Original Investigation

Association Between Inpatient Surveillance and Venous Thromboembolism Rates After Hospital Discharge

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IMPORTANCE Venous thromboembolism (VTE) surveillance practices in hospitals, but not adherence to Surgical Care Improvement Program VTE prophylaxis measures, have been reported to explain the variation in VTE rates in hospitals.

OBJECTIVE To examine the relationship between inpatient surveillance testing for VTE and postdischarge VTE rates at the hospital level to determine whether more frequent inpatient surveillance is associated with reduced occurrence of postdischarge VTEs.

DESIGN, SETTING, AND PARTICIPANTS Retrospective study of a US national cohort of Veterans Affairs (VA) patients. National VA Surgical Quality Improvement Program outcome data were linked to VA administrative data on patients undergoing inpatient surgery from 2005 to 2009 and were included in the Surgical Care Improvement Program VTE measurement population.

MAIN OUTCOMES AND MEASURES Surveillance was identified using *Current Procedural Terminology* codes for diagnostic VTE imaging. Relationships between hospital-level surveillance and VTE rates were assessed with Pearson correlation coefficients, and the postdischarge VTE rate was modeled using linear regression, adjusting for hospital volume, inpatient VTE rate, inpatient surveillance rate, and case mix.

RESULTS Of 25 975 patients at 79 VA facilities, 296 (1.4%) experienced a VTE during the index hospitalization, and 114 (0.4%) experienced a postdischarge VTE within 30 days after surgery. The median length of stay was 11 days for those with a positive surveillance test result and 9 days for those with a negative test result. There was a positive correlation between inpatient surveillance and inpatient VTE rates (R = 0.33, P = .003) but no significant correlation of inpatient surveillance with either postdischarge surveillance (R = 0.11, P = .29) or postdischarge VTE rates (R = 0.03, P = .76). In an adjusted regression model of the postdischarge VTE rate, only the inpatient VTE rate was significant (β = 0.13, P = .05).

CONCLUSIONS AND RELEVANCE Hospitals with higher VTE surveillance rates have higher inpatient VTE rates but not decreased postdischarge VTE rates. However, hospitals with higher inpatient VTE rates have higher postdischarge VTE rates, which suggests that surveillance may be influenced by higher observed rates and not surveillance practices alone.

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Venous thromboembolism (VTE) is a recognized occurrence among patients who have undergone surgery and is influenced by both patient risk factors and type of surgical procedure.[1-5] The burden of deep venous thrombosis includes significant long-term morbidity of postthrombotic syndrome and the risk for mortality with associated pulmonary embolism.[6,7] In addition, the 1-year financial burden of treating the complications associated with VTE has been estimated at $33 000.[8] Studies[9,10] support the notion that appropriate prophylaxis can reduce the incidence of postoperative VTE. As such, measures to reduce the rates of VTE have been a target of national efforts to improve the safety and quality of surgical care, including the Surgical Care Improvement Project (SCIP).

The Centers for Medicare and Medicaid Services enacted SCIP in 2006 to reduce the numbers of preventable postoperative complications and included 2 measures for VTE prevention. Adherence to SCIP is accomplished by meeting criteria for both the SCIP VTE-1 process measure (assessing whether appropriate VTE prophylaxis was ordered up to 24 hours after surgery) and the SCIP VTE-2 process measure (measuring whether surgery patients received appropriate VTE prophylaxis within 24 hours prior to and following surgery).[11] Despite the use of evidence-based guidelines in the creation of SCIP measures, studies[12-14] have failed to show that adherence to SCIP-VTE measures reduce postoperative VTE rates.

Evidence demonstrates that process measures such as SCIP have not yielded the intended reduction in the numbers of complications, and consequently the Affordable Care Act has shifted the focus toward outcomes as a more relevant measure of surgical quality. Recently, the issue of surveillance bias has emerged as a threat to the validity of the use of outcomes as quality metrics, particularly for VTE. Hospital VTE rates were found to be strongly associated with hospital VTE surveillance practices and not with hospital adherence to SCIP-VTE measures.[15,16] The controversy surrounding this concept is whether hospital surveillance practices are due to a higher population risk of VTE or to practice preferences for surveillance to allow for early detection before clinical symptoms. The former practice would suggest increased surveillance as a response to a higher-risk population for VTE, whereas the latter would suggest vigilance with the intent for high-quality care.

