



## Venous thromboembolism prevention compliance: A multidisciplinary educational approach utilizing NSQIP best practice guidelines

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### ABSTRACT

**Background:** Review of our institutional National Surgical Quality Improvement Project (NSQIP) data found higher rate of Venous Thromboembolic Events (VTE) (2.5% vs. 1.1%). Compared to the national benchmark. Our goal was to identify opportunities for quality improvement.

**Methods:** We compared NSQIP general surgery data from January 2015–December 2016 (period 1) to January 2017–December 2018 (period 2). A multidisciplinary committee was developed and patient centered education implemented to enhance VTE compliance.

**Results:** Over 50% of all the patients who developed VTE were non-compliant with chemical prophylaxis. The majority of non-compliance was due to pain. During period 1 there were 12 VTEs in 482 cases, while in period two, 18 VTEs in 2347 cases (2.5% vs. 0.8%; RR 2.3, 95% CI 1.5–3.7,  $p < 0.001$ ). Missed chemical prophylaxis decreased from 50 to 17 per week after the intervention.

**Conclusion:** A multidisciplinary, patient centered approach to increase VTE prevention decreases VTE rates to below a comparable benchmark.

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### Introduction

Venous thromboembolic events (VTEs) are a common yet the preventable cause of morbidity and mortality in hospitalized patients across the United States.<sup>1</sup> VTEs are estimated to account for 5–10% of all deaths among hospitalized patients and are associated with significant morbidity.<sup>2</sup> The Agency for Healthcare Research and Quality (AHRQ) and the American College of Chest Physicians recommend VTE prophylaxis that includes both mechanical, like sequential compression devices (SCDs), and pharmacologic prophylaxis with anticoagulants such as heparin and enoxaparin.<sup>3,4</sup> Furthermore, national societies such as the Centers for Medicare and Medicaid Services, and the American College of Surgeons use VTEs as surrogate indicators of quality in the healthcare.

Surgical patients are at increased risk of developing VTE due to multiple clinical factors, such as the type of procedure, physiologic changes that result from traumatic injuries, and disease pathology such as cancer.<sup>5</sup> The incidence of VTE has been described to be as low as 0.8% for low risk operations and as high as 2–3% for high risk orthopedic, neurosurgical and oncologic procedures.<sup>6</sup> Additionally, patients who undergo emergency general surgery have a reported rate of VTE of 2.5%.<sup>7</sup> Despite the increased risk of VTEs amongst surgical patients and recommendations for prophylaxis, compliance remains a challenge with only 59% of surgical patients receiving American College of Chest Physicians recommended VTE prophylaxis.<sup>8</sup>

The American College of Surgeons National Surgical Quality Improvement Program (ACS NSQIP) is a nationally validated surgical outcomes database that measures risk-adjusted outcomes to improve care across institutions.<sup>9,10</sup> The program collects 135 previously described variables and measures outcomes up to 30-day postoperatively.<sup>9,10</sup> The data collection is performed at each participating institution by a Surgical Clinical Reviewer trained by

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NSQIP to review the medical records and enter the data based on strict NSQIP criteria. NSQIP's ability to provide institution specific quality data that can be compared to the national benchmark makes it the ideal database to use for quality improvement endeavors.<sup>11</sup> As part of a quality improvement project, we queried our institution's ACS NSQIP to evaluate our DVT rate compared to the national NSQIP benchmark. We found a higher rate of VTEs (2.5% vs. 1.1%) compared to similar university-based institutions. Our goal was to perform a clinical chart review to identify and target opportunities for our quality improvement initiative.

## Methods

The ACS NSQIP is a prospective, validated national database, that measures the quality of surgical care. The University of Florida College of Medicine Jacksonville is a tertiary referral, safety net hospital that is an ACS NSQIP participating site. Previously described collected variables include patient demographics, pre-operative risk factors and post-operative events were collected for patients who received general surgery procedures.<sup>12</sup> The Institutional Review Board approved this study.

We compared our institutional NSQIP general surgery data focusing on the incidence of VTE during two time periods from January 2015–December 2016 (period 1: pre-intervention) and January 2017–December 2018 (period 2: post-intervention). After collecting data from the pre-intervention period, we formed a multidisciplinary, institutional VTE committee composed of physicians, nurses, pharmacists, NSQIP data abstracters, and investigators.

