

Preventing Hospital-Acquired Venous Thromboembolism: Improving Patient Safety With Interdisciplinary Teamwork, Quality Improvement Analytics, and Data Transparency

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BACKGROUND: Hospital-acquired venous thromboembolism (HA-VTE) is a potentially preventable cause of morbidity and mortality. Despite high rates of venous thromboembolism (VTE) prophylaxis in accordance with an institutional guideline, VTE remains the most common hospital-acquired condition in our institution.

OBJECTIVE: To improve the safety of all hospitalized patients, examine current VTE prevention practices, identify opportunities for improvement, and decrease rates of HA-VTE.

DESIGN: Pre/post assessment.

SETTING/PATIENTS: Urban academic tertiary referral center, level 1 trauma center, safety net hospital; all patients.

INTERVENTION: We formed a multidisciplinary VTE task force to review all HA-VTE events, assess prevention practices relative to evidence-based institutional guidelines, and identify improvement opportunities. The task force developed an electronic tool to facilitate efficient VTE event review and designed decision-support and reporting tools, now integrated into the electronic health record, to

bring optimal VTE prevention practices to the point of care. Performance is shared transparently across the institution.

MEASUREMENTS: Harborview benchmarks process and outcome performance, including patient safety indicators and core measures, against hospitals nationally using Hospital Compare and Vizient data.

RESULTS: Our program has resulted in >90% guideline-adherent VTE prevention and zero preventable HA-VTEs. Initiatives have resulted in a 15% decrease in HA-VTE and a 21% reduction in postoperative VTE.

CONCLUSIONS: Keys to success include the multidisciplinary approach, clinical roles of task force members, senior leadership support, and use of quality improvement analytics for retrospective review, prospective reporting, and performance transparency. Ongoing task force collaboration with frontline providers is critical to sustained improvements. *Journal of Hospital Medicine* 2016;11:S38–S43. © 2016 Society of Hospital Medicine

Venous thromboembolism (VTE), including deep vein thrombosis (DVT) and pulmonary embolism (PE), is a serious and growing public health problem. In the United States an estimated 900,000 people are affected and more than 100,000 die from VTE or related complications each year. More than half of VTE events occur in association with hospitalization or major surgery; many are thought to be preventable.^{1–5} The Centers for Medicare and Medicaid Services (CMS), Centers for Disease Control and Prevention (CDC), and the Agency for Healthcare Research and Quality (AHRQ),^{6–9} among

other organizations, have identified VTE as a potentially preventable “never” event. Evidence-based guidelines and resources exist to help support hospital-acquired venous thromboembolism (HA-VTE) prevention.^{1–10} Harborview Medical Center, a tertiary referral center with more than 17,000 patients hospitalized annually, many requiring surgery, serves one of the highest-risk populations for HA-VTE development. Despite high rates of VTE prophylaxis in accordance with an established institutional guideline,^{11,12} VTE remains the most common hospital-acquired condition in our institution.

OBJECTIVES

To improve the safety and care of all patients in our medical center and eliminate preventable HA-VTE events, we set out to: (1) incorporate evidence-based best practices in VTE prevention and treatment into current practice in alignment with institutional guidelines, (2) standardize the review process for all HA-VTE events to identify opportunities for improvement, (3) utilize quality improvement (QI) analytics and information technology (IT) to actively

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improve our processes at the point of care, and (4) share process and outcome performance relating to VTE prevention transparently across our institution

METHODS

To prevent HA-VTE, we employ a multifactorial strategy that includes designated clinical leadership, active engagement of all care team members, decision support tools embedded in the electronic health record (EHR), QI analytics, and retrospective and prospective reporting that provides ongoing measurement and analysis of the effectiveness of implemented interventions.

Setting/Patients

Harborview Medical Center, a 413-bed academic tertiary referral center and the only level 1 adult and pediatric trauma and burn center for a 5-state area, also serves as the primary safety-net provider in the region. Harborview has centers of excellence in trauma, neurosciences, orthopedic and vascular surgery and rehabilitation, and is the only certified comprehensive stroke center in 5 states. With more than 17,000 admissions annually, including over 6000 trauma cases, HA-VTE is a disease that spans critical and acute care settings and impacts patients on all clinical services. Harborview serves a population that is at extremely high risk for VTE as well as bleeding, particularly patients who have sustained central nervous system trauma or polytrauma.

