Original Research Article

Adherence to NICE guidelines for Venous Thromboembolism (VTE) Prophylaxis in Surgical Patients – Audit Examining the Impact of Electronic Prescribing and Medicines Administration (EPMA)

Abstract

Background: Venous thromboembolism (VTE) poses a significant healthcare burden, leading to mortality and long-term complications. Despite guidelines, VTE prophylaxis rates remain low. In surgical settings, VTE prophylaxis is effective but often administered inappropriately. The National Institute of Health and Care Excellence (NICE) guidelines provide a comprehensive approach to VTE risk assessment and prophylaxis, emphasizing patient safety.

Aims: This audit at Lister Hospital- East and North Herts NHS Trust in the United Kingdom aims to assess compliance with NICE guidelines for VTE prophylaxis in surgical patients, assess the impact of the newly introduced Electronic Prescribing and Medicines Administration (ePMA) system, to identify areas for improvement in patient care and policy development.

Methods: This retrospective observational study analysed Lister Hospital's medical records to assess compliance with NICE guidelines for VTE prophylaxis in 88 surgical ward patients between Dec 2021 and Mar 2022. Data was collected from medical charts using convenience sampling, allowing for nonrandomized selection. Researchers assessed protocol adherence using six steps: 1st VTE assessment checklist completion, 1st Dalteparin prescription, 1st Dalteparin administration, 2nd VTE assessment, TEDS prescription, and TEDS administration.

Results: This audit revealed variability in protocol adherence among patients, with concerns such as incomplete checklists n=49 (55.7%), low stocking prescription adherence n=36 (40.9%), and rare second VTE assessments n=7 (8%). Younger patients showed better protocol completion, and gender differences were noted, with females being more compliant with TEDS usage. Post-ePMA implementation, there were significant decreases in adherence for 1st VTE Checklist ($p = 0.00001$), second VTE assessments ($p = 0.05$), and TEDS prescription ($p = 0.0001$) compared to the pre-ePMA group.

Conclusion: Adherence to NICE guidelines is currently suboptimal and interventions are required to optimise the adherence to guidelines and improve the effectiveness of ePMA. Improving understanding of the importance of adherence to the NICE guidelines on VTE prophylaxis, addressing protocol completion gaps, and enhancing education of ePMA system usage are key strategies for optimizing the ePMA model's effectiveness in the future. Medical practitioners in the surgical sections should undertake educational sessions via posters or presentations outlining the NICE guidelines. Appropriate and comprehensive training sessions tailored towards evidenced shortcomings in completing the protocol and ePMA usage is recommended, with further bi-annual mandatory training sessions to ensure and reinforce staff competencies. Categories: General Surgery, Healthcare Technology, Therapeutics Keywords: electronic prescribing and medicines administration (epma), pulmonary embolism, deep vein thrombosis, surgical patients, vte prophylaxis protocol

Categories: General Surgery, Healthcare Technology, Therapeutics, advances in medicine

Keywords:electronic prescribing and medicines administration (epma), pulmonary embolism, deep vein thrombosis, surgical patients, vte prophylaxis protocol

Introduction

Venous thromboembolism (VTE) is a significant condition that causes a healthcare burden to most hospitalised medical patients. VTEs contribute to the primary cause of mortalities, and persons who survive them are at risk of reoccurring episodes, primary cardiovascular conditions, and lost disability for years that can be hard to manage [1]. Despite applying nationally uniform guidelines and recommendations, VTE prophylaxis rates remain low, risking patient wellness and challenging healthcare outcomes [2]. Over 40% of hospitalised persons are at risk of VTE, while over 10% develop VTE in the hospital. Some VTE complications such as pulmonary embolism, post thrombotic syndrome and chronic thromboembolic pulmonary hypertension may worsen or recur after patients are discharged [3,4]. VTE Prophylaxis, such as anticoagulants, demonstrates increased effectiveness in reducing VTE rates in surgical wards. Despite the increased effectiveness of VTE prophylaxis in surgical settings, the vast majority of administered VTE prophylaxes are inappropriate, and research has found that only approximately 60% receive the proper treatment approach [5]. Primarily, patients develop complications and toxicity due to ineffective methods or providers' failure to adhere to national guidelines on VTE prophylaxis protocol. However, advancing interventions and adhering to the national guidelines on VTE prophylaxis protocols can contribute to better management of VTEs.

According to the National Institute of Health and Care Excellence (NICE)[6], the NICE guideline was nationally adopted to enable healthcare providers to assess and reduce the risk of VTEs for patients aged 16 and above. Healthcare personnel should consider patients' risks of bleeding before administering VTE prophylaxis. Therefore, the NICE guideline is a holistic tool that permits medical personnel to develop patients' VTE treatment plans while engaging in suitable interventions. The NICE guidelines require healthcare providers and physicians to adhere to several practices. Practitioners should assess all patients to ascertain bleeding swiftly and VTE risk after admission or during the initial consultant review. They should use tools published in peer-reviewed journals, professionals and professional networks, or a national body in the UK. VTE prophylaxis should commence within fourteen hours after admission unless population-specific recommendations differ or state otherwise. Surgical doctors and practitioners should reassess all trauma, surgical, and medical patients for bleeding and VTE risks during consultant review or when patients' conditions change. This protocol as stated by the NICE guidelines should be followed by every NHS Trust. Every hospital in the country should be compliant with this protocol to ensure appropriate evidence based clinical practice.

