VTE Prophylaxis in Trauma: Walking the Tightrope

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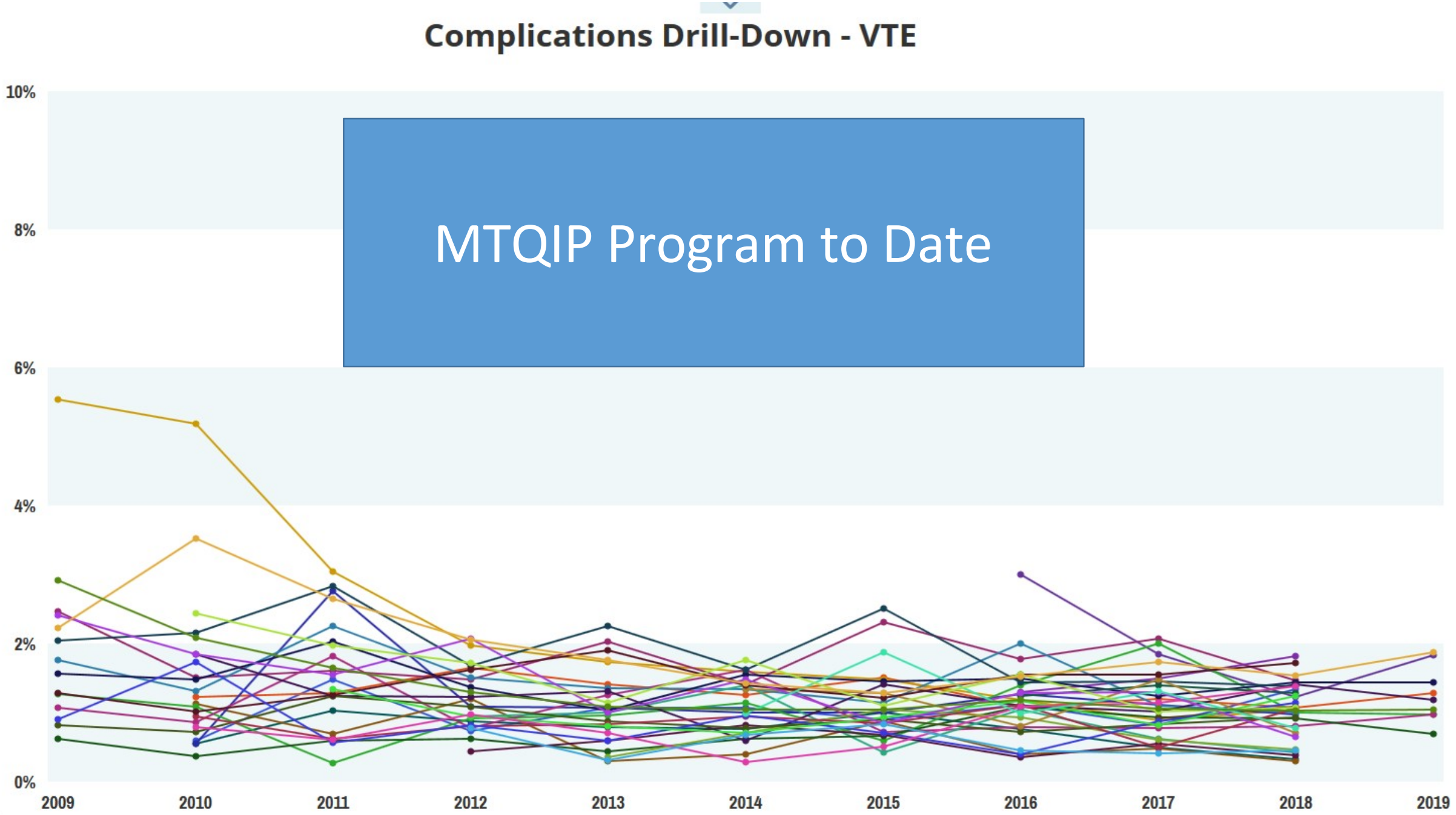
EXPERTISE

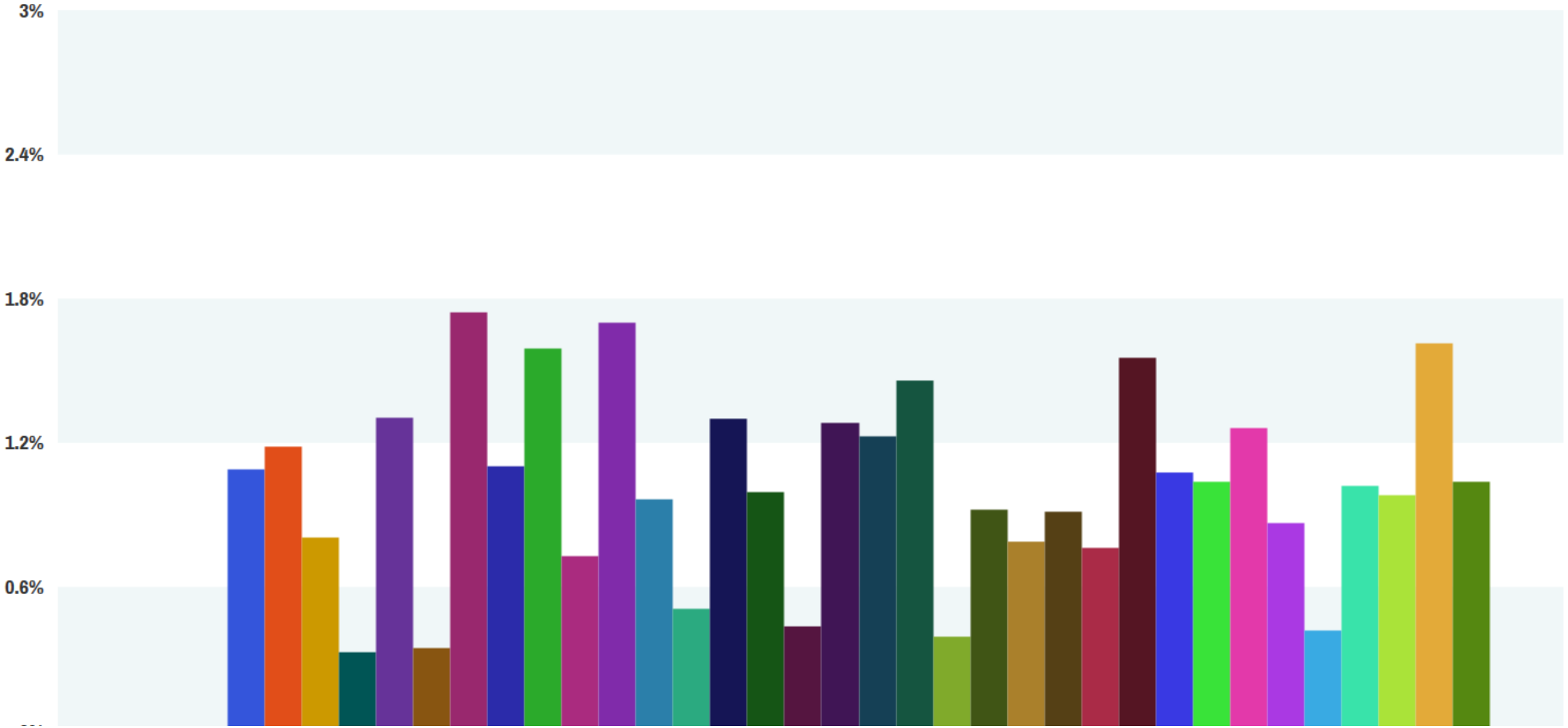
Acute Care Surgery, Appendectomy, Blunt and ...read more

RESEARCH INTERESTS

Delivery Systems and Outcomes in Trauma ...read more


Complications Drill-Down - VTE
MTQIP Program to Date
10%
8%
6%
4%
2%
0%
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019

Complications Drill-Down - VTE



VTE

Pathophysiology & Clinical Presentation & Treatment

Venous Thromboembolism (VTE)

Venous Thromboembolism (VTE)

- Deep vein thrombosis (DVT)
- Pulmonary embolism (PE)

