Reducing Hospitalizations and Emergency Department Visits in Patients With Venous Thromboembolism Using a Multicomponent Care Transition Intervention

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Abstract

Preventing utilization of hospital and emergency department after diagnosis of venous thromboembolism is a complex problem. The objective of this study is to assess the impact of a care transition intervention on hospitalizations and emergency department visits after venous thromboembolism. We randomized adults diagnosed with a new episode of venous thromboembolism to usual care or a multicomponent intervention that included a home pharmacist visit in the week after randomization (typically occurring at time of discharge), illustrated medication instructions distributed during home visit, and a follow-up phone call with an anticoagulation expert scheduled for 8 to 30 days from time of randomization. Through physician chart review of the 90 days following randomization, we measured the incidence rate of hospital and emergency department visits for each group and their ratio. We also determined which visits were related to recurrent venous thromboembolism, bleeding, or anticoagulation and which where preventable. We enrolled 77 intervention and 85 control patients. The incidence rate was 4.50 versus 6.01 visits per 1000 patient days in the intervention versus control group (incidence rate ratio = 0.71; 95% confidence interval = 0.40-1.27). Most visits in the control group were not related to venous thromboembolism or bleeding (21%) and of those that were, most were not preventable (25%). The adjusted incidence rate ratio for the intervention was 1.05 (95% confidence interval = 0.57-1.91). Our patients had a significant number of hospital and emergency department visits after diagnosis. Most visits were not related to recurrent venous thromboembolism or bleeding and of those that were, most were not preventable. Our multicomponent intervention did not decrease hospitalizations and emergency department visits.

Keywords

anticoagulation, clinical pharmacy, home care services, patient education, preventative medicine

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What do we already know about this topic?

Hospitalization and emergency department (ED) visits following an initial case of venous thromboembolism (VTE) comprise a significant health burden.

How does your research contribute to the field?

A multicomponent intervention including pharmacist home visit, illustrated medication instructions, and subsequent telephone consultation with an anticoagulation expert does not appear to be sufficient to reduce hospital and ED visits related to VTE.

What are your research's implications toward theory, practice, or policy?

To reduce utilization of hospital and ED after VTE diagnosis, future interventions should address comorbid health problems and support patients more broadly than providing education around VTE and anticoagulation.

Introduction

Venous thromboembolism (VTE) comprising deep vein thrombosis (DVT) and pulmonary embolism (PE) is the cause of significant health burden in the United States. The annual incidence of VTE is 900 000 and the cost of treating these cases totals approximately $10 billion.[1] Utilization of hospital or emergency department (ED) after initial case of VTE is an important part of this burden. The frequency of this utilization after hospitalization for VTE has been estimated in 1 report to equal 20%.[1] Although other cardiopulmonary conditions such as congestive heart failure and myocardial infarction have been the primary focus of payer efforts in terms of preventing readmissions, VTE would appear to be another prime target for quality improvement and cost containment efforts.[2]

Preventing utilization of hospital and ED after diagnosis of VTE is a complex problem. Patients typically start on an anticoagulant in cases of initial VTE or resume taking an anticoagulant at a new dose or with new instructions in the case of recurrent VTE. Many issues may complicate initiation and maintenance of anticoagulation thereafter. Patients may have trouble obtaining anticoagulant medication. The prescribed anticoagulant can interact with other medications or conflict with patient diets. In addition, patients may not appreciate the importance of strict adherence with anticoagulation or have the knowledge of which symptoms to report as demonstrated previously.[3] Each of these scenarios could lead to recurrent VTE or major bleeding, which in turn will result in hospitalization or an ED visit. In addition, patients with VTE frequently have other underlying conditions particularly malignancy (ie, malignancy-associated VTE) or have undergone recent surgery (ie, provoked VTE).[1,4]

The various scenarios that could lead to hospitalizations and ED visits suggest the need for a comprehensive, multicomponent intervention. A prominent, previous study enrolling patients admitted with cardiac problems did not see a reduction in utilization for a care transition intervention including medication reconciliation by a pharmacist at the time of discharge, illustrated medication instructions, and telephone consultation with a pharmacist in the days after discharge.[5] To have more impact whether for cardiac disease or VTE likely requires a more intensive intervention that goes beyond telephonic pharmacist consultation and one that

goes beyond the immediate postdischarge period. To our knowledge, there is no prior study that has rigorously evaluated the effectiveness of a multicomponent, pharmacist-based care transition intervention that we hypothesized would be necessary for reducing utilization after diagnosis for patients with VTE.