Also, practitioners must measure patients requiring anti-embolism stockings and provide stockings of the correct size. Further, trained nurses must provide fit anti-embolism stockings and guide patients on using the stockings. Healthcare facilities must encourage and instruct patients who use anti-embolism stockings to use them always until their mobility increases significantly [6]. The NICE guideline expects personnel and facilities to monitor anti-embolism stockings use among patients and assist those who wear them incorrectly. Discomfort, pain, skin markings, discolouration, and blistering-on bony prominences and heels necessitates the termination of the use of anti-embolism stockings. Utilising intermittent pneumatic compressions is a suitable alternative.

Further, the NICE guideline offers general surgery-specific procedures to surgical doctors and practitioners. First, doctors should offer VTE prophylaxis to abdominal surgery patients with elevated VTE treatment, including urological, gastrointestinal, and urology patients. Second, surgical doctors should initiate mechanical VTE prophylaxis after admitting patients for abdominal surgery and choose between intermittent pneumatic compression or anti-embolism stockings. Third, they should maintain prophylaxis until patients' reduced mobility significantly diminishes relative to their projected and normal

mobility. Fourth, doctors should augment VTE prophylaxis for at least seven days for patients who have undergone abdominal surgery. Their VTE risks outweigh their bleeding risks, considering individual patients' factors and medical judgement [6]. Lastly, surgical professionals should consider encompassing VTE prophylaxis to 28 days postoperatively for abdominal cancer patients.

Adherence to NICE guidelines provides healthcare professionals a standard treatment for all patients. This audit aims to find out the adherence to NICE guidelines in Lister Hospital for Venous Thromboembolism (VTE) Prophylaxis in surgical patients and the effect the introduction of the Electronic Prescribing and Medicines Administration system has had on adherence to the guidelines. The objective is the assess the compliance with accepted NICE guidelines for VTE prophylaxis in surgical inpatients admitted to surgical wards under Urology and General Surgery over a four-month period at Lister Hospital- East & North Herts NHS Trust. This will help to identify the gaps in the system and a more practical and appropriate policy can be made keeping in view the results of this audit.

This article was previously presented as a meeting abstract at the ESCP 17th Scientific & Annual Meeting, 21 - 23 September 2022, Dublin, Ireland.

Materials And Methods

Study Setting and Design:

The descriptive and observational study design was based on the in-depth retrospective chart review of Lister Hospital's medical records and drug charts for compliance with the NICE guidelines of VTE prophylaxis. The design allowed researchers to evaluate in-patient drug charts and examinations of eightyeight patients admitted to surgical wards from December 2021 to March 2022. The retrospective chart and records review resulted in a qualitative research design where we collected data from existing databases without intervention or interaction with research subjects. As a descriptive study, the design allows for assessing medical data regarding a descriptive phenomenon [7,8]. The study design was purely observational, where researchers interacted with data from established and already-occurring events to espouse naturally occurring relationships and outcomes before and after interventions. Accurate medical evidence interpretation requires an in-depth understanding of the relationships between outcomes and exposures [9]. The charts provided adequate information for the assessment and determination of the hospital's compliance with the NICE guidelines on VTE prophylaxis protocol and the effect of the Electronic Prescribing and Medicines Administration system (ePMA).

Inclusion and Exclusion Criteria:

A total of 88 patients admitted to general surgery wards at Lister Hospital East and North Hertfordshire Trust were audited on their VTE prophylaxis during their admission. The audit was conducted at two time periods: 1. Feb 2022 (Pre-ePMA) n=53, and 2. March 2022 (Post-ePMA) n=35. 2 patients were excluded because of the incomplete recorded data. Researchers included eighty-eight patients: 50 males and 38 females. The exclusion criteria excluded two patients since their data records were incomplete.

Data Collection:

Research and audit data were obtained from medical charts. Researchers collected information on several patient variables: gender, team, age, wards, protocol adherence (along six steps), and protocol stages. Also, researchers obtained variables' data before and after ePMA adherence for comparisons and analyses. These comparisons of different data sets within the four months allowed for a comprehensive audit of the impacts of adherence to guidelines on VTE prophylaxis protocol. Researchers used convenience sampling, drawing the eighty-eight patients admitted to surgical wards between December 2021 and March 2022. Convenience sampling is adequate for cross-sectional research studies since it allows for simultaneous and nonrandomised selection of a population group from a specified period, exposures, and

outcomes [10]. The sampling technique is most common during a retrospective chart review due to its methodological rigour [11]. Also, the sampling technique permits researchers to comprehend the inherent and developing qualities of representative participants or populations for more expansive conceptualisation or generalisation. Since the sampling criteria were non-randomised, it embraced inclusion and exclusion criteria. The inclusion criteria demanded that patients be admitted to general surgery wards at Lister Hospital East and North Hertfordshire Trust, audited for VTE prophylaxis during their admissions, and fall within the December 2021 and March 2022 timelines.

Assessment and Protocol:

Additionally, researchers cross-checked the acquired data against the six VTE prophylaxis protocol steps. The six steps the researcher cross-checked aided in performance tracking and qualitative analysis of results. Researchers verified the six protocol steps by confirming the completion of the checklist, prescription of 1st Dalteparin, administration of 1st Dalteparin, the undertaking of second VTE, prescription of TEDS, and administration of TEDS.

Results

Data was collected for a total of eighty-eight patients (Males: 50, Females: 38) in the audit period from December 2021 to March 2022 in the Lister Hospital. The mean age was 66.6 years with a range from 19 to 97 years. The demographic details of the patients are given in Table 1.

