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Knowledge, attitude and practice of venous thromboembolism prophylaxis in cancer patients among physicians in a teaching hospital in Nigeria: a cross- sectional study

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Knowledge, attitude and practice of venous thromboembolism prophylaxis in cancer patients among physicians in a teaching hospital in Nigeria: a cross-sectional study

Running title: VTE prophylaxis in cancer: physicians' knowledge, attitude and practice

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ABSTRACT

Background: Cancer-associated venous thromboembolism (VTE) is a leading, largely preventable cause of death in people with cancer. Guidelines recommend risk-stratified prophylaxis, but little is known about how physicians in sub-Saharan Africa apply them. We assessed physicians' knowledge, attitude and practice of VTE prophylaxis in cancer patients.

Methods: Seventy-two physicians in a teaching hospital completed a self-administered questionnaire. Knowledge (10 items) was graded with Bloom's cut-offs. Predictors of knowledge were examined with multiple linear regression, and predictors of ever prescribing prophylaxis for cancer patients with Firth penalised logistic regression.

Results: The mean knowledge score was 6.78 ± 1.97 out of 10; 40.3% had good, 37.5% moderate and 22.2% poor knowledge. Only 47.2% knew that cancer-specific risk assessment models (RAMs) exist, and 41.7% that not every cancer patient needs prophylaxis. Although 94.4% considered prophylaxis important, only 25.0% knew of formal guidelines. Overall, 55.7% had prescribed prophylaxis for cancer patients, mostly low molecular weight heparin. No respondent used the Khorana score; the Wells score was the most cited "RAM" (43.1%). No factor independently predicted knowledge. Prescribing was less likely in paediatrics than in medical departments (adjusted odds ratio [aOR] 0.04, 95% CI 0.00–0.34) and more likely with guideline awareness (aOR 7.46, 95% CI 1.14–70.82), but was not associated with knowledge.

Conclusion: Physicians valued VTE prophylaxis but lacked knowledge of risk stratification and guidelines, and worked without institutional protocols. Practice reflected department and guideline awareness rather than knowledge. Protocols that embed a cancer-specific RAM in routine workflow are needed.

Keywords: thromboprophylaxis; cancer-associated thrombosis; Khorana score; knowledge, attitudes and practice; physicians; Nigeria

INTRODUCTION

Venous thromboembolism (VTE), comprising deep vein thrombosis and pulmonary embolism, is a frequent complication of malignancy. Patients with cancer have a several-fold higher risk of VTE than the general population, and roughly one in five VTE events occurs in a person with cancer [1–3]. Cancer-associated thrombosis interrupts anticancer treatment, increases bleeding and recurrence risk, raises costs and is a leading cause of death in patients receiving outpatient chemotherapy [3,4]. The risk arises from the interplay of tumour biology, patient factors and treatment, including surgery, systemic therapy, central venous catheters and hospitalisation [5,6].

Because much of this burden is preventable, major guidelines now recommend structured prophylaxis. The American Society of Hematology (ASH), the American Society of Clinical Oncology (ASCO) and the European Society for Medical Oncology (ESMO) recommend thromboprophylaxis for hospitalised medical patients with cancer and for those undergoing cancer surgery, and risk-stratified prophylaxis for ambulatory patients receiving systemic therapy [3,7,8]. For ambulatory patients, the central step is risk assessment with a validated cancer-specific risk assessment model (RAM), most commonly the Khorana score [6,9]. Randomised trials of apixaban and rivaroxaban in patients with a Khorana score of 2 or more, together with Cochrane meta-analyses, have shown that targeted prophylaxis reduces VTE at the cost of some increase in bleeding [10–12]. Routine prophylaxis for all patients with cancer is therefore not recommended; the decision must weigh thrombotic against bleeding risk [13,14].

Despite these recommendations, uptake in practice remains poor. Surveys from North America and Europe describe wide variation in thromboprophylaxis practice, limited use of risk scores and concerns about bleeding among surgeons and oncologists [15–17]. Knowledge, attitude and practice (KAP) studies among healthcare workers show that gaps in knowledge of risk assessment

tools are common, even where general awareness is high [18–20]. Patients with cancer also have limited awareness of VTE, which places a greater burden on clinicians to identify those at risk [21].

Evidence from sub-Saharan Africa is sparse. Studies from the region describe low rates of formal risk assessment and prophylaxis in hospitalised patients and generally poor knowledge among medical staff [22,23]. In Nigeria, the Khorana score has been applied to patients with breast cancer using routine blood counts [24], yet how physicians assess and prevent VTE in cancer patients has not been well described. Understanding where the gaps lie, and which physicians are most and least likely to provide prophylaxis, is necessary to design effective interventions.

This study therefore assessed the knowledge, attitude and practice of VTE prophylaxis in cancer patients among physicians in a Nigerian teaching hospital, and identified factors associated with knowledge and with prescribing practice.

Methods

Study design and settings

This was a cross-sectional, questionnaire-based study conducted at the University of Ilorin Teaching Hospital, a tertiary teaching hospital in Ilorin, Nigeria, between January 2018 and June 2018. The hospital provides specialist cancer care across medical, surgical, gynaecological and paediatric departments.

Participants

Physicians of various ranks (house officers, junior residents, senior residents) in clinical and laboratory departments were invited to participate using convenience sampling. Data collection was through a semi-structured paper questionnaire distributed to physicians. Completion was voluntary and anonymous.

