



Program* Promotes the Establishment of Hospital VTE Prevention Programs

Arlene E. Fleck MNEd, RN, CCM
Clinical Quality Program Consultant,
Hospital Performance Management

Deborah J. Donovan, MLLS, RHIA, CPHQ
Director, Provider and
Hospital Performance Management

Mary Kathleen Blank, MPH, CIC, CPHQ
Manager, Hospital Performance Management
Highmark Inc.

ABSTRACT

The Agency for Healthcare Research and Quality (AHRQ) reports that efforts to reduce the incidence of venous thromboembolism (VTE) can result in substantial reductions in morbidity and mortality in addition to substantial cost savings. VTE is also a focus of the Centers for Medicare and Medicaid Services and the Joint Commission and will be a mandated quality measure in the future. Highmark's QualityBLUE Hospital Pay-for-Performance Program has targeted improvements in averting VTE with 25 hospitals in its service area. Recognizing the scope of the problem is the first step to confronting it. Evidence-based programs are then developed to prevent VTE, and their implementation has substantially reduced the number of VTE events. The successful application of processes that are unique to the individual hospitals and in alignment with best practices has resulted in an 18% decrease in the deep venous thrombosis (DVT) rate and a 21% decrease in the pulmonary embolism (PE) rate in the participating hospitals. The total cost savings of preventing 77 DVT cases and 63 PE cases was projected at nearly \$2 million. Lives have been saved, and morbidity has been avoided. This unique program lets hospitals be on the forefront of incorporating activities, well before regulatory agencies mandate such efforts. (Pa Patient Saf Advis 2011 Jun;8[2]:55-62.)

INTRODUCTION

In 2008, the Surgeon General's Office acknowledged venous thromboembolism (VTE) as a major public health problem in the United States and requested multiple stakeholders to come together in a coordinated approach to reverse the increasing trend projected for this health issue.¹ VTE—blood clots—is an occlusion of the venous system and includes both deep venous thrombosis (DVT) and pulmonary embolism (PE). DVT occurs when a clot forms in a deep vein, such as in the thigh, calf, or upper extremity. A PE results when a piece of thrombus dislodges from this clot and travels to the lungs. While approximately one-third of patients with symptomatic DVT also develop a PE, only a smaller subset of cases are fatal events because of improved diagnostic testing and effective anticoagulation therapy.² VTE is frequently cited in the literature inclusive of the Agency for Healthcare Research and Quality and the National Quality Forum as the most common preventable cause of hospital death.³⁻⁶ Much attention has been focused on the prevention of VTE in surgical patients. In fiscal year (FY) 2010, Highmark Inc., an independent licensee of the BlueCross BlueShield Association, created an indicator for the QualityBLUE Hospital Pay-for-Performance Program focusing on the prevention of blood clots in the high-risk medical population and in intensive care units (ICUs). Unlike the Centers for Medicare and Medicaid Services (CMS) Surgical Care Improvement Project requirements to report timeliness and appropriateness of VTE prophylaxis with select surgical populations, no such current requirements exist for the vulnerable medical population.

PROBLEM

A review of the literature shows that the incidence of VTE varies widely because the disease can be clinically silent and its diagnosis cannot be consistently confirmed. In an incidence-based model developed by Heit et al., symptomatic VTE is estimated to exceed 600,000 cases annually in the United States, of which approximately two-thirds are healthcare acquired.⁷ Two popular cited population VTE studies, one conducted in Worcester, Massachusetts, and the other in Olmsted County, Minnesota, suggest that the annual incidence of VTE is 1 per 1,000 people.^{8,9} Another study using the 2003 national inpatient sample from the Healthcare Cost and Utilization Project reported 56% of hospital discharged patients were at moderate to very high risk for developing a VTE.¹⁰ In the Commonwealth of Pennsylvania, the Patient Health Care Cost Containment Council's September 2010 Hospital Performance Report released data showing a 53% increase in PE volumes from 2002 until 2009.¹¹

In 2008 the American College of Chest Physicians (ACCP) reported evidence to recommend routine thromboprophylaxis for most hospitalized patient groups, including surgical and medical patients.¹² These evidence-based clinical practice guidelines have been developed to rigorously provide therapeutic interventions to prevent VTE and are specific to patient subsets within the broad category of medical surgical populations such as vascular surgery, orthopedic surgery, neurosurgery, critical care, and oncology. The ACCP guidelines provide a system of graded recommendations to balance risks such as bleeding or death with the benefits of prophylactic therapies specific to patient subsets. This type of reference tool support leads to better clinician compliance with hospital efforts to improve rates of VTE prophylaxis.