Most studies examining surveillance have been limited to the index hospitalization, and data are lacking on how SCIP adherence and inpatient VTE surveillance affect postdischarge VTE rates. In the present study, we sought to determine if inpatient surveillance practices affected outpatient VTE outcomes at the hospital level. We hypothesized that hospitals with higher levels of inpatient surveillance will have higher VTE rates due to surveillance bias but will have lower rates of postdischarge VTE because preclinical VTE would be detected prior to discharge.

Methods

This is a retrospective study of a national cohort of Veterans Affairs (VA) patients with data on SCIP-VTE measures matched to outcomes from the VA Surgical Quality Improvement Program (VASQIP) database from 2006 to 2009. Patient-level SCIP data were merged with VASQIP data, which included information on patient comorbidities and demographics; surgical characteristics such as emergency vs elective case status, work relative value unit, and surgical subspecialty; and postoperative outcomes including VTE. The study protocol was reviewed and approved by the Birmingham VA Medical Research and Development Committee and the institutional review board, as well as by the VA Surgical Quality Data Use Group and the VA Office of Information and Analytics in the VA central office, Washington, DC. Requirement for informed consent was waived by the institutional review board in the setting of a retrospective study using previously collected data.

Patient Population

The SCIP population for the SCIP-VTE measures includes patients who underwent major surgical procedures, including orthopedic, colorectal, gynecologic, neurosurgical, and urologic surgical procedures. The SCIP-VTE module excludes vascular procedures, and our study excluded cardiac cases because the VASQIP collects different variables for cardiac procedures vs noncardiac procedures. The SCIP patient population used for this analysis has been previously described.[13] Hospitals with no reported inpatient VTEs and patients with missing descriptions of surgical data and outcomes were excluded from our study.

Data Sources

Surgical Care Improvement Project

The Veterans Health Administration Office of Information and Analytics External Peer Review Program contracts with the West Virginia Medical Institute to collect VA hospital SCIP measures. Beginning in 2006, these data have been collected by the VA according to guidelines established by the Joint Commission and the Centers for Medicare and Medicaid Services. Abstractor reliability is assessed regularly.

VA Surgical Quality Improvement Program

The VASQIP uses trained clinical nurse reviewers to collect demographic data, preoperative laboratory data, and data on surgical characteristics and 30-day postoperative outcomes for a sample of VA patients undergoing major surgery. The quality of the data at a sample of VA medical centers has previously been shown to be reliable.[3]

Corporate Data Warehouse

Administrative data from both inpatient and outpatient databases of the VA Corporate Data Warehouse were used to identify inpatient and postdischarge surveillance tests.

Study Variables

The independent variables of interest were facility rates of index hospitalization surveillance and adherence to the SCIP VTE-2 process measure. Inpatient surveillance was defined using *Current Procedural Terminology* codes (71260, 71250, 71270, 71275, 71550, 71551, 71552, 71555, 75741, 75743, 75746, 75820, 75822, 78445, 78456, 78457, 78458, 78585, 78584, 78580, 78599, 78598, 78597, 78582, 93970, and 93971) and

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International Classification of Diseases, Ninth Revision, Clinical Modification codes (8877, 8843, 8866, and 9215) to identify venous duplex ultrasonographic images of the extremities, ventilation-perfusion scans, and/or computed tomographic angiography scans of the chest that occurred before discharge and at least 1 day prior to any diagnosed VTE. Facility rates were calculated with the number of patients who had a VTE surveillance test as the numerator and the total number of SCIP patients as the denominator. Adherence to the SCIP VTE-2 process measure was reported by the SCIP.

The dependent variable of interest was the occurrence of deep venous thrombosis or pulmonary embolism after hospital discharge but within 30 days of surgery, as reported by the VASQIP. These complications were combined to create a composite VTE outcome variable with only the first event included in our study for those patients who may have incurred both outcomes. Facility rates were calculated with the number of VTE-diagnosed patients as the numerator and the total number of SCIP patients as the denominator. Venous thromboembolisms that were identified prior to or on the day of hospital discharge were considered "index" events, and VTEs that occurred after discharge from the index hospitalization were considered "postdischarge" events, even if it resulted in a readmission to the hospital.