Intervention

In 2010, at the request of the Harborview Medical Executive Board and Medical Director, we formed the Harborview VTE Task Force to assess VTE prevention practices across services and identify improvement opportunities for all hospitalized patients. This multidisciplinary team, co-chaired by a hospitalist and trauma surgeon, includes representatives from trauma/general surgery, orthopedic surgery, hospital medicine, nursing, pharmacy, and QI. Task force members represent critical and acute care as well as the ambulatory setting. Additional stakeholders and local experts including IT directors and analysts, continuity of care nurses, and other clinical service representatives participate on an ad hoc basis.

Since its inception, the VTE Task Force has met monthly to review performance data and develop improvement initiatives. Initially we collaborated with experts across our health system to update an existing institutional VTE prophylaxis guideline to reflect current evidence-based standards.^{1,3-5,12} We met with all clinical services to ensure that the guidelines incorporated departmental best practices. These guidelines were integrated into our Cerner-based (Cerner Corp., North Kansas City, MO) computerized provider order entry (CPOE) system to support accurate VTE risk assessment and appropriate ordering of prophylaxis.

The VTE Task Force collaborated with QI programmers to develop an electronic tool, the Harborview VTE Tool (Figure 1),¹³ that allows for efficient,

standardized review of all HA-VTE at monthly meetings. The tool uses word and phrase search capabilities to identify PEs and DVTs from imaging and vascular studies and links those events with pertinent demographic and clinical data from the EHR in a timeline. Information about VTE risk assigned by physicians in the CPOE system is extracted as well as specific VTE prophylaxis and treatment (drug, dose, timing of administration of medications, reason for doses being held, and orders for and application of mechanical prophylaxis). Using the VTE tool, the task force reviews each VTE event to assess the accuracy of VTE risk assignment, the appropriateness of prophylaxis received relative to guidelines, and the adequacy of VTE treatment and follow-up. This tool has facilitated our review process, decreasing time from >30 minutes of manual chart review per event to several minutes. In recent months, a quality analyst has prescreened all VTEs prior to task force discussion to further improve efficiency. The tool allows the team to assess the case together and reach consensus regarding VTE prevention.

Prompt event reviews allow the task force to provide timely feedback about specific VTE events to physicians, nurses, and pharmacists. Cases with potential opportunities for improvement are referred to a medical center-wide QI committee for secondary review. Areas of opportunity identified are tracked and trended to direct ongoing system improvement cycles. In 2014, as a result of reviewing patient cases with VTE diagnosed after discharge, we began a similar review process to assess current practice and standardize prophylaxis across care transitions.

In response to opportunities identified from reviews, the VTE Task Force developed multiple reporting tools that provide real-time, actionable information to clinicians at the bedside. Daily electronic lists highlight patients who have not received chemical or mechanical prophylaxis in 24 hours and are utilized by nursing, pharmacy, and physician groups. Patients receiving new start vitamin K antagonists or direct oral anticoagulants are identified for pharmacists and discharge care coordinators to support early patient/family education and ensure appropriate follow-up. Based on input from frontline providers, tools are continually refined to improve their clinical utility. A timeline of initiatives that the Harborview VTE Task Force has championed is outlined in Figure 2.

To bring HA-VTE prevention information to the point of care, we developed a VTE Prevention/Treatment Summary within the EHR (Figure 3). Information about VTE risk assigned by the physician based on guidelines, current prophylaxis orders (pharmacologic/nonpharmacologic) and administration status, therapeutic anticoagulation and pertinent laboratory values are imported into a summary snapshot that can be accessed on demand by any member of the care team from within the patient's chart. The same data elements are being imbedded in resident physician and nursing handoff tools