* QualityBLUE: A Hospital Pay-for-Performance Program, an initiative of Highmark Inc., an independent licensee of the BlueCross BlueShield Association.



DVT prevalence varies widely and is reported for patients not receiving thromboprophylaxis for general surgery as 15% to 40%, for medical patients 10% to 20%, and for critical care patients as 10% to 80%.¹² Lack of VTE prophylaxis among medical patients is more prevalent than for surgical patients. The DVT FREE Registry, a trial of 5,451 inpatients and outpatients with an ultrasound-confirmed DVT from 183 geographic sites, found that only 42% of the patients received prophylaxis, and nonsurgical patients were much less likely to have received prophylaxis than were surgical patients.¹³

VTE prophylaxis evidence-based guidelines have been available for hospitals to review and use for nearly 20 years.¹⁴ Yet despite existence of these guidelines, studies have found low rates of compliance with the guidelines. The ENDORSE study (Epidemiologic International Day for Evaluation of Patients at Risk for Venous Thromboembolism in the Acute Hospital Care Setting) assessed the proportion of 68,183 hospitalized at-risk patients who received appropriate prophylaxis in 358 hospitals in 38 countries. Results of the study showed that appropriate prophylaxis was administered to only 59% of the surgical patients and 40% of the medical patients.¹⁵ Appropriate prophylaxis was defined as administration of the correct type of prophylaxis and dose for the correct duration of time specific to a particular patient population as defined by the ACCP guidelines. In another study of 390,024 patients discharged from 500 hospitals in the United States, only 13% of medical discharges and 16% of surgical discharges received appropriate prophylaxis.¹⁶ The studies report that VTE practices in hospitals are suboptimal and it is important for hospitals to improve current practices.

Measures to prevent VTE have been widely studied because of the incidence, associated mortality and morbidity, and annual care costs of more than \$1.5 billion.¹⁷ The economic burden of VTE in

direct medical costs is large because of not only the index hospitalizations but also the high rate of readmissions and long-term complications resulting from the event. Readmission rates for a VTE (DVT and PE) are 5% for a principal diagnosis and 14% for a secondary diagnosis.¹⁸ The average cost per DVT or PE discharge including 12 months of follow-up was \$10,804 and \$16,644, respectively.¹⁸ Hospital costs incurred by patients who develop VTE complications are double those for patients who do not develop these complications.¹⁹

In Highmark's FY 2010 pay-for-performance program population, 25 hospitals reported 2,018 VTE events (across all payers), compared with the 154 Pennsylvania hospitals reporting 14,984 events for federal FY 2009 in the September 2010 Pennsylvania Hospital Performance Report.¹¹ These volumes of adverse events suggest that much additional hospital focus is needed to create effective prevention programs.

HOSPITAL PAY-FOR-PERFORMANCE APPROACH

To address this growing healthcare quality of care concern, Highmark Inc. incorporated the VTE prevention and care coordination indicator as part of the QualityBLUE Hospital Pay-for-Performance Program. This indicator allows hospitals to assess and quantify the development of healthcare-acquired VTE and work to prevent these events, as well as to ensure that patients discharged on warfarin therapy have appropriate education to coordinate their care across healthcare settings. The QualityBLUE program is an innovative program designed to "chase zero"—eliminate adverse events that have been identified nationally as areas of opportunity in the health care environment. Highmark's QualityBLUE program began in 2001 with six participating hospitals and has grown to 63 hospitals in Pennsylvania and West Virginia. The program aligns hospital

reimbursement dollars with the delivery of high-quality, safe healthcare based on performance. QualityBLUE hospitals are required to implement evidence-based practices designed to deliver high-quality care. Performance is evaluated and scored based on achievement of targeted compliance goals, including the ability to reduce adverse events. Program requirements include defined performance measures, measurement results (process and outcomes), and facility-specific critical analysis.

Twenty-five QualityBLUE hospitals chose to participate in the VTE prevention and care coordination indicator in the FY 2010 program year to improve patient care by reducing occurrences of healthcare-acquired DVT and PE. Patients who developed a DVT or PE during their index hospitalization or 30 days post-discharge were included in the outcome assessment measurement for this indicator. Hospital performance was also scored on process measurements, which included the hospital's compliance for administering VTE prophylaxis on medical patients at high risk for developing a VTE and compliance for providing discharge instructions on anticoagulation therapy for all hospitalized patients discharged on warfarin. To achieve successful reimbursement, hospitals are scored by a standardized method and must demonstrate a decreasing trend of VTE events and 90% or greater compliance for both administering appropriate VTE prophylaxis and providing appropriate discharge instructions to patients on warfarin.