The VTE committee performed a clinical chart review, and identified low compliance to VTE preventative measures as a major contributing factor to our VTE rates. A survey of the nurses across the institution was conducted after period 1 to identify barriers to the implementation of VTE prophylaxis.

## Intervention

All clinicians (physicians, pharmacists, advance practitioners, and nurses) were educated at minimum of once about the effects of non-compliance with VTE prevention measures using power point presentations during morbidity and mortality conference, grand rounds, surgical performance improvement meetings, resident education sessions, and at departmental meetings. Clinicians were also tasked with reinforcing patient education pre-operatively and perioperatively on multiple encounters using an education pamphlet (Fig. 1) specifically developed to educate patients regarding the importance of VTE prophylaxis. Patient re-education was provided if patients refused any method of prophylaxis. Lastly, pharmacists were asked to verify that adequate weight-based doses of anticoagulants were administered, and to further educate patients who refused VTE prophylaxis once hospitalized. Systematic interventions included the purchase of new Sequential Compression Devices (SCDs) as part of routine purchasing to improve the quality of equipment. Compliance of chemical VTE prophylaxis was surveilled by random pre and post intervention sampling performed by the pharmacists.

## Statistics

Patient characteristics were reported as mean for all continuous variables and frequencies with percentages for all categorical variables. Pearson's chi square was used to compare categorical variables. Univariate and bivariate statistics were calculated using Stata statistical software, v10 (College Station, TX).

## Results

We identified a total of 2829 patients during the study period, 482 were within study period 1 and 2347 during study period 2. Among those patients, the mean age was 53 years, the majority were White females with a mean BMI of 29. Nearly half of the patients had hypertension requiring medical treatment, less than 5% had disseminated cancer and over 90% of patients received general anesthesia, nearly 60% of the procedures done were done as an inpatient and less than 20% were done on an emergent basis (Table 1). A total of 30 VTEs were identified during both study periods. Twelve VTEs were reported during study period 1, while 18 VTEs were reported in study period 2 (2.5% vs 0.8%, RR 2.3, 95% CI 1.5–3.7,  $p < 0.001$ ). Of the patients who developed VTEs, the mean age was 57, the mean BMI was 22.3, and over 10% of patients were reported to have disseminated cancer. All patients who developed VTE received general anesthesia, 90% of cases were done as inpatient procedures, and 20% were done on an emergent basis (Table 1).

Three hundred and eighty-three patients were identified in the period 1, the mean age in for patients in the pre-intervention group was 59.9 years, over 50% of patients were female and White, the mean BMI was 29.3, and 26% of patients were coded as current smokers. The majority of procedures were done using general anesthesia (99%), 22% were done on an emergent basis and over half were inpatient procedures (Table 2). In period 2, 2347 patients were included, the mean age was 53.2 years, 53.3% were female, and 58.5% were White. The mean BMI was 29.4, and 25% were reported as current smokers. Similar to period 1, 99% of patients underwent general anesthesia, 60% of the procedures were done on an in-patient basis and 20% were considered emergent. Unlike period 1, 1% of patients in period 2 had spinal anesthesia, and less than 1% had epidural or moderate sedation.

From the chart review, we found that over 50% of the patients who developed VTE were non-compliant with chemical prophylaxis. Pre-intervention compliance monitoring revealed that over 50 doses of anticoagulation were consistently missed, while post-intervention monitoring showed less than 20 doses of anticoagulation were missed. Random pre and post study sampling of missed doses of chemical prophylaxis decreased from 50 to 17 in a 7-day period. Table 3 depicts the results of the pre-intervention online survey of nurses citing pain (64.6%) as the most common reason for non-compliance with VTE chemoprophylaxis, and discomfort due to "hot and sweaty legs" (34.9%) as the main reason for non-compliance with mechanical prophylaxis. Additionally, the survey revealed that 22.5% of nurses perceived patients to wear SCDs 10 h out of their 12-h shift, and only 12% of nurses believed patients wore SCDs during the entire 12-h shift. When asked about communication to providers, and EMR recording of non-compliance, nurses reported notifying practitioners less than half of the time (47.7%), and documenting refusal in the EMR 76% of the time. Lastly, when asked about ways to improve compliance to VTE prophylaxis, nearly half (49.2%) of respondents thought that patient education by the physician team would have the greatest impact.