Questionnaire

A structured, self-administered questionnaire was developed by the investigators from current guidelines [3,7,8] and previous KAP studies. Before use, it was reviewed for content and clarity by a haematologist and pretested on 6 physicians who were not included in the analysis. It had four sections: (1) demographic and professional characteristics, including sex, years of clinical practice, rank, department, whether the respondent actively managed cancer patients, and the number seen per year; (2) knowledge, with 10 statements answered "yes", "no" or "don't know"; (3) attitude and institutional context, covering the perceived importance of prophylaxis, awareness of formal guidelines, the existence of hospital and departmental protocols, incorporation of a RAM in the workflow, and whether a formal protocol would help; and (4) practice, covering whether the respondent had ever prescribed VTE prophylaxis for cancer and non-cancer patients, its frequency, the agents used, the RAMs used and the laboratory tests used.

Scoring

Each knowledge item was scored 1 for a correct response and 0 for an incorrect, "don't know" or missing response, giving a total score of 0 to 10. Correct answers were defined from guideline recommendations; for example, "all cancer patients should be placed on VTE prophylaxis" was scored correct if answered "no", reflecting risk-stratified prophylaxis [3,7]. Knowledge was graded with Bloom's cut-offs as good (≥80%), moderate (60–79%) or poor (<60%) [25]. Internal consistency of the knowledge items was assessed with the Kuder–Richardson 20 (KR-20) coefficient. The primary practice outcome was having ever prescribed VTE prophylaxis for a cancer patient.

Ethical approval

The study was approved by the Ethical Review Committee of the University of Ilorin Teaching Hospital. The questionnaire carried consent information, and completion was taken as consent. No identifying information was collected.

Statistical analysis

Categorical variables were summarised as frequencies and percentages and continuous variables as mean ± standard deviation (SD) or median and interquartile range (IQR). Because knowledge scores were not normally distributed (Shapiro–Wilk $p < 0.001$), they were compared across groups with the Mann–Whitney U or Kruskal–Wallis test, and their correlation with years of practice was assessed with Spearman's rank correlation. Associations between respondent characteristics and prescribing were tested with Pearson's chi-square test or a Fischer exact test where expected cell counts were small. Departments were grouped as medical (internal medicine, haematology, family medicine and medical microbiology), surgical (general surgery, obstetrics and gynaecology, and orthopaedics) and paediatrics.

Multivariable models included department group, rank, sex and guideline awareness, chosen a priori and on the basis of bivariate findings. Knowledge score was modelled with multiple linear regression, and good knowledge with logistic regression. Prescribing was modelled with logistic

regression that additionally included knowledge score. Because only one paediatric respondent had prescribed prophylaxis, producing near-complete separation, logistic models were fitted with Firth's penalised likelihood, with profile-likelihood 95% confidence intervals (CIs) [26,27]. Results are presented as unstandardised coefficients (B) or adjusted odds ratios (aOR) with 95% CIs. Responses to multiple-answer items were analysed as the proportion of all respondents selecting each option. Analyses were performed in SPSS, and $p < 0.05$ was considered significant.

Results

Characteristics of respondents

Seventy-two physicians took part (Table 1). Most were male (70.8%), had practised for 5–9 years (45.8%) and were residents (junior 41.7%, senior 41.7%); 16.7% were house officers, and no consultant responded. Respondents came from eight departments, most commonly paediatrics and internal medicine (23.6% each). Most (80.6%) actively managed cancer patients, although 58.3% saw fewer than 20 per year.

Knowledge

Almost all respondents had heard of VTE prophylaxis (97.2%), knew that cancer is a risk factor for VTE (97.2%) and agreed that it can be prevented in cancer patients (94.4%) (Table 2, Figure 1). Knowledge was weaker for risk stratification. Only 47.2% knew that cancer-specific RAMs exist, with 45.8% answering "don't know", and only 41.7% recognised that not all cancer patients should receive prophylaxis; 43.1% thought all should. Only 22.2% correctly answered that VTE does not occur only in veins. About two-thirds knew that VTE is not a normal haemostatic response (66.7%) and that clinical (66.7%) and laboratory features (62.5%) can be used in RAMs, with most of the remainder answering "don't know" rather than giving a wrong answer.

The mean knowledge score was 6.78 ± 1.97 out of 10 (median 7, IQR 6–8). Twenty-nine respondents (40.3%) had good knowledge, 27 (37.5%) moderate and 16 (22.2%) poor. The KR-20 coefficient was 0.65.

Attitudinal and institutional support

Attitude was favourable: 94.4% considered VTE prophylaxis clinically important in cancer patients, and 86.1% thought a formal protocol would help their practice (Table 3). Institutional support was weak. Only 25.0% were aware of formal guidelines on VTE prophylaxis in cancer. Only 4.2% reported a hospital protocol and 2.8% a departmental protocol; half (50.0%) did not know whether a hospital protocol existed. Only 5.6% reported that a RAM was built into the workflow.

Practice

Thirty-nine of 70 respondents (55.7%) had ever prescribed VTE prophylaxis for cancer patients, compared with 57 of 71 (80.3%) for non-cancer patients (Table 4). Only 18.1% prescribed prophylaxis routinely, 19.4% most of the time and 26.3% less often or rarely, while 29.2% reported never prescribing it and 6.9% did not answer the question on frequency. Low molecular weight heparin (LMWH) was the most frequently used agent (65.3%), followed by warfarin (36.1%), combinations (36.1%) and mechanical methods (30.6%); 13.9% had used a factor Xa or direct thrombin inhibitor.