We recently reported the findings of a multicomponent intervention including home pharmacist visit scheduled shortly after diagnosis, illustrated medication instructions, and follow-up phone call with an anticoagulation expert weeks after diagnosis for patients with VTE.[6] Of note, we did not find a significant effect on interview-based outcomes including quality of care transition as per the Care Transition Measure-15 collected 30 days after randomization,[7] patient knowledge of anticoagulation and VTE, and patient anticoagulation beliefs and a proxy for adherence. In this article, we focus on the utilization of hospitalizations and ED visits for the same trial patients.

Methods

Population

We included English-speaking adults aged 18 and older with an episode of VTE diagnosed in the previous 2 weeks in hospital or ambulatory settings (office or ED) and prescribed warfarin, direct oral anticoagulant, or low molecular weight heparin. We excluded patients being discharged to a nursing home.

Setting

We conducted this study within the UMass Memorial Health Care (UMMHC) system, a multihospital health care system in central Massachusetts. The University of Massachusetts Medical School (UMMS) Institutional Review Board (IRB) reviewed and approved this study.

Procedure

Recruitment and randomization. We screened radiology reports daily for new cases of VTE. We then approached patients either in person, during the encounter in which the patient received VTE diagnosis, or up to 2 weeks afterwards

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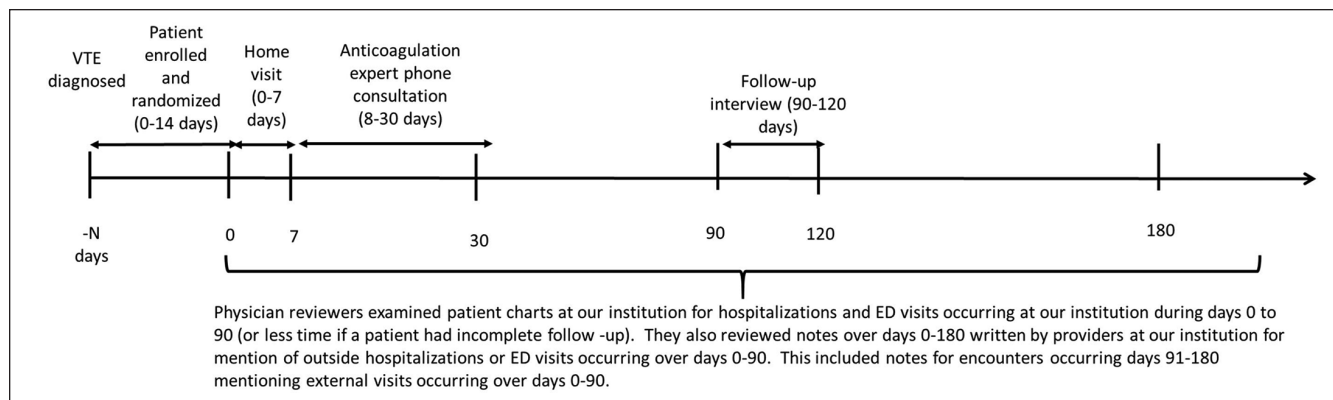Email: alok.kapoor@umassmemorial.org

Figure 1. Study intervention and data collection flow diagram.
Note. We recruited patients' N days after VTE diagnosis; we permitted up to 14 days for N. We scheduled the home visit in the first 7 days and the expert phone call between 8 and 30 days after randomization. VTE = venoushromboembolism; ED = emergency department.

by telephone. In the latter case, we obtained verbal consent followed by written consent requested via mail. Following recruitment and interview for baseline information, we randomized enrolled patients to either intervention or control using the randomization module within Research Electronic Data Capture (REDCap).[8]

Intervention patients. Our intervention consisted of 3 key components listed below. We did not provide other medication management services such as international normalized ratio (INR) or other lab monitoring and deferred to the primary care provider (PCP) to arrange them. To ensure standardization of the home visit, we composed a manual for the conduct of home visits (manual available upon request of the authorship team). For each pharmacist who conducted home visits, the principal investigator (PI; AK) accompanied the pharmacist for a minimum of 2 visits prior to allowing pharmacist to conduct unsupervised visits:

