

Venous Thromboembolism Prevention in Trauma: Can We Do Better?

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Why focus on VTE?

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

<http://www.surgeongeneral.gov/topics/deepvein/calltoaction/call-to-action-on-dvt-2008.pdf>

The Surgeon General's Call to Action
to Prevent Deep Vein Thrombosis
and Pulmonary Embolism

2008



U.S. Department of Health and Human Services

Why focus on VTE?

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

<http://www.surgeongeneral.gov/topics/deepvein/calltoaction/call-to-action-on-dvt-2008.pdf>

The Surgeon General's Call to Action
to Prevent Deep Vein Thrombosis
and Pulmonary Embolism

2008



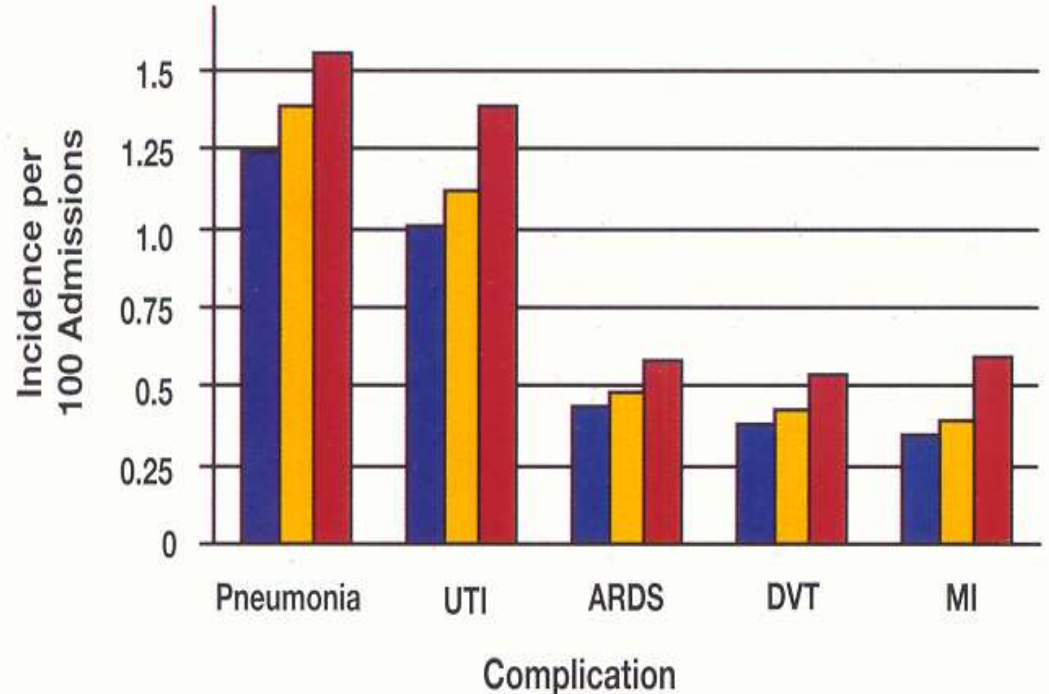
U.S. Department of Health and Human Services

DVT is 4th
most

commonly
reported
complication
in Trauma
Patients

The Journal of
TRAUMA[®]
Injury, Infection, and Critical Care

Large Trauma Registry Complication Rates
as Related to Denominator Selection



Kardooni, J Trauma 2008

DVT Incidence After Trauma

- DVT rates reported as high as 58% of moderately to severely injured patients (ISS \geq 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 (4 TKA, 4 THR)
 - 0.3%-2.5% Symptomatic VTE

Streiff & Haut, JAMA 2009

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)

Brief Summary of 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

<http://www.east.org/tpg/dvt.pdf>

DVT Prophylaxis is Vastly Underutilized!