No respondent used the Khorana, Caprini, Rogers or PROTECHT scores, and only one each used the Padua, CANclot and CATS scores. The most frequently named "RAM" was the Wells score (43.1%), and 43.1% used none. The coagulation screen (69.4%) and platelet count (40.3%) were the most commonly used laboratory tests; white cell count (9.7%), haemoglobin (8.3%) and creatinine clearance (1.4%) were rarely used.

Factors associated with knowledge

On bivariate analysis, knowledge scores were higher among male than female physicians (7.25 ± 1.53 vs 5.62 ± 2.44; p = 0.016), among residents than house officers (7.00–7.20 vs 5.17; p = 0.039) and among those aware of guidelines (7.89 vs 6.52 and 5.82; p = 0.024) (Table 5). Scores correlated weakly with years of practice (ρ = 0.28, p = 0.016) and did not differ significantly across department groups (p = 0.113) or across the eight individual departments (p = 0.399; Supplementary Table S1).

Together, department, rank, sex and guideline awareness explained 26.5% of the variance in knowledge scores (adjusted $R^2 = 0.19$; $F[6, 62] = 3.72$, p = 0.003), but none was independently associated with knowledge after adjustment (Table 5). Neither surgical (B = −0.02, 95% CI −1.26 to 1.22) nor paediatric departments (B = −0.15, 95% CI −1.50 to 1.20) differed from medical departments. Results were similar for good knowledge (Supplementary Table S2).

Factors associated with practice

Prescribing differed markedly by department (Table 6, Figure 2). It was most frequent in internal medicine (87.5%), haematology (83.3%) and general surgery (76.9%), and least frequent in paediatrics (6.2%; 1 of 16). On bivariate analysis, prescribing was also associated with male sex (68.0% vs 25.0%; p = 0.001), higher rank (house officers 27.3%, junior residents 48.3%, senior residents 73.3%; p = 0.018), seeing more than 20 cancer patients a year (81.8% vs 44.2%; p = 0.004) and guideline awareness (88.9% vs 47.5% and 33.3%; p = 0.004). It was not associated with knowledge level (p = 0.786); mean knowledge scores were similar in those who had and had not prescribed (7.00 vs 6.61; p = 0.420).

In the multivariable model (n = 67), paediatric physicians had much lower odds of prescribing than physicians in medical departments (aOR 0.04, 95% CI 0.00–0.34; p = 0.002), whereas surgical departments did not differ from medical ones (aOR 1.61, 95% CI 0.38–7.27). Awareness of formal guidelines was independently associated with prescribing (aOR 7.46, 95% CI 1.14–70.82; p = 0.035). Associations with senior rank (aOR 6.79, 95% CI 0.81–69.62) and male sex (aOR 4.30, 95% CI 0.91–23.23) were no longer significant. Knowledge score had an adjusted OR below 1 (0.63, 95% CI 0.37–0.96; p = 0.029).

Discussion

This study found that physicians in a Nigerian teaching hospital valued VTE prophylaxis in cancer patients and knew the basic facts, but lacked knowledge of risk stratification and cancer-specific RAMs, were largely unaware of guidelines and worked without institutional protocols. Prescribing depended strongly on department and guideline awareness, and was not related to knowledge as measured.

The near-universal recognition that cancer increases VTE risk and that VTE is preventable mirrors findings among oncologists and other clinicians elsewhere [13,16]. The gaps lay in the steps that turn awareness into appropriate prophylaxis. More than half did not know that cancer-specific RAMs exist, and 43.1% believed that all cancer patients should receive prophylaxis. This contrasts with current guidelines, which recommend risk-stratified prophylaxis for ambulatory patients and caution against routine prophylaxis in low-risk groups [3,7,8]. A belief in universal prophylaxis is not harmless: Cochrane and meta-analytic evidence shows that prophylaxis increases major bleeding, and that extended prophylaxis in medically ill patients with cancer increases haemorrhage without reducing VTE [12,14]. Similar weaknesses in knowledge of risk assessment

tools have been reported among Chinese physicians, nurses and other healthcare workers [18–20], and among medical staff in Guinea [22], which suggests that risk assessment is a common blind spot rather than a local one. The low proportion answering correctly that VTE does not occur only in veins indicates that some physicians do not think of pulmonary embolism, which lodges in the pulmonary arteries, as part of VTE.

The practice data reinforce these knowledge gaps. No respondent used the Khorana score, the RAM recommended by ASCO, ESMO and ASH for ambulatory patients and used to select patients in the AVERT and CASSINI trials [3,7,8,10,11]. Instead, the most commonly cited tool was the Wells score, which estimates the pre-test probability of deep vein thrombosis in symptomatic patients and has no role in deciding prophylaxis [28]. This confusion between diagnostic and preventive tools has practical consequences: patients at high thrombotic risk may go unrecognised, while prophylaxis decisions rest on clinical impression. Low use of RAMs is not unique to this setting: fewer than 10% of oncologists are reported to use a risk assessment tool, and Turkish oncologists did not routinely use the Khorana score [16,17].