1. *Home visit.* The home visit occurred within 7 days of randomization. During the home visit, the pharmacist conducted a medication self-management simulation that builds on the "show me"/teach back paradigm advocated by experts.[9] This followed a protocol we previously validated.[10] Briefly, we requested that the patients collect all of their medications and pill organizers. We then asked patients to sequentially identify each of their medications on their medication list, explain the reason for taking each medication, and indicate/demonstrate how and with what frequency to take each medication. Although the primary focus of our intervention was to support use of anticoagulation, the pharmacist reviewed up to 9 other medications during the simulation and remediated any errors. Next, the pharmacist asked a series of open-ended questions to gauge each patient's knowledge of VTE, anticoagulation, drug interactions, symptoms to report, and dietary restrictions. Although our

team internally discussed and reviewed individual cases with our pharmacist and strategized about how best to educate patients, we did not provide patients a set of fixed materials/handouts but rather relied on the discretion and judgment of the individual pharmacist including for advising patients what to do in the event of acute bleeding episodes. The combination of remediation during the simulation filling in gaps in knowledge during the open-ended questions section, and review of illustrated medication instructions constituted the education provided by the pharmacist during home visits (see Supplemental Appendix A for data collection form).

2. *Illustrated medication instructions.* Near the end of the home visit, the pharmacist reconciled the patient's medications and printed illustrated medication instructions on a mobile color printer using PictureRx, an educational aid developed by the authors of the previously mentioned care transition intervention study.[5] The Web-based software uses icons to aid patients in understanding the purpose and dosing schedule of their medications.

3. *Anticoagulation expert telephone consultation.* Between 8 and 30 days from the time of randomization, our anticoagulation expert, a nurse practitioner working in the UMMHC Anticoagulation Clinic, contacted each intervention patient via telephone. The nurse practitioner's credentials include MS, NP-BC, and CACP (Certified Anticoagulation Care Provider). During the telephone call, the anticoagulation expert used the same open-ended format discussed above to gauge and remediate patient knowledge. She also reconciled meds and sent the patient a color copy of the illustrated medication instructions if there were any changes in medications since the time of the home visit or if the patient did not complete the home visit (see Figure 1 for illustration of intervention timeline)

Control patients. Control patients received standard discharge paperwork (without illustrated medication instructions) from hospital or ED. At the time of our study, our health system used Siemens Soarian Clinicals electronic medical record in the hospital[11] and ED PulseCheck in the emergency room.[12] Items in patient discharge instructions included reason and main diagnosis for visit, follow-up instructions and appointments, diet to observe, and instructions for returning to institution, for example, fever, shortness of breath and so on. Control patients did not have any contact with our intervention pharmacist or anticoagulation expert.

Outcome

Our outcome was the count of hospitalizations and ED visits identified through both chart review of our electronic medical record (EMR) and telephone calls to patients conducted 90 days after randomization. We selected 90 days to include the period over which many patients (ie, those with provoked VTE) complete anticoagulation.

Chart review with blinded outcome adjudication. Physicians from our team (SJ, RE, AN, AM, or XC) reviewed the EMR for each patient to identify hospitalization or ED visit occurring up to 90 days after randomization. Prior to reviewing charts unsupervised, the PI (AK) reviewed charts in duplicate in batches of 5. Once the reviewer developed sufficient proficiency that there were no major discrepancies between his/her review and the PI, the reviewer continued reviewing charts unsupervised. To capture events occurring outside of our health system, our reviewers also examined progress notes and telephone encounters in our EMR for information about external utilization. We did not collect documentation from external facilities. To blind reviewers to patient treatment allocation, we created customized logins for them which prevented access to documentation made by the pharmacist or anticoagulation expert:

Further characterization of visits using chart review. For each hospitalization or ED visit identified, we recorded several variables. These included whether the visit related to VTE, bleeding, or anticoagulation (i.e. the index condition) including any related symptoms or recurrence. If the visit was related to the index condition, the reviewer also recorded whether he or she felt the visit was preventable with better adherence with anticoagulant, better control of anticoagulant, avoidance of another medication that could have interfered with anticoagulant, or better education of the patient about what to expect (e.g. minor bleeding while brushing teeth). If not related to VTE, bleeding, or anticoagulation, we documented an alternate reason for the visit. For each patient, we recorded up to 3 visits given the clinical experience of our authors that patients would not typically utilize more than 3 visits.

Follow-up interview. We called and asked patients whether they were hospitalized or went to the ED outside of our health system within the 90 days following randomization into our study. If either had occurred, we asked when and where they occurred and inquired about the reason for the visit.

Covariates

We identified demographic and clinical factors associated with utilization and readmission in general and after VTE diagnosis in particular. We selected these factors based on clinical expertise of our authors as well as previous studies.[1,13,14] (see Table 1 for full listing)

Time observed

For each patient, we assessed the length of follow-up (which we refer to as "time observed") over the 90 days following randomization. Specifically, during chart review, our physician reviewers recorded the last day that the patient accessed care within our health system. If the last day of follow-up occurred on or before the date of randomization, we assigned a nominal time observed of 0.5 days consistent with the practice of other longitudinal studies.[15-17] For patients with less than 90-day follow-up within our health system, we accepted information reported during 90-day interviews about hospitalizations and ED visits occurring externally. We illustrate this and all other scenarios in Figure 2.