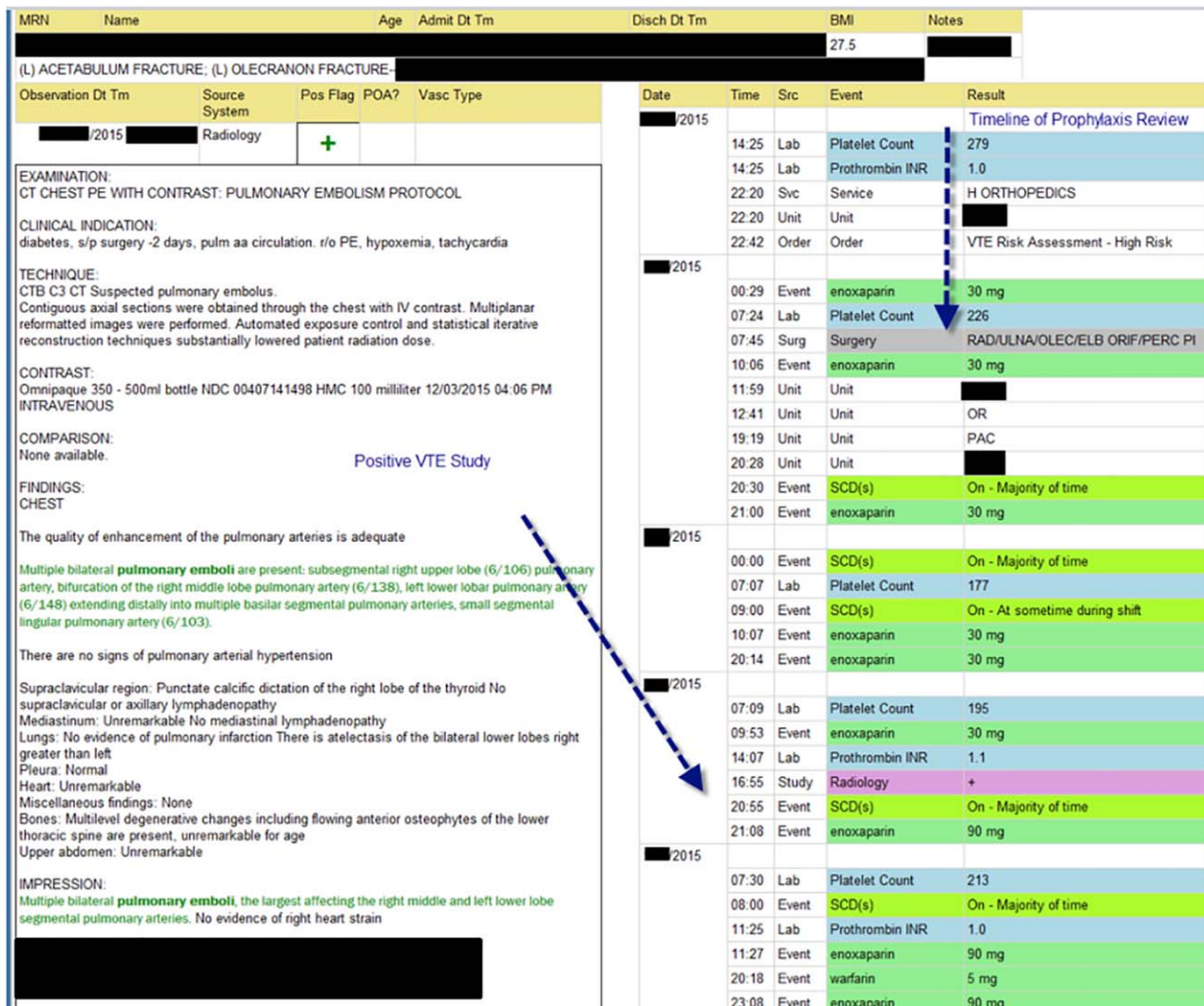


FIG. 1. The Harborview Venous Thromboembolism Tool. Abbreviations: BMI, body mass index; CT, chest tomography; Dt, date; INR, International Normalized Ratio; MRN, medical record number; PE, pulmonary embolism; POA, present on admission; SCD, sequential compression device; Src: source; Tm, time; VTE, venous thromboembolism. Abbreviations: L, left; Disch, Discharge; Pos, Positive; Vasc, Vascular; s/p, status/post; r/o, rule out; Rad, Radius; Olec, Olecranon; Elb, Elbow; ORIF, Open Reduction Internal Fixation; Perc, Percutaneous; PI, Pin; OR, Operation; PAC, Post Anesthesia Care (Unit); mg, milligrams.

Year	2010	2011	2012	2013	2014	2015	2016
Initiatives	VTE Task Force created	Standardized prevention practices standardized across services	Standardized medication administration; VTE Pharmacy Summit		Standardized mechanical prophylaxis charting	Standardized peri-procedural prevention; VTE Nursing Summit	Standardized discharge prophylaxis for orthopaedic trauma patients
Guidelines	Guidelines updated		Guidelines updated with new national guidelines				
Reviews	Post-operative HA-VTE (PSI) review initiated	Expanded review to all HA-VTE		Expanded review to education/follow-up for new warfarin	Expanded review to post-discharge VTE; treatment		
Information Technology Tools and Reports	Harborview VTE Tool	Report of patients with no VTE prevention in 24 hours	Report of mechanical prophylaxis ordered but not applied/charted	CPOE VTE risk assessment and prevention; report of new-start warfarin	Pharmacy dashboard to track patients on therapeutic anticoagulation	VTE risk and prevention CPOE order sets refined for select services	VTE Prevention/Treatment Chart Summary
Metrics	PSI 12			CMS Core Measures			Meaningful Use; eCQM