Incidence of 5 to 60%

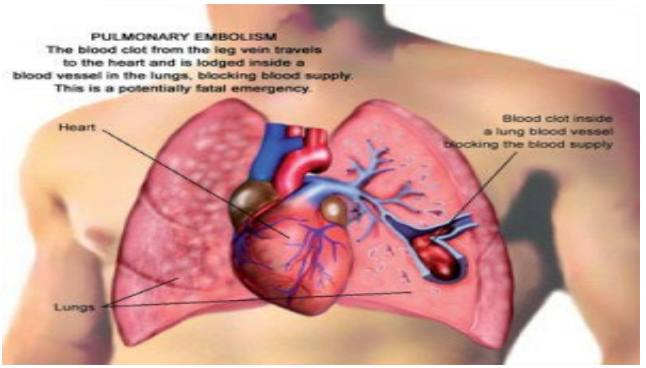
Risk factors

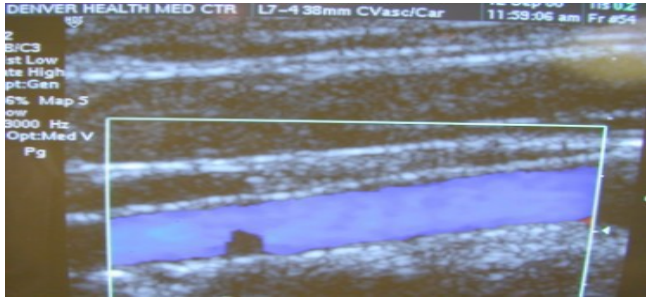
Pelvic and lower extremity fractures

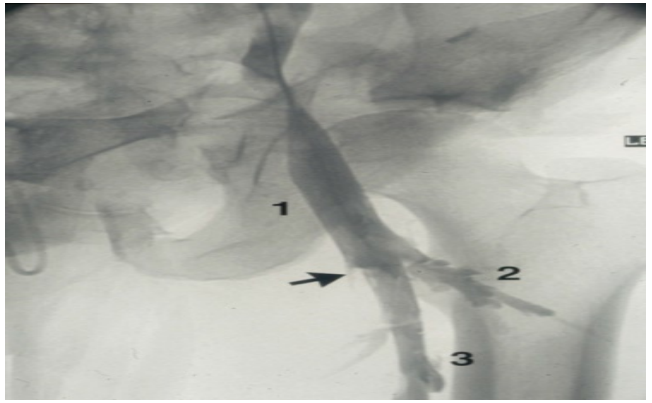
Head Injury

Spine Injury

Prolonged immobilization







Polytrauma management

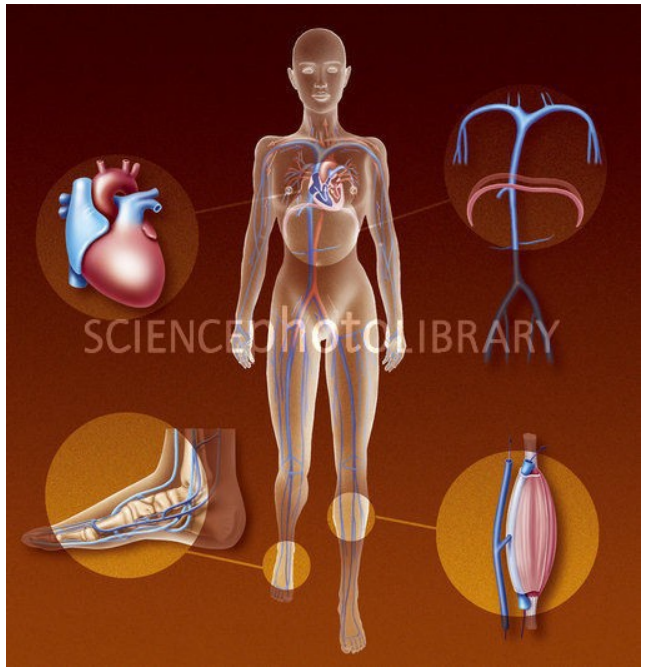
Aim & Objectives

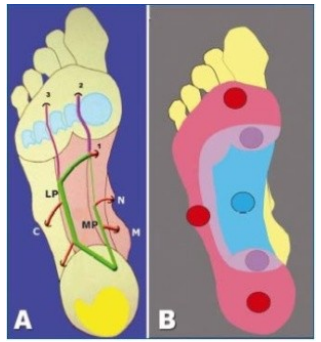
Avoid prolonged bed rest

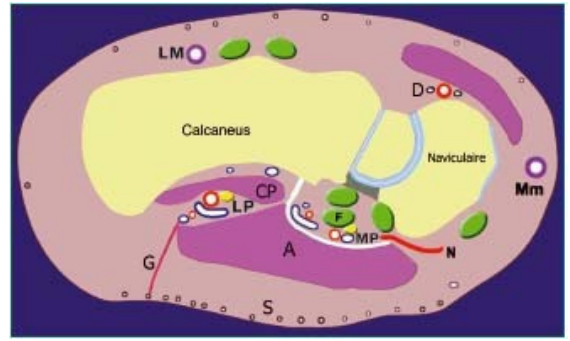
Early mobilization

Early weight bearing

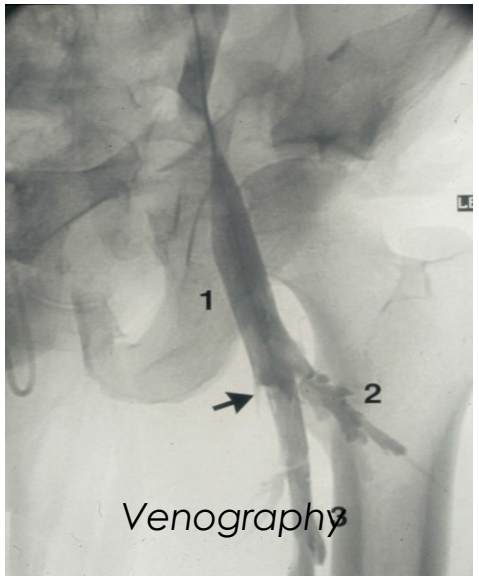
Restore patient independency





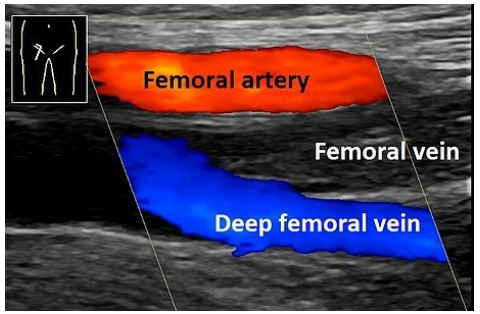


Venous Thromboembolism (VTE)



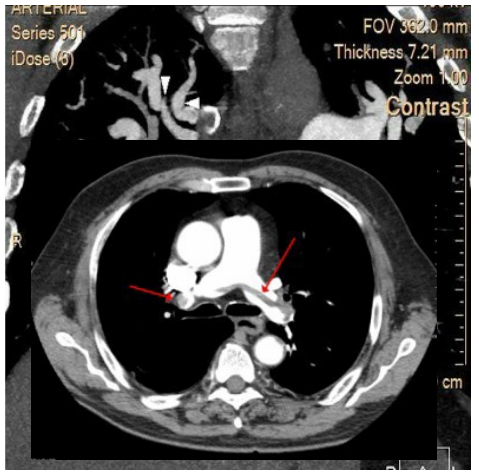
DVT

- Occur in 60% with ISS > 9
- 35% - 60% DVT with pelvic fracture



PE

- The Most common preventable cause of death in trauma



Deep venous thrombosis (DVT)

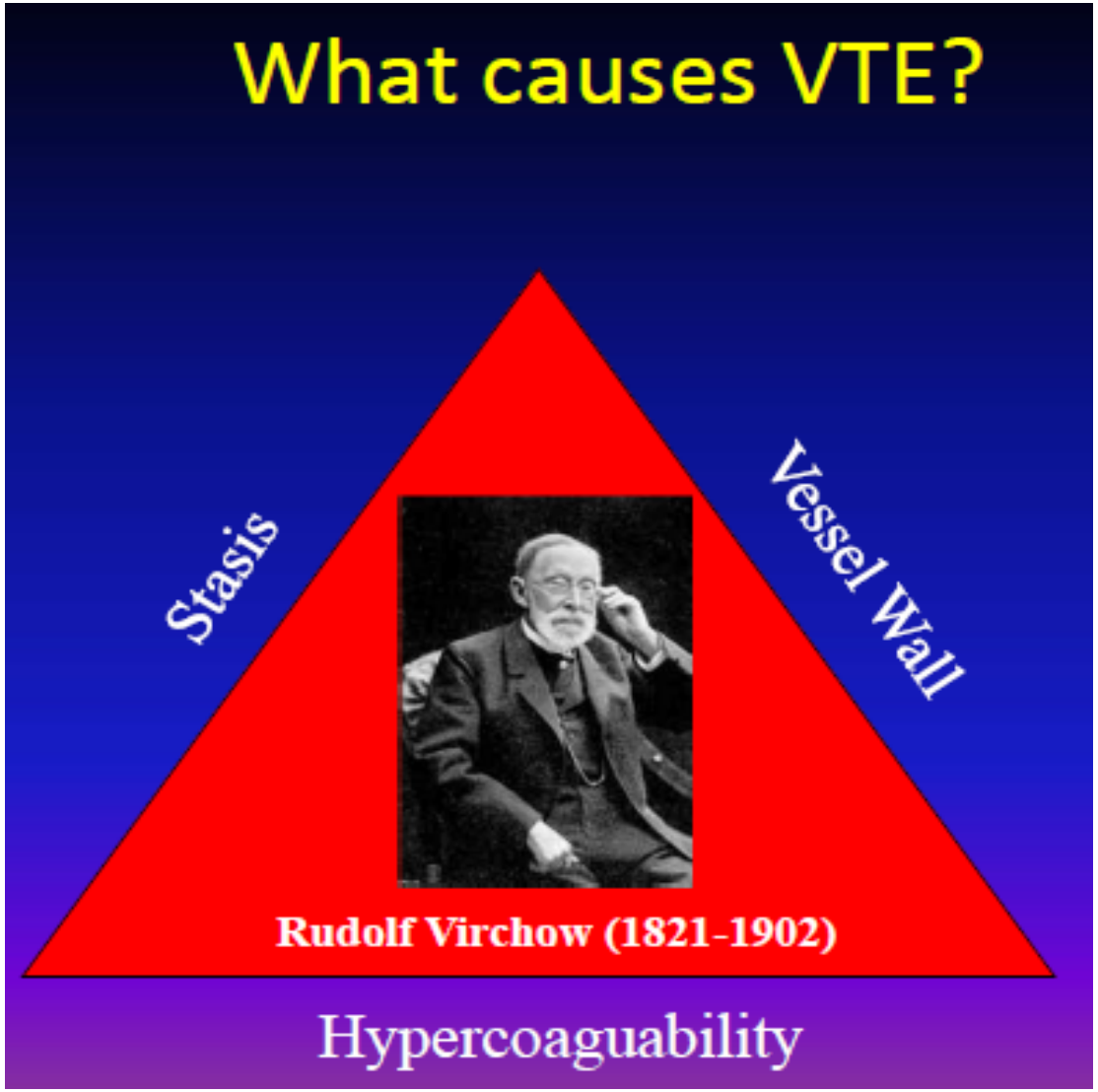
Virchow Triad

1 Hypercoagulability

2 Endothelial Injury

3 Venous Stasis

Present in almost all polytrauma patients



1-Hypercoagulability

- Tissue Thromboplastin
- Activated Procoagulants
- Decreased Fibrinolytic Activity
- Catecholamine Release
- Ineffective Heparin Clearance of Activated Clotting Factors

2- Endothelial Injury

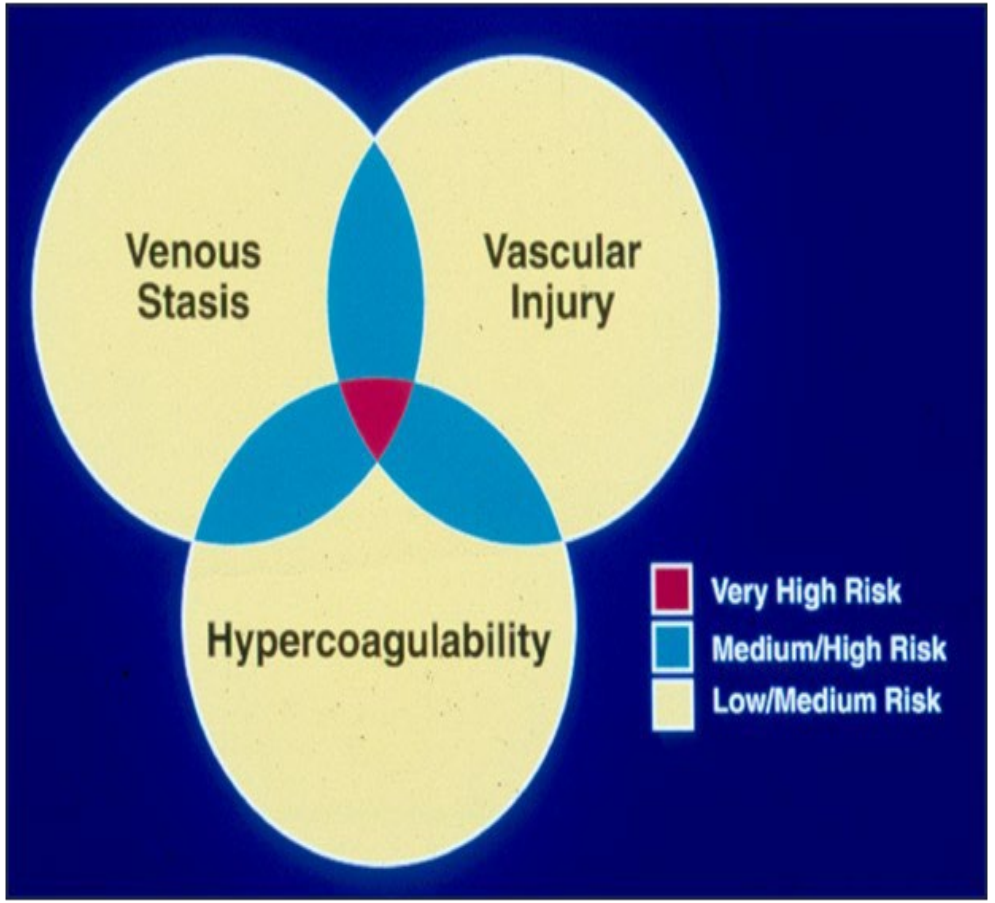
- Direct Trauma to Vein at time of Injury
- Compression of the Vein Secondary to Fracture Position
- Vein Manipulation at Time of Fracture Fixation

3- Venous Stasis

- Immobilization
- Hypotension
- Venous Occlusion
- Edema
- Fracture Position
- Tourniquet

Virchow Triad

Present in almost all Polytrauma patients



Prevention of deep venous thrombosis (DVT)

Goals:

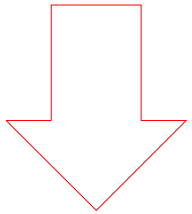
- Effective
- Low Complication Rate
- High Compliance Rate
- Cost Effective