PROGRAM REQUIREMENTS

Defined Performance Measures

To participate in the indicator, hospitals were required to measure hospitalwide patients (excluding patients under age 18, those hospitalized for behavioral problems, and obstetrical patients) diagnosed with healthcare-acquired DVT and PE during the index hospitalization or within 30 days following discharge. Patients diagnosed

with a VTE may or may not have been readmitted to the hospital facility within 30 days. The healthcare-acquired event case-finding methodology included discovery from hospital radiology reports, outpatient encounters, and emergency department visits. This additional case-finding methodology was more difficult for hospitals to pursue if they did not have an electronic medical record system in place.

The hospital was also required to select two units that predominately housed a high-risk medical population for VTE development to measure VTE prophylaxis compliance. Hospitals that selected the VTE indicator for the first time were required to choose an ICU that housed predominately medical patients as one of the two units. Each unit measured the total number of patients that received appropriate VTE prophylaxis or had a documented reason for no VTE prophylaxis being given the day of or day after hospital admission or transfer to the selected unit. The medical population of patients versus surgical population was chosen since the lack of VTE prophylaxis among medical patients is more prevalent.

Lastly, hospitals were required to measure the total number of acute care hospitalized patients discharged to home on warfarin who received comprehensive patient-specific written discharge instructions. This measure was developed to align with the 2010 Joint Commission National Patient Safety Goal 3, "Improving the Safety of Using Medications," and the CMS Venous Thromboembolism National Hospital Inpatient Quality Measures VTE-5, "Venous Thromboembolism Discharge Instructions." The use of warfarin has been related to adverse events that result from complex dosing, insufficient monitoring, and inconsistent patient compliance.²⁰ The discharge instructions were to include education that addressed the following components: (1) importance of follow-up blood work monitoring, including details of with whom and date;

(2) compliance issues related to follow-up appointments and taking medication as instructed; (3) dietary instructions; and (4) the potential for adverse drug reactions or interactions. All four components had to be addressed for the instructions to count as compliant. Sampling was permitted for this measurement for hospitals that discharged more than 25 patients a month on warfarin.

Critical Analysis: How to Develop a VTE Prevention Program

Each hospital was responsible for writing a critical analysis for the VTE indicator, summarizing key program objectives, implementation strategies, and results. The critical analysis discusses the hospital's improvement strategies, educational efforts, lessons learned, barriers to implementation, and facility-specific return on investment. Common themes and strategies were identified in the hospital's VTE critical analysis, and it provided examples of important steps for creating a VTE prevention program. Hospitals described the initial step as identifying key personnel to form an interdisciplinary VTE team. Examples would be physicians and nurses from surgical and nonsurgical departments, residents, health educators, data abstractors, and personnel from pharmacy, dietary, laboratory, quality services, and information systems departments. A physician champion was identified to lead the team and address any barriers identified by the physician staff. In some hospitals, pharmacists successfully assumed the role of team champion.

Teams were then tasked with reviewing the literature to create evidence-based VTE prevention guidelines (see "Resource List"). Gaps between the current prophylaxis practices and the literature were identified. Guidelines were created to include development of a VTE risk assessment, identification of contraindications to prophylaxis, and the development of VTE prevention physician order sets, including specialty order sets for orthopedics,

neurology, and oncology. Depending on the hospital's level of information technology support, the prevention guidelines could be pre-printed documents on the chart or electronic decision support tools such as a mandated risk assessment and standardized computer-generated orders. One of the most challenging steps identified by hospitals was the timely medical executive committee approval process for the guidelines.

A key part of the initiative was education for physicians, hospital staff, and patients. One facility identified education as a "core essential for the success of the program." Examples were VTE grand rounds, mandatory continuing medical education, new physician VTE orientation packets, an interactive storyboard rotated throughout the hospital, participation in March VTE prevention month with posters and newsletters, one-on-one education with physicians, preoperative education materials for patients, community lectures involving the local library and senior residential centers, an annual breakfast program to educate skilled nursing facilities, and screensavers for the computers. More creative strategies were developed to engage physicians to be compliant with the VTE protocols, including the following:

- Provider- and service-specific report cards of VTE events and mortalities were created and reviewed by medical staff.
- Unit-level and physician-level VTE prophylaxis data compliance was displayed on the two study units, including names of noncompliant physicians.
- Compliance letters were sent to physicians with data comparing them to their peers, overall hospital compliance rate, and hospital goals.
- Noncompliant physicians were contacted by nurses regarding completion of prophylaxis orders or appropriate documentation related to contraindications after review of



RESOURCE LIST

The following resources were used to develop an evidence-based hospital venous thromboembolism prevention program:

Academy of Family Physicians and the American College of Physicians

Current diagnosis of venous thromboembolism in primary care: a clinical practice guideline. Available from Internet: <http://www.annals.org/content/146/6/454.full>.

