparin 90mg SC q12H	None	-Incorrect VTE reassessment scoring - S/P Abdominal wash and exploration -Limited ambulation of the patient
Nephrotic syndrome; readmitted	26 y/o, Male 13 days	PE (2023)	Enoxaparin 40mg SC OD	None	-Incorrect VTE reassessment scoring -inadequate discharge medication VTE prophylaxis -On bedrest

The table above reveals that majority of HA-VTE patients are older adults. The ages ranged from 22 to 92 years, with 63.6% (7/11) of the patients being aged 50 or older, which is consistent with the higher VTE risk in older populations. In terms of sex, 54.5% (6/11) of the patients were female, and 45.5% (5/11) were male. Regarding the type of VTE acquired, 63.6% (7/11) of the patients developed deep vein thrombosis (DVT), while 36.4% (4/11) experienced pulmonary embolism (PE). The predominance of DVT is common in hospitalized patients with limited mobility, while PE was more frequently observed in patients with additional complications such as surgery or severe infections like COVID-19. Findings also revealed that there are varying degrees of VTE prophylaxis implemented to 11 patients in response to different risk factors. Pharmacological prophylaxis was utilized in most cases; however, several patients faced contraindications such as thrombocytopenia or active bleeding. Notably, many patients were discharged without appropriate VTE prophylaxis despite being at risk.

The duration of hospitalization was also recorded, with 54.5% (6/11) of patients having a hospital stay of 13-20 days, 18.2% (2/11) of patients having a hospital stay of 21-30 days, and 27.3% (3/11) of patients having a hospital stay of 31 or more days. The ALOS of the 11 patients was 27.6 days which is longer than the patients without HA-VTE with ALOS of 3-7 days. These results suggest that longer hospital stays increase the risk of developing VTE. As a result, healthcare providers implemented appropriate VTE prevention measures, particularly for patients with extended hospital stays, to mitigate this risk and improve patient outcomes. This finding is supported by several studies that have shown that prolonged hospitalization increases the risk of developing VTE, as immobility and other factors associated with hospitalization can lead to blood clots forming.



Graph 1: Hospital-acquired venous thromboembolism (HA-VTE) incidents from 2018 to 2023.

Mean observation -	0.4
Average moving range	0.7
Three sigma - 3σ	1.8
Upper process limit (% expressed as decimals)	-1.49/ 2.20
Upper moving range Limit	2.3

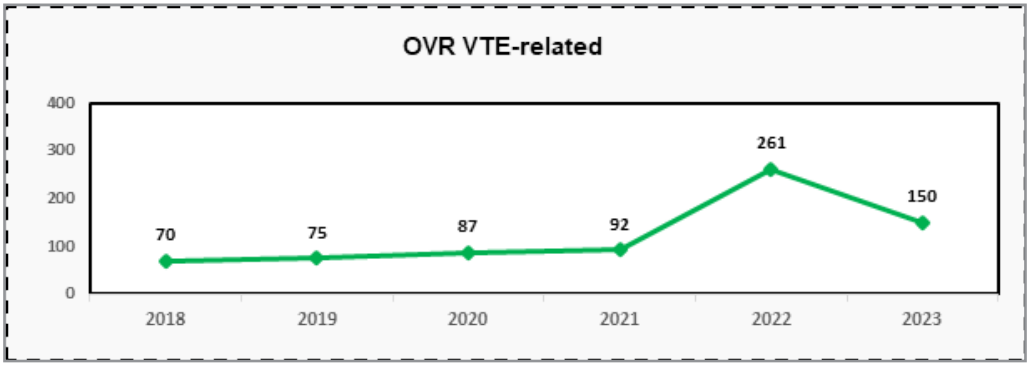
Upper Control Limits (UCL) and Lower Control Limits (LCL) for both the Individuals (I) chart and Moving Range (MR) chart:

UCL for I chart = $\mu + (3 * 3\sigma) = 0.4 + (3 * 1.8) = 5.8$
LCL for I chart = $\mu - (3 * 3\sigma) = 0.4 - (3 * 1.8) = -5.0$

UCL for MR chart = $M\bar{R} * UMRL = 0.7 * 2.3 = 1.61$
LCL for MR chart = $M\bar{R} / UMRL = 0.7 / 2.3 = 0.30$

Graph 1 shows HA-VTE incidents from April 2018 to January 2023, this indicates a stable trend and expected outcome with some deviation from the target. The mean observation was 0.4, with an average moving range of 0.7. However, in February 2023 (2/544), there was a special cause of concern necessitating a root cause analysis (RCA) and the implementation of corrective action plans to address all identified and confirmed HA-VTE cases.