The gender distribution of patients is displayed graphically in figure 1. with N = 88 total

Sr No.	Patient Demographics	
1	Gender: n (%)	Males: 50 (56.8%)
		Females: 38 (43%)
2	Mean age (years)	66.6
3	Type of Admission: n (%) (Team Distribution)	Emergency: 60 (68%)
		Elective: 28 (31.8%)
4	Ward: n inpatients (%)	7aN: 29 inpatients (32%)
		7aS: 15 inpatients (17%)
		7bN: 23 inpatients (26%)
		7bS: 21 inpatients (23.8%)

TABLE 1: Summary of Patients' Demographics

Surgical Wards: 7aN (29 inpatients), 7aS (15 inpatients), 7bN (23 inpatients), 7bS (21 inpatients). Located on the 7th Floor and separated in to A and B sides with each side further separated into a North (N) and South (S) region on which surgical inpatients are admitted.

patients.

The distribution of wards on which the patients where admitted is displayed graphically in figure

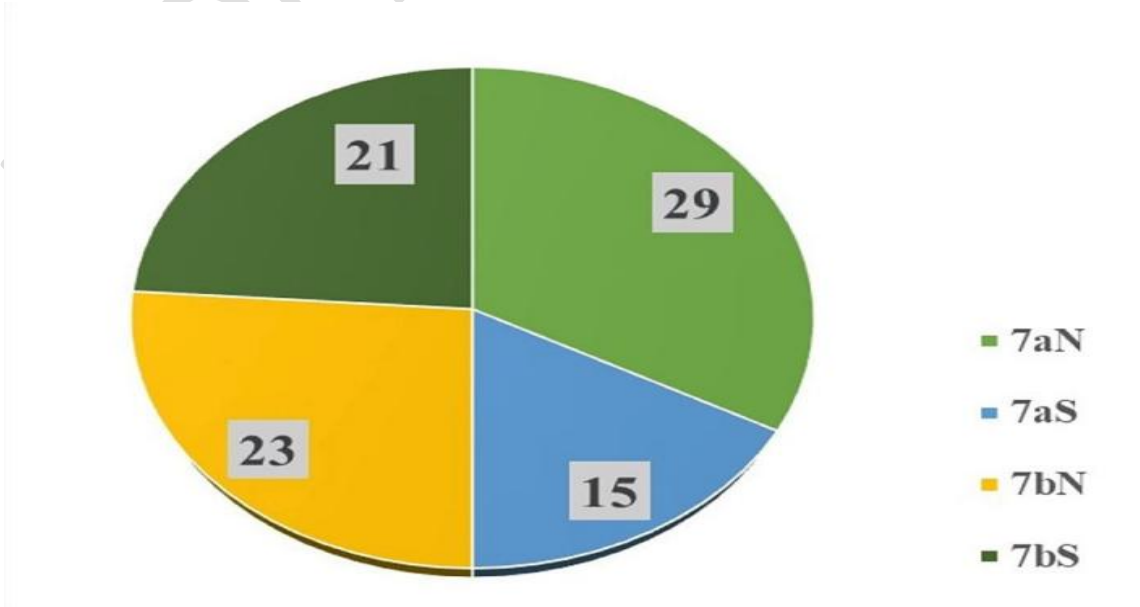

FIGURE 2: Ward Distribution (N=88)

Surgical Wards: 7aN, 7aS, 7bN, 7bS. Located on the 7th Floor and separated in to A and B sides with each side further separated into a North (N) and South (S) region on which surgical inpatients are admitted.

2 with N= 88 total patients.

Protocol Adherence:

All patients in the audit were assessed on protocol adherence in accordance with NICE guidelines. The protocol adherence was found individually in all six steps, as well as based on age, gender, ward, and team, and separate results were drawn out of each evaluation.

Protocol Adherence along 6 steps:

Protocol adherence in each of the six steps was found in the medical records and data from the ward. All patients in the audit period were studied and followed thoroughly for VTE prophylaxis.

Varied Adherence to Protocol Stages: Adherence to the VTE prophylaxis protocol varied among patients. This suggests that not all patients were following the recommended steps of the protocol consistently.

First VTE Assessment Checklist: In 55.7% of patients (n=88), practitioners did not complete the bleeding risk and clot checklist. This is an essential part of the protocol, and its omission can impact patient safety.

Dalteparin Administration: The administration of Dalteparin, likely a medication used for VTE prophylaxis, reached 85% (n=88). This indicates a relatively high compliance rate with this aspect of the protocol.

Stocking Prescription Adherence: For patients with stocking prescriptions (likely compression stockings), only 40.9% (N=88) had the stockings worn or adhered to the prescription. Compliance with this aspect of the protocol seems to be lower.

Second VTE Assessment: Completing the second VTE assessment was rare, with only 8% of patients (n=88) undergoing this step. This suggests that a significant portion of patients did not receive the recommended follow-up assessment.

Overall, it's essential to address the issues of incomplete checklist assessments, low adherence to stocking prescriptions, and the low rate of second VTE assessments to ensure that VTE prophylaxis protocols are consistently followed for all patients, regardless of their age. Patient safety and protocol adherence should be a priority in clinical practice.

The summary of Protocol Adherence along 6 steps is displayed in figure 3. The data has been represented as a percentage of adherence to each step.