The pattern of laboratory testing points the same way. The coagulation screen, which plays no part in established cancer RAMs, was the most used test, whereas the full blood count indices that make up the Khorana score (platelet count, haemoglobin and white cell count) were used by only 8–40% [9]. These indices come from a routine full blood count, and the Khorana score has already been applied to Nigerian patients with breast cancer [24], so it could be used with existing resources. Reviews of laboratory assessment in cancer-associated thrombosis highlight blood counts and biomarkers such as D-dimer for risk prediction [5]. Renal function, needed to choose and dose LMWH or direct oral anticoagulants (DOACs) safely [13], was almost never considered.

The belief that all cancer patients need prophylaxis may partly reflect where these physicians work. In hospital, where most residents encounter cancer patients, guidelines do recommend prophylaxis for medical inpatients with cancer unless contraindicated [3]. Physicians trained mainly on inpatient wards may extend this rule to all patients with cancer, including ambulatory patients in whom the balance of benefit and harm differs. Teaching should therefore distinguish clearly between the inpatient, perioperative and ambulatory settings.

LMWH was the preferred agent, in line with guideline recommendations for hospitalised and surgical patients and with evidence that LMWH is at least as effective and safe as unfractionated heparin perioperatively [3,8,29]. Two findings are of concern. More than a third had used warfarin, although guidelines recommend against vitamin K antagonists for primary prophylaxis because of their unpredictable effect and interactions with anticancer therapy [3]. Conversely, DOACs were used by only 13.9%, despite evidence supporting apixaban and rivaroxaban in high-risk ambulatory patients [7,10,11]. Mechanical prophylaxis was used by about a third of respondents. Preference for mechanical methods varies by specialty; in a Canadian survey, most surgeons used them, whereas thrombosis experts rarely recommended them [15]. Guidelines favour pharmacological prophylaxis unless bleeding risk is high [3].

Cost and availability should also be considered. In many low-resource settings, patients pay for medicines out of pocket, and the choice between LMWH, warfarin and DOACs may be shaped by price and supply as much as by evidence. Bleeding risk, renal function and interactions with anticancer drugs also vary between patients, so anticoagulant choice in cancer must be individualised [13,30]. A local protocol should therefore specify preferred agents that are both recommended and available, together with doses adjusted for renal function and body weight.

The strongest determinant of prescribing was department. Internal medicine, haematology and surgery prescribed most often, while only one of 16 paediatric respondents had done so. Part of this reflects appropriate practice: VTE is less common in children with cancer than in adults, and routine prophylaxis is not standard in paediatric oncology. However, some children with cancer, such as adolescents, those with central venous catheters and those receiving asparaginase, are at substantial risk, and the near-absence of prophylaxis suggests that risk assessment is not being considered in paediatric oncology at all. Departmental differences in VTE prophylaxis practice have also been reported in China and Guinea [18,22]. They are a reminder that practice reflects departmental culture and exposure as much as individual knowledge. Medical microbiologists, who do not prescribe for cancer patients, contributed to the medical group but are unlikely to have altered these conclusions.

Awareness of formal guidelines was the only modifiable factor independently associated with prescribing, with about seven-fold higher odds. Yet only a quarter of respondents knew of guidelines, and almost none reported a hospital or departmental protocol or a RAM embedded in the workflow. This institutional vacuum probably explains much of the gap between favourable attitudes and inconsistent practice. The 86.1% who wanted a formal protocol indicate that such a protocol would be welcomed. Elsewhere, structured programmes combining education, electronic prompts and multidisciplinary pathways have raised risk assessment and prophylaxis rates in ambulatory cancer clinics, and a quality improvement audit in Lagos has targeted the same gaps in risk assessment and prophylaxis [17,23]. Pharmacist recommendations have also improved adherence to cancer-associated VTE guidelines [31].

The gap between favourable attitudes and actual prescribing is consistent with reports from other settings. In a Canadian survey, two-thirds of medical oncologists did not routinely prescribe

thromboprophylaxis because of bleeding concerns, despite recognising the thrombotic risk of chemotherapy [15]. Reviews of prophylaxis in cancer note that clinicians are aware of VTE risk but that prophylaxis rates remain suboptimal in surgical, hospitalised and ambulatory patients [13]. In our study, bleeding concerns were not measured directly, but the absence of protocols and of any agreed RAM leaves each physician to make the risk–benefit judgement alone. In that situation, inaction is the default.

Knowledge did not predict practice. On bivariate analysis, scores were almost identical in those who had and had not prescribed, and after adjustment the association was slightly negative. We do not interpret this as knowledge reducing prescribing: the effect was small, borderline, and appeared only after adjustment for factors that are themselves related to knowledge. The more plausible explanation is that, without protocols, prescribing is driven by exposure to high-risk patients and departmental norms rather than by what individual physicians know. This differs from studies in China, where knowledge was a strong predictor of preventive practice [18,19]. Those studies measured knowledge and practice more broadly and were conducted where VTE prevention is more established. Our practice measure, having ever prescribed prophylaxis, may also reward exposure rather than appropriateness. Together, these findings suggest that education alone is unlikely to change practice; it needs to be combined with institutional protocols and decision support.

Three practical steps follow from these findings. First, the hospital should adopt a written protocol for VTE prophylaxis in cancer patients that distinguishes inpatient, perioperative and ambulatory settings and specifies the Khorana score for ambulatory patients starting systemic therapy [7,8]. Second, the score should be built into existing workflows, for example as a field on chemotherapy order forms or admission clerking sheets, so that it is calculated from the routine full blood count

rather than left to memory. Third, education should target the specific gaps identified here: the difference between diagnostic and preventive scores, the risk of bleeding with indiscriminate prophylaxis, renal dosing, and the role of DOACs. Paediatric oncology teams should be included, with guidance on which children warrant risk assessment.