In the first quarter of 2021, the VTE coordinators conducted regular awareness programs, increasing HA-VTE case reporting. This approach also made healthcare staff more vigilant and knowledgeable about the early signs and symptoms of HA-VTE, as reflected in the trend of incidents during the study period.



Graph 2: From 2018 to 2023, the number of VTE-related OVRs increased annually.

Graph 2 shows the number of VTE-related OVRs from 2018 to 2023. The graph indicates that the data increased annually, showing a general upward trend. Based on the findings, there were a total of 70 OVRs raised in 2018 regarding VTE, this increased to 75 in 2019, 87 in 2020, and further rose to 92 in 2021. The peak was observed in 2022, with the number of VTE-related OVRs surging to 261. During the first half of 2023, the VTE task force documented 150 OVRs during their rounds and reviews of patient records. The IAFH actively encourages the prompt reporting and investigation of OVRs for all incidents and reassures staff that reporting will not result in disciplinary action. Since VTE is classified as a reportable event, an OVR is submitted to the patient safety team immediately after a patient is confirmed to have developed VTE during hospitalization.

Discussion

This large-scale, real-world retrospective longitudinal study examined the impact of active monitoring on VTE management practices of healthcare providers towards patient outcomes from 2018 to 2023. The researchers found that most patients, regardless of whether they were receiving surgical or medical treatment, did not develop VTE during their hospital stay because of the active monitoring and regular education sessions by the VTE Taskforce. The findings revealed a particular vulnerability among patients aged 18–40 years, with 7 out of 33,237 patients in this age group developing hospital-acquired VTE (HA-VTE). Among those who developed HA-VTE, 6 out of 11 were male. Furthermore, deep vein thrombosis (DVT) was the most frequently reported form of HA-VTE, accounting for 7 of the 11 cases.

VTE Taskforce Committee

The IAFH has an active VTE committee to enhance VTE management and prevention at the hospital. This committee is mainly responsible for regularly reviewing VTE-related data, actively monitoring and educating patients during rounds, reporting VTE incidents, and communicating findings to hospital leaders to identify and address areas for improvement.

In addition, IAFH conducts daily consultant rounds to ensure on-time updates on patient conditions, present plan of care, and critical radiology findings prompt immediate action. To reduce the risk of VTE, IAFH has established policies, procedures, and guidelines that address prevention in high-risk groups, such as reducing the incidence of VTE in pregnant/postpartum women and adult patients admitted to hospitals. Guidelines also cover the prevention of VTE in surgical patients, antithrombotic therapy, medical patients, long-distance travelers, and stroke patients. The guidelines include recommendations for intermittent pneumatic compression devices to reduce the risk of VTE. Furthermore, VTE coordinators make sure that these policies are followed. They regularly re-orient staff on policies and protocols and address issues like the inadequate supply of essential equipment for patient care, especially those at risk for HA-VTE cases.

According to Rosenfeld and Campbell (2022), VTE committees comprise hospital employees and staff dedicated to reducing VTE risks among patients. In line with the findings, Taha et al. (2015) reported that Sheikh Khalifa Medical City (SKMC) in Abu Dhabi formed a multidisciplinary task force to enhance compliance with VTE risk assessment and evaluate its outcomes. Their study revealed that this task force successfully implemented quality improvement strategies that significantly improved compliance with electronic VTE risk assessments for general medicine patients. These changes enhance their patients' safety and prevent avoidable harm.

Similarly, Gray and Razmus (2012) stated that at Saint Francis Hospital in Tulsa, Oklahoma, a multidisciplinary VTE committee was initiated to implement a hospital-wide quality improvement (QI) program. The goal was to standardize how VTE risk assessments and prophylaxis prescriptions were handled. They found that the program worked well because of the teamwork between committee members, support from physician champions, a variety of communication and education approaches, and the use of evidence to back up the changes.

Figure 1: Multilingual pamphlet and standard education form regarding VTE prevention and Management.