Agency for Healthcare Research and Quality

Preventing hospital-acquired venous thromboembolism: a guide for effective quality improvement. Available from Internet: <http://www.ahrq.gov/qual/vtguide>.

American Academy of Orthopaedic Surgeons

Clinical guideline on prevention of pulmonary embolism in patients undergoing total hip or knee arthroplasty. Available from Internet: http://www.aaos.org/research/guidelines/pe_guideline.pdf.

American College of Chest Physicians

Evidence-based clinical practice guidelines, 8th edition. Available from Internet: <http://www.chestnet.org/accp/guidelines/antithrombotic-and-thrombolytic-therapy-8th-edition>.

American College of Obstetricians and Gynecologists (Committee on Practice Bulletins)

ACOG Practice Bulletin No. 84: Prevention of deep vein thrombosis and pulmonary embolism. Available from Internet: <http://www.acog.org>.

Institute for Healthcare Improvement

IHI improvement map: Venous thromboembolus (VTE) prevention & treatment. Available from Internet: <http://www.ihl.org/imap/tool/#Process=5b9bfd5a-1e17-433b-a9d4-602fafef73c8>.

Institute for Clinical Systems Improvement

Venous thromboembolism diagnosis and treatment [guideline online]. Available from Internet: http://www.icsi.org/guidelines_and_more/gl_os_prot/cardiovascular/venous_thromboembolism/venous_thromboembolism_6.html.

National Comprehensive Cancer Network

Clinical practice guidelines in oncology: venous thromboembolic disease. Available from Internet: http://www.nccn.org/professionals/physician_gls/pdf/vte.pdf.

National Institute for Health and Clinical Excellence

Venous thromboembolism: reducing the risk. Available from Internet: <http://www.nice.org.uk/CG92>.

Society of Hospital Medicine

Preventing hospital-acquired venous thromboembolism: guide for effective quality improvement. Available from Internet: http://www.hospitalmedicine.org/ResourceRoomRedesign/RR_VTE/html_VTE/00_ImplementationGuide.cfm.

a patient case by pharmacy and the nurse manager.

- An organizational quality dashboard was used to communicate performance outcomes to all staff, including members of the board.
- Electronic decision support tools were used that mandate VTE risk reassessment with change in patient's level of care.

Nursing engagement was viewed as a critical component of success and included surveys to query staff on successes and barriers of the VTE prevention program. The pharmacy manager conducted reviews of patients who were ordered sequential compression devices (SCD) for utilization compliance with immediate educational follow-up for noncompliant staff. Morning huddles were held to discuss a patient's status, including VTE prophylaxis, and decision support software solutions were used that created automatic hard stops to prevent nurses from advancing discharge instructions without addressing the appropriate warfarin patient teaching.

Data collection and analysis is another critical step in the VTE quality improvement program. Monthly tracking of data is required by the QualityBLUE program. Hospital performance on the program, including analysis of the data, is presented two times, during midyear and year-end presentations to the QualityBLUE team. In addition to the required data collection tool measures, the unit prophylaxis compliance, the number of DVT and PE events, and compliance for warfarin discharge education, hospitals evaluated other metrics to drive performance improvement. The hospitals' critical analyses discussed the following:

- Healthcare-acquired VTE trends by service lines and physicians
- VTE prophylaxis ordered on discharge for patients readmitted with a DVT or PE

- Potentially preventable VTE events, patients with a healthcare-acquired VTE who did not receive appropriate (type, dose, duration, and timely administration) VTE prophylaxis
- Nursing documentation of an SCD being used by a patient, including the time the device was not being used by the patient and secret shopper visual audits to compare nursing documentation with patient experience
- Patient satisfaction survey results related to their experience with SCD (e.g., Did patient understand reason for device? Was the equipment uncomfortable? Did the patient keep device on as ordered?)
- Return trips to the operating room related to bleeding for patients on VTE prophylaxis
- Staff survey results related to the staff's knowledge of the VTE prevention program
- Readmission analysis of VTE patients that includes review of discharge anticoagulation therapy
- Pilot projects that determined that pharmacists might be the best patient educator for warfarin discharge instructions

A hospital's success in decreasing the number of VTE events in their hospital is related to establishing individualized approaches that may be unique to their hospital. However, common themes related to lessons learned in the implementation of the VTE prevention program were noted. (See "Lessons Learned.")