A Prospective Registry of 5,451 Patients With Ultrasound-Confirmed Deep Vein Thrombosis

Samuel Z. Goldhaber, MD, and Victor F. Tapson, MD, for the DVT FREE Steering Committee*

We enrolled 5,451 patients with ultrasound-confirmed deep vein thrombosis (DVT), including 2,892 women and 2,559 men, from 183 United States sites in our prospective registry. The 5 most frequent comorbidities were hypertension (50%), surgery within 3 months (38%), immobility within 30 days (34%), cancer (32%), and obesity (27%). Of the 2,726 patients who had their DVT diagnosed while in the hospital, only 1,147 (42%) received prophylaxis within 30 days before diagnosis. ©2004 by Excerpta Medica, Inc.

(Am J Cardiol 2004;93:259-262)

Venous thromboembolism risk and prophylaxis in the acute hospital care setting (ENDORSE study): a multinational cross-sectional study

*Alexander T Cohen, Victor F Tapson, Jean-Francois Bergmann, Samuel Z Goldhaber, Ajay K Kakkar, Bruno Deslandes, Wei Huang, Maksim Zayaruzny, Leigh Emery, Frederick A Anderson Jr, for the ENDORSE Investigators**

- 68,183 patients
- 358 hospitals in 32 countries
- Prophylaxis
 - 58.5 % compliance - surgical patients
 - 39.5 % compliance - medical patients

Cohen, Lancet 2008

**“The disconnect
between evidence
and execution
as it relates to DVT
prevention amounts
to a public
health crisis.”**

*Samuel Z. Goldhaber, M.D.,
Associate Professor
of Medicine,
Harvard Medical School*



**DEEP-VEIN THROMBOSIS:
ADVANCING AWARENESS
TO PROTECT PATIENT LIVES**

White Paper

Public Health Leadership Conference on Deep-Vein Thrombosis
Washington, D.C. • February 26, 2003

American Public Health Association

**DVT: Advancing
Awareness to Protect
Patient Lives**

**American Public
Health Association
(APHA)
White Paper 2003**

Agency for Healthcare Research and Quality (AHRQ)

Deep vein thrombosis (DVT)-related pulmonary embolism (PE) is the most common cause of preventable hospital death¹

DVT prophylaxis of at-risk patients is the #1 strategy to improve patient safety in hospitals¹

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



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

Evidence-Based
Practice

Patient Safety

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

<http://www.ahrq.gov/research/findings/evidence-based-reports/services/quality/ptsafetysum.pdf>

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



Agency for Healthcare Research and Quality
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Evidence-Based
Practice

Patient Safety

Chapter 28. Prevention of Venous Thromboembolism: Brief Update Review

Elliott R. Haut, M.D., FACS; Brandyn D. Lau, M.P.H.

- “Strategies to increase appropriate prophylaxis for VTE” included on list of top 10 “Strongly Encouraged Patient Safety Practices”

<http://www.ahrq.gov/research/findings/evidence-based-reports/patientsftyupdate/ptsafetyIIchap28.pdf>

Surveillance Bias and Public Reporting of VTE



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How did I get interested in VTE?

- Adult Trauma Performance Improvement
- Paraphrased letter we received
- Dear Johns Hopkins Adult Trauma
- You have the highest DVT rate of all Trauma Centers in Maryland
- Why?
- Sincerely, Maryland Institute for Emergency Medical Services Systems (MIEMSS)

A New Research Idea is Born

- Johns Hopkins screens aggressively
- What do other trauma centers do?
- Does this impact reported DVT rates?