Additional patient-level covariates were included, such as demographics, functional status, lifestyle variables (eg, tobacco use), and comorbidities collected in the VASQIP. Facility-level analyses used the facility-specific mean values or rates for these covariates to account for different patient populations at different hospitals.

Statistical Analyses

The unadjusted relationships among patient-level variables were assessed using the χ^2 test and the Wilcoxon rank sum test. The unadjusted relationships of hospital-level rates were assessed using simple linear regression. Linear regression analysis was used to examine the adjusted relationship between facility rates of index VTE diagnosis, SCIP VTE-2 adherence, and postdischarge VTE rates.

The adjusted relationship between facility rates of index surveillance, SCIP VTE-2 adherence, and postdischarge VTE was assessed with ordinary least squares regression models. Factors identified to have significant bivariate associations with postdischarge VTE rates were included as covariates. Backward stepwise selection was used to identify a parsimonious model. Analyses were completed using SAS version 9.2 (SAS Institute Inc). The significance level was set at $P < .05$.

Results

The study cohort included 25 975 patients meeting the criteria for the SCIP-VTE measures at 79 VA facilities. The characteristics of the cohort were stratified by surveillance and VTE occurrence and are shown in **Table 1**. The overall VTE surveillance rate of the cohort was 18.8%, with a 1.6% VTE rate. Being older than 60 years of age and the comorbidities of insulin-dependent diabetes mellitus, peripheral vascular disease, a history of myocardial infarction, acute renal failure, or a malignant neoplasm were associated with higher surveillance and VTE rates. Surgical characteristics associated with increased surveillance and VTE rates included orthopedic and neurosurgical procedures, as well as the presence of other postoperative complications.

Factors associated with positive and negative surveillance test results are shown in **Table 2**. Thoracic procedures had the highest rates of negative surveillance test results, while gynecologic procedures had a higher likelihood of positive surveillance compared with other types of procedures. The percentage of VTE surveillance practices performed varied widely at the hospital level, ranging from 5.5% to 50.4% with a median surveillance rate of 17.6% (**Table 3**). The hospital-level VTE rate ranged from 0.3% to 4.6%.

Correlations between surveillance practices, hospital characteristics, and VTE occurrence are displayed in **Table 4**. The proportion of patients meeting the SCIP-VTE measures and the surgical volume of the hospital were not significantly associated with surveillance or VTE occurrence. The postoperative hospital length of stay was positively correlated with both surveillance ($R = 0.45$, $P < .05$) and index VTE rate ($R = 0.25$, $P < .05$) but negatively correlated with postdischarge VTE rate ($R = -0.11$, $P = .31$), in part because of the duration of exposure time in the hospital. Inpatient surveillance was positively correlated with inpatient VTE rates ($R = 0.33$, $P = .003$) (**Figure**, A) but not with either postdischarge surveillance or VTE occurrence ($R = 0.03$, $P = .76$) (Figure, B). A multiple linear regression model assessing predictors of hospital postdischarge VTE rates adjusted for patient risk factors and predischarge complications found that the index hospitalization VTE rate was the strongest predictor of postdischarge VTE occurrence ($\beta = 0.13$, $P = .05$). Neither predischarge nor postdischarge surveillance rates were associated with postdischarge VTE rates.

Discussion

Using national VA data from the SCIP-VTE measure population, we found that hospitals with higher inpatient surveillance rates had higher inpatient VTE rates, but we found no correlation between inpatient surveillance and postdischarge surveillance or VTE rates. However, higher inpatient VTE rate was a significant predictor of outpatient VTE rate, which suggests that surveillance rates may be more influenced by higher observed rates and less by facility-level surveillance practice preferences. One of the strengths of our study is that both surveillance and VTE outcomes were assessed for the same population and that information on postdischarge VTE outcomes was available. In addition, we confirmed that adherence to the SCIP VTE-2 process measure was not associated with VTE outcome, even after adjusting for hospital VTE surveillance rates.