Analysis

First, we examined the distribution of the covariates for intervention versus control patients. We then measured the incidence rate of hospitalization and ED visits in each group. For our calculations, we calculated incidence rate as the number of events divided by the sum of time observed in each group.

To assess the independent effect of our intervention on hospitalization and ED visits, we constructed a multivariate model that included covariates as well as the group assignment and time observed for each patient. Given that more than 70% of patients in our study did not have any hospitalization or ED visits, we chose a negative binomial distribution to fit our data. In order to establish a parsimonious model, we entered all covariates mentioned above in our equation and then selectively removed those that did not change the effect of our intervention. Given small numbers, we did not specifically examine the effect of patient performance in the medication management simulation or other parts of our intervention.

Because several patients assigned to the intervention did not complete 1 or more of the components of our intervention, we conducted 2 sets of analyses. The first included those patients not completing all parts of the interventions—that is,

Table 1. Comparison of Demographic and Clinical Factors for Patients With Venous Thromboembolism Assigned to Multicomponent Care Transition Intervention Versus Controls.

Demographic and clinical factors	Intervention patients Frequency (% out of 77 total)	Control patients Frequency (% out of 85 total)	P value
Gender			
Female	32 (41.6)	38 (44.7)	.69
Male	45 (58.4)	47 (55.3)	
Racial background			
White	68 (88.3)	64 (75.2)	.18
Black	4 (5.2)	7 (8.2)	
Asian/Pacific Islander/Native American/Alaskan/More than 1 race	2 (2.6)	6 (7.1)	
Don't know/Prefer not to answer/Missing	3 (3.9)	8 (9.4)	
Ethnicity			
Hispanic	2 (2.6)	9 (10.6)	.09
Not Hispanic	73 (94.8)	72 (84.7)	
Don't know/Prefer not to answer/Missing	2 (2.6)	4 (1.2)	
Income level			
≤100% poverty level	8 (10.4)	5 (5.9)	.3
100%-400% poverty level	19 (24.7)	15 (17.7)	
>400% poverty level	23 (29.9)	24 (28.2)	
Don't know/Prefer not to answer/Missing	27 (35.1)	41 (48.2)	
Education			
High school or below	21 (27.3)	18 (21.2)	.54
Above high school	54 (70.1)	63 (74.1)	
Missing	2 (2.6)	4 (4.7)	
Health literacy: confidence filling out medical forms			
Inadequate (Somewhat/A little bit/Not at all)	21 (27.3)	17 (20.0)	.46
Adequate (Extremely/Quite a bit)	54 (70.1)	64 (75.3)	
Missing (Don't know/Prefer not to answer)	2 (2.6)	4 (4.7)	
Patient activation: PAM-13 score			
1. Disengaged and overwhelmed	4 (5.2)	8 (9.4)	.44
2. Becoming aware, but still struggling	11 (14.5)	18 (21.2)	
3. Taking action	31 (40.8)	28 (32.9)	
4. Maintaining behaviors and pushing further	30 (39.5)	31 (36.5)	
Charlson Comorbidity Index			
0	35 (45.5)	29 (34.1)	.03
1	21 (27.3)	17 (20.0)	
2	8 (10.4)	23 (27.1)	
3+	13 (16.9)	16 (18.8)	
VTE type			
DVT alone	40 (52.0)	33 (38.8)	.25
PE	24 (31.2)	34 (40.0)	
Both	13 (16.9)	18 (21.2)	
VTE etiology			
Provoked VTE	28 (36.4)	35 (41.2)	.92
Cancer associated	9 (11.7)	10 (11.8)	
Unprovoked VTE	31 (40.3)	30 (35.3)	
Unclear/Unable to determine/Missing	9 (11.7)	10 (11.8)	
Anticoagulant prescribed			
Warfarin	37 (48.1)	39 (45.9)	.92
Direct oral anticoagulant	29 (37.7)	32 (37.7)	
Enoxaparin	11 (14.3)	14 (16.5)	
Care transition type			
Hospital to home	48 (62.3)	59 (69.4)	.49
ED to home	15 (19.5)	16 (18.8)	
Ambulatory to home	14 (18.2)	10 (11.8)	

