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ORIGINAL RESEARCH

Implementation of an Acute Venous Thromboembolism Clinical Pathway Reduces Healthcare Utilization and Mitigates Health Disparities

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BACKGROUND: Acute venous thromboembolism (VTE) is prevalent, expensive, and deadly. Published data at our institution identified significant VTE care variation based on payer source. We developed a VTE clinical pathway to standardize care, decrease hospital utilization, provide education, and mitigate disparities.

METHODS: Target population for our interdisciplinary pathway was acute medical VTE patients. The intervention included order sets, system-wide education, follow-up phone calls, and coordinated posthospital care. Study data (n = 241) were compared to historical data (n = 234), evaluating outcomes of hospital admission, length of stay (LOS), and reutilization, stratified by payer source.

RESULTS: A total of 241 patients entered the VTE clinical care pathway: 107 with deep venous thrombosis (44.4%) and 134 with a pulmonary embolism (55.6%). Within the pathway, uninsured VTE patients were admitted at a lower rate than insured patients (65.9 vs 79.1%; $P = 0.032$). LOS decreased from 4.4 to 3.1 days ($P < 0.001$) for admitted VTE patients and from 5.9 to 3.1 days among uninsured patients ($P = 0.0006$). Overall, 30-day emergency department recidivism remained 11%, but declined (17.9% to 13.6%) among uninsured patients ($P = 0.593$). Fewer pathway patients (5.8%) were readmitted compared to historical patients (9.4%, $P = 0.254$). Individual cost of care decreased from \$7610 to \$5295 ($P < 0.005$) for any VTE patient, and from \$9953 to \$4304 ($P = 0.001$) per uninsured patient.

CONCLUSIONS: Implementing an interdisciplinary, clinical pathway standardized care for VTE patients and dramatically reduced hospital utilization and cost, particularly among uninsured patients. Results of this novel study demonstrate a model for improving transitional care coordination with local community health clinics and delivering care to vulnerable populations. Other disease populations may benefit from the development of a similar model. *Journal of Hospital Medicine* 2014;9:430–435. © 2014 Society of Hospital Medicine

Venous thromboembolism (VTE), including deep venous thrombosis (DVT) and pulmonary embolism (PE), is common, costly, and often fatal. Annual VTE incidence in the United States is over 1 million, including over 220,000 PE patients who have an average hospital length of stay (LOS) of 8 days, with a rising per-patient cost of over \$40,000.[1,2] Nearly half of all PE readmissions occur within 30 days; recurrent DVT events are 21% more costly than the initial event.[3] Likewise, 30-day PE mortality is 8%, with most deaths occurring within 1 hour of initial presentation.[4,5]

Rapid implementation of therapeutic anticoagulation has reduced morbidity and mortality in VTE. Ineffective and untimely treatment increases disease progression, significant medication-related adverse events, and cost. The Joint Commission recognized this risk and included National Patient Safety Goal 3.5.01 to reduce adverse events.[6] Appropriate use of anticoagulation was further emphasized by national quality initiatives through Joint Commission VTE core measures endorsed by the National Quality Forum and the Centers for Medicare and Medicaid Services.[7]

Many models of outpatient VTE care pathways exist. Early models focused on the feasibility of low-molecular-weight heparins (LMWH) in the ambulatory setting, with transition to long-term warfarin. Focus shifted to comprehensive disease pathway implementation aimed at reducing healthcare resource utilization. These pathways have reduced cost and unnecessary hospital stays and minimized complications through enrolling low-risk patients. To our knowledge, results of an interdisciplinary VTE care pathway have not been published from a large urban academic institution, where a substantial uninsured population exists.

Examining baseline VTE practices and care delivered at our institution provided critical knowledge in effectively developing a novel model of care. Prior to pathway development, acute VTE patients were

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typically admitted for initiation of therapeutic anticoagulation and appropriate overlap of injectable anticoagulants with warfarin. Significant healthcare disparities were seen among VTE patients at our institution: uninsured patients stayed in the hospital 2 additional days and accumulated twice the rate of 30-day emergency department (ED) reutilization and cost than insured patients.[8] Discharged VTE patients were managed through a pharmacy-run anticoagulation clinic pending primary care provider (PCP) follow-up. We speculated many uninsured VTE patients lacked sufficient disease and treatment information, and lacked surveillance and timely access to medical care following hospitalization. We hypothesized that through (1) targeted education of patients and providers, (2) coordination of timely follow-up for at-risk patients, and (3) posthospital monitoring, we could achieve standardized care for all acute DVT and low-risk PE patients. As a result, we aimed to decrease hospital LOS and produce fewer return visits and readmissions.