Methods:

- Mechanical
- Pharmacologic

Prevention of deep venous thrombosis (DVT)

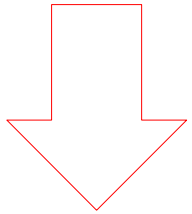
Mechanical
Non Pharmacologic



- **Early Mobilization**
- **Elastic Stockings**
- **Pneumatic Compression**
- **Vena Cava Filter**

Prevention of deep venous thrombosis (DVT)

Pharmacologic (for Trauma)



Unfractionated Heparin

LMWH Heparin

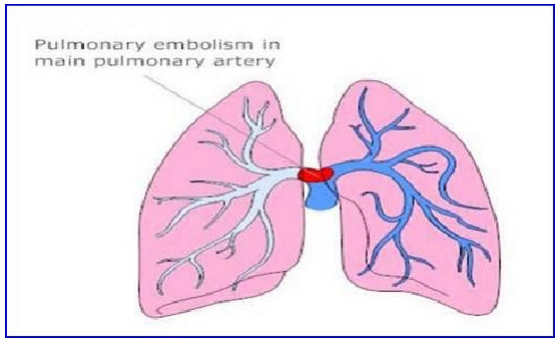
Pulmonary Embolism
(PE)

Pulmonary Embolism
PE

The most common Preventable cause of death in trauma

The classic presentation:

Abrupt onset of pleuritic chest pain, shortness of breath & hypoxia



Most patients have no obvious symptoms at presentation

Symptoms may vary

- sudden catastrophic hemodynamic collapse
- gradually progressive dyspnea

The diagnosis of pulmonary embolism suspected in patients with respiratory symptoms unexplained by an alternative diagnosis

Pulmonary Embolism
PE Diagnosis

Clinical

Shortness of breath, agitation, confusion

Laboratory

↓ **PaO2,** ↑ **A-a gradient:** *Alveolar–arterial gradient Normal = (Age/4) + 4)*

Diagnostic studies

V/Q scans *(Ventilation/perfusion lung scans)*

Pulmonary Angiogram, CT PA (CT *pulmonary angiogram)*

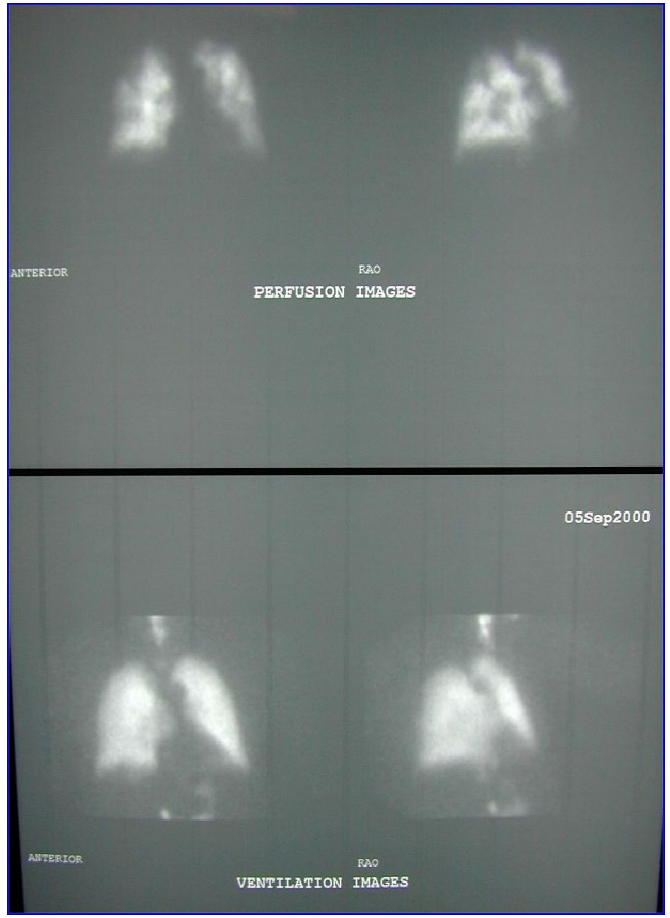
Ventilation Perfusion Scan
V/Q scans (Screening Tool)

VQ scan - initial PE workup

CT scan - CT pul angio replacing VQ

Ventilation Perfusion mismatch results

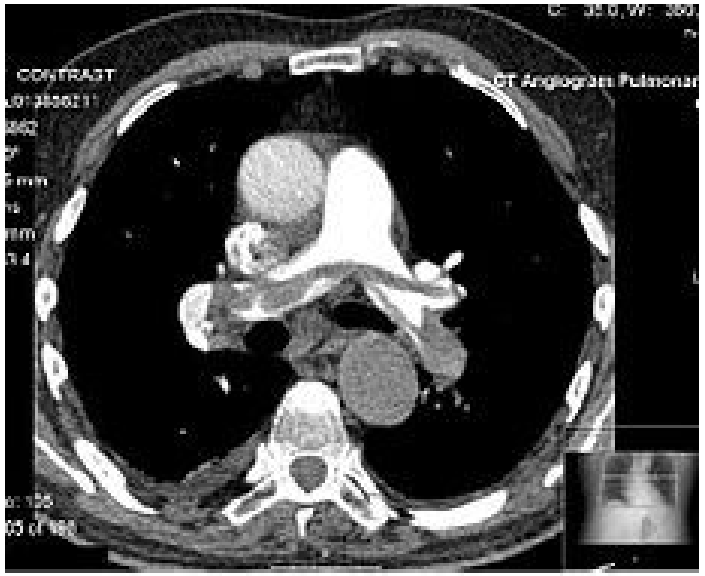
- **Low probability**
  - **15% False Negative**
- **Medium**
  - **Need Angiogram**
- **High probability**
  - **15% False Positive**

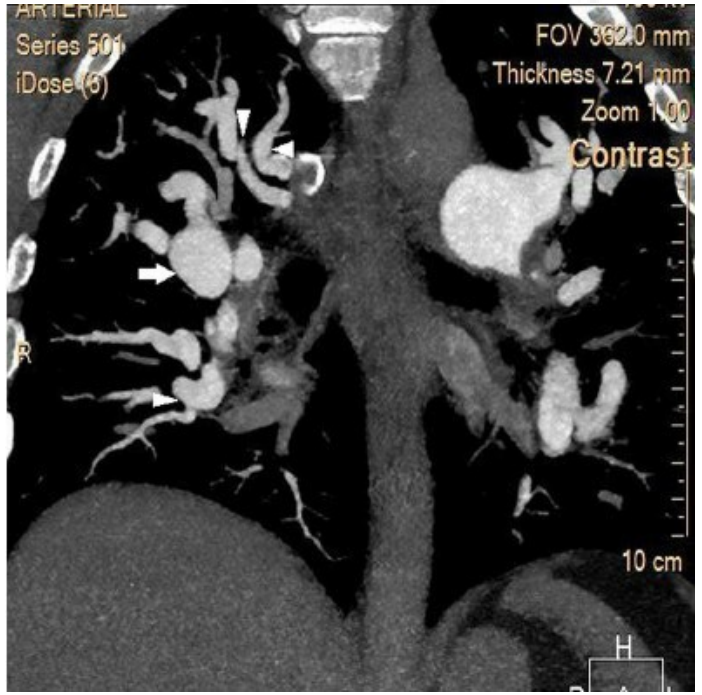


Pulmonary Angiogram

- Angiographic Evaluation of pulmonary vascular tree
- Allows Placement of IVC Filter in same setting if indicated
- Sensitive - Standard in PE Detection. Diagnostic

CT pulmonary Angiogram
CT PA



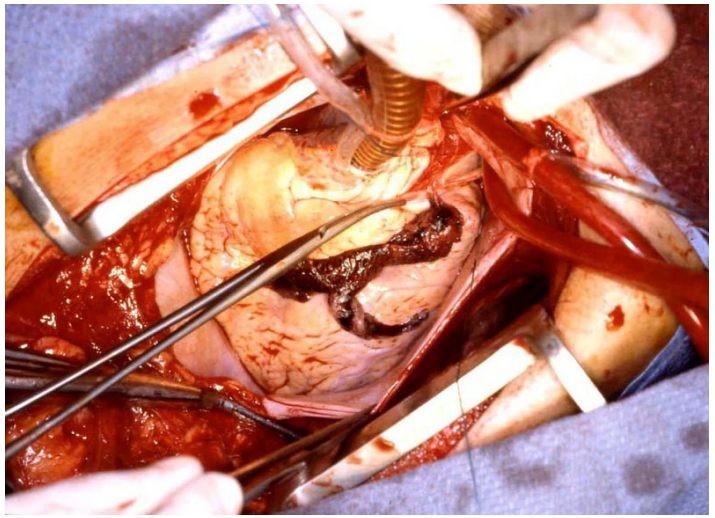


Example of a CTPA
A saddle embolus
The white area above the center is the pulmonary artery opacified by radiocontrast Inside it, the grey matter is blood
Clot

The black areas on either side are the lungs, with around it the chest wall.

Pulmonary Embolism
PE Treatment

- Anticoagulation
- Filter
  - for recurrent event despite anticoagulation
- Thrombectomy
  - Serious Acute PE
  - Patient in extremous
  - Large identifiable PE



Why focus on VTE?

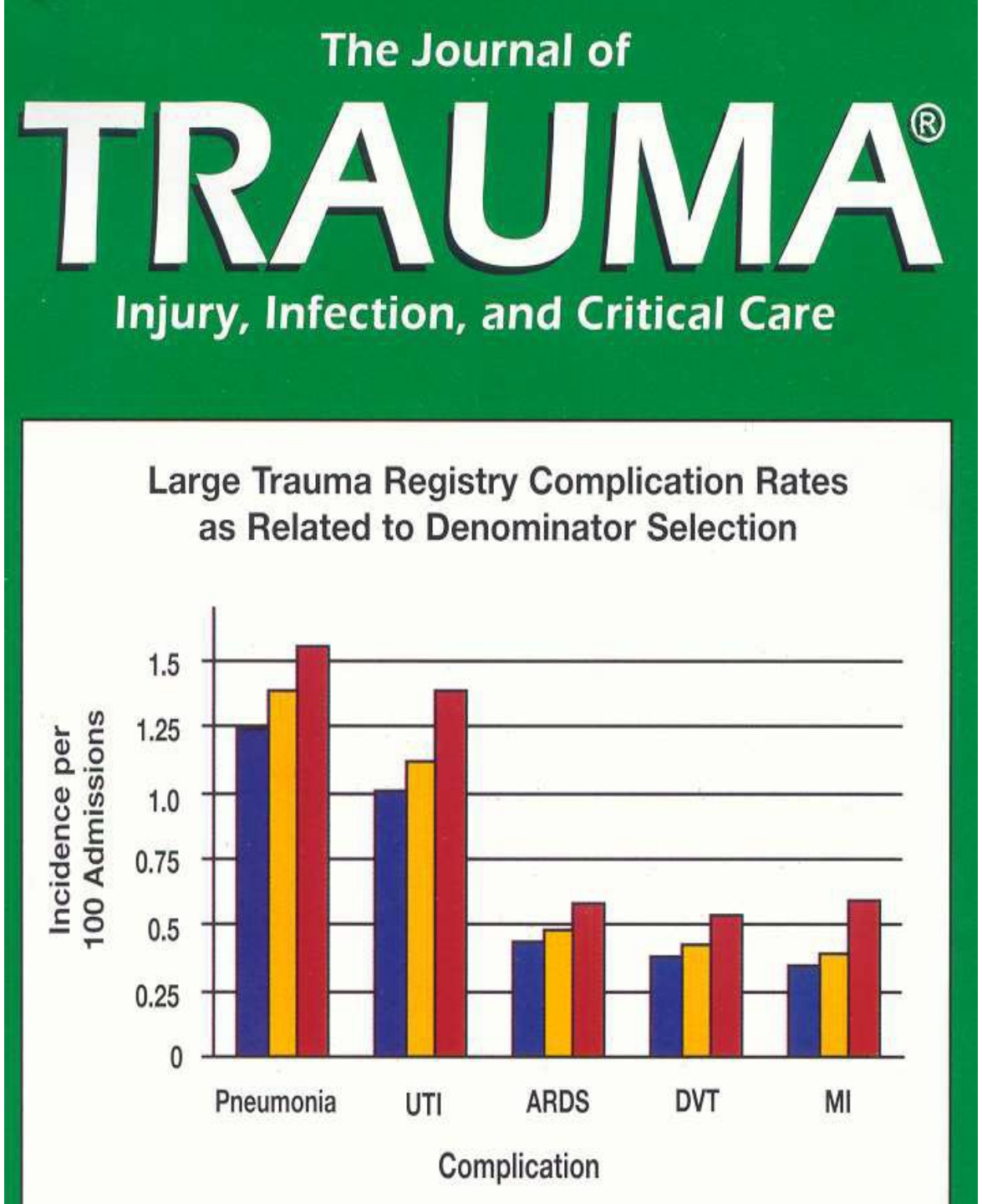
- VTE is common
  - 350,000 to 600,000 Americans suffer DVT and/or PE each year

Why focus on VTE?