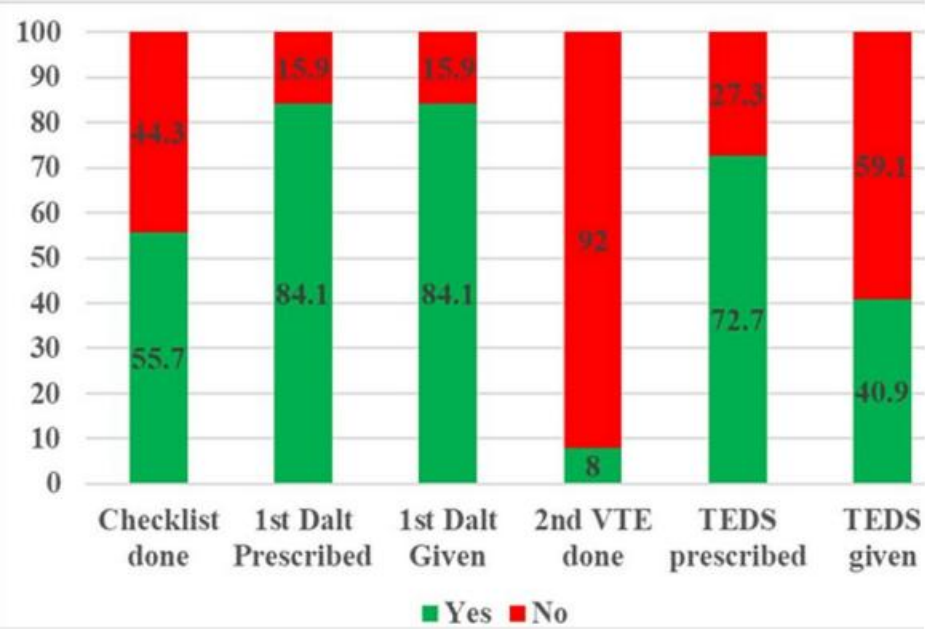

FIGURE 3: Summary of Protocol Adherence along 6 steps. The data has been represented as a percentage (%) of adherence to each step. (n=88)

The data has been represented as a percentage (%) of adherence to each step. N=88

Protocol Adherence in terms of Age:

It appears that there is a correlation between the completion of VTE prophylaxis protocol stages and the age of the patients. Patients with lower mean ages were more likely to have 5 out of 6 protocol stages completed. Patients with lower age were more likely to have completion of all protocol steps as compared to patients with higher age. The summary of the distribution of mean age according to protocol adherence has been given in Figure 4.

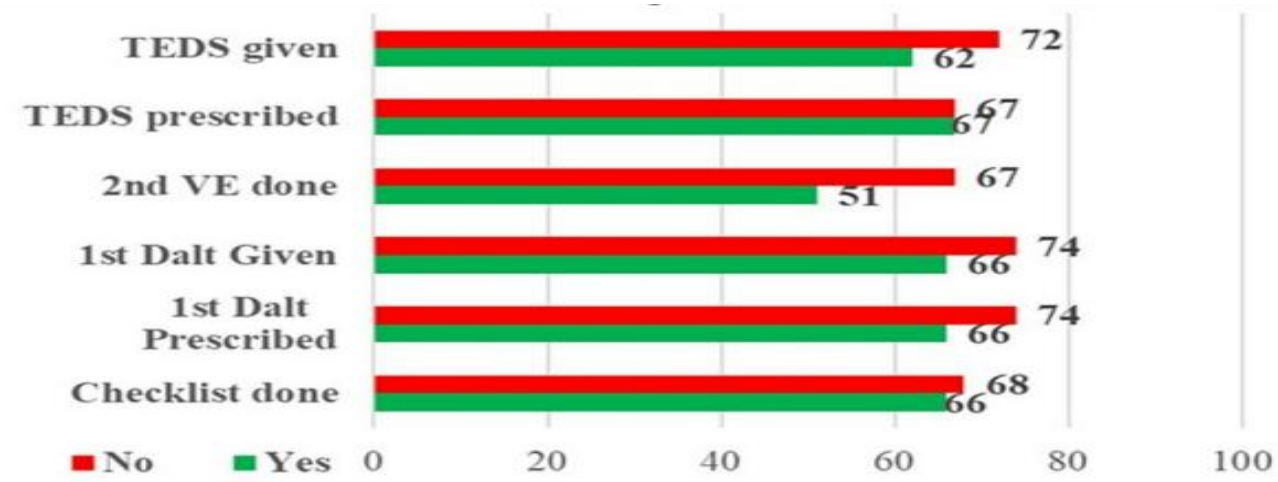

FIGURE 4: Mean Age according to Complete Protocol Stages. (n=88)

The data has been represented as mean age in adherence to each step.

Protocol Adherence in terms of Gender:

When comparing patient adherence to the protocol based on gender, no significant variation was detected, with both males and females demonstrating similar results and compliance rates. However, a subtle difference emerged concerning the use of TEDS (compression stockings), where females exhibited higher compliance. Furthermore, the data indicated that females received more frequent prescriptions for TEDS in comparison to males. These findings suggest that, overall, gender did not significantly impact protocol adherence, but it did influence the usage of TEDS, with females being more adherent to this specific aspect of the prophylaxis protocol. The results are displayed in figure *5*.