Note. PAM = patient activation measure; DVT = deep venous thrombosis; PE = pulmonary embolism; VTE = venous thromboembolism; ED = emergency department.
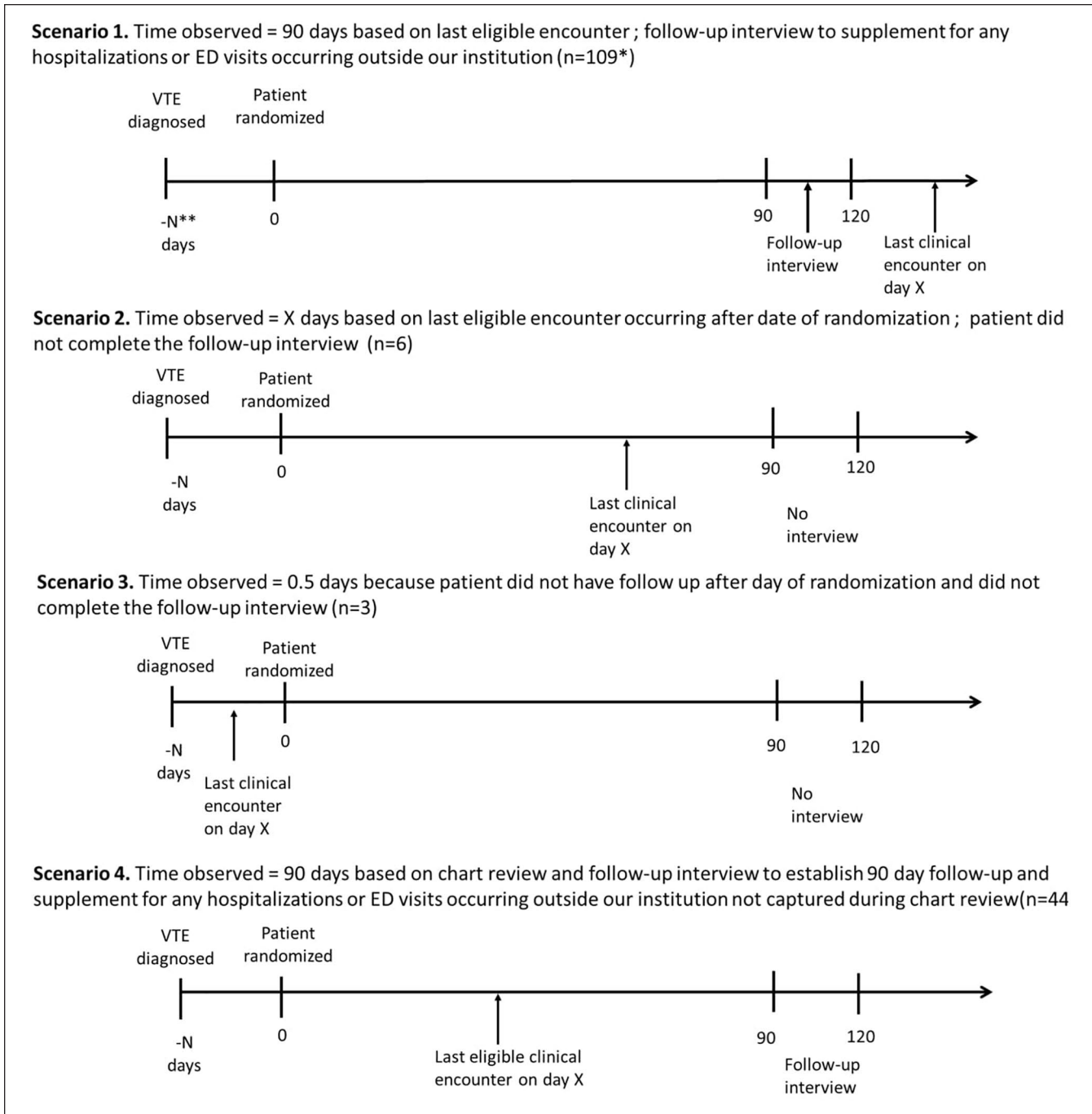
Scenario 1. Time observed = 90 days based on last eligible encounter ; follow-up interview to supplement for any hospitalizations or ED visits occurring outside our institution (n=109*)

Scenario 2. Time observed = X days based on last eligible encounter occurring after date of randomization ; patient did not complete the follow-up interview (n=6)

Scenario 3. Time observed = 0.5 days because patient did not have follow up after day of randomization and did not complete the follow-up interview (n=3)

Scenario 4. Time observed = 90 days based on chart review and follow-up interview to establish 90 day follow-up and supplement for any hospitalizations or ED visits occurring outside our institution not captured during chart review(n=44

Figure 2. Determination of time observed for incidence rate calculation in 4 different scenarios.
Note. VTE = venous thromboembolism; ED = emergency department; ITT = intention to treat.
*Number in parentheses represents the number of patients from ITT cohort which fit with this scenario. **We recruited patients N days after VTE diagnosis; we permitted up to 14 days for N.