Measurement Results

For many hospitals, this quality initiative was the first-ever measurement and analysis of facility VTE events, and this analysis prioritized the importance of a VTE prevention program for such hospitals. For the first process measure, hospitals

showed a significant increase for VTE prophylaxis compliance in the nine months of the program year. Figure 1 represents combined prophylaxis compliance for the two high-risk units studied for the aggregate of the 25 participating hospitals. A steady improvement from FY 2010 quarter 1 to quarter 3 can be noted. The average first quarter compliance was 76%, which increased to 94%, representing a 24% change from quarter 1 through quarter 3. This is a statistically significant increase (p -value < 0.05). Twenty-one hospitals, or 84%, had a 90% or greater VTE prophylaxis compliance for both units in the last quarter of the program year. The range of hospital compliance scores for the final quarter was from 87% to 100%.

The second measurement for the VTE indicator was monitoring compliance for discharge instructions specific to warfarin anticoagulation therapy. The focus of this measure was to ensure that patients or their families received instructions on safely self-administering this drug. Figure 2 shows the steady increase in appropriate warfarin discharge instruction compliance over the nine months of the program year. Aggregate compliance for FY 2010 quarter 1 was 60%, which increased to 92% by quarter 3. This is a statistically significant increase (p -value < 0.05).

The 25 QualityBLUE hospitals reported a total of 1,222 DVTs and 859 PEs over a nine-month period. Figure 3 displays the DVT and PE aggregate rate per quarter for all participating hospitals. The aggregate DVT rate is reported at 0.53 per 100 patient admissions for the first quarter of the FY 2010 program year compared with a DVT rate of 0.43 per 100 patient admissions for the third quarter of the year. This decrease in the DVT rate between the quarters represents a percent reduction of 18%, which is statistically significant (p -value < 0.05) and translates to a potential 77 averted DVT cases. Potential cost savings of \$831,908 is estimated from the 77 DVT averted cases, calculated

LESSONS LEARNED

- Opportunities did exist for VTE prevention practice changes.
- Real-time, day-to-day monitoring of VTE prophylaxis compliance is needed instead of retrospective data collection.
- Application of standardized processes based on evidence-based guidelines can reduce healthcare-acquired VTE.
- Continuous monitoring of all quality improvement processes and staff feedback is required.
- Input by frontline staff is essential to identify opportunities and barriers.
- Decision support alerts embedded in care processes for the practitioner is the ideal means for sustaining change in practice.
- Clinical pharmacists' roles expanded in the hospital VTE prevention program to include team champion, patient educator for warfarin discharge instructions, and physician educator for ensuring patients receive appropriate prophylaxis (type, dose, duration), including weight adjustment dosing if needed.
- Real-time, face-to-face communication with physicians and nurses regarding best practices and evidence-based medicine proved vital in achieving VTE compliance.
- Repeated educational sessions throughout the year will help to inform physician and nursing staff about the VTE prevention program.
- Engaging nursing staff in fun, creative educational activities, such as hospital safety fairs, can increase awareness and compliance.
- Direct and transparent physician performance feedback is important.



from the estimated costs of \$10,804 to treat one DVT case, including the costs for 12 months of follow-up care.¹⁸ Similarly, Figure 3 shows a reduction that was noted for the PE rate between quarter

1 and quarter 3 of the program year. A rate of 0.38 per 100 patient admissions was reported for the first quarter and a rate of 0.30 for the third quarter. This decrease is a 21% statistically significant

change (p -value < 0.05) and represents 63 potentially averted PE cases. Cost savings estimated for the 63 averted cases is \$1,048,572, based on \$16,644 per case and including costs for 12 months of follow-up care.¹⁸

The aggregate performance of the 25 hospitals participating in the VTE prevention and care coordination indicator showed statistically significant improvements for all indicator performance measurements. These improvements directly relate to better patient outcomes, the ultimate goal for healthcare delivery.