FIG. 2. Harborview VTE Task Force initiatives 2010 to present. Abbreviations: CMS, Centers for Medicare and Medicaid Services; CPOE, computerized provider order entry; eCQM, Electronic Clinical Quality Measures; HA-VTE, hospital-acquired venous thromboembolism; PSI, Patient Safety Indicator (Agency for Healthcare Research and Quality); VTE, venous thromboembolism.

VTE Summary (*This visit*) VTE Risk Assessment - High Risk
Prophylaxis enoxaparin 30 mg subcutaneous Q12 hours
Mechanical Prophylaxis Not ordered
Coagulation Results (*This visit within 24 hours*) PLT 177; INR 1.1
Other antithrombotic agents administered (*This visit within 24 hours*) None

VTE Summary (*This visit*) VTE Risk Assessment - High Risk
Prophylaxis enoxaparin 30 mg subcutaneous Q12 hours; **Charted Not Done: patient refused**
Mechanical Prophylaxis Not ordered
Coagulation Results (*This visit within 24 hours*) PLT 160; INR 1.1
Other antithrombotic agents administered (*This visit within 24 hours*) None

VTE Summary (*This visit*) VTE Risk Assessment - At Risk
Prophylaxis Not ordered
Mechanical Prophylaxis Sequential Compression Device: **Contraindication to pharmacologic VTE prophylaxis. Continue until pharmacologic prophylaxis is started. SCD: Not charted within 12 hours.**
Coagulation Results (*This visit within 24 hours*) PLT 152; INR 1.1
Other antithrombotic agents administered (*This visit within 24 hours*) aspirin 81 mg daily

FIG. 3. Prototype examples of venous thromboembolism prevention/treatment summary. Abbreviations: INR, International Normalized Ratio; PLT, platelet; SCD, sequential compression device; VTE, venous thromboembolism. mg, milligrams; Q, every.

to highlight VTE prevention for all hospitalized patients and ensure optimal prophylaxis at transitions of care.

To emphasize Harborview's commitment to VTE prevention and ensure that care providers across the institution are aware of and engaged in this effort, we utilize our intranet to disseminate information in a fully transparent manner. Both process and outcome measures are available to all physicians and staff at service and unit levels on a Web-based institutional dashboard. Data are updated monthly by QI analysts and improvement opportunities are highlighted in multiple fora. Descriptions of the quality metrics that are tracked are summarized in Table 1.

MEASUREMENTS

Outcomes

Harborview benchmarks performance against hospitals nationally using the CMS Hospital Compare data and with peer academic institutions through Vizient data (Vizient, Irving, TX). To measure the impact of our initiatives, the task force began tracking postoperative VTE rates based on the AHRQ Patient Safety Indicator

(PSI) 12 and expanded to include HA-VTE rates for all hospitalized patients. We also report performance on Core Measure VTE-6: incidence of potentially preventable VTE.

Process

We monitor VTE prophylaxis compliance based on the CMS Core Measures VTE-1 and 2, random samples of acute and critical care patients without VTE. Internally, we measure compliance with guideline-directed therapy for all HA-VTE cases reviewed by the task force. With the upcoming retirement of the CMS chart-abstracted measures, we are developing methods to track appropriate VTE prophylaxis provided to all eligible patients and will replace the sampled populations with this more expansive dataset. This approach will provide information for further improvements in VTE prophylaxis and act as an important step for success with the Electronic Clinical Quality Measures under the Meaningful Use program.

RESULTS

Our VTE prevention initiatives have resulted in improved compliance with our institutional guideline-directed VTE prophylaxis and a decrease in HA-VTE at our institution.