"intention-to-treat (ITT) cohort." The second included only "completers."

Although we did not assess the power of our study design to detect a difference in hospitalizations or ED visits a priori, we estimated, post hoc, the range of statistical power our study had to detect, a 5% to 50% decrease in the use of hospital and ED. We performed all calculations in Statistical Analysis Software (SAS) 9.4.[18]
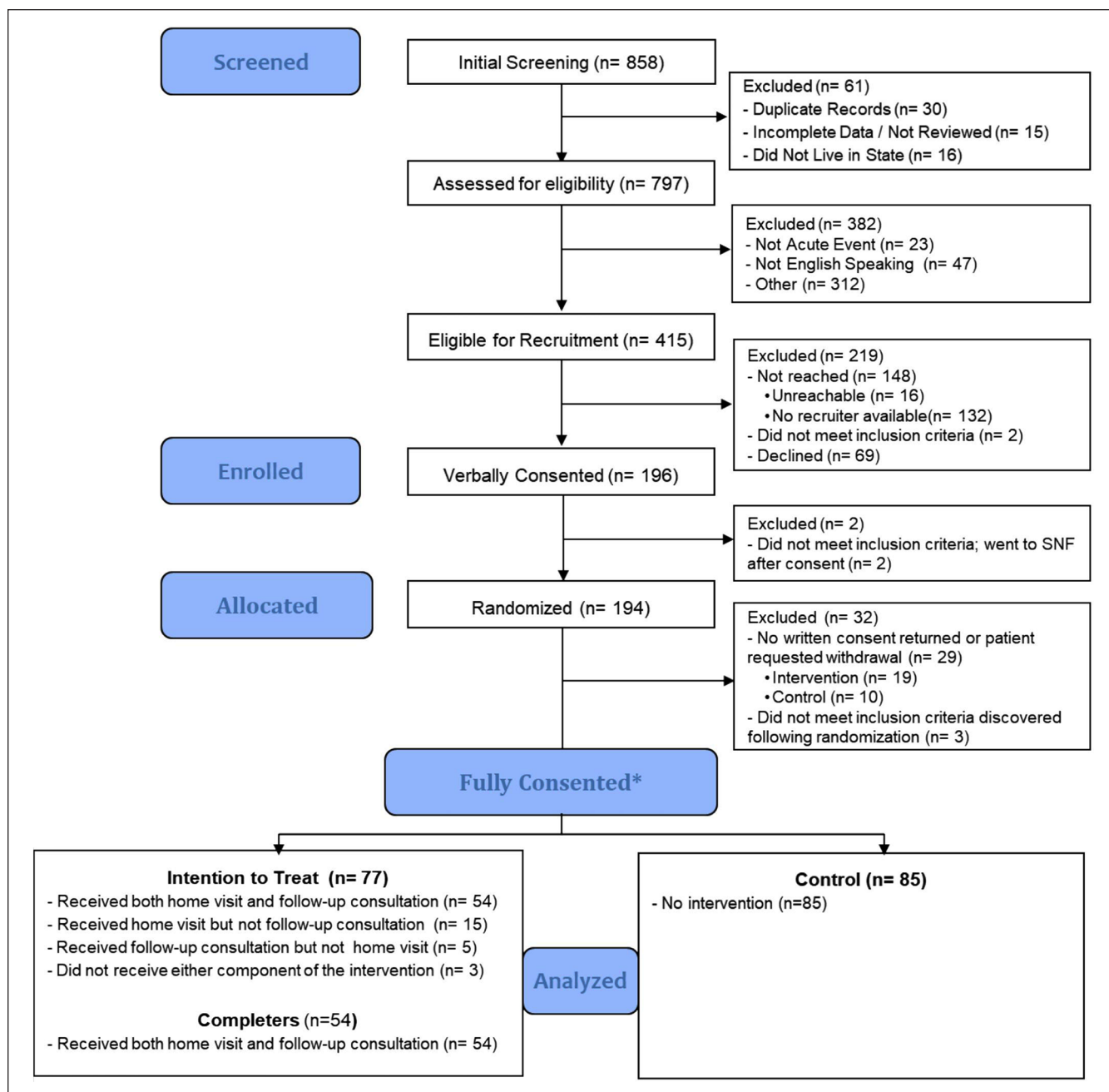
Figure 3. CONSORT diagram of patients included in study recruitment, randomization, and analysis.
Note. *Fully consented represent those individuals consented in person and providing written consent from the outset and those consented by telephone and having returned written consent within 50 days of randomization.