This study adds data from an under-represented setting and examined both knowledge and practice with multivariable methods suited to small samples. Several limitations apply. It was a single-centre study with a modest sample size, which limits generalisability and precision; the wide confidence intervals for department reflect sparse data. Practice was self-reported and measured as ever prescribing, which does not capture appropriateness, and questions on frequency, agents and RAMs referred to cancer and non-cancer patients together. The cross-sectional design precludes causal inference. Finally, the association with sex was not independent of department: women made up nearly half of paediatric respondents but fewer than a quarter of those in medical departments, so the bivariate sex difference largely reflects where female physicians worked and should be interpreted cautiously.

Conclusion

Physicians in this teaching hospital recognised the threat of VTE in cancer patients and valued prophylaxis, but did not know how to stratify risk, did not use cancer-specific RAMs and were largely unaware of guidelines. Prescribing depended on department and guideline awareness rather than knowledge, and paediatric physicians rarely considered prophylaxis. These findings point to a system gap rather than an attitude problem. Hospitals should adopt a formal VTE prophylaxis protocol for cancer patients that embeds the Khorana score in routine workflow, alongside targeted education on risk stratification, choice of agent and bleeding risk for all departments that treat cancer.

Declarations

Ethics statement: This study was performed in line with the principles of the Declaration of Helsinki. Approval was granted by the Ethics Committee of University of Ilorin Teaching Hospital (ERC PAN/2015/12/1483).

Consent to participate: Informed consent was obtained from all individual participants included in the study.

Consent to publish: Not applicable.

Conflict of interest: The author has no conflicts of interest to declare.

Data availability statement: The data supporting the conclusions of this article can be made available by the author upon reasonable request.

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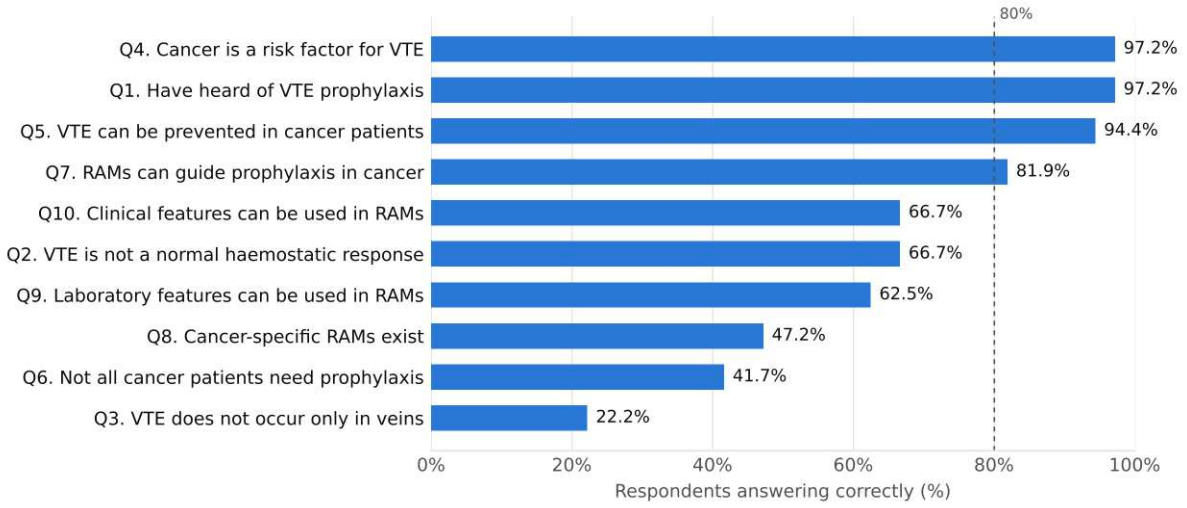

Figure 1. Proportion of respondents (N = 72) answering each knowledge item correctly, sorted from highest to lowest. The dashed line marks the 80% threshold for good knowledge. Items are worded to show the correct answer. VTE, venous thromboembolism; RAMs, risk assessment models.