Beyond these measures, IAFH places great importance on educating patients, with regular educational sessions conducted by physicians, Nurses, and VTE Coordinators to ensure patients are well-informed about the risk of acquiring VTE, prevention methods, and signs and symptoms of DVT/PE. A multilingual pamphlet (Fig. 1) regarding VTE is provided to each patient to help them better understand the disease. Furthermore, patients who receive pharmacological prophylaxis are given explanations about the benefits and risks of their prescribed medication for the informed decision-making of patients.

The VTE Taskforce of IAFH also ensures that healthcare staff have accurate and up-to-date information about each patient's care plan and risk factors. Attending physicians and nurses provide comprehensive education on DVT/PE prevention and management. They take the lead and document in the patient education form (Fig.1). This ensures that key information is consistently communicated to patients and their families. To prevent DVT risk, post-operative patients are actively encouraged and supported in early ambulation.

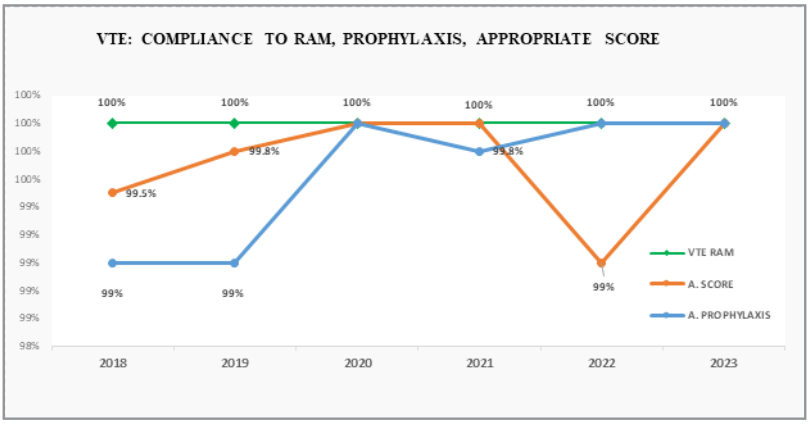
Access to precise and reliable health information is important for patients to make informed decisions and actively participate in their care [7]. Providing timely, targeted education can significantly reduce the failure to administer VTE prophylaxis in hospitalized patients, which improves healthcare quality by using real-time data to focus on at-risk individuals [8].

A study by Piazza et al. (2012) found that pharmacist-led, personalized education sessions resulted in better medication adherence to injectable VTE prophylaxis prescribed by clinicians and decreased the number of patients refusing doses. In contrast to this, a study by Halboup et al. (2022) revealed a lack of VTE awareness and understanding of its prevention among hospitalized patients in Yemen. Patients who were unaware of the condition often had misconceptions about their role in DVT prevention.

VTE Risk Assessment Methods (RAM) Compliance, Appropriate Score and Prophylaxis

IAFH Routine assessments cover all factors influencing patient care. All adult patients admitted to the hospital will be assessed for VTE risk using the VTE risk assessment tool. This evaluation is conducted upon admission or during the Pre-Operative Assessment for elective surgical patients. Radiologists are responsible for reporting cases of DVT/PE to the IAFH VTE Coordinators, who then interview the patients and review their medical records. If the patient is readmitted within 90 days, it is considered hospital-acquired VTE. Graph 3 shows the VTE compliance to RAM, prophylaxis, and appropriate score, which shows consistent hitting or even above the benchmark in the past 5 years, which reflects the commitment of IAFH to effective VTE prevention and management.

According to Mehta and Bhave (2023), VTE risk assessment models (RAMs) have been created and validated for at-risk groups, including hospitalized patients with medical or surgical conditions, cancer patients, and pregnant women. Research shows that using these RAMs consistently leads to higher prophylaxis rates and reduces the overall burden of VTE. For instance, Ismail et al. (2022) found that VTE assessment compliance was similar among medical and surgical patients, with 78% and 80% of each group being assessed. However, there were significant differences in thromboprophylaxis prescribing: 33% of at-risk surgical patients received prophylaxis, while only 14% of at-risk medical patients did.



Graph 3: VTE RAM compliance, appropriate score, and prophylaxis KPIs of IAFH from 2018- 2023.