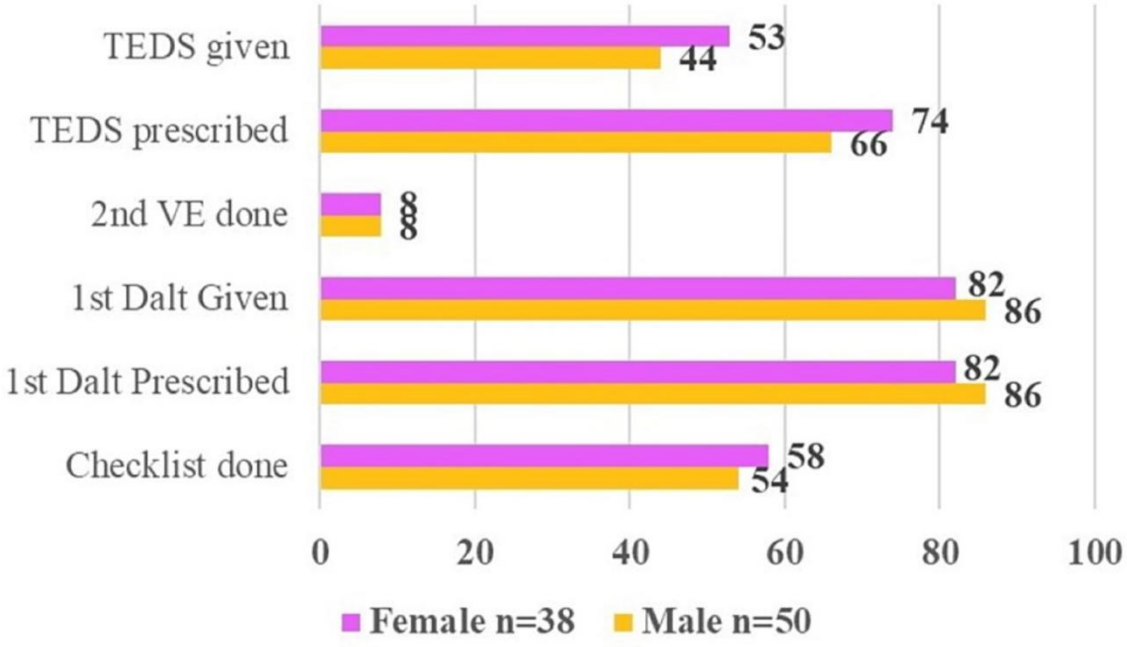

FIGURE 5: Gender Percentage adherence according to Protocol Stages.

The data has been represented as percentage (%) where males (n=50) and females (n=38)

Protocol Adherence in terms of Ward:

The assessment of protocol adherence conducted separately for each ward revealed a consistent pattern across most wards, with each step of the protocol showing similar data. However, a concerning trend emerged as the data indicated that the second VTE assessment was infrequently performed in all wards, highlighting the need for focused attention on this protocol step to improve overall patient care and safety.

Among all the data collected and considering the total number of patients, Ward 7AN stood out as an area of concern. It was observed that in Ward 7AN, a significant number of patients did not have most protocol steps followed, suggesting a potential need for targeted interventions, additional training, or quality improvement initiatives in this specific ward to enhance adherence and ensure that patients receive consistent and appropriate VTE prophylaxis care. Protocol stages completion according to wards has been displayed in figure 6.

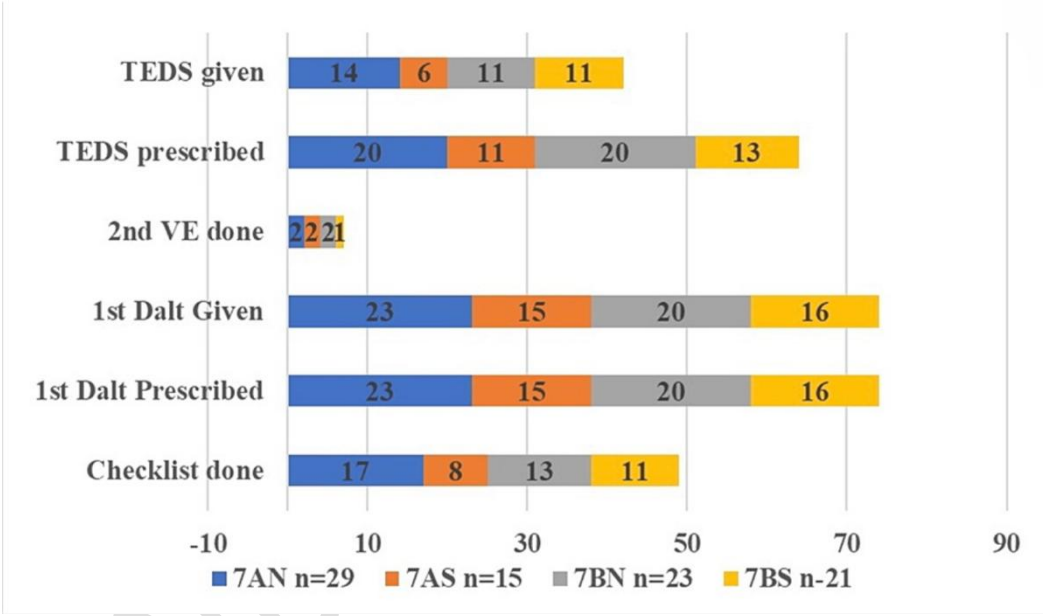

FIGURE 6: Protocol Stages completion according to Wards

The data has been represented as the number of patients who underwent each step in a particular ward. (n=88)

Comparison of Protocol adherence, Pre- and post-ePMA:

The comparison of protocol adherence before and after the implementation of electronic prescription and medication administration (ePMA) revealed statistically significant ($P < 0.05$) differences in certain protocol steps. Specifically, the values for the Checklist, second VTE assessment, and TEDS prescription were notably higher in the pre-ePMA patient group compared to the post-ePMA patient group. These differences were statistically significant, with p-values of 0.00001, 0.05, and 0.0001, respectively .