CONCLUSIONS

The QualityBLUE indicator lets hospitals be on the forefront of incorporating improvements well before they are mandated by regulatory agencies. Currently, CMS and the Joint Commission have voluntary requirements to report the Venous Thromboembolism National Hospital Inpatient Quality Measures. However, starting in 2012, the Medicare and Medicaid Electronic Health Record Incentive Program meaningful use requirements will require participating hospitals to electronically submit these six VTE clinical quality measures.²¹

The QualityBLUE hospital pay-for-performance program could be replicated by health plans nationwide. The program components for operation, data collection tools, and program manual align with national evidence-based practices. Detailed measurement definitions and result expectations are developed annually and keep pace with national healthcare quality agendas and changes in clinical practice. For example, with the development of numerous novel oral anticoagulants such as Pradaxa® (dabigatran etexilate), which has recently been FDA approved to prevent strokes in atrial fibrillation patients, the use of warfarin may be replaced, and monitoring warfarin patient education will be obsolete.²² Established targets for threshold performance both in compliance

Figure 1. FY 2010 VTE Prophylaxis Compliance (Units 1 and 2) by Quarter, All QualityBLUE Participating Hospitals—Aggregate

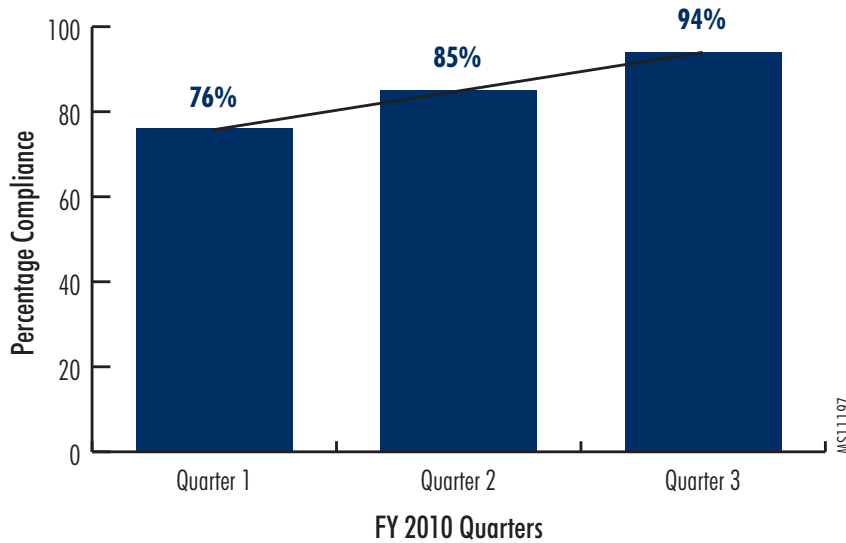


Figure 2. FY 2010 Compliance for Appropriate Warfarin Discharge Instructions by Quarter, All QualityBLUE Participating Hospitals—Aggregate

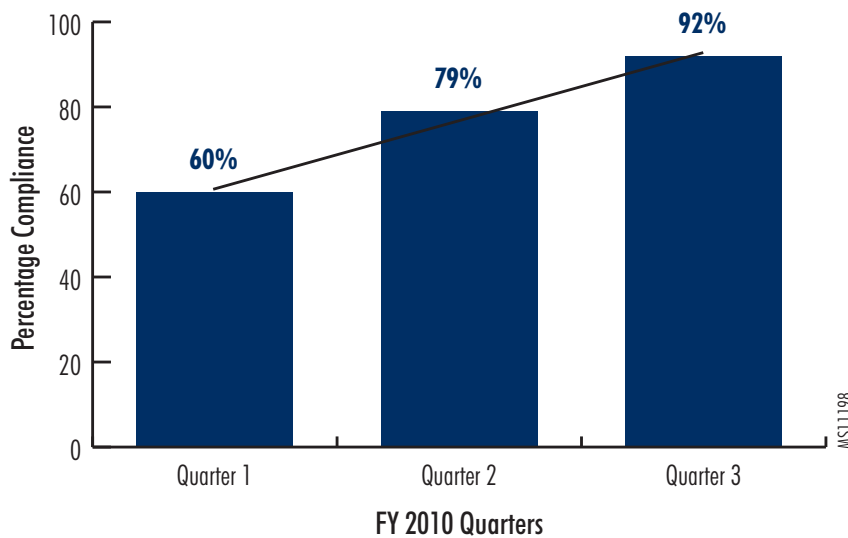
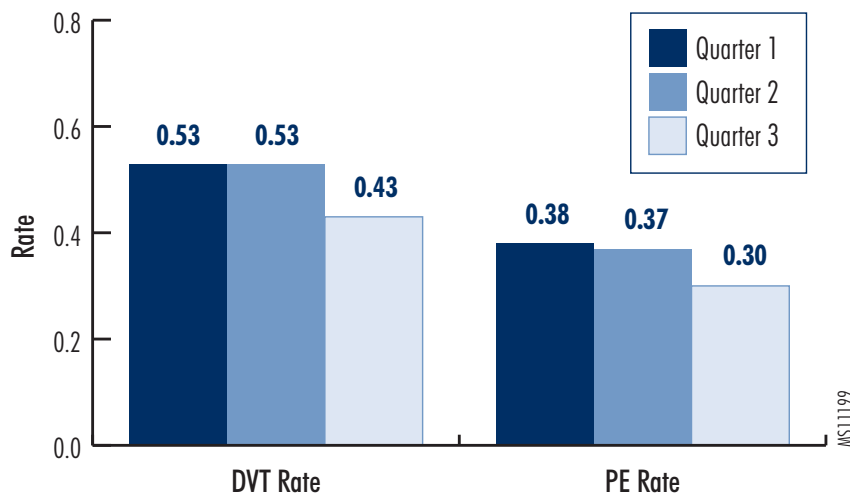