Conflict Regarding Duplex Screening for **asymptomatic** DVT

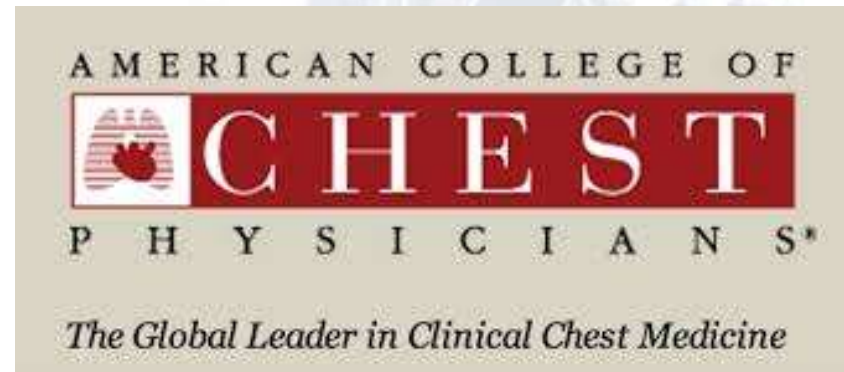
- Conflicting data on efficacy and cost-effectiveness of duplex screening of **asymptomatic** trauma patients
- *Pro:* Identify DVT early allowing treatment before fatal PE
- *Con:* Large expense, not cost effective, harm from anticoagulation

Should we Screen High-Risk Trauma Patients for DVT?

Conflicting Guidelines



vs.



Rogers, J Trauma 2002
Gould, CHEST 2012

Eastern Association for the Surgery of Trauma (EAST) Guideline

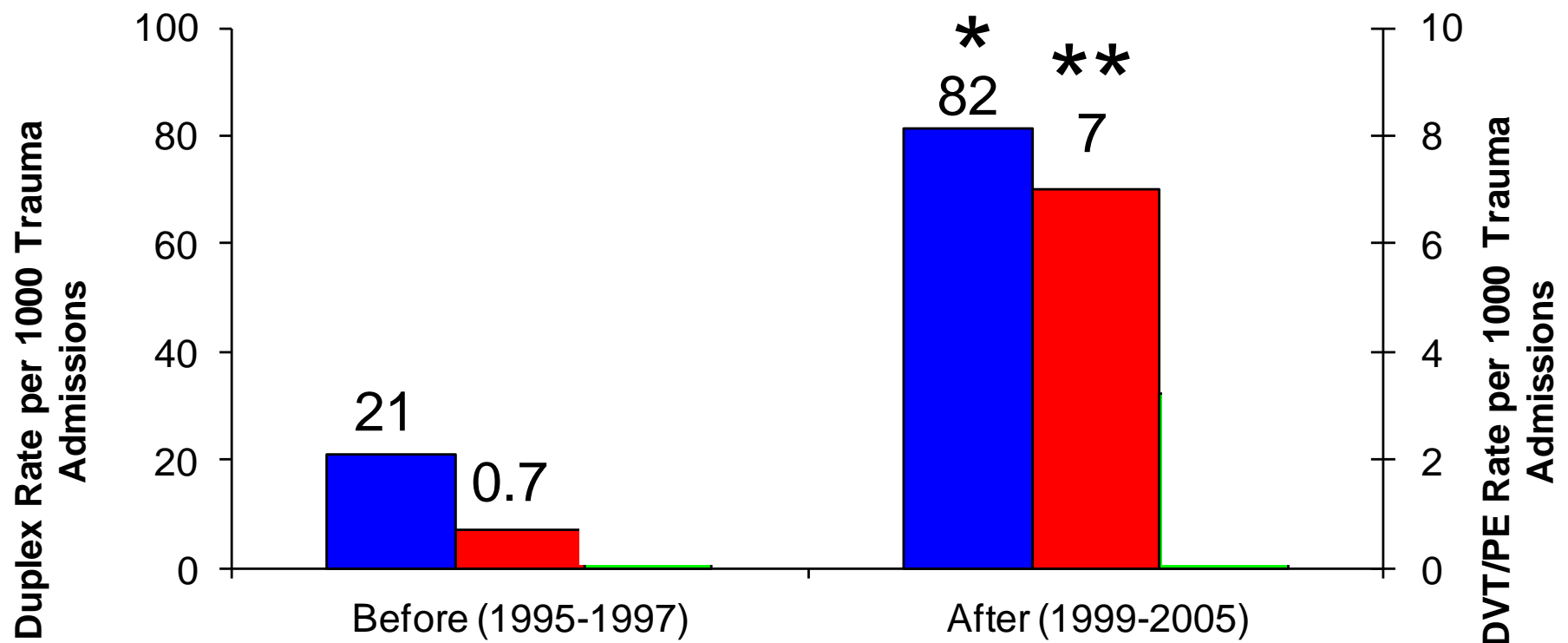
- “Serial duplex ultrasound imaging of high-risk asymptomatic trauma patients to screen for DVT **may be cost-effective and decrease the incidence of PE.**”