- VTE is Deadly
  - >100,000 deaths per year
- More deaths than combined from
  - Breast Cancer
  - Motor Vehicle Collisions
  - AIDS

DVT is 4th most commonly reported complication in Trauma Patients

Kardooni, J Trauma 2008



DVT Incidence After Trauma

- DVT rates reported as high as 58% of moderately to severely injured patients (ISS>=9)

- Rates lower in broader trauma populations
  - 0.36% in overall NTDB (Knudson)
  - 0.38%-0.54% in NTDB (Kardooni)

Geerts, NEJM 1994
Knudson, Ann Surg 2004
Kardooni, J Trauma 2008

Why focus on VTE?

- VTE is (mostly) preventable

VTE Should NOT be Considered a "Never Event"

- Not ALL events are preventable
- VTE occurs even in patients receiving best practice prophylaxis
- 8 RCTs of VTE Prophylaxis in Joint Replacement Surgery
  - 0.3%-2.5% Symptomatic VTE

Streiff & Haut, JAMA2009

Evidence Based
VTE Prophylaxis Guidelines

- American College of Chest Physicians (ACCP)
- Eastern Association for the Surgery of Trauma (EAST)
- American Academy of Orthopedic Surgeons (AAOS)
- American College of Obstetricians and Gynecologists (ACOG)
- American College of Physicians (ACP)

Evidence Based Prophylaxis Guidelines in Trauma

- American College of Chest Physicians (ACCP)
- Eastern Association for the Surgery of Trauma (EAST)

- **Give LMWH- (Enoxaparin 30mg q12)**
- If LMWH contraindicated- use mechanical
  - Sequential Compression Devices (SCDs)

Geerts, CHEST 2008
www.east.org/tpg/dvt.pdf

Agency for Healthcare Research and Quality (AHRQ)

Deep vein thrombosis (DVT)-related pulmonary embolism (PE) is the most common cause of preventable hospital death[1]

> DVT prophylaxis of at-risk patients is the #1 strategy to improve patient safety in hospitals[1]

Making Health Care Safer II: An Updated Critical Analysis of the Evidence for Patient Safety Practices

AHRQ
Agency for Healthcare Research and Quality
Advancing Excellence in Health Care • www.ahrq.gov

Evidence-Based Practice

Patient Safety

Top 10 Safety Practices

Table C. Strongly encouraged patient safety practices

- Preoperative checklists and anesthesia checklists to prevent operative and post-operative events
- Bundles that include checklists to prevent central line-associated bloodstream infections
- Interventions to reduce urinary catheter use, including catheter reminders, stop orders, or nurse-initiated removal protocols
- Bundles that include head-of-bed elevation, sedation vacations, oral care with chlorhexidine, and subglottic-suctioning endotracheal tubes to prevent ventilator-associated pneumonia
- Hand hygiene
- "Do Not Use" list for hazardous abbreviations
- Multicomponent interventions to reduce pressure ulcers
- Barrier precautions to prevent healthcare-associated infections
- Use of real-time ultrasound for central line placement
- Interventions to improve prophylaxis for venous thromboembolisms

based-reports/services/quality/ptsafetysum.pdf

A Classic Example of Surveillance Bias

- Providers who screen more aggressively by performing more duplex ultrasounds may identify more cases of DVT and appear to provide worse quality of care than those providers who order fewer tests

Haut & Pronovost, JAMA2011

Defining Preventable Harm
The VTE Example

- We suggested that “performance measures could link a process of care with adverse outcomes when defining incidences of preventable harm”

Preventable Harm =
VTE + No Prophylaxis

Haut & Pronovost, JAMA2011

What approaches can improve VTE prophylaxis ?

- “Passive dissemination of guidelines is unlikely to improve VTE prophylaxis practice.”

- “A number of active strategies used together, which incorporate some method for reminding clinicians to assess patients for DVT risk and assisting the selection of appropriate prophylaxis, are likely to result in the achievement of optimal outcomes.”

Tooher, A Systematic Review of Strategies to Improve Prophylaxis for Venous Thromboembolism in Hospitals. Ann Surg 2005.

Improving VTE Prophylaxis at The Johns Hopkins Hospital

Lessons from the Johns Hopkins Multi-Disciplinary Venous Thromboembolism (VTE) Prevention Collaborative

BMJ 2012;344:e3935

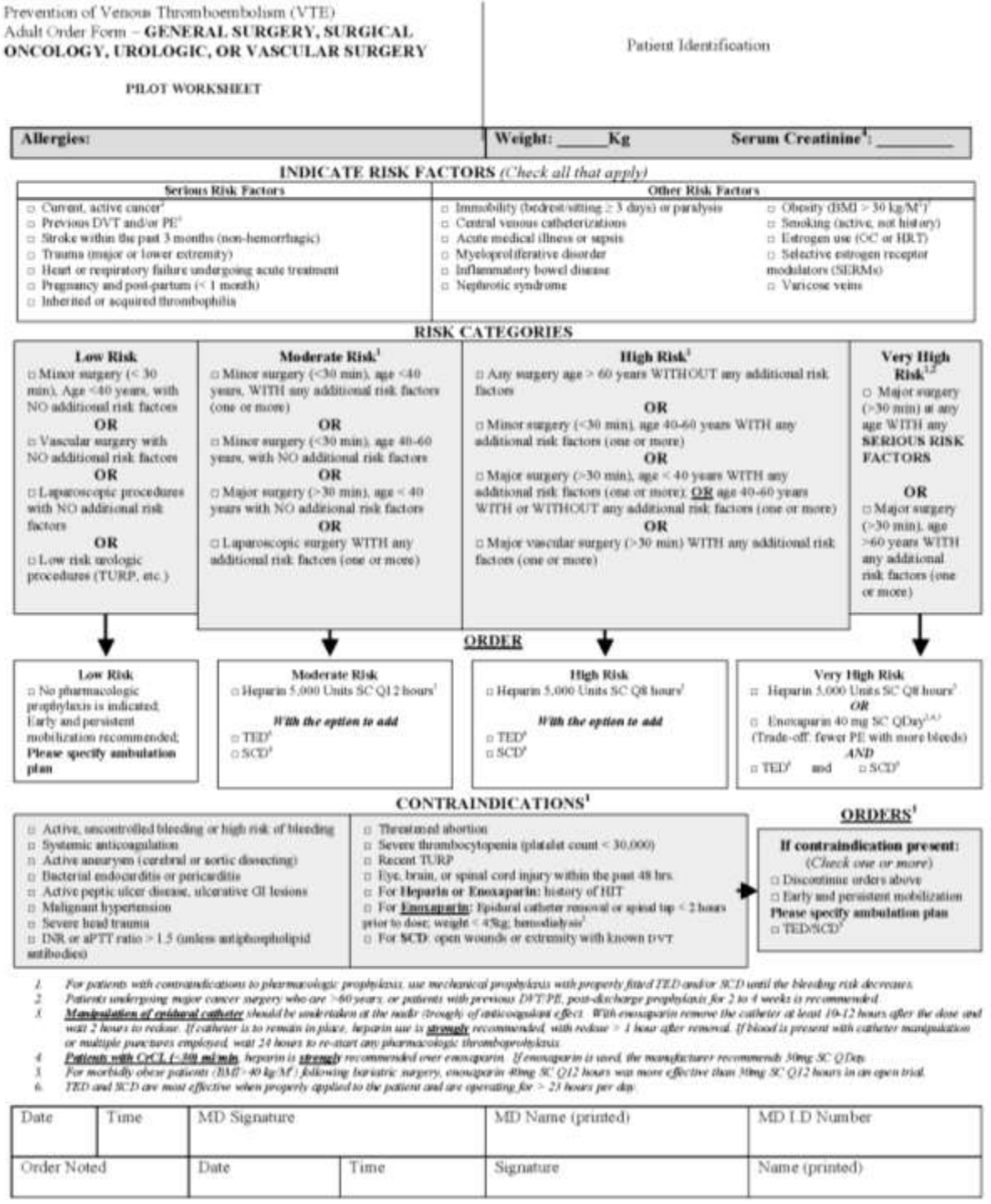
Michael B Streiff *associate professor of medicine*[1 2], Howard T Carolan *quality and innovations project administrator*[3], Deborah B Hobson *patient safety clinical specialist, surgical intensive care nurse and coordinator*[3 4], Peggy S Kraus *clinical specialist for anticoagulation*[5], Christine G Holzmueller *senior research coordinator II, medical writer and editor*[3 6], Renee Demski *senior director, quality and safety*[3], Brandyn D Lau *medical informatician*[7], Paula Biscup-Horn *clinical pharmacy specialist, anticoagulation management*[8], Peter J Pronovost *professor, director, senior vice president for patient safety and quality*[6 3 9 10], Elliott R Haut *associate professor of surgery*[3 4 6 9 11]

Streiff, BMJ 2012

Improving VTE Prophylaxis at The Johns Hopkins Hospital

Paper Order Sets

Streiff, BMJ 2012



Prevention of Venous Thromboembolism (VTE)
Adult Order Form – **GENERAL SURGERY, SURGICAL ONCOLOGY, UROLOGIC, OR VASCULAR SURGERY**

PILOT WORKSHEET

Patient Identification

Allergies: | **Weight:** _____Kg | **Serum Creatinine**[1]: _____

INDICATE RISK FACTORS *(Check all that apply)*

Serious Risk Factors

- Current, active cancer[2]
- Previous DVT and/or PE[3]
- Stroke within the past 3 months (non-hemorrhagic)
- Trauma (major or lower extremity)
- Heart or respiratory failure undergoing acute treatment
- Pregnancy and post-partum (< 1 month)
- Inherited or acquired thrombophilia

Other Risk Factors

- Immobility (bedrest/sitting ≥ 3 days) or paralysis
- Central venous catheterizations
- Acute medical illness or sepsis
- Myeloproliferative disorder
- Inflammatory bowel disease
- Nephrotic syndrome
- Obesity (BMI > 30 kg/M²)[4]
- Smoking (active, not history)
- Estrogen use (OC or HRT)
- Selective estrogen receptor modulators (SERMs)
- Varicose veins

RISK CATEGORIES

Low Risk
- Minor surgery (< 30 min), Age <40 years, with NO additional risk factors

OR
- Vascular surgery with NO additional risk factors

OR
- Laparoscopic procedures with NO additional risk factors

OR
- Low risk urologic procedures (TURP, etc.)