These findings are displayed in table 2 and Figure 7. They suggest that the introduction of ePMA may have had an impact on the adherence to these specific protocol steps. However, it is important to note that the p- values for other protocol steps were deemed insignificant, implying that the electronic system may not have had a statistically significant effect on those aspects of protocol adherence. Further analysis and investigation may be needed to understand the reasons behind these differences and to assess the overall impact of ePMA on patient care and protocol compliance.

Outcome	Pre-ePMA (n=53) (%)	Post-ePMA (n=35) (%)	P-Value (P<0.05 significant)
Checklist Done	75	25.7	0.00001
1st Dalt Prescribed	85	82.9	0.85 Not Significant
1st Dalt given	85	82.9	0.85 Not Significant
2nd VTE done	11	2.9	0.05
TEDS prescribed	83	57.1	0.0001
TEDS given	39.6	42.9	0.77 Not Significant

TABLE 2: Comparison of Protocol stage completion Pre(n=53) and Post(n=35) ePMA

The data has been represented as percentage (%) where Pre ePMA (n=53) and Post ePMA (n=35). P value is considered significant at $P < 0.05$

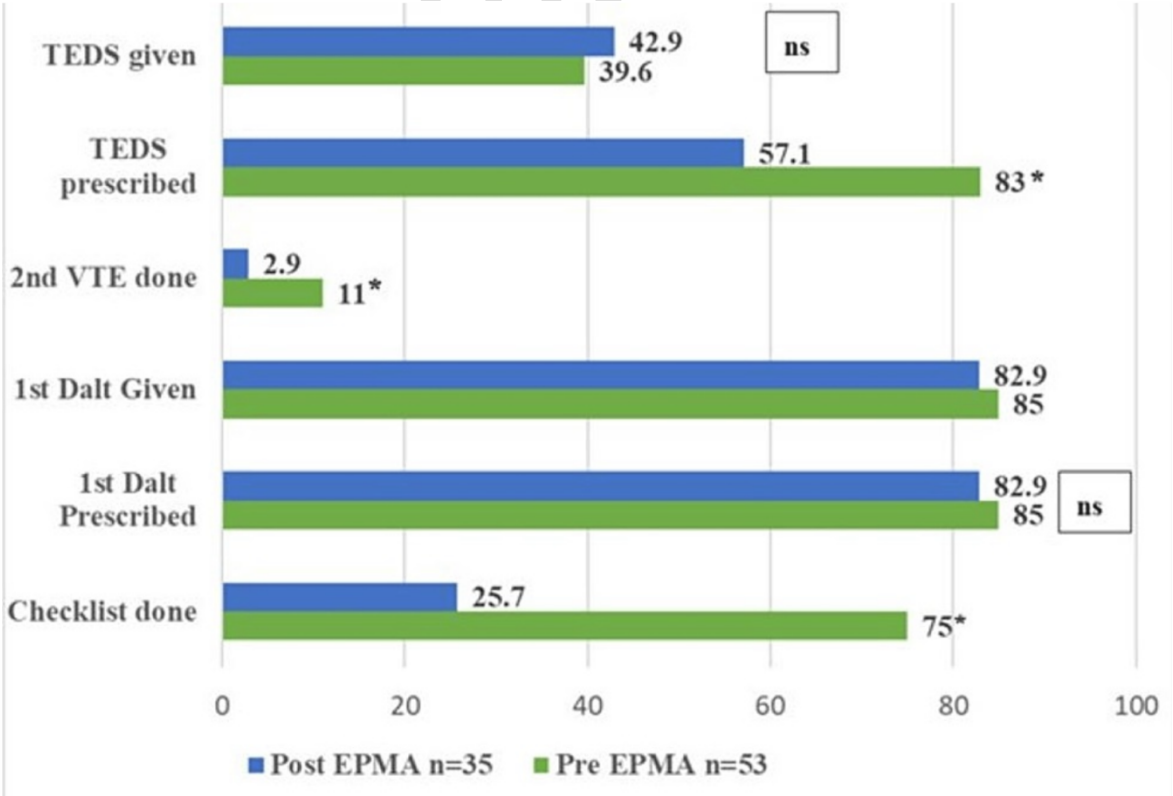

FIGURE 7: Comparison of Protocol completion percentage at each

stage, Pre(n=53) and Post(n=35) ePMA.

The data has been represented as the percentage (%) of patients who had completion of each protocol stage both pre (n=53) and post (n=35) ePMA.

In this audit, it was found that there was significant variability in protocol completion among patients. Of concern was the fact that over half of the patients did not have the bleeding risk and clot checklist completed, which is a crucial element of the protocol. While the administration of Dalteparin reached a relatively high compliance rate of 85%, adherence to stocking prescriptions was notably lower at 40.9%. Moreover, the completion of the second VTE assessment was rare, with only 8% of patients undergoing this step. Interestingly, there was a correlation observed between patient age and protocol completion, with younger patients more likely to have five out of six protocol stages completed. Gender differences were also noted, with females being more compliant in using TEDS (compression stockings) and receiving more TEDS prescriptions compared to males. These findings highlight the need for targeted interventions and improved adherence strategies to ensure consistent adherence to VTE prophylaxis protocols across all patient demographics.