METHODS

Study Setting and Population

Acute medical VTE patients were targeted, where they were either discharged directly from the ED or admitted to a medicine service. Acute VTE was defined as primary or secondary diagnosis of new, lower extremity DVT, PE or concurrent DVT, and PE. Patients were identified and tracked by a professional research assistant (PRA) using our electronic medical record (EMR) search filter of all 120 discharge diagnoses for acute DVT and PE.

Our hospital is a 375-bed, academic medical center in a metropolitan area of under 3 million people. ED volume is approximately 55,000 patients per year.

Exclusion Criteria

We excluded patients classified as surgical/postoperative/admitted to a surgery service, pregnant/postpartum/admitted to an obstetrical service, hospital direct admissions (including outside hospital transfers), and oncology service admissions. Clinically unstable patients requiring intensive care unit admission and/or thrombolytic therapy, and patients with upper extremity, recurrent, or catheter-associated VTE were also excluded. To allow for comparative data, exclusion criteria were similar to those used in the historical, retrospective chart review performed previously at our institution.[8]

VTE Clinical Care Pathway

The pathway was developed as a quality improvement project through a multidisciplinary, collaborative effort, including pharmacists (inpatient and outpatient), administrative staff in the anticoagulation clinic, nurse leaders and educators, physician faculty (ED, inpatient and outpatient), case managers (inpatient and ED), and providers from local community health clinics, who provide the majority of follow-up care for our uninsured patients.

We sought care standardization and system-wide education for all acute, medical, lower-extremity DVT and low-risk PE patients, with a focus on coordination of transitional care. All pathway patients were provided education, lab testing, and outpatient medications including LMWH and warfarin. For patients lacking insurance, medications were provided through a medication assistance program at no cost to the patient. Timely outpatient clinic follow-up and posthospital phone calls were targeted safety net features to facilitate timely hospital discharge and program success. We also aimed to meet nationally mandated quality of care measures and benchmarks. Funding for this project, obtained through a quality improvement (QI) grant from the hospital supported a PRA and educational materials.

The Colorado Multiple Institutional Review Board approved the protocol prior to study implementation. Specific elements of the care pathway have been outlined (see Supporting Information, Figure 1, in the online version of this article). The initial rollout of the program occurred as a pilot in the ED for patients presenting with DVT only to assess feasibility. Based on this success, the pathway team expanded the program to inpatients, including those with PE, and augmented the educational program.

Measures

Evaluation of the intervention was completed by real-time chart extraction and phone interviews within 72 hours of hospital discharge and a chart review at 6 weeks following discharge. Chart review determined the number of follow-up visits within 30 days to the anticoagulation clinic and episodes of recidivism. Study data (n = 241) were obtained from February 1, 2011 to June 30, 2012 and compared to previously published retrospective data on VTE patients at our institution (n = 234) from December 1, 2007 to April 4, 2009.[8]

We obtained patient demographics (age, gender, ethnicity, insurance category) and admission status from the EMR. We collected data on ED recidivism within 30 days (for VTE-related issues), LOS, and readmissions within 30 days of discharge. We also collected total cost data for all VTE care from hospital administrative billing data including initial presentation and VTE-related return visits to the ED and readmissions.