Our study is congruent with a previous report[15] of the strong association between inpatient surveillance rates and the rate of inpatient VTEs diagnosed. However, the prior report[15] was limited to only inpatient VTE outcomes that were

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Table 1. Characteristics of Patient Population by VTE Surveillance and Occurrence[a]

Characteristic	Overall (n= 25 975)	Surveillance Test (n = 4874)	*P* Value	VTE Occurrence (n = 410)	*P* Value
Demographics					
Sex					
Male	24 339 (94)	4632 (19)	<.001	392 (2)	.11
Female	1636 (6)	242 (15)		18 (1)	
Age, y					
<60	8747 (34)	1391 (16)	<.001	89 (1)	<.001
≥60	17 228 (66)	3483 (20)		321 (2)	
Race (n = 22 882)[b]					
White	16 221 (71)	3064 (19)	.72	270 (2)	.24
Black	3470 (15)	667 (19)		49 (1)	
Other	3191 (14)	589 (19)		42 (1)	
Comorbidities					
Diabetes mellitus					
None	20 471 (79)	3747 (18)	<.001	303 (2)	.04
Noninsulin-dependent	3620 (14)	701 (19)		72 (2)	
Insulin-dependent	1884 (7)	426 (23)		35 (2)	
History of PVD	480 (2)	131 (27)	<.001	12 (3)	.10
Steroid use	654 (3)	159 (24)	<.001	12 (2)	.60
Previous MI	114 (0.4)	39 (34)	<.001	6 (5)	.002
Smoker	4874 (19)	1406 (29)	.44	79 (2)	<.001
Evidence of cancer	410 (2)	83 (20)	.44	10 (2)	.20
Preoperative acute renal failure	133 (1)	63 (47)	<.001	5 (4)	.04
Progressive renal insufficiency	220 (1)	88 (40)	<.001	8 (4)	.01
10% weight loss within 6 mo	1127 (4)	281 (25)	<.001	33 (3)	<.001
BMI category (n = 25 292)[c]					
Underweight	543 (2)	135 (25)	<.001	9 (2)	.30
Normal	5792 (23)	1065 (18)		78 (1)	
Obese	8657 (34)	1554 (18)		132 (2)	
Morbidly obese	10 300 (41)	1968 (19)		182 (2)	
ASA class					
≤2	6488 (25)	907 (14)	<.001	81 (1)	.03
3	17 149 (66)	3281 (19)		284 (2)	
≥4	2338 (9)	686 (29)		45 (2)	
Surgery characteristics					
Length of stay, median (IQR), d	6 (4-9)	9 (6-16)	<.001	10 (6-20)	<.001
Surgical work RVU, median (IQR)	23 (22-23)	23 (22-23)	.03	22 (21-25)	.004
SCIP VTE-2 compliant	23 623 (91)	4433 (19)	.99	373 (2)	.98
Procedure type					
Orthopedic	14 718 (57)	2885 (20)	<.001	217 (2)	.06
Thoracic	637 (3)	186 (29)		7 (1)	
Urology	1446 (6)	154 (11)		19 (1)	
Gastrointestinal	8372 (32)	1567 (19)		155 (2)	
Neurosurgery	200 (1)	43 (22)		6 (3)	
Gynecology	602 (2)	39 (7)		6 (1)	
Admission type					
Emergent	2110 (8)	556 (26)	<.001	48 (2)	.03
Urgent	2698 (10)	663 (25)		51 (2)	
Elective	21 167 (82)	3655 (17)		311 (1)	
Postoperative complications[d]					
Neurologic	119 (1)	60 (50)	<.001	10 (8)	<.001
Renal	438 (2)	170 (39)	<.001	18 (4)	<.001
Infectious	1809 (7)	662 (37)	<.001	76 (4)	<.001
Cardiovascular	513 (2)	216 (42)	<.001	27 (5)	<.001
Respiratory	1366 (5)	718 (53)	<.001	73 (5)	<.001

Abbreviations: ASA, American Society of Anesthesiologists; BMI, body mass index (calculated as weight in kilograms divided by height in meters squared); IQR, interquartile range; MI, myocardial infarction; PVD, peripheral vascular disease; RVU, relative value unit; SCIP, Surgical Care Improvement Project; VASQIP, Veterans Affairs Surgical Quality Improvement Program; VTE, venous thromboembolism.