Figure 3. FY 2010 DVT and PE Rates by Quarter, All QualityBLUE Participating Hospitals—Aggregate



Rate per 100 patient admissions.

NOTES

1. U.S. Department of Health and Human Services. The surgeon general's call to action to prevent deep vein thrombosis and pulmonary embolism [online]. 2008 [cited 2010 Sep 28]. Available from Internet: <http://www.surgeongeneral.gov/topics/deepvein>.
2. White RH. The epidemiology of venous thromboembolism. *Circulation* 2003 Jun;107(23 Suppl 1):14-8.
3. Heit JA, O'Fallon M, Petterson TM, et al. Relative impact of risk factors for deep vein thrombosis and pulmonary embolism. *Arch Intern Med* 2002 Jun;162(11):1245-8.
4. Tapson VF, Hyers TM, Waldo AL, et al. Antithrombotic therapy practices in US hospitals in an era of practice guidelines. *Arch Intern Med* 2005 Jul 11; 165(13):1458-64.
5. Clagett GP, Anderson FA, Heit J, et al. Prevention of venous thromboembolism. *Chest* 1995 Oct;108(4 Suppl):312S-334S.
6. National Quality Forum. National voluntary consensus standards for prevention and care of venous thromboembolism: policy, preferred practices, and initial performance measures—a consensus report [online]. 2006 [cited 2011 Jan 20]. Available from Internet: http://www.qualityforum.org/Publications/2006/12/National_Voluntary_Consensus_Standards_for_Prevention_and_Care_of_Venous_Thromboembolism__Policy,_Preferred_Practices,_and_Initial_Performance_Measures.aspx.
7. Heit JA, Cohen AT, Anderson FA Jr. Estimated annual number of incident and recurrent, non-fatal and fatal venous thromboembolism (VTE) events in the US. *Blood* 2005;106(11):267a.
8. Anderson FA Jr, Wheeler HB, Goldberg RJ, et al. A population-based perspective of the hospital incidence and case-fatality rates of deep vein thrombosis and pulmonary embolism. *Arch Intern Med* 1991 May;151(5):933-8.
9. Silverstein MD, Heit JA, Mohr DN, et al. Trends in the incidence of deep vein thrombosis and pulmonary embolism: a 25-year population based study. *Arch Intern Med* 1998 Mar 23;158(6): 585-93.
10. Anderson FA, Zayaruzny M, Heit JA, et al. Estimated annual numbers of US acute-care hospital patients at risk for venous thromboembolism. *Am J Hematol* 2007 Sep;82(9):777-82.
11. Pennsylvania Health Care Cost Containment Council. Hospital performance report, FFY 2009 [online]. [cited 2010 Sep 27]. Available from Internet: <http://www.phc4.org/reports/hpr/09/docs/hpr2009keyfindings.pdf>.
12. Geerts WH, Bergqvist D, Pineo GF, et al. Prevention of venous thromboembolism: American College of Chest Physicians evidence-based clinical practice guidelines (8th edition). *Chest* 2008 Jun;133(6 Suppl):S381-453S.
13. Goldhaber SZ, Tapson VF; DVT Free Steering Committee. A prospective registry of 5,451 patients with ultrasound-confirmed deep vein thrombosis. *Am J Cardiol* 2004 Jan 15;93(2):259-62.
14. Clagett GP, Anderson Jr FA, Levine MN, et al. Prevention of venous thromboembolism. *Chest* 1992 Oct;102 (4 Suppl):391S-407S.
15. Cohen AT, Tapson VF, Bergmann JF, et al. Venous thromboembolism risk and prophylaxis in the acute hospital care setting (ENDORSE study): a multinational cross-sectional study. *Lancet* 2008 Feb 2;371(9610):387-94.