Outcomes

Descriptive information, including demographics, admission status and type of VTE event are summarized for the VTE care pathway. Pathway patients, stratified by payer status (uninsured vs insured), were compared to previously described historical controls.[8]

TABLE 1. Demographics of VTE Care Pathway Patients

	Patients, N = 241	Uninsured, N = 88	Insured, N = 153	*P* Value
Mean age, y (SD)	52.4 (15.8)	46.7 (13.9)	55.5 (16.1)	<0.0001
Median age, y (IQR)	53 (42–63.5)	56 (44.3–67)	49 (35.3–58.5)	
Gender, male, n (%)	113 (46.9)	44 (50.0)	69 (45.1)	0.548
Pulmonary embolism, n (%)	134 (55.6)	37 (42.0)	97 (63.3)	0.036
All VTE, hospital admission, n (%)	179 (74.3)	58 (65.9)	121 (79.1)	0.032
PE, hospital admission, n (%)	132 (54.8)	37 (42.0)	95 (97.9)	1.00

NOTE: **Abbreviations:** DVT, deep vein thrombosis; ED, emergency department; IQR, interquartile range; PE, pulmonary embolism; SD, standard deviation; VTE, venous thromboembolism.

Primary outcomes included comparisons of total costs, LOS, and 30-day ED recidivism and hospital readmission rates. Further comparisons were made between insured and uninsured patients on these same outcomes.

Data Analysis

Data are presented as proportions or mean ± standard deviation unless indicated otherwise. Categorical data were compared using the Fisher exact test or χ^2 test, where appropriate. Continuous variables were compared using the Student *t* test. All tests were 2-tailed. Statistical analyses of the results were performed using GraphPad Prism 4.0 (GraphPad Software, San Diego, CA) and InStat 3.06 (GraphPad Software). A *P* value <0.05 was considered statistically significant for this study.

RESULTS

Care Pathway Cohort

We enrolled 241 medical patients with acute VTE during the 19-month study period (Table 1). Of these, 107 (44.4%) presented with DVT alone, whereas the remaining 134 (55.6%) had PE. Eighty-eight of the 241 VTE patients were uninsured (36.5%). Uninsured patients were younger on average (46.7 vs 55.5 years; $P < 0.0001$) and more commonly presented with DVT only (58.0% vs 36.7%; $P = 0.036$).

Utilizing the pathway, the majority of VTE patients (179; 74.3%) were admitted to the hospital. Among the uninsured, 58 of 88 (65.9%) patients were admitted compared to 121 of 153 (79.1%) among the insured ($P = 0.032$). Among 107 DVT patients, 47 were admitted (43.9%), including 20 of 51 uninsured DVT patients (39.2%) compared to 27 of 56 insured DVT patients (48.2%). Nearly all PE patients (132 of 134; 98.5%) were admitted. Two insured PE patients were not admitted.

Care Pathway Versus Historical Cohort

Comparing VTE care pathway patients to historical VTE patients (prior to intervention), the age and gender, as well as number of VTE events, VTE type, and admission status were similar (Table 2).

TABLE 2. Clinical Care Pathway Versus Historical VTE

Outcome	Historical VTE, N = 234	Pathway VTE, N = 241	*P* Value
Age, y, mean	53.1	52.4	0.64
Male, n (%)	125 (53.4)	113 (47.0)	0.46
DVT (%)	106 (45.3)	107 (44.4)	0.92
Uninsured (%)	38 (35.8)	51 (47.7)	0.93
PE (%)	128 (54.7)	134 (55.6)	0.92
Uninsured (%)	29 (22.7)	38 (28.4)	0.11
Admitted (%)	171 (73.1)	179 (74.3)	0.85
DVT (%)	43 (40.6)	47 (43.9)	0.91
Uninsured (%)	17 (39.6)	20 (42.6)	0.94
PE (%)	128 (100)	132 (98.5)	0.91
Uninsured (%)	29 (100)	38 (100)	0.32
LOS, d, mean (SD)	4.4 (3.8)	3.1 (2.9)	<0.001
Uninsured	5.9 (5.1)	3.1 (2.9)	<0.001
Insured	3.8 (3.1)	3.1 (2.9)	0.69
ED revisit, n (%)	26 (11.1)	27 (11.2)	0.974
Uninsured, n (%)	12 (17.9)	12 (13.6)	0.59
Readmission, n (%)	16 (9.4)	10 (5.6)	0.25
Uninsured, n (%)	5 (10.9)	2 (3.4)	0.24
Total cost, $, mean (SD)	7610 (9988)	5295 (7975)	0.005
Uninsured	9953 (14211)	4304 (6596)	0.001
Insured	6698 (7564)	5875 (8650)	0.36
Cost, admitted, $, mean (SD)	10324 (8988)	7038 (8965)	0.044
Uninsured	14420 (13351)	6375 (7462)	0.005
Insured	8843 (6565)	7353 (9288)	0.599

NOTE: Categorical data were compared using the Fisher exact test or χ^2 test, where appropriate. Continuous variables were compared using the Student *t* test. All tests were 2-tailed. **Abbreviations:** DVT, deep vein thrombosis; LOS, length of stay; PE, pulmonary embolism; SD, standard deviation; VTE, venous thromboembolism.