Discussion

The audit and assessment of healthcare data from Lister Hospital provides retrospective and analytical results that will improve the understanding of the outcomes of implementing the ePMA system on adherence to NICE guidelines on VTE prophylaxis protocols for surgical care. The analysis considered hospitalised patients over those in community care since they are at higher risk of developing VTE during their in-patient stays than general populations or patients in community care [12]. Research indicates that the risk of VTE among patients undergoing surgical procedures such as orthopaedic surgeries ranges from 50-60% [13]. The methodological rigour provided by purposive sampling created an avenue for effectively auditing hospitalised patients at Lister Hospital East and North Hertfordshire Trust. The audit occurred in February and March and included 53 and 35 patients. These two different periods reflect the outcomes based on the checklists before and after the implementation of ePMA. Although the results revealed that VTE prophylaxis protocol was covered at each stage, the results varied, and the coverage was not universal. The expectations are that the NICE guidelines should focus on all hospitalised patients and provide patient- centred care across different healthcare specialities [14]. Therefore, adherence to NICE guidelines should allow enhanced VTE prophylaxis administration and reduced DVT incidences [15].

Further, the comparison of VTE protocol outcomes, before and after the adherence to the NICE protocol and ePMA, show a significantly significant margin difference for checklist done, 2nd VTE done, and TEDS prescribed. Notably, the checklist was completed in just over half (55.7%). However, the pre- and post-ePMA comparisons indicate that the checklist was done better in the pre-ePMA (75%) than in the post-ePMA (25.7). Similarly, the 2nd VTE was better in the pre-ePMA (11%) than the post-ePMA (2.9%). A similar phenomenon occurs in the TEDS-prescribed checklist protocol, where the pre-ePMA displays better outcomes (83%) than the post-ePMA (57.1%). Another difference that creates concern regarding the effectiveness of the NICE guidelines and the impacts of ePMA implementation is the relationship between.

the prescribed and given TEDS. For instance, while doctors prescribed 72.2% of TEDS for patients, only 40.9% were administered with 85% of Dalteparin prescriptions. Therefore, the guideline and protocol adherence contributes to a mishap between prescriptions and administration of VTE prophylaxis

medication. Failure to effectively manage and prevent VTE leads to deep-vein thrombosis, blood coagulation, venous stasis, and pulmonary embolisms [16]. Therefore, the results suggest that the NICE guidelines and ePMA implementation affect TEDS administration and could risk VTE for surgical and hospitalised patients. Also, the low completion rate of the second VTE suggests another mishap. Notably, the pre-ePMA sample suggested that medical personnel were likely to complete five out of six steps in the VTE prophylaxis protocol for patients of lower mean age. VTE is more common in older adults since they are at risk of anticoagulant-related thrombosis or bleeding [17]. Therefore, the protocol steps' low completion rate demands an enhanced focus on older patients to prevent complications or mortalities.

The introduction of the ePMA system was a significant factor that affected the effectiveness and completion of the VTE prophylaxis protocol. Five of six elements in the protocols in post-ePMA had lower completion, and only TEDS given had a higher percentage in the post-ePMA assessment outcomes. Elements of the checklist done, second VTE, and TEDS prescribed reached a significance of three. These results are counterintuitive as introducing the new system should ideally enhance performance [18]. However, it may well reflect the change's newness or perhaps point to reduced completion when the automated system is in place. Therefore, the issue must be addressed to determine the appropriate causality and offer recommendations and changes.

Limitations

Several limitations affected the validity and effectiveness of the study. First, the sample size was small and underpowered to detect variations. While convenience sampling and samples create high internal validity, methodological rigour, and trustworthiness, they contribute to limited detection power, and the results lack generalizability [19]. The study results cannot be generalised in other healthcare facilities or a broader context. Second, the time of audit is of concern. Some patients under the sample may not have been in the hospital long enough to complete the VTE prophylaxis protocol cascade and may be completed in due course. Therefore, the disparities between the pre-and post-ePMA can be explained by the possibility of incomplete cascades. Third, since the ePMA was a newly introduced model, the results cannot be definitive during the audit. The outcomes can improve over time as medical staff increase their knowledge and enhance their utilisation capacity.

Conclusions

Adherence to NICE guidelines are currently suboptimal and interventions are required to optimise the adherence to guidelines and improve the effectiveness of ePMA. The study showed that despite the necessity of a move towards increasing digitalisation of modern healthcare provision; if this is done inappropriately without due diligence, it has the potential of resulting in negative outcomes due to the poor utilization of the technology. While the newness of the ePMA model is a factor to consider in adapting the results; improving understanding of the importance of adherence to the NICE guidelines on VTE prophylaxis, addressing protocol completion gaps, and enhancing education of ePMA system usage are key strategies for optimizing the ePMA model's effectiveness in the future. The newness of the ePMA model suggests that the results can improve and eventually become the asset it is expected to be, and result in the gaps in protocol outcomes being reduced as VTE management increases.

However, updates to the paper drug chart system such as moving the TEDS mechanical/stocking VTE prophylaxis prescription section to the regular medication section of the in-patient drug chart/record can bridge the gap during the transitional period. Also, medical practitioners in the surgical sections should undertake educational sessions via posters outlining the NICE guidelines. Appropriate and comprehensive training tailored towards evidenced shortcomings in completing the protocol and ePMA usage is recommended, with further bi-annual mandatory training sessions to ensure and reinforce staff competencies. Future follow-ups should focus on VTE development and continuous adherence to the protocol.