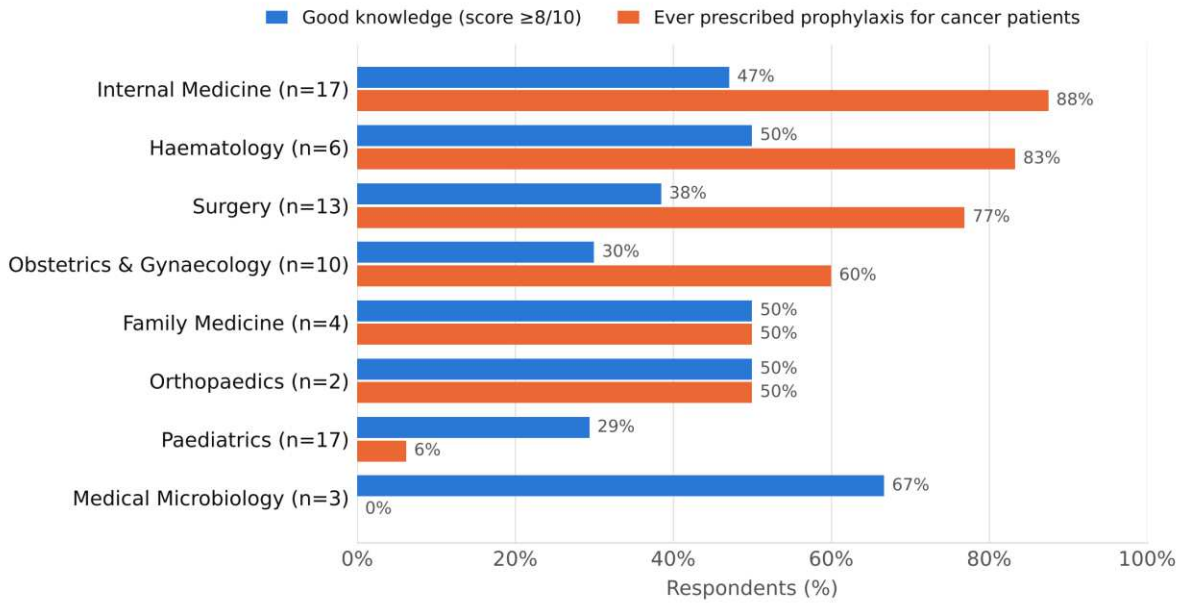

Figure 2. Proportion of respondents with good knowledge (score ≥8/10) and proportion who had ever prescribed VTE prophylaxis for cancer patients, by department. Departments are ordered by prescribing rate. Orthopaedics, Medical Microbiology and Family Medicine had fewer than five respondents each.

Table 1. Characteristics of respondents (N = 72)

Characteristic	n (%)
Sex	
Male	51 (70.8)
Female	21 (29.2)
Years of clinical practice	
<5 years	17 (23.6)
5-9 years	33 (45.8)
10-14 years	19 (26.4)
≥15 years	3 (4.2)
Rank	
House Officer	12 (16.7)
Junior Resident	30 (41.7)
Senior Resident	30 (41.7)
Department	
Paediatrics	17 (23.6)
Internal Medicine	17 (23.6)
General Surgery	13 (18.1)
Obstetrics and Gynaecology	10 (13.9)
Haematology	6 (8.3)
Family Medicine	4 (5.6)
Medical Microbiology	3 (4.2)
Orthopaedics	2 (2.8)
Actively manages cancer patients	
Yes	58 (80.6)

Characteristic	n (%)
No	13 (18.1)
No response	1 (1.4)
Cancer patients seen per year	
None	2 (2.8)
<20	42 (58.3)
21–50	18 (25.0)
51–100	5 (6.9)
No response	5 (6.9)

Table 2. Knowledge of VTE and VTE prophylaxis among respondents (N = 72)

Statement	Correct answer	Yes, n (%)	No, n (%)	Don't know, n (%)	No response, n (%)	Correct, n (%)
1. Have heard of VTE prophylaxis	Yes	70 (97.2)	1 (1.4)	0 (0.0)	1 (1.4)	**70 (97.2)**
2. VTE is a normal haemostatic response	No	16 (22.2)	48 (66.7)	3 (4.2)	5 (6.9)	**48 (66.7)**
3. VTE occurs only in veins	No	49 (68.1)	16 (22.2)	3 (4.2)	4 (5.6)	**16 (22.2)**
4. Cancer is a risk factor for developing VTE	Yes	70 (97.2)	1 (1.4)	0 (0.0)	1 (1.4)	**70 (97.2)**
5. VTE can be prevented in cancer patients	Yes	68 (94.4)	0 (0.0)	3 (4.2)	1 (1.4)	**68 (94.4)**
6. All cancer patients should be placed on VTE prophylaxis	No	31 (43.1)	30 (41.7)	11 (15.3)	0 (0.0)	**30 (41.7)**
7. RAMs can be used for VTE prophylaxis in cancer patients	Yes	59 (81.9)	0 (0.0)	11 (15.3)	2 (2.8)	**59 (81.9)**
8. There are RAMs specific for cancer patients	Yes	34 (47.2)	1 (1.4)	33 (45.8)	4 (5.6)	**34 (47.2)**
9. Laboratory features can be used for RAMs	Yes	45 (62.5)	1 (1.4)	23 (31.9)	3 (4.2)	**45 (62.5)**
10. Clinical features can be used for RAMs	Yes	48 (66.7)	0 (0.0)	19 (26.4)	5 (6.9)	**48 (66.7)**
Overall knowledge						
Score out of 10, mean ± SD						6.78 ± 1.97
Score out of 10, median (IQR)						7 (6–8)
Good (≥80%), n (%)						29 (40.3)
Moderate (60-79%), n (%)						27 (37.5)

Statement	Correct answer	Yes, n (%)	No, n (%)	Don't know, n (%)	No response, n (%)	Correct, n (%)
Poor (<60%), n (%)						16 (22.2)

VTE, venous thromboembolism; RAMs, risk assessment models; SD, standard deviation; IQR, interquartile range.

Each correct answer scored 1; incorrect, "don't know" and blank answers scored 0. Knowledge level by Bloom's cut-offs: good ≥80%, moderate 60–79%, poor <60%. Kuder–Richardson-20 = 0.649.