## Discussion

NSQIP has long been used to improve the quality of surgical care. In the 1990s, the Veterans Health Administration NSQIP helped decrease postoperative complication rates by 30% in a three-year implementation period.<sup>10</sup> Additionally, previous studies have utilized NSQIP to identify gaps in surgical care, specifically in VTE prevention leading to the development of mandatory VTE risk calculators within EMR systems to improve VTE prophylaxis adherence.<sup>13,14</sup> The prevention of VTEs is not the only quality

# Preventing Surgical Complications

Many issues can arise when someone is having surgery. Two of these issues are deep vein thrombosis and pulmonary embolism. These methods are important in order to prevent LIFE THREATENING conditions and DEATH. Please expect these interventions to be used while you are recovering from your surgery.

## What is deep vein thrombosis or DVT?

DVT occurs when a blood clot forms in a vein deep inside the body. These clots are most commonly found in the thigh or lower leg.

## Why is a DVT blood clot dangerous?

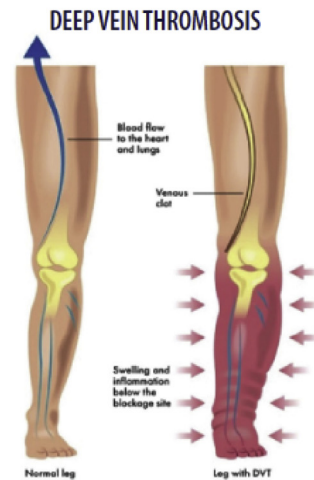
The blood clot can travel to your brain, heart, lungs and other organs and cause damage. Then it is called a pulmonary embolism or PE. The moving clot causes decreased blood flow to vital organs such as your brain, heart and lungs and can be deadly.

## What are the symptoms of DVT and PE blood clots?

Watch for pain, tenderness, swelling, redness and increased warmth on one side. Talk to your doctor if you develop shortness of breath, chest pain, dizziness or rapid heart rate.

## Steps to prevent clots:

- 1. WALK EARLY AFTER SURGERY** – Walking or therapeutic exercise after surgery reduces the risk of clots forming.
- 2. USE COMPRESSION STOCKINGS** – Stockings aid in venous blood return by compressing the lower leg.
- 3. USE A SEQUENTIAL COMPRESSION DEVICE (SCD)** – Compression devices act as artificial muscle contractions to propel blood to the heart.
- 4. TAKE MEDICATION** – Medications are given to reduce your blood's ability to clot. Common medications you may see while recovering from your surgery include (but are not limited to):
  - ▶ Heparin and Lovenox – These medications are commonly given by injection at least two times a day (while hospitalized) into fatty tissues, such as your stomach.
  - ▶ Coumadin (Warfarin) – This medication is a pill taken by mouth one or more times a day.



## WHAT ARE THE RISK FACTORS FOR DEVELOPING DVT/PE?

- ▶ Cancer, previous or current
- ▶ Coagulation (clotting) abnormalities
- ▶ Hormone therapy or oral contraceptives (birth control)
- ▶ Immobility for long periods, such as bed rest
- ▶ Over 40 years old
- ▶ Overweight or obese
- ▶ Personal or family history of clots/ DVTs
- ▶ Surgery

If you have any questions, please talk to your nurse or doctor.

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Fig. 1. Venous thromboembolic event patient education pamphlet.

measure that NSQIP has been used to act upon, Nimeri et al. described how they used NSQIP to improve overall morbidity and decrease the rate of VTEs, surgical site and urinary tract infections, unplanned and prolonged intubations, as well as to lower costs and improve surgical care at Sheikh Khalifa Medical City.<sup>15</sup> In this study, we demonstrate how NSQIP can be used as a tool to develop an outcome improvement project, that when combined with multidisciplinary, patient centered interventions can lead to sustained, improved outcomes.