Moderate Risk[1]
- Minor surgery (<30 min), age <40 years, WITH any additional risk factors (one or more)

OR
- Minor surgery (<30 min), age 40-60 years, with NO additional risk factors

OR
- Major surgery (>30 min), age < 40 years with NO additional risk factors

OR
- Laparoscopic surgery WITH any additional risk factors (one or more)

High Risk[1]
- Any surgery age > 60 years WITHOUT any additional risk factors

OR
- Minor surgery (<30 min), age 40-60 years WITH any additional risk factors (one or more)

OR
- Major surgery (>30 min), age < 40 years WITH any additional risk factors (one or more); OR age 40-60 years WITH or WITHOUT any additional risk factors (one or more)

OR
- Major vascular surgery (>30 min) WITH any additional risk factors (one or more)

Very High Risk[1,2]
- Major surgery (>30 min) at any age WITH any **SERIOUS RISK FACTORS**

OR
- Major surgery (>30 min), age >60 years WITH any additional risk factors (one or more)

ORDER

Low Risk
- No pharmacologic prophylaxis is indicated. Early and persistent mobilization recommended. **Please specify ambulation plan**

Moderate Risk
- Heparin 5,000 Units SC Q12 hours[1]

With the option to add
- TED[5]
- SCD[5]

High Risk
- Heparin 5,000 Units SC Q8 hours[1]

With the option to add
- TED[5]
- SCD[5]

Very High Risk
- Heparin 5,000 Units SC Q8 hours[1]

OR
- Enoxaparin 40 mg SC QDay[1,4,6] (Trade-off: fewer PE with more bleeds)

AND
- TED[5] and SCD[5]

CONTRAINDICATIONS[1]
- Active, uncontrolled bleeding or high risk of bleeding
- Systemic anticoagulation
- Active aneurysm (cerebral or aortic dissecting)
- Bacterial endocarditis or pericarditis
- Active peptic ulcer disease, ulcerative GI lesions
- Malignant hypertension
- Severe head trauma
- INR or aPTT ratio > 1.5 (unless antiphospholipid antibodies)
- Threatened abortion
- Severe thrombocytopenia (platelet count < 30,000)
- Recent TURP
- Eye, brain, or spinal cord injury within the past 48 hrs.
- For **Heparin or Enoxaparin:** history of HIT
- For **Enoxaparin:** Epidural catheter removal or spinal tap < 2 hours prior to dose; weight < 45kg; hemodialysis[1]
- For **SCD:** open wounds or extremity with known DVT

ORDERS[1]

If contraindication present:
(Check one or more)
- Discontinue orders above
- Early and persistent mobilization

Please specify ambulation plan
- TED/SCD[5]

1. *For patients with contraindications to pharmacologic prophylaxis, use mechanical prophylaxis with properly fitted TED and/or SCD until the bleeding risk decreases.*
2. *Patients undergoing major cancer surgery who are >60 years, or patients with previous DVT/PE, post-discharge prophylaxis for 2 to 4 weeks is recommended.*
3. ***Manipulation of epidural catheter** should be undertaken at the nadir (trough) of anticoagulant effect. With enoxaparin remove the catheter at least 10-12 hours after the dose and wait 2 hours to redose. If catheter is to remain in place, heparin use is **strongly** recommended, with redose > 1 hour after removal. If blood is present with catheter manipulation or multiple punctures employed, wait 24 hours to re-start any pharmacologic thromboprophylaxis.*
4. ***Patients with CrCL (~30 ml/min**, heparin is **strongly** recommended over enoxaparin. If enoxaparin is used, the manufacturer recommends 30mg SC Q12hrs.*
5. *For morbidly obese patients (BMI > 40 kg/M²) following bariatric surgery, enoxaparin 40mg SC Q12 hours was more effective than 30mg SC Q12 hours in an open trial.*
6. *TED and SCD are most effective when properly applied to the patient and are operating for > 23 hours per day.*

Date	Time	MD Signature	MD Name (printed)	MD I.D Number
Order Noted	Date	Time	Signature	Name (printed)

Improving VTE Prophylaxis at The Johns Hopkins Hospital

- Mandatory VTE risk stratification tool into the computerized provider order entry (CPOE) system

- Advanced computerized clinical decision support (CDS)

Streiff, BMJ 2012

Benefits of the Computerized VTE Prevention System

- Puts VTE prevention into the work flow
- Enables rapid, accurate risk stratification and risk-appropriate VTE prophylaxis
- Applies evidence directly to clinical care
- Allows for performance monitoring/reporting

Streiff, BMJ 2012

Keys to Success

- Multidisciplinary team
  - Physicians, Nurses, Pharmacists, Informatics
- Leadership buy-in
- Collaborate with service teams
- Educate front-line providers
- Measure baseline performance
- Conduct ongoing performance evaluations

Streiff, BMJ 2012

The “Nursing” Elephant in the Room

Missed Doses of VTE Prophylaxis

A Big Assumption

- Physicians assume that medication orders are consistently delivered
- But is that truly the case?
- Does prescription = administration?

Steps to Optimal Pharmacologic VTE Prophylaxis

Do Missed VTE Prophylaxis Doses Matter?

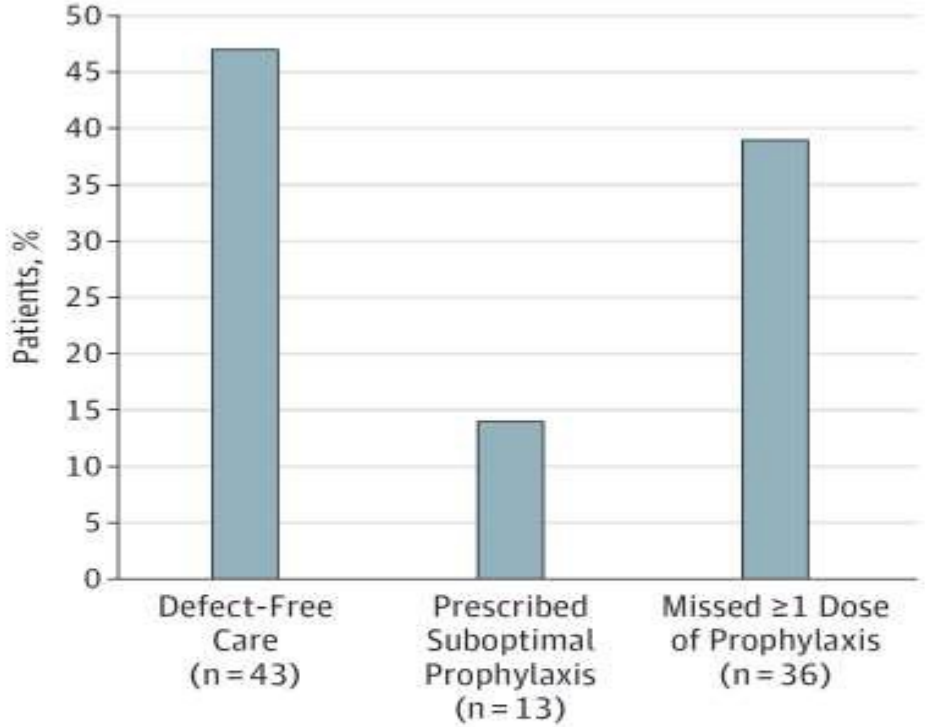
- **Methods**
  - Retrospective analysis
  - 202 trauma and general surgery patients ordered enoxaparin
- **Results**
  - Overall incidence of DVT = 15.8%
  - 58.9% of patients missed >=1 dose
  - DVT compared missed vs. no missed doses
    - 23.5% vs. 4.8% ($p < 0.01$)

Louis, JAMA Surgery2014

Do Missed VTE Prophylaxis Doses Matter?

- 92 VTE patients
- 39% missed
  >=1 dose of prophylaxis

Figure. Categorization of Patients With Hospital-Acquired VTE By Process of Care Appropriateness



Of the 92 patients with a venous thromboembolism (VTE), 43 (47%) received defect-free care, while 49 (53%) had truly potentially preventable VTE and were in the prophylaxis-failure group (ie, 13 of 92 patients were prescribed suboptimal prophylaxis [14%], and 36 of 92 patients missed ≥1 dose of prescribed prophylaxis [39%]).

Haut, JAMA Surgery2015

Missed Doses of VTE Prophylaxis Medications at Johns Hopkins

- December 1, 2007 to June 30, 2008
  - >100,000 doses
  - 12% of doses not administered
    - Patient refusal most frequent (~60%) documented reason

Shermock, PlosOne 2013

OPEN ACCESS Freely available online

PLOS ONE

Patterns of Non-Administration of Ordered Doses of Venous Thromboembolism Prophylaxis: Implications for Novel Intervention Strategies

Kenneth M. Shermock[1,2,6,8]*, Brandyn D. Lau[3,6], Elliott R. Haut[3,4,5,8], Deborah B. Hobson[3,8], Valerie S. Ganetsky[1], Peggy S. Kraus[1], Leigh E. Efird[1], Christoph U. Lehmann[10], Brian L. Pinto[1], Patricia A. Ross[1], Michael B. Streiff[7,8,9]

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Abstract

Background: Recent studies have documented high rates of non-administration of ordered venous thromboembolism (VTE) prophylaxis doses. Intervention strategies that target all patients have been effective, but prohibitively resource-intensive. We aimed to identify efficient intervention strategies based on patterns of non-administration of ordered VTE prophylaxis.

Methods and Findings: In this retrospective review of electronic medication administration records, we included adult hospitalized patients who were ordered pharmacologic VTE prophylaxis with unfractionated heparin or enoxaparin over a seven-month period. The primary measure was the proportion of ordered doses of VTE prophylaxis not administered, assessed at the patient, floor, and floor type levels. Differences in non-administration rates between groups were assessed using generalized estimating equations. A total of 103,160 ordered VTE prophylaxis doses during 10,516 patient visits on twenty-nine patient floors were analyzed. Overall, 11.9% of ordered doses were not administered. Approximately 19% of patients missed at least one quarter and 8% of patients missed over one half of ordered doses. There was marked heterogeneity in non-administration rate at the floor level (range: 5–27%). Patients on medicine floors missed a significantly larger proportion (18%) of ordered doses compared to patients on other floor types (8%, Odds Ratio: 2.4, $p<0.0001$). However, more than half of patients received at least 86% of their ordered doses, even on the lowest performing floor. The 20% of patients who missed at least two ordered doses accounted for 80% of all missed doses.

Conclusions: A substantial proportion of ordered doses of VTE prophylaxis were not administered. The heterogeneity in non-administration rate between patients, floors, and floor types can be used to target interventions. The small proportion of patients that missed multiple ordered doses accounted for a large majority of non-administered doses. This recognition of the Pareto principle provides opportunity to efficiently target a relatively small group of patients for intervention.

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Anonymous, voluntary, web-based survey regarding nursing practice on VTE care.