Additional Information

Disclosures

Human subjects: All authors have confirmed that this study did not involve human participants or tissue. Animal subjects: All authors have confirmed that this study did not involve animal subjects or tissue.

References

1. Wang K, Yap, ES, Goto S, Zhang S, Siu C, Chiang C: The diagnosis and treatment of venous thromboembolism in Asian patients. Thrombosis Journal. 2018, 16:1-12. 10.1186/s12959-017-0155-z

2. Mahlab-Guri K, Otman MS, Replianski N, Rosenberg-Bezalel S, Rabinovich I, Sthoeger Z: Venous thromboembolism prophylaxis in patients hospitalised in medical wards. Medicine. 2020, 99:1-8. 10.1097/md.0000000000019127

3. Ageno W, Hunt BJ: Reducing the burden of venous thromboembolism in the acute medically ill population with extended-duration thromboprophylaxis. European Heart Journal Supplements. 2018, 20:6-11. 10.1093/eurheartj/suy015

4. Skeik N, Westergard E: Recommendations for VTE prophylaxis in medically ill patients . Annals of Vascular Diseases. 2020, 13:38-44. 10.3400/avd.ra.19-00115

5. Abukhalil AD, Nasser A, Khader H, Albandak M, Madia R, Al-Shami N, Naseef H: VTE Prophylaxis Therapy: Clinical Practice vs Clinical Guidelines. Vascular Health and Risk Management, Volume. 2022, 18:701-710. 10.2147/vhrm.s382050

6. National Institute for Health and Care Excellence: NICE Guideline. NICE . 2023, 1-47.

7. Johnston K, Lakzadeh P, Donato B, Szabo SM: Methods of sample size calculation in descriptive

retrospective burden of illness studies. BMC Medical Research Methodology. 201919, 1-7. 10.1186/s12874-

018-0657-9

8. Sköld CM, Janson C, Elf ÅK, Fiaschi M, Wiklund K, Persson HL: A retrospective chart review of pirfenidone- treated patients in Sweden: the REPRIS study. European Clinical Respiratory Journal. 2016, 3:1-7. 10.3402/ecrj.v3.32035

9. Talari K, Goyal M: Retrospective studies - utility and caveats . Journal of the Royal College of Physicians of Edinburgh. 2020, 50:398-402. 10.4997/jrcpe.2020.409

10. Singh AP, Vadakedath S, Kandi V: Clinical research: a review of study designs, hypotheses, errors, sampling types, ethics, and informed consent. Cureus. 2023, 15:1-12. 10.7759/cureus.33374

11. Buxton PS: The Retrospective Record Review: A Methodological Option for Educational Research . Journal of Research in Education. 2021, 30:17-34.

12. Ambra N, Mohammad OH, Naushad VA, et al.: Venous Thromboembolism Among Hospitalized Patients: Incidence and Adequacy of Thromboprophylaxis - A Retrospective Study. Vascular Health and Risk Management. 2022, 18:575-587. 10.2147/vhrm.s370344

13. Bui M, Hung DD, Vinh PQ, Hiep NH, Anh LL, Dinh TC: Frequency and Risk Factor of Lower-limb Deep Vein Thrombosis after Major Orthopedic Surgery in Vietnamese Patients. Open Access Macedonian Journal of Medical Sciences. 2020, 7:4250-4254. 10.3889/oamjms.2019.369

13. Bui M, Hung DD, Vinh PQ, Hiep NH, Anh LL, Dinh TC: Frequency and Risk Factor of Lower-limb Deep Vein Thrombosis after Major Orthopedic Surgery in Vietnamese Patients. Open Access Macedonian Journal of Medical Sciences. 2020, 7:4250-4254. 10.3889/oamjms.2019.369

14. Nana M, Shute C, Williams R, Kokwaro F, Riddick K, Lane H: Multidisciplinary, patient-centred approach to improving compliance with venous thromboembolism (VTE) prophylaxis in a district general hospital. BMJ Open Quality. 202017, 10.1136/bmjoq-2019-000680

15. Shlebak A, Sandhu P, Ali V, Jones G, Baker C: The impact of the DoH Commissioning for Quality and Innovation incentive on the success of venous thromboembolism risk assessment in hospitalised patients. A single institution experience in a quality outcome improvement over a 4-year cycle. JRSM Open. 2016, 0:1-6. 10.1177/2054270416632702

16. Kakkos SK, Caprini JA, Geroulakos G, Nicolaides A, Stansby G, Reddy DJ, Ntouvas I: Combined intermittent pneumatic leg compression and pharmacological prophylaxis for prevention of venous thromboembolism. The Cochrane Library. 2016, 9:1-73. 10.1002/14651858.cd005258.pub3

17. Gross PL, Chan N: Thromboembolism in older adults. Frontiers in Medicine. 2021, 7:1-9.

10.3389/fmed.2020.470016

18. Gallier S, Topham A, Nightingale P, et al.: Electronic prescribing systems as tools to improve patient care: a learning health systems approach to increase guideline concordant prescribing for venous thromboembolism prevention. BMC Medical Informatics and Decision Making. 2022, 22:1-9. 10.1186/s12911-022-01865-y

19. Andrade C: The inconvenient truth about convenience and purposive samples . Indian Journal of Psychological Medicine. 2020, 43:86-88. 10.1177/0253717620977000