[a] Data are No. (%) of patients, unless otherwise indicated. For the second column, the denominator is 25 975 patients, unless otherwise indicated. For the third and fifth columns, the denominator is the No. of patients given in the second column for each row.

[b] This uses all observations with race/ethnicity coded in the VASQIP; 3093 patients (11.9%) had missing data.

[c] This uses all observations with BMI coded in the VASQIP; 683 patients (2.6%) had missing data.

[d] All postoperative complications were identified using VASQIP variables. Neurologic includes neurologic deficit, cerebrovascular accident, and coma. Renal includes acute renal failure and renal insufficiency. Infectious includes wound infection, wound closure dehiscence, and urinary tract infection. Cardiovascular includes MI and other cardiac complications separate from cardiac arrest. Respiratory includes pneumonia, reintubation, and failure to wean from mechanical ventilation.

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Table 2. Characteristics Associated With Positive and Negative Surveillance Results for 4874 Patients

Characteristic	Total No. of Patients	VTE Surveillance Test Result, No. (%) of Patients		*P* Value
		Positive	Negative	
Overall	4874	360 (7)	4514 (93)	
Demographics				
Sex				
Male	4632	342 (7)	4290 (93)	.98
Female	242	18 (7)	224 (93)	
Age, y				
<60	1391	77 (6)	1314 (95)	.002
≥60	3483	283 (8)	3200 (92)	
Race (n = 4320)[a]				
White	3064	232 (8)	2832 (92)	.70
Black	667	45 (7)	622 (93)	
Other	589	40 (7)	549 (93)	
Comorbidities				
Diabetes mellitus				
None	3747	268 (7)	3479 (93)	.41
Noninsulin dependent	701	60 (9)	641 (91)	
Insulin dependent	426	32 (8)	394 (93)	
History of PVD	131	11 (8)	120 (92)	.73
Steroid use	159	11 (7)	148 (93)	.84
History of MI	39	6 (15)	33 (85)	.05
Smoker	1405	68 (5)	1337 (95)	<.001
Evidence of cancer	83	10 (12)	73 (88)	.10
Preoperative acute renal failure	63	4 (6)	59 (94)	.87
Progressive renal insufficiency	88	8 (9)	80 (91)	.54
10% weight loss within 6 mo	281	28 (10)	253 (90)	.09
BMI category (n = 4722)[b]				
Underweight	135	9 (7)	126 (93)	.53
Normal	1065	67 (6)	998 (94)	
Obese	1554	119 (8)	1435 (92)	
Morbidly obese	1968	156 (8)	1812 (92)	
ASA class				
≤2	907	67 (7)	840 (93)	.23
3	3281	253 (8)	3028 (92)	
≥4	686	40 (6)	646 (94)	
Surgery characteristics				
Length of stay, median (IQR), d		11 (7-20)	9 (5-16)	<.001
Surgical work RVU, median (IQR)		23 (22-23)	23 (22-23)	.20
SCIP-VTE compliant	4433	330 (7)	4103 (93)	.60
Procedure type				
Orthopedic	2885	196 (7)	2689 (93)	.008
Thoracic	186	6 (3)	180 (97)	
Urology	154	14 (9)	140 (91)	
Gastrointestinal	1567	132 (8)	1435 (92)	
Neurosurgery	43	6 (14)	37 (86)	
Gynecology	39	6 (15)	33 (85)	
Admission type				
Emergent	556	42 (8)	514 (92)	.95
Urgent	663	47 (7)	616 (93)	
Elective	3655	271 (7)	3384 (93)	
Postoperative complications[c]				
Neurologic	60	8 (13)	52 (87)	.08
Renal	170	15 (9)	155 (91)	.50
Infectious	662	68 (10)	594 (90)	.002
Cardiovascular	216	27 (13)	189 (88)	.003
Respiratory	718	61 (8)	657 (92)	.22

Abbreviations: ASA, American Society of Anesthesiologists; BMI, body mass index (calculated as weight in kilograms divided by height in meters squared); IQR, interquartile range; MI, myocardial infarction; PVD, peripheral vascular disease; RVU, relative value unit; SCIP, Surgical Care Improvement Project; VASQIP, Veterans Affairs Surgical Quality Improvement Program; VTE, venous thromboembolism.