Academic Level I TC Community Level II TC

N=221 53% BSN

78% Full time

Median RN Experience 13 yrs Type: ED/Floor/ICU

46% reported attending some type of VTE education

Evaluation of hospital nurses' perceived knowledge and practices of venous thromboembolism assessment and prevention

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Venous thromboembolism (VTE) is a preventable cause of hospital death. Bedside registered nurses (RNs) are a key group that can be the first to recognize risks of patients in acute care settings. The purpose of this study was to identify bedside hospital RNs' perceived knowledge of VTE, their assessment practices, their self-efficacy in conducting VTE prevention care, and their perceived barriers to performing VTE risk assessment. An anonymous web-based survey on VTE risk assessment and prevention was conducted with RNs who provided direct patient care at two hospitals. RNs who were not directly involved in bedside patient care such as managers and educators were excluded. A total of 221 RNs completed the survey. Most participants rated their overall knowledge of VTE risk assessment between "good" (44%) and "fair" (28%). VTE assessment frequencies performed by participants varied widely. Participants reported high confidence in their ability to educate patients and families about VTE symptoms, prevention, and treatments. Participants were least confident in their own ability to conduct a thorough VTE risk assessment. Greater self-reported VTE knowledge was associated with greater VTE assessment frequency and self-efficacy for VTE preventive care. The most common perceived barriers in performing VTE risk assessment were lack of knowledge (21%) and lack of time (21%). The findings demonstrate a substantial need for focused education about VTE prevention for hospital nurses and support for hospital systems to monitor VTE care. Despite the Joint Commission emphasis on VTE risk assessment in all hospitalized patients, there remains a gap between current, evidence-based recommendations for VTE prevention and reported nursing practices.
(J Vasc Nurs 2014;32:18-24)

Venous thromboembolism (VTE) manifesting as deep vein thrombosis (DVT) and pulmonary embolism (PE) is a major health care problem affecting hundreds of thousands of Americans annually. Over half of these individuals develop their VTE in hospitals or in the 30 days after hospital discharge.[1] PE is the most common preventable cause of hospital death in the United States.[2] Annually, PE accounts for an estimated 300,000 dealths.[2] Despite ample availability of evidence-based guidelines recommending pharmacologic and mechanical prophylaxis in hospitalized patients,[3–5] prevention of VTE is inadequate for many hospitalized patients with medical illnesses, including congestive heart failure, chronic lung disease, cancer, and infectious disease.[6]

Many public and private organizations, including the Centers for Medicare and Medicaid Services, the Joint Commission, National Quality Forum, the Agency for Healthcare Research and Quality, and the Leapfrog group, have developed health care provider performance measures, quality indicators, guidelines, public reporting initiatives, incentive programs, and negative reimbursements aiming to improve quality of care and reduce unnecessary health care costs related to VTE preventions.[1,7] The Joint Commission has recently added anticoagulation therapy safety as one of the National Patient Safety Goals.[8] Antithrombotic therapy using anticoagulants is recommended by the American College of Chest Physicians to prevent VTE.[3–5]

VTE risk assessment requires the coordination of care across multiple disciplines supported by a system that assists in the process of delivering and tracking outcomes of care.[9] Multifaceted approaches, including either a paper-based or computer-based physician reminder on risk assessment and decision support, and a continuous iterative process of audit and feedback, have shown to be effective initiatives and strategic plans.[10,11] These

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Declaration of Conflicting Interests: No conflict of interest is declared by any author.

Findings from this study were presented at the Western Institute of Nursing in 2012.

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Lee 2014 J Vascular Nursing

70%

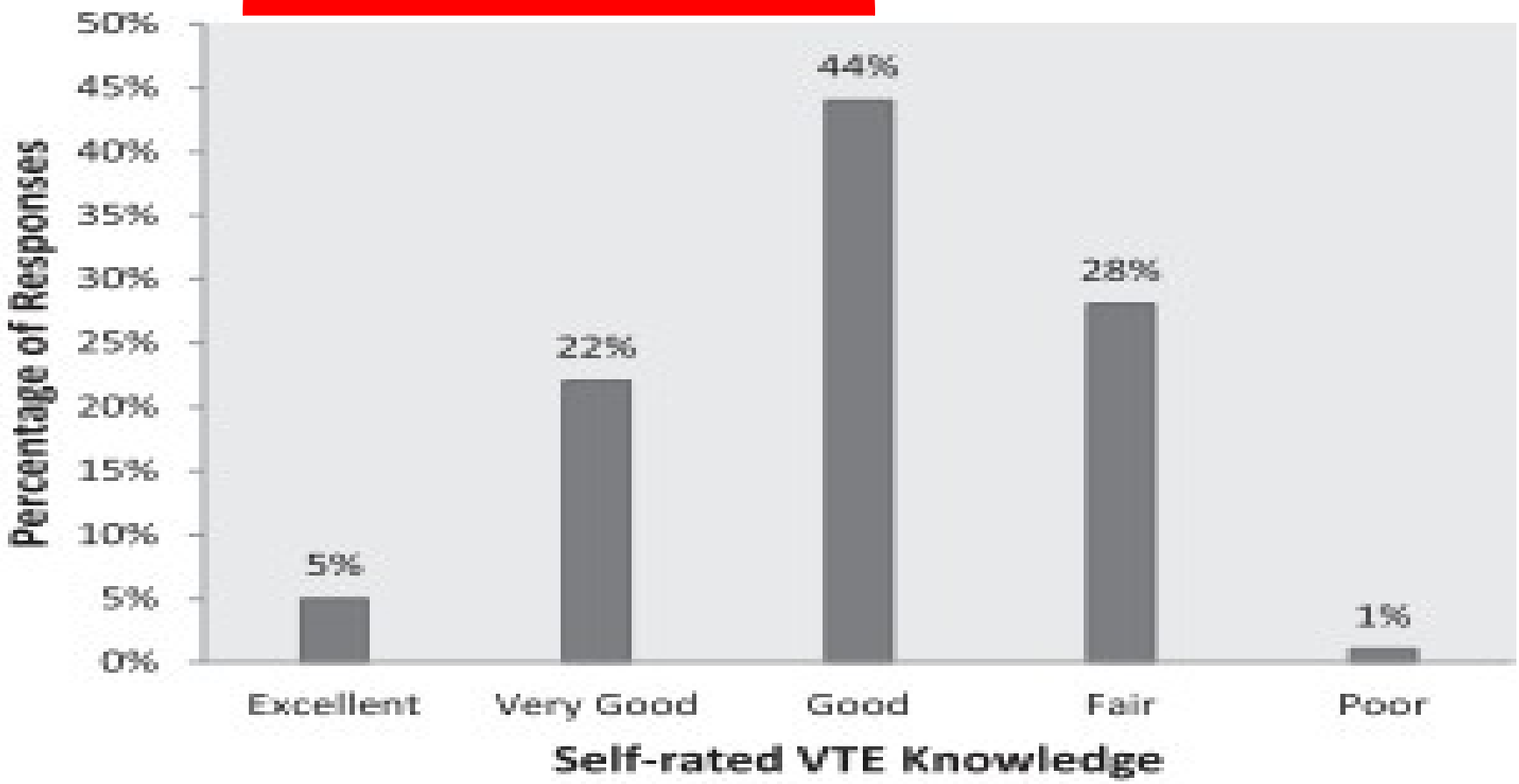

Figure 1. *Nurses' perceived venous thromboembolism knowledge.*

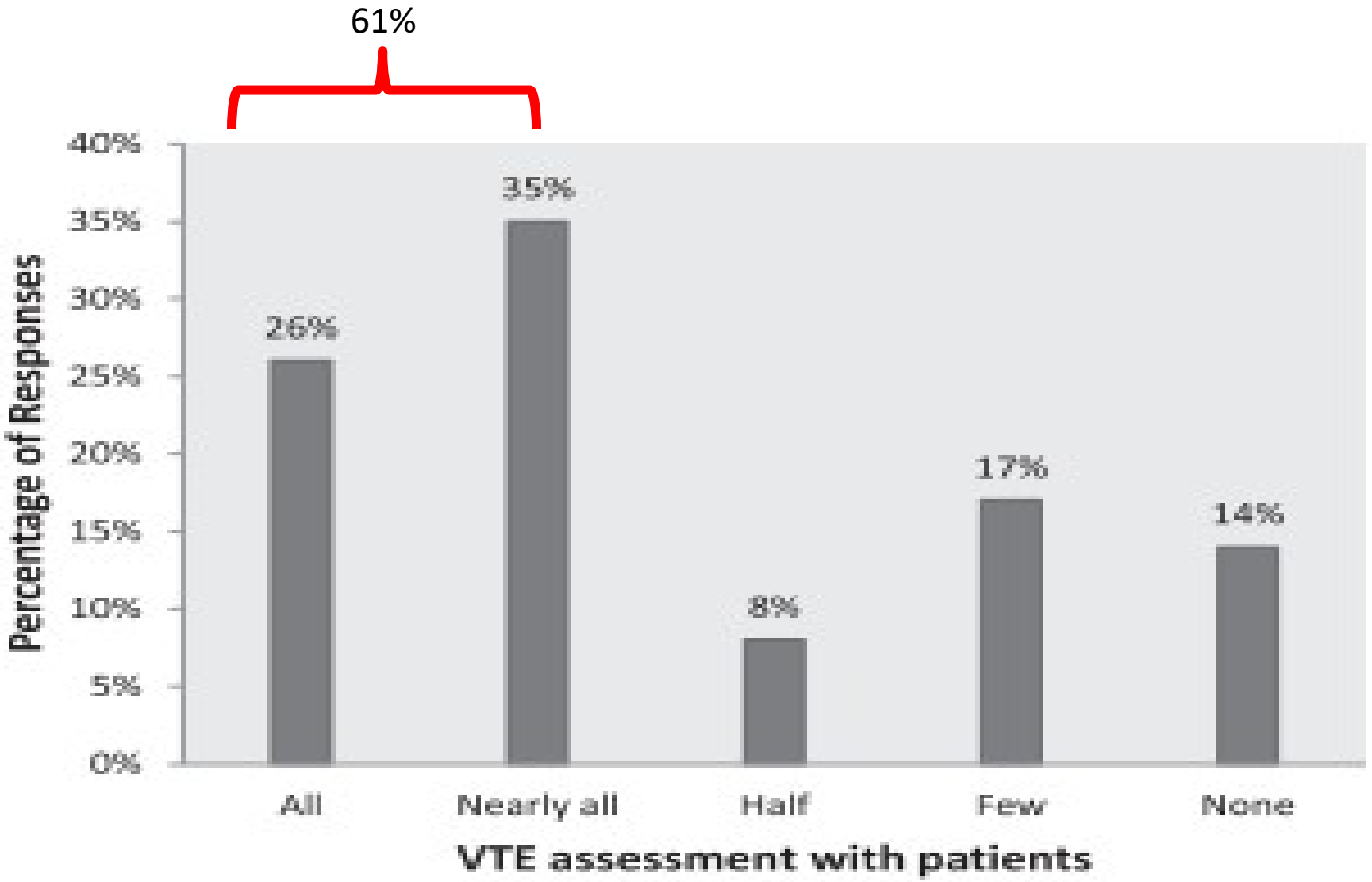

Figure 2. *Nurse self-reported frequency of venous thromboembolism assessment with patients.*

TABLE 2

NURSES' SELF-EFFICACY IN PRACTICING VTE PREVENTION CARE

How Sure Are You That You Can…. ?	*Mean (SD)*	*None of the Time (score of 1), (%)*	*A Little of the Time (score of 2), (%)*	*Some of the Time (score of 3), (%)*	*Most of the Time (score of 4), (%)*	*Always (score of 5), (%)*
Conduct a thorough VTE risk assessment.	3.50 (1.0)	11 (5)	26 (12)	57 (26)	93 (42)	33 (15)
Educate the patient on oral anticoagulants.	3.88 (1.0)	4 (2)	20 (9)	42 (19)	87 (40)	67 (30)
Effectively use mechanical devices for VTE prevention.	4.21 (0.9)	4 (2)	7 (3)	24 (11)	89 (40)	96 (44)
Educate patients and their families about the signs, symptoms, treatment, and prevention of DVT and PE.	3.89 (0.8)	0 (0)	16 (7)	45 (20)	108 (49)	52 (24)
Advise at-risk patients about lifestyle changes.	3.63 (0.9)	3 (1)	25 (11)	59 (27)	96 (44)	37 (17)
Encourage early mobilization and leg exercises.	4.05 (0.8)	2 (1)	8 (4)	25 (11)	126 (57)	59 (27)

Note. The *n*s (either 221 or 220) vary slightly across variables owing to missing data.