Table 3. Attitude towards VTE prophylaxis and institutional support (N = 72)

Item	Yes, n (%)	No, n (%)	Don't know, n (%)	No response, n (%)
VTE prophylaxis is clinically important in cancer patients	68 (94.4)	1 (1.4)	3 (4.2)	0 (0.0)
Aware of formal guidelines on VTE prophylaxis in cancer patients	18 (25.0)	40 (55.6)	11 (15.3)	3 (4.2)
My hospital has a formal prophylaxis protocol for cancer patients	3 (4.2)	33 (45.8)	36 (50.0)	0 (0.0)
My department has a formal prophylaxis protocol for cancer patients	2 (2.8)	45 (62.5)	24 (33.3)	1 (1.4)
A VTE RAM is incorporated in the workflow and every cancer patient is assessed	4 (5.6)	44 (61.1)	20 (27.8)	4 (5.6)
A formal prophylaxis protocol for cancer patients would help my practice	62 (86.1)	1 (1.4)	5 (6.9)	4 (5.6)

VTE, venous thromboembolism; RAM, risk assessment model.

Table 4. Practice of VTE prophylaxis among respondents (N = 72)

Practice	n (%)
Ever prescribed VTE prophylaxis for cancer patients	
Yes	39 (54.2)
No	31 (43.1)
No response	2 (2.8)
Ever prescribed VTE prophylaxis for non-cancer patients	
Yes	57 (79.2)
No	13 (18.1)
Don't know	1 (1.4)
No response	1 (1.4)
Frequency of prescribing	
Routinely	13 (18.1)
Most of the time	14 (19.4)
Less often	14 (19.4)
Rarely	5 (6.9)
Never/not stated	21 (29.2)
No response	5 (6.9)
Type of prophylaxis prescribed*	
Low molecular weight heparin	47 (65.3)
Warfarin	26 (36.1)
Combination of above	26 (36.1)
Mechanical	22 (30.6)
Factor Xa inhibitor / direct thrombin inhibitor	10 (13.9)
None	4 (5.6)

Practice	n (%)
Unfractionated heparin	3 (4.2)
Not stated	9 (12.5)
Risk assessment model used*	
Wells score	31 (43.1)
None	31 (43.1)
Padua Prediction Score	1 (1.4)
CANclot score	1 (1.4)
CATS score	1 (1.4)
Caprini score	0 (0.0)
Rogers score	0 (0.0)
Khorana score	0 (0.0)
PROTECHT score	0 (0.0)
Not stated	10 (13.9)
Laboratory tests used for VTE prophylaxis in cancer patients*	
Coagulation screen (PT/INR, APTT)	50 (69.4)
Platelet count	29 (40.3)
D-dimer	14 (19.4)
White cell count	7 (9.7)
Haemoglobin	6 (8.3)
Lipid profile	5 (6.9)
Homocysteine	4 (5.6)
von Willebrand factor	2 (2.8)
Factor VIII	1 (1.4)
Creatinine clearance	1 (1.4)

Practice	n (%)
sP-selectin	0 (0.0)
Not stated	19 (26.4)

VTE, venous thromboembolism; APTT, activated partial thromboplastin time; PT/INR, prothrombin time/international normalised ratio; CATS, Vienna Cancer and Thrombosis Study.

*Multiple responses allowed; percentages use all 72 respondents as denominator and do not sum to 100. Frequency, type of prophylaxis and risk assessment model refer to prescribing for cancer and/or non-cancer patients.

Table 5. Factors associated with knowledge score: bivariate and multiple linear regression analysis

Variable	n	Score, mean ± SD	p-value	Adjusted B (95% CI)	p-value
Sex			**0.016[a]**		
Male	51	7.25 ± 1.53		1.04 (-0.27 to 2.35)	0.118
Female	21	5.62 ± 2.44		Reference	
Years of clinical practice			0.112[b]	Not in model	
<5 years	17	5.71 ± 2.52			
5-9 years	33	6.82 ± 1.61			
10-14 years	19	7.58 ± 1.80			
≥15 years	3	7.33 ± 0.58			
Rank			**0.039[b]**		
House Officer	12	5.17 ± 2.59		Reference	
Junior Resident	30	7.00 ± 1.58		1.35 (-0.33 to 3.02)	0.112
Senior Resident	30	7.20 ± 1.79		1.04 (-0.82 to 2.91)	0.269
Department			0.113[b]		
Medical	30	7.30 ± 1.86		Reference	
Surgical	25	6.60 ± 2.04		-0.02 (-1.26 to 1.22)	0.974
Paediatrics	17	6.12 ± 1.93		-0.15 (-1.50 to 1.20)	0.828
Actively manages cancer patients			0.688[a]	Not in model	
Yes	58	6.72 ± 1.96			
No	13	7.00 ± 2.16			
Cancer patients seen per year			0.326[a]	Not in model	
20 or fewer	44	7.05 ± 1.93			

Variable	n	Score, mean ± SD	p-value	Adjusted B (95% CI)	p-value
More than 20	23	6.52 ± 2.02			
Aware of formal guidelines			**0.024[b]**		
Yes	18	7.89 ± 1.68		1.16 (-0.28 to 2.60)	0.113
No	40	6.52 ± 1.88		Reference†	
Don't know	11	5.82 ± 2.32		Reference†	

B, unstandardised regression coefficient (adjusted difference in knowledge score out of 10); CI, confidence interval; SD, standard deviation.

[a]Mann–Whitney U test; [b]Kruskal–Wallis test. Years of practice also correlated with knowledge score (Spearman ρ = 0.282, p = 0.016). Multiple linear regression with HC3 robust standard errors, n = 69; R^2 = 0.265, adjusted R^2 = 0.194, F(6, 62) = 3.72, p = 0.003. †"No" and "don't know" combined as reference. Bold, p < 0.05.