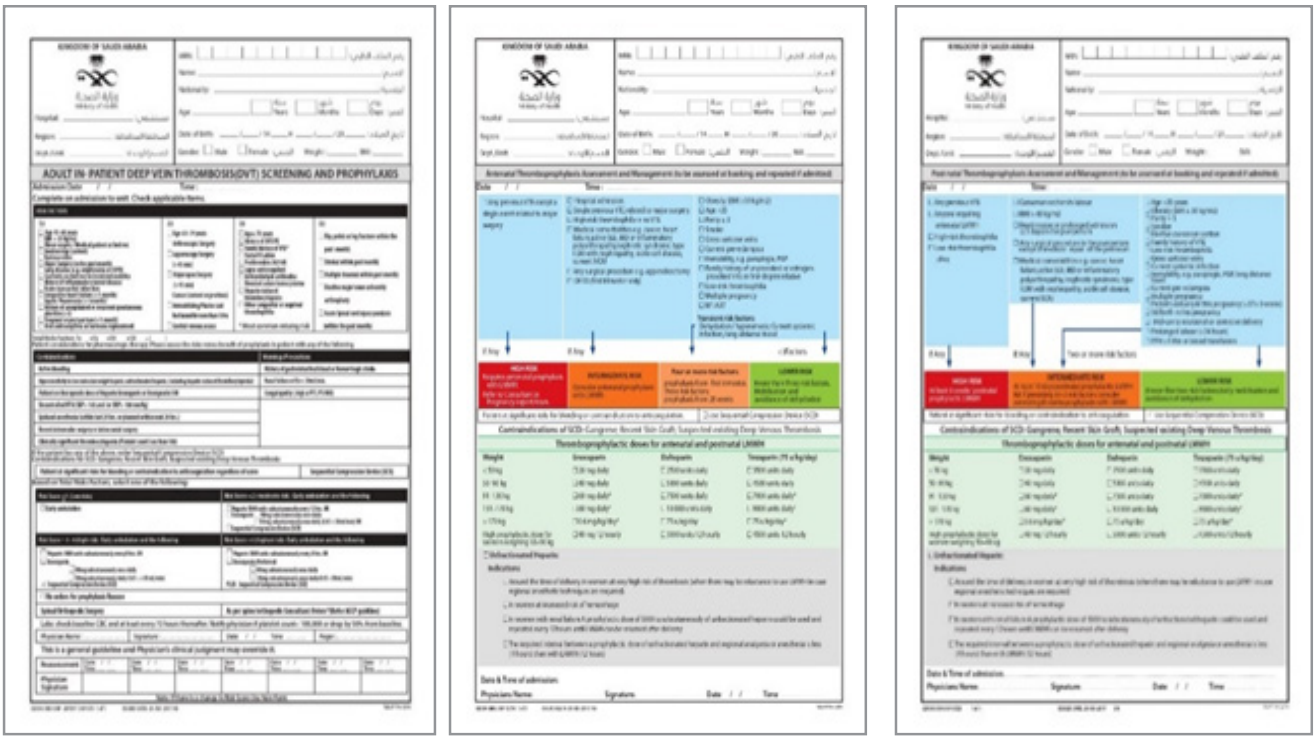


Figure 2: Risk Assessment Tools
(Adult In-Patient DVT Screening and Prophylaxis, and Antenatal and Post Natal Thromboprophylaxis Assessment and Management)

IAFH uses a structured approach to prevent VTE through risk assessment tools for specific patient groups. The Adult Risk Assessment Form (Fig 2) was used to assess the risk of DVT for both medical and surgical patients. Similarly, the hospital utilizes the Antenatal and Post-Natal Assessment forms (Fig 2) to assess the admitted pregnant and post-delivery patients. IAFH ensures 100% compliance with VTE risk assessments and ensures that all patients admitted to the hospital undergo the evaluation. This process was documented in medical records or completed electronically to ensure a standardized assessment for all patients, including high-risk, allowing physicians to identify VTE prevention needs promptly. Therefore, timely and accurate assessment, scoring, and prophylaxis administration are important to effective VTE risk management upon admission.

VTE risk assessment is a practical tool in healthcare that identifies patients at risk of VTE. Widely used risk assessment models are often featured in clinical guidelines or backed by evidence from studies or real-world practice. These models guide interventions aimed at preventing VTE by identifying patients at risk [9]. However, Häfliger et al. (2024) found that the accuracy and predictive performance of the RAMs studied are limited, raising doubts about their clinical value. They emphasize the need for more precise methods to predict VTE risk in medical inpatients and more research to evaluate how well these tools work.