Mixed Methods Research (Qualitative Observation and Quantitative Nursing Survey)
12 nursing units

Nurses on units with low administration rates often believe they have the skills to determine which patients require VTE prophylaxis.

More likely to believe that ordered does are discretionary (optional)

Hidden Barriers to Delivery of Pharmacological Venous Thromboembolism Prophylaxis: The Role of Nursing Beliefs and Practices

Stacy Elder, PharmD, Deborah B. Hobson, BSN, Cynthia S. Rand, PhD, Michael B. Streiff, MD, Elliott R. Haut, MD, Leigh E. Efird, PharmD, Peggy S. Kraus, PharmD, Christoph U. Lehmann, MD, and Kenneth M. Shermock, PharmD, PhD

Background: Standardized electronic order sets for venous thromboembolism prophylaxis have increased the proportion of patients receiving venous thromboembolism prophylaxis. However, ordering venous thromboembolism prophylaxis does not ensure consistent administration.

Objective: To explore causes of variability in the rate of administration of ordered doses of pharmacological venous thromboembolism prophylaxis among hospital units.

Design: Mixed methods study, including qualitative observation and quantitative nursing survey administration.

Subjects: Nurses included in observations were practicing on an inpatient unit, caring for patients with orders to receive venous thromboembolism prophylaxis consisting of low-dose unfractionated heparin or low–molecular weight heparin. Nurses on 12 inpatient units with disparate rates of administration were included in the survey.

Measures: Qualitative observation data were collected until thematic saturation was achieved. Survey was conducted to identify beliefs and practices surrounding nursing administration of venous thromboembolism prophylaxis.

Results: During observations, some nurses presented pharmacological venous thromboembolism prophylaxis to their patients as an optional therapy. Nurses on low-performing units are more likely to believe that pharmacological venous thromboembolism prophylaxis is ordered for patients who do not require it. More often, they also acknowledge that nurses use their clinical decision-making skills to determine when to omit unnecessary doses of prescribed venous thromboembolism prophylaxis.

Conclusions: Nurses on units with low administration rates often believe they have the skills to determine which patients require pharmacological venous thromboembolism prophylaxis. They are also more likely to believe that ordered doses are discretionary and offer the medication as optional to patients.

Key Words: venous thromboembolism, pharmacological venous thromboembolism prophylaxis, prophylaxis, nursing, mixed methods, heparin, low–molecular weight heparin

(*J Patient Saf* 2016;12: 63–68)

Venous thromboembolism (VTE) is a significant cause of morbidity and mortality in hospitalized patients, represent-

international surveys have documented that clinicians often fail to prescribe VTE prophylaxis for at-risk patients.[7–11] Consequently, health care reimbursement organizations, such as the Centers for Medicare and Medicaid Services (CMS), have designated hospital-acquired VTE as an event that should never occur in some patient populations because of the availability of prophylactic measures.[12] In an attempt to comply with these objectives and maximize patient safety, the development of computerized electronic alerts and standardized VTE prophylaxis order sets have increased the proportion of patients receiving VTE prophylaxis and decreased VTE events.[13,14]

However, ordering VTE prophylaxis does not necessarily ensure consistent administration. Nonadherence has been observed with mechanical prophylaxis and may contribute to preventable, hospital-acquired VTE.[15–17] Fanikos et al. reviewed 2047 doses and observed that 10% of prophylactic low dose unfractionated heparin (LDUH) and low molecular weight heparin (LMWH) doses were not administered.[18] The most common reason for missed doses of prophylaxis was cited as patient refusal, accounting for 44% of omitted doses.[18] We noted a similar pattern at our institution where a review of 107,000 doses of VTE prophylaxis suggested that 11.8% of doses were not administered, and 59% of those were documented as refused.[17] Furthermore, we observed marked variation in the percent of ordered doses of VTE prophylaxis that were not administered across hospital units (range, 5%–27%).[17]

To explore potential causes for variation in the rate of administration of pharmacological VTE prophylaxis, we initiated a mixed methods study of VTE prophylaxis delivery on selected high and low performing nursing units at the Johns Hopkins Hospital. We hypothesized that nursing attitudes, beliefs, and practices surrounding VTE prophylaxis corresponded with patterns in administration rate of these medications.

METHODS

We conducted a mixed methods study at a large academic medical center, between October 2010 and October 2011. Be-

Elder 2016 J Patient Safety

My Nursing Judgement

‘Hey Ms. R, it’s time for your heparin dose,
but as long as I see you up, high-fiving me in the hallways, we can hold off for now.’’

‘‘We make the clinical decision all the time as to whether a patient needs VTE prophylaxis everyday, based on how much the patient is ambulating.’’

‘‘Sometimes, if it is the middle of the night and [LDUH] is the only medication I have to give a patient, I won’t wake them up just to give VTE prophylaxis.’’’’

The Grumpy Refusing Patient

‘‘I’ve had Mr. F all weekend and he has been refusing. I’m not even going to ask him.’’

‘‘This patient has been here four months and he literally yells at us when we ask him about heparin because he says we should know by now that he doesn’t want it. So we try to avoid that [situation] and we don’t ask him anymore.’’

The Active Refusing Patient

‘‘It is difficult to convince patients, who ambulate frequently and are very active, [of] the need for DVT prophylaxis because telling them that they are at increased risk while hospitalized because they ’are not as active’ doesn’t apply.

They say ‘ well I refuse heparin because I stretch, walk and exercise here.’’’

‘‘I try to talk bed -bound patients into taking their heparin.’’

The Patient Doesn’t Need It-Judgement

‘‘If you walk up and down the entire floor three times today, I will talk to the doctor about stopping the heparin.’’

‘‘Just so you know, often I forget to tell the physician to discontinue the heparin shots if a patient is ambulating, so I just document it as ‘patient condition inappropriate.’ You may see a lot of that.’’

Nurses Knowledge Deficit

‘‘Nurses don’t know what the screening criteria are for giving or not giving the subcutaneous heparin shot. Nurses believe if the pt is ambulating then they do not need the subcutaneous injection."

This is FALSE and represents a knowledge deficit in nurses.

Nurses need to know the screening criteria and why they are giving the subcutaneous injection.’’

Anonymous Survey
IM and GS Residents
Single Trauma Center

32% IM and 3% GS Residents

Thought that VTE prophylaxis is not necessary in an independently ambulating patient.

J Thromb Thrombolysis (2016) 42:463–470
DOI 10.1007/s11239-016-1378-8

Prescriber knowledge and attitudes regarding non-administration of prescribed pharmacologic venous thromboembolism prophylaxis

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Abstract Pharmacologic venous thromboembolism (VTE) prophylaxis is important patient safety practice in hospitalized patients. However, a substantial number of ordered doses are not administered. Patient and nursing attitudes and behaviors can influence whether a patient receives a dose. The objective of this single center study was to evaluate prescriber knowledge and attitudes regarding missed doses of pharmacologic VTE prophylaxis. An anonymous, 9-question survey was administered to internal medicine and general surgery resident physicians. The survey captured prescriber opinions on issues related to non-administration of VTE prophylaxis. Thirty-two percent of medicine residents compared with 3 % of surgery ($P < 0.001$). Study findings indicate the need for additional resident physician education. Further investigation is needed to assess these beliefs and ensure patients receive necessary VTE prophylaxis.

Keywords Thromboembolism · VTE prophylaxis · Patient safety · Survey

Introduction

Venous thromboembolism (VTE), a common disorder comprised of either deep vein thrombosis or pulmonary

Piechowski, 2016 J Throm Thrombolysis

PCORI Project

pcori | Patient-Centered Outcomes Research Institute

- Preventing Venous Thromboembolism: Empowering Patients and Enabling Patient-Centered Care via Health Information Technology

Principal Investigator
Elliott Haut, MD, PhD

Organization	Funding Announcement
Johns Hopkins University	Assessment of Prevention, Diagnosis, and Treatment Options
State	**Project Budget**
Maryland	$1,499,194
Year Awarded	**Project Period**
2013	3 years

nurse-communication-prevent-life-threatening-complication

Our PCORI Objectives

- 1) Enable patients to make informed decisions about their preventive care by improving the quality of patient-nurse communication about the harms of VTE and benefits of VTE prophylaxis
- 2) Empower patients to take an active role in their VTE preventive care
- 3) Identify and facilitate active engagement of patients who are not administered doses of VTE prophylaxis using a real-time escalating alert

Educate the Nurses

Double blinded
Cluster Randomized Trial
21 Med-Surg Floors
933 nurses

Static Ed Module

Dynamic Interactive Module

Both worked
Significantly improved
VTE Prophy Administration

PLOS ONE

RESEARCH ARTICLE

Effectiveness of two distinct web-based education tools for bedside nurses on medication administration practice for venous thromboembolism prevention: A randomized clinical trial

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Data Availability Statement: Data are available

Abstract

Background

Venous thromboembolism (VTE) is a common cause of preventable harm in hospitalized patients. While numerous successful interventions have been implemented to improve prescription of VTE prophylaxis, a substantial proportion of doses of prescribed preventive medications are not administered to hospitalized patients. The purpose of this trial was to evaluate the effectiveness of nurse education on medication administration practice.

Lau 2017 PLOS one

Expanded Analysis to 4 hospitals within the Johns Hopkins System

10-15% of doses not administered

44% missed >=1 dose

(Range 36% - 52%)

Significant Problem

Missed Doses of Venous Thromboembolism (VTE) Prophylaxis at Community Hospitals: Cause for Alarm

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KEY WORDS: venous thromboembolism; quality improvement; safety.
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DOI: 10.1007/s11606-017-4203-y

INTRODUCTION

Venous thromboembolism (VTE) is a leading cause of potentially preventable harm. Randomized controlled trials have demonstrated that VTE prophylaxis, when administered completely, significantly reduces the risk for deep vein thrombosis, pulmonary embolism (PE), and fatal PE.[1]

Numerous interventions have been successful in improving the prescription of VTE prophylaxis.[2] Unfortunately, few in-

through December 31, 2015, to identify patients who were prescribed pharmacological VTE prophylaxis, including unfractionated heparin (5000 U q12h/q8h or 7500 U q12h/q8h), enoxaparin (30 mg q12h/q24h or 40 mg q12h/q24h), fondaparinux (2.5 mg q24h), and dalteparin (5000 U q24h). Nurses must document every dose as either administered or not administered for each scheduled administration time. We calculated the proportion of overall doses not administered and the proportion of patients who missed ≥1 dose, by individual hospital and hospital type. Proportions were compared using chi-square tests. This study was approved by the Johns Hopkins Medicine Institutional Review Board.

Lau 2017 JGIM

Review of EMR missed doses
4 different units
For 1 month
Single Trauma Center

Overall, 13% of doses (all Meds) not given
Highest (2x more likely) for VTE prophylaxis

Reason:
#1: Pt refusal (esp. SQ anticoagulants)

NOTE

Nonadministration of medication doses for venous thromboembolism prophylaxis in a cohort of hospitalized patients

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Purpose. Results of a study to characterize patterns of nonadministration of medication doses for venous thromboembolism (VTE) prevention among hospitalized patients are presented.

Methods. The electronic records of all patients admitted to 4 floors of a medical center during a 1-month period were examined to identify patients whose records indicated at least 1 nonadministered dose of medication for VTE prophylaxis. Proportions of nonadministered doses by medication type, intended route of administration, and VTE risk categorization were compared; reasons for nonadministration were evaluated.