16. Amin A, Stenkowski S, Yang G, Lin J. Inpatient thromboprophylaxis use in US hospitals: adherence to the seventh American college of chest physician's recommendations for at-risk medical and surgical patients. *J Hosp Med* 2009 Oct 8;4(8):E15-21.
17. Spyropoulos AC, Hurley JS, Ciesla GN, et al. Management of acute proximal deep vein thrombosis: pharmacoeconomic evaluation of outpatient treatment with enoxaparin vs inpatient treatment with unfractionated heparin. *Chest* 2002 Jul;122(1):108-14.
18. Spyropoulos AC, Lin J. Direct medical costs of venous thromboembolism and subsequent hospital readmissions rates: an administrative claims analysis from 30 managed care organizations. *J Manag Care Pharm* 2007 Jul-Aug;13(6):475-86.
19. Ollendorf DA, Vera Lionch M, Oster G. Cost of venous thromboembolism following major orthopedic surgery in hospitalized patients. *Am J Health Syst Pharm* 2002 Sep;59(18):1750-4.
20. The Joint Commission accreditation program: hospital national patient safety goals effective July 1, 2010 [online]. [cited 2010 Aug 19]. Available from Internet: http://www.jointcommission.org/assets/1/6/2011_NPSGs_HAP.pdf.
21. Centers for Medicare and Medicaid Services. Medicare and Medicaid EHR incentive program: meaningful use stage 1 requirements overview [online]. 2010 Aug 24 [cited 2010 Sep 27]. Available from Internet: http://www.cms.gov/EHRIncentivePrograms/Downloads/MU_Stage1_ReqOverview.pdf.
22. U.S. Food and Drug Administration. FDA approves Pradaxa to prevent stroke in people with atrial fibrillation [press release online]. 2010 Oct 19 [cited 2011 Jan 17]. Available from Internet: <http://www.fda.gov/NewsEvents/Newsroom/PressAnnouncements/ucm230241.htm>.

PENNSYLVANIA PATIENT SAFETY ADVISORY

This article is reprinted from the Pennsylvania Patient Safety Advisory, Vol. 8, No. 2—June 2011. The Advisory is a publication of the Pennsylvania Patient Safety Authority, produced by ECRI Institute and ISMP under contract to the Authority. Copyright 2011 by the Pennsylvania Patient Safety Authority. This publication may be reprinted and distributed without restriction, provided it is printed or distributed in its entirety and without alteration. Individual articles may be reprinted in their entirety and without alteration provided the source is clearly attributed.

This publication is disseminated via e-mail. To subscribe, go to <http://visitor.constantcontact.com/d.jsp?m=1103390819542&p=oi>.

To see other articles or issues of the Advisory, visit our website at <http://www.patientsafetyauthority.org>. Click on "Patient Safety Advisories" in the left-hand menu bar.

THE PENNSYLVANIA PATIENT SAFETY AUTHORITY AND ITS CONTRACTORS



The Pennsylvania Patient Safety Authority is an independent state agency created by Act 13 of 2002, the Medical Care Availability and Reduction of Error ("Mcare") Act. Consistent with Act 13, ECRI Institute, as contractor for the Authority, is issuing this publication to advise medical facilities of immediate changes that can be instituted to reduce Serious Events and Incidents. For more information about the Pennsylvania Patient Safety Authority, see the Authority's website at <http://www.patientsafetyauthority.org>.



ECRI Institute, a nonprofit organization, dedicates itself to bringing the discipline of applied scientific research in healthcare to uncover the best approaches to improving patient care. As pioneers in this science for nearly 40 years, ECRI Institute marries experience and independence with the objectivity of evidence-based research. More than 5,000 healthcare organizations worldwide rely on ECRI Institute's expertise in patient safety improvement, risk and quality management, and healthcare processes, devices, procedures and drug technology.



The Institute for Safe Medication Practices (ISMP) is an independent, nonprofit organization dedicated solely to medication error prevention and safe medication use. ISMP provides recommendations for the safe use of medications to the healthcare community including healthcare professionals, government agencies, accrediting organizations, and consumers. ISMP's efforts are built on a nonpunitive approach and systems-based solutions.