[a] This uses all observations with race/ethnicity coded in the VASQIP; 554 patients (11.4%) had missing data.

[b] This uses all observations with BMI coded in the VASQIP; 152 patients (3.1%) had missing data.

[c] All postoperative complications were identified using VASQIP variables. Neurologic includes neurologic deficit, cerebrovascular accident, and coma. Renal includes acute renal failure and renal insufficiency. Infectious includes wound infection, wound closure dehiscence, and urinary tract infection. Cardiovascular includes MI and other cardiac complications separate from cardiac arrest. Respiratory includes pneumonia, reintubation, and failure to wean from mechanical ventilation.

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determined from administrative data. A follow-up study[16] using Medicare data to assess hospital surveillance patterns and National Surgical Quality Improvement Program data to determine VTE rates confirmed that surveillance was associated with VTE occurrence. However, an important limitation of this follow-up study[16] is that hospital surveillance was measured for a different surgical population than that for VTE outcome. If increased surveillance fully explains increased inpatient VTE rates, then we would expect that postdischarge VTE rates would decrease as more VTEs would be diagnosed prior to hospital discharge. In our study, we found a positive association between inpatient VTE and postdischarge VTE rates. This suggests that the majority of inpatient surveillance may be ordered appropriately and that hospitals with higher rates of at-risk patients have higher inpatient and postdischarge VTE rates. Interestingly, inpatient surveillance was not correlated with postdischarge surveillance, which suggests that surveillance practices are limited to the inpatient setting.

Currently, the Center for Medicaid and Medicare Services uses administrative claims data to compose the Patient Safety Indicators used in assessing quality measures. In 2015, the Patient Safety Indicators, including VTE, will be included in the Value-Based Purchasing program. Although administrative data are convenient and accessible, the reliability for capture of actual events is questionable. One analysis[17] found that studies using administrative data overestimated VTE rates by 40% compared with those using clinical data. One of the strengths of our study is the use of VASQIP data, which include both inpatient and postdischarge events occurring within 30 days of surgery accessed from medical records. Both the VASQIP and the National Surgical Quality Improvement Program (which is modeled after the VASQIP) have been shown to be superior in validity and reliability to Patient Safety Indicators for assessing VTE outcomes.[17,18] Our study, which assessed surveillance and outcomes in the same surgical population for each hospital, did find a positive association between the use of surveillance tests and VTE outcomes using VASQIP-assessed events.

Several studies[19-21] have been published on individual hospital VTE prevention strategies with subsequent improvement in VTE outcomes, whereas increased SCIP-VTE adherence has not been shown to be associated with decreased VTE rates.[13,15] The lack of robustness for the SCIP-VTE measures likely explains the lack of improved VTE outcomes despite high adherence rates. For example, a patient who underwent major abdominal surgery and received chemical prophylaxis within 24 hours after surgery without receiving any other prophylactic medication throughout the duration of the hospitalization would meet the criteria for SCIP-VTE compliance. Successful reductions in hospital VTE rates have been achieved by focusing on risk stratification and an appropriate duration of VTE prophylactic measures that are not limited to prophylaxis alone.[19-21] This scenario suggests that the definition for SCIP-VTE adherence should be expanded beyond the initial 24 hours after surgery if it is to be a useful quality measure. Perhaps, a threshold proportion of hospital days covered by VTE

Table 3. Hospital Rates of VTE Variables Stratified by Index and Postdischarge Hospitalization