Results. Overall, 12.7% of all medication doses prescribed to patients in the study cohort (n = 75) during the study period (857 of 6,758 doses in total) were not administered. Nonadministration of 1 or more doses of VTE prophylaxis medication was nearly twice as likely for subcutaneous anticoagulants than for all other medication types (231 of 1,112 doses [20.8%] versus 626 of 5,646 doses [11.2%], $p < 0.001$). For all medications prescribed, the most common reason for nonadministration was patient refusal (559 of 857 doses [65.2%]); the refusal rate was higher for subcutaneous anticoagulants than for all other medication categories (82.7% versus 58.8%, $p < 0.001$). Doses of antiretrovirals, immunosuppressives, antihypertensives, psychiatric medications, analgesics, and antiepileptics were less commonly missed than doses of electrolytes, vitamins, and gastrointestinal medications.

Conclusion. Scheduled doses of subcutaneous anticoagulants for hospitalized patients were more likely to be missed than doses of all other medication types.

Keywords: anticoagulants, electronic medical records, medication adherence, nonadministration, patient safety

Am J Health-Syst Pharm. 2018; 75:392-7

Popoola 2018 Am J Health-Syste Pharm

What do Patients Want?

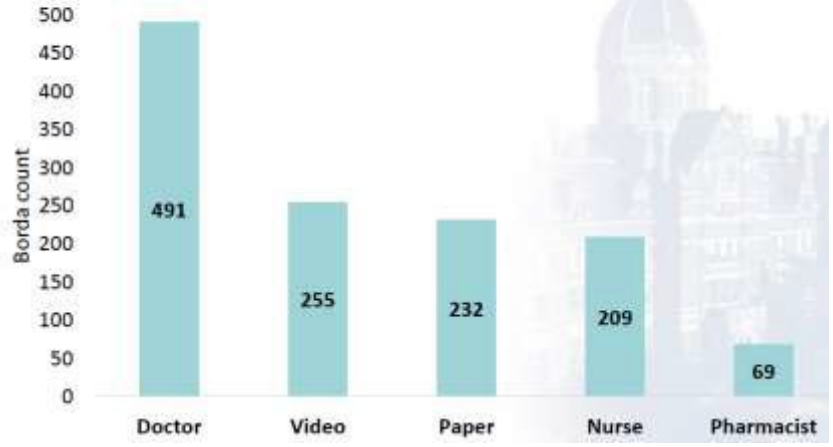
Haut, Johns Hopkins

Modified Delphi Method

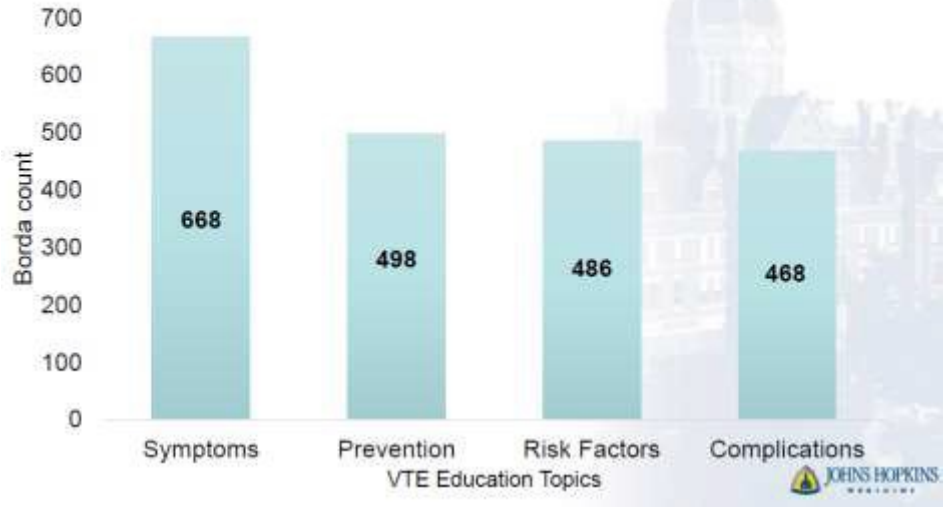
- Iterative process involving surveys, feedback and revisions
- Engaged patients and family members
- Recruited via email and/or social media (websites, Facebook, Twitter) through respective organizations
- > 400 respondents

What Do Patients Want?

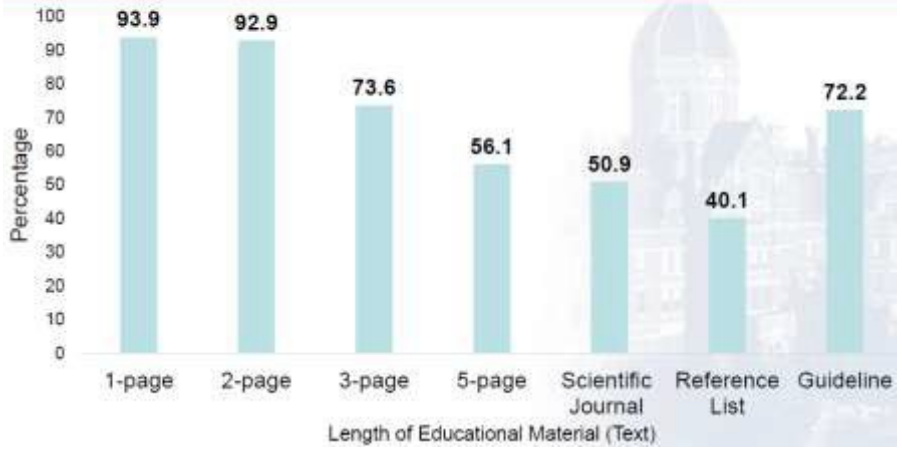
How Do Patients Want To Learn About VTE?



What Do Patients Want to Learn about VTE



How Much Are Participants Willing to Read?



Preferred Length Of Video?

Intervention Project

- Real time alert of dose non-administration from POE system via pager/email
- Patient education bundle
  - Targeted education
  - Direct one-on-one discussion with nurse
  - Supported by paper handout and/or video
- Prospective Cohort Study
  - April 2015 to December 2015 (8 months)

The Future of VTE Prevention?
What is on the Horizon?

- Current recommendations are basically a “one size fits all” approach
- Can we do better?
- Do different patients require different:
  - Medications (i.e. anti-platelets, aspirin)?
  - Doses?
  - Frequency?

The Future of VTE Prevention?

- Precision medicine / targeted prevention

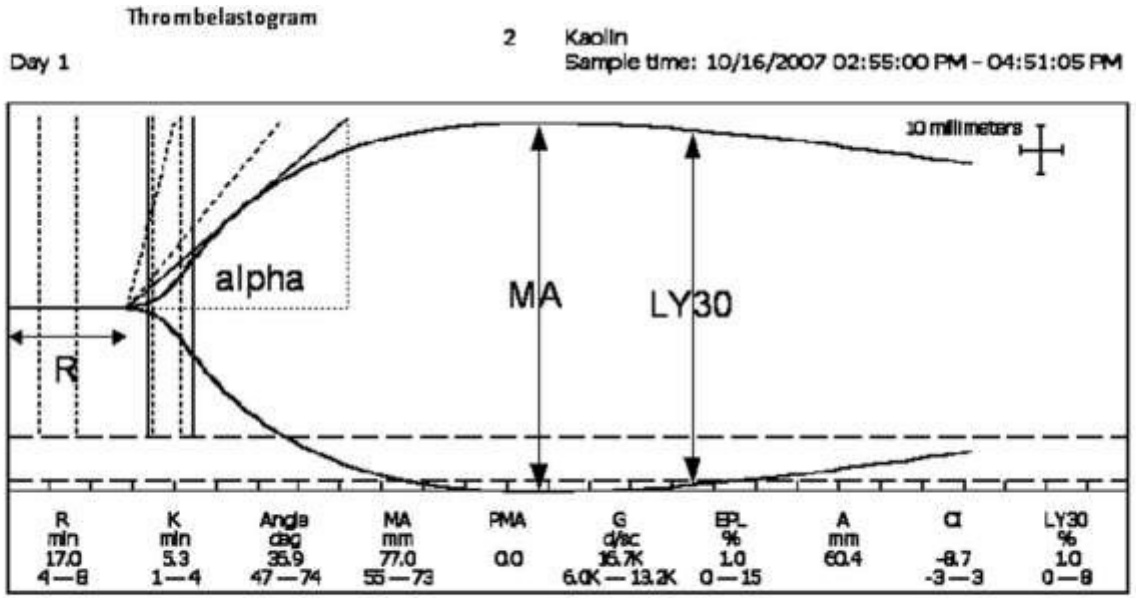


Fig. 2. *A sample TEG tracing showing various parameters. The initial time to clot formation (R) is measured in minutes. Alpha angle represents the rate at which the clot is strengthening. MA measured in millimeters and represents the maximum clot strength. The percentage of clot LY30 after MA represents fibrinolytic activity.*

TEG For VTE?

Van, J Trauma 2009

The Future of VTE Prevention?

Thrombelastography Versus AntiFactor Xa Levels in the Assessment of Prophylactic-Dose Enoxaparin in Critically Ill Patients

Philbert Y. Van, MD, S. David Cho, MD, Samantha J. Underwood, MS, Melanie S. Morris, MD, Jennifer M. Watters, MD, and Martin A. Schreiber, MD

- Purpose "to analyze whether TEG could be used to predict which enoxaparin-treated patients would develop DVT."
- "TEG… may be used to guide dosing."

Van, J Trauma 2009

The Future of VTE Prevention?

Admission rapid thrombelastography predicts development of pulmonary embolism in trauma patients

Bryan A. Cotton, MD, MPH, Kristin M. Minei, BA, Zayde A. Radwan, BS, Nena Matijevic, PhD, PharmD, Evan Pivalizza, MD, Jeanette Podbielski, BSN, Charles E. Wade, PhD, Rosemary A. Kozar, MD, PhD, *and* **John B. Holcomb, MD,** *Houston, Texas*

- "Admission r-TEG mA values can identify patients with an increased risk of in- hospital PE."
- "Further studies… whether alternative anticoagulation strategies should be used for these high-risk patients."

Cotton, J Trauma 2012

The Future of VTE Prevention?

Platelets are dominant contributors to hypercoagulability after injury

Jeffrey N. Harr, MD, MPH, Ernest E. Moore, MD, Theresa L. Chin, MD, Arsen Ghasabyan, MPH, Eduardo Gonzalez, MD, Max V. Wohlauer, MD, Anirban Banerjee, PhD, Christopher C. Silliman, MD, PhD, *and* Angela Sauaia, MD, PhD, *Denver, Colorado*

- "These data suggest an important role for antiplatelet therapy in VTE prophylaxis following trauma, particularly after 48 hours."

Harr, J Trauma 2013

The Future of VTE Prevention?

Coagulation Profile Changes Due to Thromboprophylaxis and Platelets in Trauma Patients at High-Risk for Venous Thromboembolism

CASEY J. ALLEN, M.D., CLARK R. MURRAY, B.S., JONATHAN P. MEIZOSO, M.D., JULIET J. RAY, M.D., LAURA F. TEISCH, B.S., XIOMARA D. RUIZ, M.D., MENA M. HANNA, M.D., GERARDO A. GUARCH, M.D., RONALD J. MANNING, ARNP, ALAN S. LIVINGSTONE, M.D., ENRIQUE GINZBURG, M.D., CARL I. SCHULMAN, M.D., PH.D., NICHOLAS NAMIAS, M.D., KENNETH G. PROCTOR, PH.D.

- "Platelet function is a dominant contributor to…. hypercoagulability."
- "Antiplatelet therapy may be indicated"

Allen, Am Surgeon 2015