Results

ITT cohort

Of the 415 eligible patients, 194 verbally consented to participate in the study and were still eligible at the time of randomization. As we also required written consent and many patients did not return written consent documents to us, our fully consented, ITT cohort included 162 patients: 77 intervention patients and 85 controls (Figure 3). This cohort was

mostly white with a high school or higher level education. There were no significant differences between intervention and control patients for most variables apart from the Charlson comorbidity Index which was lower in intervention patients ($P = .03$). Approximately two thirds of our population had a transition from hospital to home. Transition from hospital to home included cases of DVT or PE developing during admission or cases of DVT or PE requiring hospitalization after diagnosis in the ambulatory setting (Table 1).

Table 2. Frequency of Hospitalizations and ED Visits and Descriptive Information About Visits in Intention-to-Treat Cohort.

	Intervention frequency (% total intervention visits)	Control frequency (% total control visits)	P value*
Hospitalizations	11 (44.0)	23 (60.5)	.05
Related to VTE, bleeding, or anticoagulation	6 (24.0)	3 (7.9)	
Reason for visit			
Recurrent VTE	0 (0.0)	0 (0.0)	
Bleeding—major or nonmajor clinically relevant	1 (4.0)	2 (5.3)	
Other (eg, shortness of breath, suspicion of new VTE not confirmed, minor bleeding)	5 (20.0)	1 (2.6)	
Preventable[a]	2 (8.0)	2 (5.3)	
Not preventable	4 (16.0)	1 (2.6)	
Not related to VTE, bleeding or anticoagulation	5 (20.0)	20 (52.6)	
ED visits	14 (56.0)	15 (39.5)	.93
Related VTE, bleeding, or anticoagulation	8 (32.0)	4 (10.5)	
Reason for visit			
Recurrent VTE	0 (0.0)	0 (0.0)	
Bleeding—major or nonmajor clinically relevant	4 (16.0)	0 (0.0)	
Other (eg, shortness of breath, suspicion of new VTE not confirmed, minor bleeding)	4 (16.0)	4 (10.5)	
Preventable[a]	3 (12.0)	0 (0.0)	
Not preventable	5 (20.0)	4 (10.5)	
Not related to VTE, bleeding, or anticoagulation	6 (24.0)	11 (28.9)	
Total number of visits	25	38	.11
Total number of days patients in group observed	5778	6320	
Incidence rate (per 1000 patient days followed)	4.33	6.01	
Incidence rate ratio (intervention compared with controls)[b]	0.71 (95% CI = 0.40-1.27)		

Note. There were 77 patients in the intervention group and 85 in the control group. VTE = venous thromboembolism; ED = emergency department; CI = confidence interval.
[a]We asked reviewers to mark preventable if visit would have been preventable with better adherence with medication, better control of anticoagulant, avoidance of another medication that could have interfered with anticoagulant, or better education of the patient about what to expect (minor bleeding while brushing teeth, etc).
[b]In the table, we cite the unadjusted incident rate ratio; in the body of the article, we describe the process of controlling for confounding which resulted in an adjusted incident rate ratio 1.05 (95% CI = 0.57-1.91).
*P value calculated with chi-square test.

Combined population information. In the 90 days after randomization, the combined population of intervention and control patients had 34 hospitalizations and 29 visits to the ED for a total of 63 encounters. Of the 63 encounters, 25 (39.7%) occurred in the first 30 days affecting 19 of 162 patients (11.7%). Overall, 46 patients (28.4%) had at least 1 encounter with 33 patients (20.4%) having exactly 1 encounter, 6 patients (3.7%) having 2 encounters, and 5 patients (3.1%) having 3 encounters.

Comparison of visits in intervention versus controls. There were differences in the frequency and type of hospitalizations/ED visits utilized by intervention versus control patients. Intervention patients had significantly fewer total visits compared with controls (25 vs 38). Of the 25 visits in intervention patients, 14 (56.0%) were related to VTE, bleeding, or anticoagulation compared with only 7 (18.4%) of 38 total visits for controls. Other causes of hospital or ED utilization included upper respiratory tract diseases, musculoskeletal pain complaints, and neurologic events (eg, stroke, seizure;

Supplemental Appendix B). Of the visits related to VTE, bleeding, or anticoagulation, only 5 intervention group visits were preventable and only 2 control visits were preventable (Table 2).