Variable	% of Patients	
	Median (IQR)	Range
SCIP VTE-2 compliance	92.6 (86.1-95.8)	63.6-100.0
Surveillance test performed		
Any[a]	17.6 (13.5-21.5)	5.5-50.4
Index[b]	13.4 (9.0-16.4)	3.0-42.0
Postdischarge[c]	4.9 (3.0-6.4)	0.0-34.6
VTE diagnosed		
Any[a]	1.5 (1.0-2.2)	0.3-4.6
Index[b]	1.0 (0.6-1.5)	0.2-3.6
Postdischarge[c]	0.4 (0.0-0.7)	0.0-1.4
Readmitted within 30 d		
Any reason	20.9 (18.0-23.3)	8.6-32.4
Related to VTE	0.3 (0.0-0.5)	0.0-1.25

Abbreviations: IQR, interquartile range; SCIP, Surgical Care Improvement Project; VTE, venous thromboembolism.

[a] Includes index hospitalization and up to 30 days following discharge date.

[b] Index hospitalization of the surgical procedure.

[c] Denotes the 30-day time period following discharge of index hospitalization.

Table 4. Hospital-Level Correlations With Index and Postdischarge VTE

Variable	Median % of Patients	VTE Diagnosis			
		Index Hospitalization[a]		Postdischarge[b]	
		R Value	*P* Value	*R* Value	*P* Value
SCIP VTE-2 compliance	92.6	−0.13	.20	0.02	.90
Surveillance					
Any	17.6	0.22	.04	0.1	.40
Index	13.4	0.33	.003	0.03	.80
Postdischarge	4.9	−0.09	.40	0.2	.07
VTE diagnosis					
Index	1.0			0.06	.60
Postdischarge	0.4	0.06	.60		
Any readmission[c]	20.9	−0.0005	.99	0.11	.30
Length of stay, d	8.2	0.25	.02	−0.11	.30
No. of patients	327	−0.19	.08	0.06	.60

Abbreviations: SCIP, Surgical Care Improvement Project; VTE, venous thromboembolism.

[a] Diagnosed during index hospitalization of surgical procedure.

[b] Diagnosed within the 30 days following discharge of the index hospitalization.

[c] Readmission within 30 days from discharge of the index hospitalization.

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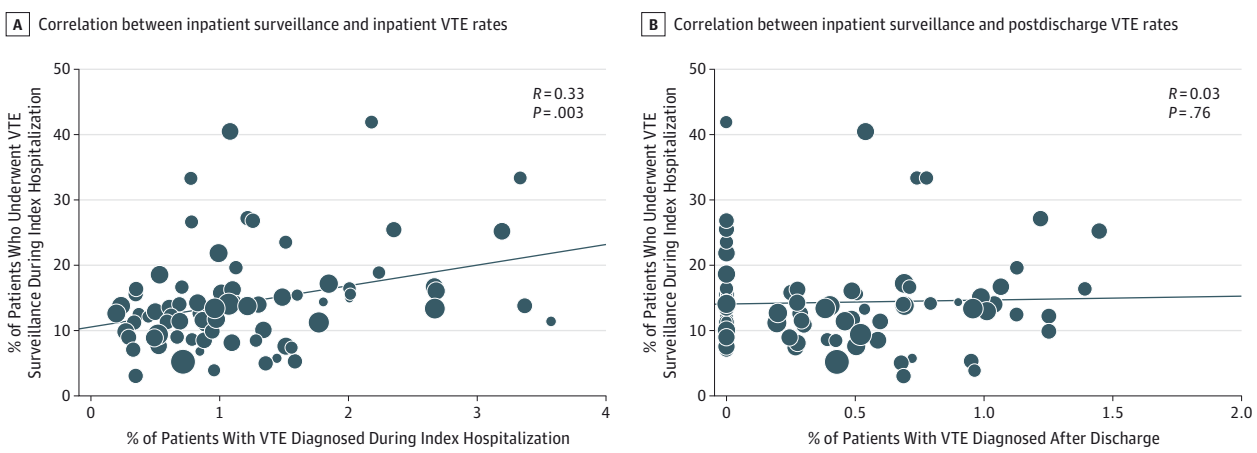
Figure. Correlations Between Inpatient Surveillance and VTE Rates



A and B, These rates are performed at the hospital level, and the different sizes of the circles reflect hospital volume. B, These rates reflect postdischarge venous thromboembolism (VTE) rates during the 30 days following discharge after index hospitalization for surgical procedure. The solid lines represent the linear regression fit across all patients. Pearson correlation coefficients and *P* values are shown.

prophylaxis (eg, ≥80%) would be a more informative measure of hospital quality regarding VTE prevention.