VTE Core Measures

Since the inception of VTE Core Measures in 2013, our annual performance on VTE-1: prophylaxis for acute care patients has been above 95% and VTE-2: prophylaxis for critical care patients has been above 98%. This performance has been consistently above the national mean for both measures (VTE-1: 91% among Washington state hospitals and 93% nationally; VTE-2: 95% among Washington state hospitals and 97% nationally). The CMS Hospital Compare current public reporting period is based on

TABLE 1. Quality Metrics

Quality Metric	Description
AHRQ PSI 12	Cases of VTE not present on admission per 1000 surgical discharges with select operating room procedures
CMS Core Measure VTE-1	Percent of patients without VTE who received VTE prophylaxis on day of or day after arrival to an acute care area, random sample
CMS Core Measure VTE-2	Percent of patients without VTE who received VTE prophylaxis on day of or day after arrival to an intensive care unit or surgery date, random sample
CMS Core Measure VTE 5	Percent of patients with hospital acquired VTE discharged to home on warfarin who received education and written discharge instructions
CMS Core Measure VTE-6	Percent of patients with hospital-acquired VTE who received VTE prophylaxis prior to the event diagnosis

NOTE: Abbreviations: AHRQ, Agency for Healthcare Research and Quality; CMS, Centers for Medicare and Medicaid Services; PSI, Patient Safety Indicator; VTE, venous thromboembolism.

information collected from July 2014 through June 2015. Our internal performance for calendar year 2015 was 96% (289 of 302) for VTE-1 and 98% (235 of 241) for VTE-2.

Harborview has had zero potentially preventable VTE events (VTE-6) compared with a reported national average of 4% since the inception of these measures in January 2013.

Guideline-Directed VTE Prevention: Patients Diagnosed With HA-VTE

The task force reviews each case to determine if the patient received guideline-adherent prophylaxis on every day prior to the event. Patients with active bleeding or those with high bleeding risk should have mechanical prophylaxis ordered and applied until pharmacologic prophylaxis is appropriate. Any missed single dose of pharmacologic prophylaxis or missed day of applied mechanical prophylaxis is considered a possible opportunity for improvement, and the case is referred to the appropriate clinical service for additional review.

Since task force launch, the percent of all patients diagnosed with HA-VTE who received guideline-directed prophylaxis increased 7% from 86% (105 of 122) in 2012 to 92% (80 of 87) in the first 9 months of 2015. Of events with possible opportunities, most were deemed not to have been preventable. Some trauma patients were ineligible for pharmacologic and mechanical prophylaxis, some were prophylaxed according to the best available evidence, and some had risk factors (for example, active malignancy) only identified after the VTE event. The few remaining events highlighted opportunities regarding standardization of pharmacologic prophylaxis periprocedurally, documentation of application of mechanical prophylaxis, and communication of patient refusal of doses, all ongoing focus areas for improvement.

Reduction in HA-VTE

Improved VTE prophylaxis has contributed to a 15% reduction in HA-VTE in all hospitalized patients over 5 years from a rate of 7.5 events/1000 inpatients in 2011 to 6.4/1000 inpatients for the first 9 months of 2015. Among postoperative patients (AHRQ PSI 12), the rate of VTE decreased 21% from 11.7/1000 patients in 2011 to 9.3/1000 patients in the first 9 months of 2015.

Patient/Family Engagement

We further improved our processes to ensure that patients with HA-VTE who discharge to home receive written discharge instructions for warfarin use (VTE-5). In 2014, performance on this measure was 91% (51 of 56 eligible patients) and in 2015 performance improved to 96% (78 of 81 eligible patients) compared with a reported national average of 91%. Additionally, 97% (79 of 81) of patients who discharged home on warfarin

after HA-VTE now have outpatient anticoagulation follow-up arranged prior to hospital discharge. We are developing new initiatives for patient and family education regarding direct oral anticoagulants.

Discussion/Conclusions

With interdisciplinary teamwork and use of QI analytics to drive transparency, we have improved VTE prevention and reduced rates of HA-VTE. Harborview's HA-VTE prevention initiative can be duplicated by other organizations given the structured nature of the intervention. The multidisciplinary approach, clinical presence of task force members, and support and engagement of senior clinical leadership have been key elements to our program's success. The existence of a standard institutional guideline based on evidence-based national guidelines and incorporation of these standards into the EHR is vital. The VTE task force has consistently used QI analytics both for retrospective review and real-time data feedback. Complete and easy accessibility and transparency of performance at the service and unit level supports accountability. Integration of the task force work into existing institutional QI structures has further led to improvements in patient safety.

Ongoing task force collaboration and communication with frontline providers and clinical departments has been critical to engagement and sustained improvements in VTE prevention and treatment. The work of the VTE task force represents the steadfast commitment of Harborview and our clinical staff to prevent preventable harm. This multidisciplinary effort has served as a model for other QI initiatives across our institution and health system.

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