Time observed. We observed intervention patients for a total of 5778 days and controls for a total of 6320 days. In Figure 3, we list the number of patients falling into each of 4 scenarios relating to the determination of time observed.

Incidence rate. The incidence rate was 4.50 visits per 1000 patient days in the intervention group and 6.01 visits per 1000 patient days in the controls. Using the negative binomial model including only treatment assignment and time observed, we found that the incidence rate ratio (IRR) of utilization for the intervention was 0.71 (95% confidence interval [CI] = 0.40-1.27). After adjusting for covariates of a parsimonious model, the IRR was no different between groups (IRR =1.05; 95% CI = 0.57-1.91), which corresponded to a power of 5% to 98% to detect a 5% to 50%

reduction in the incidence rate (with 80% power to detect a 40%-50% reduction in incidence rate). The parsimonious model included gender, income, race, Hispanic ethnicity, blood clot type, health literacy, patient activation, and Charlson score.

Completers

There were 139 patients in this cohort: 54 intervention patients and the same 85 controls. Intervention patients in this cohort were much more likely to be white and non-Hispanic compared with controls (P = .02 and .01, respectively).

In terms of hospitalizations and ED visits, we saw a similar pattern as in the ITT cohort with 17 total visits for intervention patients compared with 38 for controls. The difference in the incidence rate was larger in this cohort with 4.07 versus 6.01 visits per 1000 patient days for intervention versus controls patients (Supplemental Appendix C). After adjusting for covariates, we found the IRR for intervention cohort was 1.23 (95% CI = 0.61-2.46).

Conclusion and Relevance

We found that a significant number of visits to hospital and ED occur in the 90 days after diagnosis of VTE. Our multicomponent intervention was associated with a reduction of hospitalizations and ED visits but most of the excess visits in the control group were not related to VTE, bleeding, or anticoagulation. After adjustment for demographic and clinical factors, there was no difference in utilization between the groups.

Our study finding of a high rate of utilization occurring after VTE diagnosis is consistent with other published reports. Secemsky et al found that 17.5% of patients had readmission to hospital within 30 days of VTE hospitalization.[1] They did not measure utilization of ED, calculate an incidence rate, or follow up patients out to 90 days limiting comparison with our study. We did not have sufficient sample size to examine the distinct effect of the intervention in low health literacy patients.

The major implication of our findings is that our composite intervention was not associated with a decrease in hospitalizations or ED visits. Another major implication of our findings is that preventing utilization of hospital and ED after diagnosis of VTE likely requires more than education around VTE. Most of the hospitalizations and visits to the ED we recorded were not related to VTE, bleeding, or anticoagulation. Patients with VTE have significant other comorbidities and medication issues which drive utilization.[1] Moreover, although we anticipated utilization would track with quality of care transition as measured through the Care Transition Measure-15 (our primary outcome described in our previous article),[6] we did not explicitly design our interventions to reduce utilization. Although we conducted medication reconciliation and medication simulation during home visits, we did not provide significant education related to medications other than anticoagulants. Another avenue of future research may shift from an intervention focused on education to one focused on care coordination or patient coaching. The Care Transition Intervention developed by Eric Coleman and others found that pairing patients with a nurse transition coach reduced 90-day readmission rates by 25%.[19] The Care Transition Intervention study included older adults hospitalized for a variety of conditions. It is unclear whether a transition coach can also reduce utilization after diagnosis for VTE in adults of any age.

We acknowledge a limitation to the findings we report. A significant number of patients assigned to the intervention did not receive all parts of it. If we had more patients completing all parts of the intervention, we may have prevented additional hospitalizations related to recurrent VTE, bleeding, or anticoagulation. Nevertheless, we did not see a significant effect of our intervention in the completers cohort confirming the overall conclusion that it did not reduce 90-day utilization. The relatively small size of our study population limited our ability to find an effect size of less than 40% for our intervention, if it existed. We also caution that we did not assess our statistical power a priori and post hoc power calculations are controversial.[20] The sample size available also limited the ability to examine the effect of our intervention in subpopulations such as those with inadequate health literacy. We also did not have the sample size to look at discrete utilization of hospital versus ED.

In conclusion, we found that patients have a significant number of hospital and ED visits after VTE diagnosis. The composite intervention of a home pharmacist visit, illustrated medication instructions, and subsequent telephone consultation with an anticoagulation expert did not reduce visits related to recurrent VTE, bleeding, or anticoagulation. Future research should focus on testing other interventions for patients with VTE.

Supplemental Material

Supplemental material for this article is available online.

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