Where do we go from here with respect to VTE as a metric for surgical quality of care? Given that adherence rates to current SCIP measures are more than 95%, the opportunity to achieve further benefit must be questioned. The limited focus of the SCIP-VTE metric to the first hospital day may have the unintended consequence of decreasing emphasis on the need for prevention strategies throughout the hospitalization. Hospitals seeking to further reduce VTE rates should implement individual evidence-based VTE prophylaxis guidelines above those required by SCIP compliance. Furthermore, if surveillance is associated with an increased number of VTE diagnoses during the index hospitalization without reduction in the number of postdischarge diagnoses, the role of VTE outcomes as a valid measure of hospital quality must be reconsidered. It does appear that some hospitals have higher-risk surgical populations that cannot be completely accounted for by adjusting for patient and procedure factors and cannot be mitigated by current SCIP measures.

Our study has several limitations, including a study population composed of mostly older men, which limits the generalizability of our results to other populations. Furthermore, we only assessed VTE prevention as measured by SCIP, and other hospital VTE prevention practices could be associated with hospital surveillance practices, thus confounding our observation. We did not pursue access to data after 2009 and cannot account for any changes occurring in the past 5 years regarding VTE surveillance. However, SCIP adherence was approaching 100% by the end of the study period, and it is unlikely that prevention measures or VTE outcomes changed significantly in the past few years. Finally, only variables assessed by VASQIP medical record review were available for our analyses, leaving the possibility of bias or confounding due to unobserved factors.

Conclusions

Postdischarge VTE rates in the 30 days after surgery are not decreased by higher inpatient surveillance rates but are associated with higher inpatient VTE rates. Thus, patient risk factors and case mix likely contribute to hospital VTE rates, and surveillance bias may reflect the underlying at-risk population. Using its current definition, we find that SCIP-VTE adherence is an inadequate assessment of hospital quality because it is not associated with VTE outcomes. Further research is needed to determine whether refined VTE prophylaxis measures or outcome assessment can be reliable measures of surgical quality.

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Invited Commentary

The Controversy Surrounding Surgical Care Improvement Project–Venous Thromboembolism Process Measures

Gilbert R. Upchurch Jr, MD

Holcomb and coauthors[1] have nicely described a large series of noncardiovascular patients undergoing surgery in the Veterans Affairs Surgical Quality Improvement Program database from 2006 to 2009 in which "inpatient" and "outpatient" deep venous thrombosis rates were determined based on inpatient surveillance. This study[1] serves as a follow-up on an earlier study in which Altom et al[2] documented several important risk factors for venous thromboembolism (VTE) but no association with adherence to Surgical Care Improvement Project (SCIP)-VTE process measures. Not surprisingly, in the study by Holcomb et al,[1] there was a positive correlation between inpatient surveillance and inpatient VTEs (R = 0.33, P = .003). Interestingly and importantly, however, there was no significant correlation between inpatient surveillance and either postdischarge surveillance or postdischarge VTE rates.

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When the data are further examined in detail, it appears similar to the data from other studies in that only 18.8% of patients underwent deep venous thrombosis surveillance, with an overall VTE rate of 1.6%. The usual risk factors associated with increased deep venous thrombosis rates included being older than 60 years of age, insulin-dependent diabetes mellitus, peripheral vascular disease, a history of myocardial infarction, acute renal failure, and having a malignant neoplasm. I was surprised that obesity was not a risk factor for VTE in this study.[1] When I queried the authors about this, they responded that body mass index (underweight and not overweight) was a risk factor for surveillance but not for VTE. Tell that to surgeons who specialize in morbid obesity! The surgical characteristics associated with increased surveillance, and thus increased VTE rates, were orthopedic and neurosurgical procedures, as well as increased postoperative complications. Surveillance rates varied significantly at the hospital level. Not sur-

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