Table 6. Factors associated with ever prescribing VTE prophylaxis for cancer patients: bivariate and multivariable logistic regression analysis

Variable	Prescribed, n (%)	Not prescribed, n (%)	p-value	aOR (95% CI)	p-value
Sex			**0.001**[a]		
Male	34 (68.0)	16 (32.0)		4.30 (0.91–23.23)	0.066
Female	5 (25.0)	15 (75.0)		Reference	
Years of clinical practice			0.141[b]	Not in model	
<5 years	5 (31.2)	11 (68.8)			
5-9 years	19 (59.4)	13 (40.6)			
10-14 years	13 (68.4)	6 (31.6)			
≥15 years	2 (66.7)	1 (33.3)			
Rank			**0.018**[a]		
House Officer	3 (27.3)	8 (72.7)		Reference	
Junior Resident	14 (48.3)	15 (51.7)		3.11 (0.39–29.57)	0.283
Senior Resident	22 (73.3)	8 (26.7)		6.79 (0.81–69.62)	0.077
Department			**<0.001**[a]		
Medical	21 (72.4)	8 (27.6)		Reference	
Surgical	17 (68.0)	8 (32.0)		1.61 (0.38–7.27)	0.515
Paediatrics	1 (6.2)	15 (93.8)		0.04 (0.00–0.34)	**0.002**
Actively manages cancer patients			0.145[a]	Not in model	
Yes	34 (60.7)	22 (39.3)			
No	5 (38.5)	8 (61.5)			
Cancer patients seen per year			**0.004**[a]	Not in model	

Variable	Prescribed, n (%)	Not prescribed, n (%)	p-value	aOR (95% CI)	p-value
20 or fewer	19 (44.2)	24 (55.8)			
More than 20	18 (81.8)	4 (18.2)			
Aware of formal guidelines			**0.004[a]**		
Yes	16 (88.9)	2 (11.1)		7.46 (1.14–70.82)	**0.035**
No	19 (47.5)	21 (52.5)		Reference†	
Don't know	3 (33.3)	6 (66.7)		Reference†	
Knowledge level			0.786[a]	See score below	
Poor (<60%)	8 (53.3)	7 (46.7)			
Moderate (60-79%)	14 (51.9)	13 (48.1)			
Good (≥80%)	17 (60.7)	11 (39.3)			
Knowledge score, mean ± SD	7.00 ± 1.85	6.61 ± 1.99	0.420[c]	0.63 (0.37–0.96)	**0.029**

aOR, adjusted odds ratio; CI, confidence interval; SD, standard deviation; VTE, venous thromboembolism.

Row percentages; respondents with a missing response are excluded. [a]Pearson chi-square test; [b]Fisher–Freeman–Halton exact test (Monte Carlo); [c]Mann–Whitney U test. Multivariable model: Firth penalised logistic regression (used because of near-complete separation in the paediatric group), n = 67 with 38 events; profile-likelihood 95% CIs; knowledge score entered per 1-point increase. †"No" and "don't know" combined as reference. With paediatrics as reference, aOR for medical departments was 22.66 (2.90–355) and for surgical departments 36.50 (4.60–680). Bold, $p < 0.05$.

Supplementary Table S1. Knowledge and practice of VTE prophylaxis by department

Department	n	Knowledge score, mean ± SD	Good knowledge, n (%)	Prescribed for cancer patients, n/N (%)
Orthopaedics*	2	8.50 ± 2.12	1 (50.0)	1/2 (50.0)
Medical Microbiology*	3	8.33 ± 1.53	2 (66.7)	0/3 (0.0)
Family Medicine*	4	7.50 ± 1.29	2 (50.0)	2/4 (50.0)
Haematology	6	7.33 ± 1.37	3 (50.0)	5/6 (83.3)
Internal Medicine	17	7.06 ± 2.19	8 (47.1)	14/16 (87.5)
Surgery	13	6.69 ± 1.93	5 (38.5)	10/13 (76.9)
Paediatrics	17	6.12 ± 1.93	5 (29.4)	1/16 (6.2)
Obstetrics & Gynaecology	10	6.10 ± 2.13	3 (30.0)	6/10 (60.0)

Departments sorted by mean knowledge score. Good knowledge, score ≥8/10. Knowledge score did not differ across the eight departments (Kruskal–Wallis p = 0.399). *Fewer than five respondents; interpret with caution.

Supplementary Table S2. Predictors of good knowledge (score ≥8/10): multivariable logistic regression

Variable	aOR (95% CI)	p-value
Department: Surgical (reference: Medical)	0.86 (0.27–2.79)	0.799
Department: Paediatrics (reference: Medical)	0.83 (0.21–3.29)	0.794
Rank: Junior Resident (reference: House Officer)	1.73 (0.39–8.83)	0.476
Rank: Senior Resident (reference: House Officer)	1.27 (0.27–6.52)	0.761
Sex: Male (reference: Female)	1.21 (0.37–4.05)	0.749
Aware of formal guidelines (reference: no/don't know)	2.70 (0.76–10.39)	0.127

aOR, adjusted odds ratio; CI, confidence interval. Firth penalised logistic regression, n = 69 with 28 respondents with good knowledge; profile-likelihood 95% CIs and penalised likelihood-ratio p-values.