Using institutional NSQIP data, we found a deficit in our quality metrics and identified higher VTE rates compared to the national benchmark (2.5% vs. 1.1%). A multidisciplinary, institutional VTE committee was formed, that identified low compliance with VTE prophylaxis as the major contributing factor to our elevated VTE rates. We believe the multidisciplinary committee composed of

physicians, nurses, pharmacists, and NSQIP data abstracters, was a major contributing factor to the success of this project. The diversity within the committee allowed us to examine multiple causative factors, and target low compliance with VTE prophylaxis as the major contributor. The committee also recognized nurses as the gatekeepers of compliance as they are the ones tasked with administering and enforcing prophylactic measures. Upon acknowledging the important role played by the nurses, a survey of the nurses across the institution was performed that identified pain and discomfort as major reasons for non-compliance with VTE prophylaxis. Interestingly, the additional reasons for non-compliance were all patient-centric and included patient comfort, convenience, preference and lack of education. The survey also revealed that nearly half of the nurses who responded thought that physician-led patient education would lead to a significant increase

**Table 1**  
Patient demographic of study population and those who developed venous thromboembolism.

	All Patients Total N = 2829 (%)	Patients with VTE Total N = 30 (%)
Age (years, mean)	53.2	57.9
<b>Sex</b>	1247 (73.8)	16 (53.3)
Female	1582 (55.9)	14 (46.7)
Male		
<b>Race</b>	1656 (58.5)	20 (66.7)
White	947 (33.5)	10 (33.3)
Black		
Mean BMI	29.5	22.3
Diabetes	480 (17)	9 (30)
Ventilator dependence	30 (2.8)	1 (3.3)
History of severe COPD	119 (4.2)	0 (0)
CHF <sup>a</sup>	15 (0.53)	0 (0)
Hypertension on medication	1207 (42.7)	18 (60)
Acute renal failure <sup>b</sup>	28 (1.0)	0 (0)
Disseminated cancer	107 (3.8)	5 (16.7)
Open wound/wound infection	164 (5.8)	9 (30)
Chronic steroid use	72 (2.6)	1 (3.3)
Bleeding disorder	111 (3.9)	1 (3.3)
Transfusion <sup>c</sup>	33 (1.2)	2 (6.7)
<b>Preoperative sepsis spectrum</b>	153 (5.4)	4 (13.3)
SIRS	149 (5.3)	3 (10)
Sepsis	63 (2.2)	0 (0)
Septic shock		
<b>ASA classification</b>	152 (5.4)	1 (3.3)
1	1179 (41.2)	4 (13.3)
2	1270 (44.9)	22 (73.3)
3	185 (6.5)	3 (10)
4	12 (0.42)	0 (0)
5		
<b>Anesthesia type</b>	2816 (99.5)	30 (100)
General	8 (0.28)	0 (0)
Epidural	7 (0.25)	0 (0)
Spinal		
Inpatient procedure	1690 (59.7)	27 (90)
Emergency procedure	534 (18.9)	6 (20)

<sup>a</sup> CHF – Congestive Heart Failure 30 days before surgery.

<sup>b</sup> Acute renal failure – patients on dialysis excluded as this can falsely elevate the MELD score.

<sup>c</sup> Transfusion - >4 units packed red blood cells in 72 h before surgery.

in patient compliance.

The importance of patient centered interventions to improve outcomes cannot be stressed, and is further demonstrated by the results of our patient centered intervention. Based our survey results and previous studies that confirmed patient centered education reduced the non-administration of VTE prophylaxis we developed physician led, patient centered pre and perioperative education to increase VTE prophylaxis compliance.<sup>16,17</sup> Additionally, the VTE committee created a patient education pamphlet focused on the importance of VTE prevention and compliance with prophylaxis. After implementation of our interventions during study period two, the VTE rate at our institution has remained less than 1%, consistent with the national NSQIP benchmark rates of 1.1%. We were unable to identify a specific, single intervention that was the most effective at lowering the VTE rates. However, we believe that clinician education combined with patient education across multiple interactions proved to be the most effective. A post intervention survey of patients and the nurses would be an interesting follow up study to determine what they thought the most impactful intervention was. Given our success at maintaining low VTE rates one year out from period 2, we plan to continue educating clinicians on a yearly basis regarding the importance of VTE prophylaxis. We also plan to continue providing multidisciplinary patient education during multiple encounters pre and perioperatively. Furthermore, we plan to make the VTE patient education