<http://www.EAST.org/resources/treatment-guidelines>
Rogers, J Trauma 2002

American College of Chest Physicians (ACCP) Guidelines

- “For major trauma patients, we suggest that periodic surveillance with venous compression ultrasonography **should not be performed** (Grade 2C).”

Single Center (JHH)- Duplex & DVT rates Before v. After Screening Guideline



Before Vs. After Periods

Haut, J Trauma 2007

■ Duplex ■ DVT

$p < 0.0001$
 $p = 0.0024$

Multi-Center (NTDB)- Hospital Level Duplex & DVT rates

- Trauma centers with higher rates of duplex ultrasound report higher DVT rates to the National Trauma Data Bank

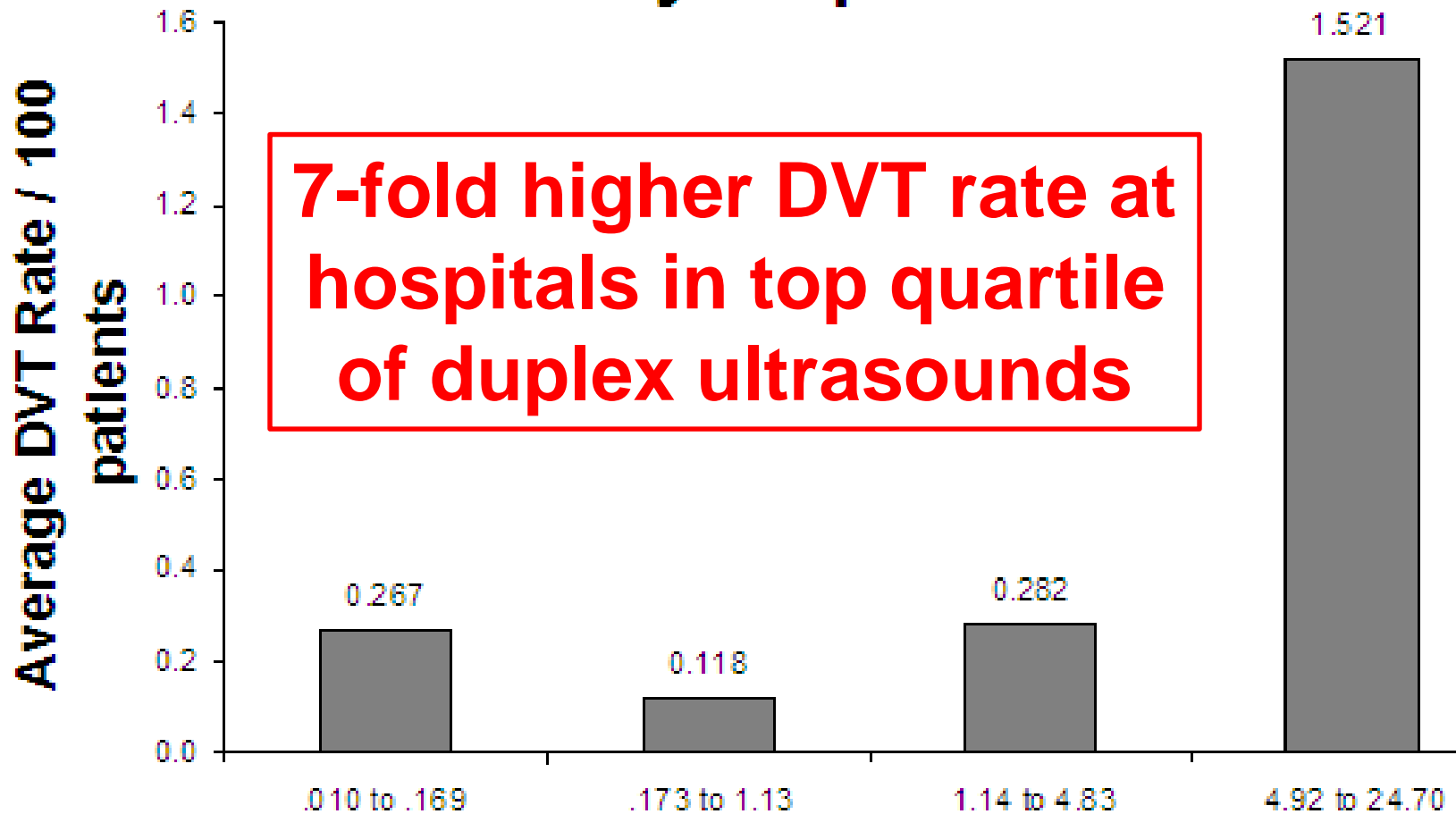
The Journal of **TRAUMA**[®] *Injury, Infection, and Critical Care*