Average hospital LOS for an admitted care pathway patient was 3.1 days versus 4.4 days in an historical VTE patient ($P = 0.0001$; Table 2). When stratified by insurance, uninsured pathway patients had a LOS of 3.1, decreased from a prepathway LOS of 5.9 days ($P = 0.0006$), whereas this did not change among insured patients (3.1 from 3.8 days [$P = 0.688$]).

For all VTE care pathway patients, 30-day ED recidivism was 11.2%, similar to prepathway data (11.1%; Table 2). This was true regardless of insurance status. Thirty-day readmission rates trended from 9.4% prepathway to 5.6% postpathway ($P = 0.254$) (Table 2). Compared to historical VTE patients, uninsured pathway patients had readmission rates of 3.4% from 10.9% ($P = 0.237$), whereas readmission rates for insured patients were 6.6% from 8.8% ($P = 0.686$).

Average cost for a VTE care pathway patient was $5295 compared to an historical cost of $7610 per VTE patient ($P < 0.005$). Among uninsured pathway patients, the cost of VTE care was $4304 compared to $9953 historically ($P = 0.001$). Among insured pathway patients, the cost of VTE care was $5875 compared to an historical cost of $6698 ($P = 0.365$).

The average VTE cost of care for an admitted pathway patient was $7038 versus $10,324 per admitted

historical patient ($P = 0.044$). For an admitted uninsured VTE pathway patient, cost was \$6375 versus \$14,420 per historical VTE patient ($P = 0.005$). For an admitted insured VTE pathway patient, the cost was \$7353 versus \$8843 per historical VTE patient ($P = 0.599$).

Patient satisfaction scores with the care pathway averaged 4.5 (1–5 Likert scale).

DISCUSSION

Development and implementation of a multidisciplinary VTE clinical care pathway at our institution represents success across multiple domains. As a QI project, we standardized care and delivered system-wide education, and provided solutions to existing gaps in posthospital care. This pathway for a common, dangerous disease requiring high-risk medications magnifies the importance of care delivered at vulnerable points. Results of our study are the first to our knowledge to mitigate healthcare disparities and reduce healthcare utilization through a care pathway across diverse populations. Hospital LOS for all VTE patients was significantly decreased, wile lowering hospital reutilization patterns, particularly among the uninsured. Hospital admission rates are now lower specifically for the uninsured patients, because ED and inpatient providers now have increased confidence in the follow-up arrangements with the safety-net clinics.

Many clinical care pathways for VTE are proven, safe, and cost-effective.[9–12] Outpatient DVT treatment delivers significant cost savings and averts unnecessary hospital stays.[13,14] A hospital-based program providing outpatient DVT treatment among inner-city patients in New York demonstrated a lower incidence of adverse events and substantial cost savings, but excluded PE patients.[15] We intentionally sought to expand our VTE program by including both PE and vulnerable uninsured patients.

Lack of health insurance and routine primary care is a major challenge to successful implementation of any care pathway. Access to timely posthospital follow-up care is far more limited in patients lacking private insurance.[16,17] Uninsured patients are less likely to receive necessary medical care and more likely to have delayed care.[18,19] Uninsured patients also have poorer short-term health and are nearly 3 times more likely to have an ED revisit following hospital discharge than insured patients.[16,20,21] At our own institution, many discharged medical patients lack timely PCP follow-up, especially the uninsured, leading to higher rates of hospital reutilization.[22] Interventions directed at the uninsured VTE patient to mitigate such disparities were specifically targeted. These included coordination of timely follow-up care in community health clinics and provision of posthospital phone calls.