VTE Risk Stratification and Risk Factors Vary Among Different Populations

All patient-related factors are taken into careful consideration when selecting prophylaxis particularly for patients with heightened risk of bleeding such as postpartum women. In such cases, pharmacological thromboprophylaxis is avoided, delayed, or discontinued as clinically indicated. These initiatives have resulted in no cases of VTE among pregnant, post-CS, and post-delivery patients, highlighting the effectiveness of the hospital's current VTE management practices. In addition, all patients 18 years old and above are reassessed for VTE risk every 24 hours or whenever clinical changes occur.

VTE prophylaxis is customized to patients based on their VTE risk score. Patients with low risk (score of 0-1) need no prophylaxis, moderate-risk patients (score of 2) may receive pharmacological prophylaxis, and high-risk patients (score of 3-4) undergo physician assessment to decide on pharmacological or mechanical prophylaxis. Lastly, patients with the highest risk (score of 5) are recommended to receive both mechanical and pharmacological prophylaxis.

The hospital has achieved a score of over 99% overall, which allows for interventions to be made according to the severity of the scores. The staff at IAFH are well-informed about proper VTE prophylaxis and are well trained in the use of Sequential Compression Devices (SCDs). If the SCDs are unavailable or malfunctioning, the staff promptly reports the issue to department heads, raises OVRs to inform responsible departments, and notifies hospital leaders of potential patient care compromises. IAFH staff are well-trained in VTE prophylaxis, including SCDs. In case of device issues, the staff promptly report them and notify hospital leaders. SCDs are always available and well-maintained for patient-centered care and safety.

Despite increased patient admissions compared to previous years, IAFH has maintained exceptional high-quality standards of patient care and services. Notably, the hospital has further enhanced its value-based service delivery, even amidst the increased patient volume. This improvement reflects the hospital's proactive initiatives and adaptive strategies aimed at reducing the incidence of VTE.

Furthermore, all healthcare professionals at IAFH ensure comprehensive VTE management by making daily patient rounds and thoroughly reviewing patient files. Patients and staff are also empowered with knowledge through regular education sessions on VTE, and hospital-acquired VTE incidents are actively reported for immediate intervention and continuous improvement in patient safety protocols.

The efficiency of VTE prevention strategies implemented at IAFH is reflected in the lower incidence of VTE events, and with active monitoring and reporting, the number of patients developing HA-VTE has decreased. Early detection and management of DVT/PE are also managed immediately, resulting in decreased length of stay and improved hospital's efficient and value-based care provided during hospitalization. Consequently, complications such as post-thrombotic syndrome, recurrent VTE, and major bleeding events have markedly decreased which shows the improved patient safety and efficiency of patient services at IAFH.

The distribution of established VTE risk factors changes depending on the age at which VTE occurs. Advanced age is the most significant and common risk factor for experiencing a first venous thromboembolic event [10]. The decision to administer prophylaxis should consider the VTE risk, age, and life expectancy of each patient. Prophylaxis is generally unnecessary for most patients with a 3-month VTE risk below 1.0%. Since most patients have a risk lower than 1%, offering prophylaxis to everyone would not be an efficient use of resources. Moreover, for patients with an estimated VTE risk under 0.26%, prophylaxis can be harmful and should be avoided [11].

Subsequently, Feng et al. (2021) discussed that the knowledge of medical personnel about VTE prophylaxis has great importance in the effectiveness of prophylaxis. Poor knowledge about VTE prevention may lead to inconsistent practices, potentially increasing VTE rates among hospitalized patients. Assareh et al. (2016) supports this and mentioned that research has shown that implementing proper VTE prevention strategies can reduce VTE incidence by up to 70%. For instance, VTE prevention and treatment protocols have been successfully applied in U.S. hospitals, resulting in a reduction in the rates of VTE.

Advances and Limitations of the Research

This study on active monitoring in VTE management at Imam Abdulrahman Al Faisal Hospital, conducted over six years, aimed to examine the occurrence of VTE among hospitalized patients and considered the seasonal variations in disease incidence. The study found that continuous education, patient rounds, and awareness among healthcare staff increased vigilance and active reporting of VTE-related cases in the hospital. This resulted in timely assessment and administration of appropriate prophylaxis, which helped to reduce the risk of VTE cases during hospitalization. In addition, the active monitoring system during the study period has enhanced adherence to evidence-based guidelines, and the use of risk assessment tools has allowed for more tailored prophylactic measures, improving patient outcomes and reducing VTE complications.