Surveillance Bias and Deep Vein Thrombosis in the National Trauma Data Bank: The More We Look, The More We Find

Charles A. Pierce, MPH, Elliott R. Haut, MD, Shahrzad Kardooni, MPH, David C. Chang, MBA, MPH, PhD, David T. Efron, MD, Adil Haider, MD, MPH, Peter J. Pronovost, MD, PhD, and Edward E. Cornwell III, MD

Pierce, J Trauma 2008

The More We Look, The More We Find



Pierce, J Trauma 2008

Duplex Rate / 100 patients by Quartile

Hospital Screening Status is an Independent Risk Factor for DVT Reporting

Haut,
J Trauma 2009

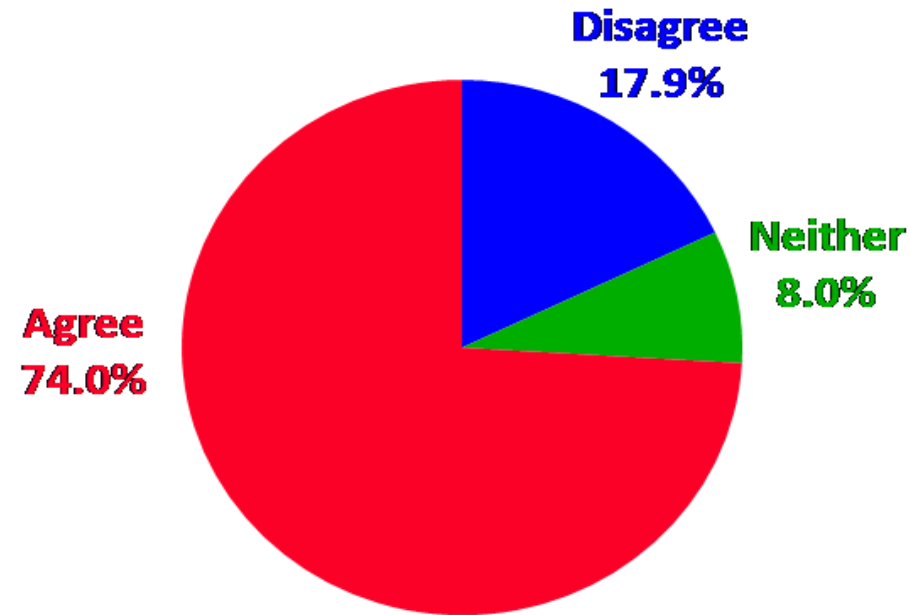
The Journal of
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Injury, Infection, and Critical Care

Independent Risk Factors for Diagnosis of Deep Vein Thrombosis in Trauma Patients

	Odds Ratio	95% Confidence Interval
Treatment at "Screening" vs. "Non-Screening" Trauma Center	2.16	1.07-4.34
Age ≥ 40 years	2.00	1.74-2.30
Extremity Injury (AIS ≥ 3)	1.96	1.68-2.30
Head Injury (AIS ≥ 3)	1.53	1.22-1.92
Ventilator Days ≥ 3	5.14	3.66-7.22
Venous Injury	2.85	1.97-4.13
Major Surgery	4.79	4.08-5.62