Efforts to improve transitional care for vulnerable patients have proven successful. Patients linked from the ED to community health clinics through scheduled follow-up have improved frequency of follow-up, receive routine care, and have reduced hospital utilization and rehospitalization.[23–25] Conversely, fewer care disparities are realized by patients within integrated systems such as the Veterans Administration.[26] Thus, the ultimate development of a VTE care pathway at our nonintegrated hospital required an innovative paradigm to deliver acute DVT and PE care. Through examining existing processes of our VTE care, we hypothesized that the main contributors of baseline care deficiencies included inadequate system-wide education, fragmented care, and significant barriers to timely follow-up.

Education of providers, patients, and system-wide process change were key elements in pathway implementation. Provider educational opportunities concerning VTE disease and treatment were identified, including safe and effective outpatient management options. We anticipated provider reluctance prescribing potentially dangerous anticoagulation medications to otherwise stable patients who might lack close posthospital supervision (eg, ED clinicians accustomed to admitting patients and inpatient teams cautious in discharging patients). We postulated that patients received inadequate VTE education and lacked appropriate skills to effectively and safely manage their new disease and medications. The diverse educational components outlined within the pathway significantly contributed to improved provider confidence in their patients' follow-up care as well as their patients' comprehension of their disease.

Timely posthospital care follow-up for all VTE patients significantly impacted our pathway results. Historically, uninsured patients lacked primary care follow-up, often waiting 3 months for an initial clinic visit. Through timely care coordination with local community health clinics, uninsured VTE care pathway patients discharged from our facility are routinely scheduled to be seen within 72 hours. Posthospital care is further addressed through follow-up phone calls, which monitor patient understanding and care, and identify how and where potential medical needs are best met. Such calls increase patient satisfaction, resolve medication issues, and result in fewer ED return visits.[27] With our intervention, patient satisfaction scores averaged 4.5 (1–5 Likert scale), reflecting strong support for phone calls and overall experience.

Direct institutional annual cost savings realized with the VTE care pathway was \$452,460. This occurred primarily as a result of nearly 50% fewer inpatient days required for admitted VTE patients. Indirect cost savings were further accomplished through increased availability of high-demand outpatient anticoagulation visits given improved timely PCP follow-up. Prior to pathway implementation, uninsured patients frequently had multiple, often unreimbursed, visits to this clinic while awaiting PCP follow-up. Additional future cost savings

may occur as healthcare reimbursement patterns are likely to include methods to penalize inefficient and high-resource usage.

There are several limitations to our study. This was a single-institution quality program with relatively small numbers. Comparison of pathway data with historical data provides an interval lag that may miss temporal changes in medical practice and disease trends. However, we believe the practice of VTE treatment changed minimally between the 2 time periods. We identified virtually the same number and type of patients in each cohort. Physician and PRA staff turnover complicated tracking patients and challenged continuous system-wide education. However, we believe consistent education and feedback to PRA faculty throughout the study period minimized variability. Although we could not verify VTE presentations to outside hospitals other than by patient self-report, it is likely that our patient population would have represented to our institution for follow-up VTE needs or bleeding concerns. As a result of timely follow-up phone calls, the number of return visits to the hospital may have been magnified, because more educated patients may have overreacted to mild symptom changes. Prior to the intervention, discharged VTE patients may not have recognized signs and symptoms of worsening disease or may not have returned to our institution for follow-up needs. Last, we did not control for comorbidities in either cohort, which may affect hospital utilization patterns, as younger patients may be less likely to be admitted or insured.

As a result of a comprehensive VTE clinical care pathway developed by key stakeholders, acute VTE patients who present to our hospital are therapeutically anticoagulated and monitored in a timely, uniform, and safe manner. We believe success reflects system-wide education and standardization of care through reducing variation, including the high-risk posthospital period. In an era of fragmented medical care, this program closes existing gaps in care and addresses the needs of vulnerable patients through strong collaboration and efficient coordination with local community health clinics. This is especially important in a dynamic healthcare landscape with an evolving payer mix that demands the medical establishment seek innovative ways to improve quality of care while reducing cost. Future research should explore etiologies and impacts of outcome variability based on insurance status, and identify other conditions and institutions demonstrating care disparities. Ultimately, implementation of this pathway provides strong evidence for improving care, meeting Joint Commission anticoagulation patient safety goals, and conserving limited resources for a common and deadly disease.

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