**Table 2**  
Patient demographic of pre and post-intervention population.

	Pre-intervention Total N = 383 (%)	Post-intervention Total N = 2347(%)
Age (years, mean)	59.9	53.2
<b>Sex</b>	228 (59.5)	16 (53.3)
Female	155 (40.5)	14 (46.7)
Male		
<b>Race</b>	221 (57.7)	1372 (58.5)
White	130 (33.9)	783 (33.4)
Black		
Mean BMI	29.3	29.4
Diabetes	67 (17.5)	388 (16.5)
Ventilator dependence	5 (1.3)	24 (1.0)
History of severe COPD	17 (4.4)	99 (4.2)
CHF <sup>a</sup>	–	13 (0.6)
Hypertension on medication	182 (47.5)	977 (41.6)
Acute renal failure <sup>b</sup>	2 (0.5)	25 (1.1)
Disseminated cancer	24 (6.3)	81 (3.5)
Open wound/wound infection	23 (6.8)	141 (6)
Chronic steroid use	7 (1.8)	63 (2.7)
Bleeding disorder	14 (3.7)	95 (4)
Transfusion <sup>c</sup>	5 (1.3)	28 (1.2)
Current smoker	101 (26.4)	590 (25.1)
<b>Preoperative sepsis spectrum</b>	27 (7)	123 (5.2)
SIRS	12 (3.1)	134 (5.7)
Sepsis	6 (1.6)	56 (2.4)
Septic shock		
<b>ASA classification</b>	15 (3.9)	131 (5.6)
1	174 (45.4)	957 (40.8)
2	168 (43.9)	1064 (45.3)
3	15 (3.9)	163 (6.9)
4	1 (0.3)	11 (0.5)
5		
<b>Anesthesia type</b>	382 (99.7)	2337 (99.6)
General	–	7 (0.3)
Epidural	–	1 (1.0)
Spinal	–	2 (0.1)
MAC/IV		
Inpatient procedure	1690 (59.7)	1412 (60.2)
Emergency procedure	85 (22.2)	6 (20)

<sup>a</sup> CHF – Congestive Heart Failure 30 days before surgery.

<sup>b</sup> Acute renal failure – patients on dialysis excluded as this can falsely elevate the MELD score.

<sup>c</sup> Transfusion - >4 units packed red blood cells in 72 h before surgery.

**Table 3**  
Nursing survey results of reasons for non-compliance of venous thromboembolism prophylaxis.

Reasons for chemoprophylaxis refusal	Total n = 130 (%)
Pain	84 (64.6%)
Inconvenient timing	9 (6.9%)
Patient preference	14 (10.8%)
Lack of education	3 (2.3%)
Unknown/other	20 (15.4)
<b>Reasons for mechanical refusal</b>	<b>Total n = 129 (%)</b>
Hot/sweaty	45 (34.9%)
Pain	11 (8.5%)
Bulky	13 (10.1%)
Inconvenience	10 (7.8%)
Receiving chemoprophylaxis	5 (3.9%)
Patient is ambulatory	3 (2.3%)
Fall risk	3 (2.3%)
Unknown/other	39 (30.2%)

pamphlet part of the pre-operative instruction materials provided to patients scheduled for surgery.

Limitations to this study include use of the NSQIP database which only includes a representative sample of patients rather than of all patients. However, utilization of a validated database, allowed us to identify areas of improvement compared to the outcomes of



similar institutions. Ideally, a randomized, controlled trial would help determine the best method of intervention to increase patient compliance with VTE prophylaxis. However, the quality improvement nature of this study did not allow for a randomization of the intervention as we believed implementation of our efforts were necessary to improve the quality of care within our patients. Additionally, it is important to note that the study includes inconsistent pre and post-intervention study periods, as well as have a small sample size in the pre-intervention period due to a gap in institutional NSQIP participation, this could have led to sampling bias. However, our findings of VTE occurrences were concerning to proceed with an intervention, yet a larger study sample is necessary to further study the effects of interventions.

## Conclusions

Noncompliance with VTE prophylactic measures in high-risk patients increases the occurrence of post-operative VTEs. ACS NSQIP is a useful tool to identify institutional deficits in quality measures leading to quality improvement initiatives. Establishing multidisciplinary teams to develop patient centered tools to increase education of patients and healthcare providers can decrease VTE rates.

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## Declaration of competing interest

The authors have no conflicts of interest to declare.

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