On the other hand, the study did not focus on the specific risk factors contributing to hospital-acquired VTE. It did not investigate the differences between patients who developed VTE while hospitalized and those who experienced it after leaving the hospital. Additionally, it was also limited because it was based on retrospective data, which may not capture all variables influencing patient outcomes. This study was a single-center study, and patients underwent multiple dynamic assessments during their hospital stay because of the changes in their condition and treatment. Furthermore, the researchers also faced challenges with limited workforce and funding, which meant they could not follow up with patients after discharge. As a result, the study was unable to gather data on VTE-related events that might have happened within three months of patients' discharge. This could lead to an underestimation of the VTE rate compared to what they were able to report.

Conclusion

In conclusion, this study demonstrated the significant impact of active monitoring on VTE management and patient outcomes. It shows the significance of the active role of VTE Coordinators in monitoring the HCP's practices in VTE risk assessment for

achieving improved patient outcomes and delivering efficient, value-based, and high-quality care at Imam Abdulrahman Al Faisal Hospital. The study revealed that most patients did not develop VTE due to the active monitoring and prevention of the hospital. However, cases were more common among older adults with prolonged hospital stays, with deep vein thrombosis (DVT) being the most frequently reported type [12-15].

Furthermore, the increase in reported cases of hospital-acquired VTE doesn't mean care quality and services have declined. Instead, it shows that healthcare providers are better at identifying and reporting these cases promptly. IAFH is focusing on more patient-centered and proactive approaches, teamwork and ongoing efforts to improve the quality of their VTE management strategies. The hospital VTE task force has significantly improved patient safety and prophylaxis through ongoing education and routine hospital rounds [16-20].

They have also improved the way that risks are assessed and how prevention is applied to reduced preventable VTE cases that occur in the hospital. This also reduces the risk for complications associated with VTE and improves patient care by allowing patients to recover faster. As a result, patients are spending less time in the hospital or intensive care, and it also saves on health care costs. To continue these positive results, it is important to stay vigilant, prioritize education, and follow the established guidelines and protocols for preventing the risks of VTE [21-25].

IAFH's effective efforts to lower VTE risk point to the success of its VTE prevention and management protocols. Moreover, the education and training provided at the hospital, along with safety campaigns, and improving the healthcare providers' understanding of and adherence to practice guidelines strongly emphasizes its commitment to managing VTE and patient care [26-29].

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Conflict of Interest Statement

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.

Ethics Approval

Ethics approval for this study was not required as it involved a retrospective cohort analysis of anonymized patient data. Patient confidentiality was strictly maintained throughout the study, adhering to all relevant data protection and privacy regulations.

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Author Contributions

Conceptualization, R. Daowd, A. Algarni, S. Saab, M. Almograbi, S. Mumtaz, A. Quilapio, I. Alnajjar and N. Alrashed; Data curation, , R. Daowd, S. Saab, S. Mumtaz, A. Quilapio and I. Alnajjar; Formal analysis, R. Daowd, A. Algarni, S. Saab and A. Quilapio; Investigation, R. Daowd, A. Algarni and I. Alnajjar; Methodology, R. Daowd, M. Almograbi and A. Quilapio; Project administration, R. Daowd, S. Saab, M. Almograbi, S. Mumtaz, I. Alnajjar and N. Alrashed; Resources, Rateb Daowd and Ateeq Algarni; Software, Rateb Daowd, Amira Fatmah Quilapio and Naif Alrashed; Supervision, A. Algarni, S. Saab, M. Almograbi, S. Mumtaz and I. Alnajjar; Validation, R. Daowd, S. Saab, M. Almograbi, S. Mumtaz, A. Quilapio, I. Alnajjar and N. Alrashed; Visualization, R. Daowd, A. Algarni, M. Almograbi, S. Mumtaz, A. Quilapio and N. Alrashed; Writing – original draft, R. Daowd and A. Quilapio; Writing – review & editing, R. Daowd, A. Algarni, S. Saab, M. Almograbi, S. Mumtaz, A. Quilapio, I. Alnajjar and N. Alrashed.

Data Availability Statement

The data analyzed in this study are not publicly available due to hospital confidentiality and data management policy but are available from the corresponding author on a reasonable request.

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