Variability in Trauma Surgeons Opinions of DVT Screening

- AAST/EAST member survey
- 317 individual trauma surgeons



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, JAMA 2011

Implications

Surveillance Bias in Outcomes Reporting

Elliott R. Haut, MD

Peter J. Pronovost, MD, PhD

DVT, some clinicians use duplex ultrasound to screen high-risk asymptomatic trauma patients for DVT. Other clinicians argue this approach is neither clinically necessary nor

Variability
in DVT
Screening



Variability
in DVT
Rates
Reported



Biased
DVT
Rates

Haut & Pronovost, JAMA 2011



“We’ll just use the test results anyway because it’s the only data we have”

<http://dilbert.com/strips/comic/2010-11-07>

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, JAMA 2011

We Talked

- Centers for Medicare & Medicaid Services listened



Medicare

Medicaid/CHIP

Medicare-Medicaid
Coordination

Private
Insurance

Innovation
Center

Regulations
and Guidance

Research, Statistics,
Data and Systems

Outreach and
Education

[Home](#) > [Regulations and Guidance](#) > [EHR Incentive Programs](#) > [Meaningful Use](#)

EHR Incentive Programs

[Getting Started](#)

[Registration & Attestation](#)

[Medicare and Medicaid EHR
Incentive Program Basics](#)

[Meaningful Use](#)

[Stage 2](#)

[Clinical Quality Measures \(CQMs\)](#)

[Certified EHR Technology](#)

[Eligible Hospital Information](#)

[Medicaid State Information](#)

[Data and Program Reports](#)

Meaningful Use

The Medicare and Medicaid EHR Incentive Programs provide financial incentives for the “meaningful use” of certified EHR technology to improve patient care. To receive an EHR incentive payment, providers have to show that they are “meaningfully using” their EHRs by meeting thresholds for a number of objectives. CMS has established the objectives for “meaningful use” that eligible professionals, eligible hospitals, and critical access hospitals (CAHs) must meet in order to receive an incentive payment.

The Medicare and Medicaid EHR Incentive Programs are staged in three steps with increasing requirements for participation. All providers begin participating by meeting the Stage 1 requirements for a 90-day period in their first year of meaningful use and a full year in their second year of meaningful use. After meeting the Stage 1 requirements, providers will then have to meet Stage 2 requirements for two full years. Eligible professionals participate in the program on the calendar years, while eligible hospitals and CAHs participate according to the federal fiscal year.

EHR Incentives:
Learn about Stage 2

Click Here >



- Financial incentives for the “meaningful use” of certified EHR technology to improve patient care

“Meaningful Use” Quality Reporting Criteria Related to VTE

- “Meaningful Use” of Electronic Health Record (EHR) Technology
 - VTE1 Prophylaxis within 24 hours of arrival
 - VTE2 ICU VTE Prophylaxis
 - VTE3 Anticoagulation Overlap Therapy
 - VTE4 Platelet Monitoring on UFH
 - VTE5 VTE Discharge Instructions
 - VTE6 Incidence of Potentially Preventable VTE

“Meaningful Use” Definition of Potentially Preventable VTE

- VTE-6 Incidence of Potentially Preventable VTE
- “This measure assesses the number of patients diagnosed with confirmed VTE during hospitalization (not present or suspected at admission) who did not receive VTE prophylaxis between hospital admission and the day before the VTE diagnostic testing order date.”

Surveillance Bias in VTE Reporting in Surgery



Original Investigation

Evaluation of Surveillance Bias and the Validity of the Venous Thromboembolism Quality Measure

Karl Y. Bilimoria, MD, MS; Jeanette Chung, PhD; Mila H. Ju, MD; Elliott R. Haut, MD; David J. Bentrem, MD, MS; Clifford Y. Ko, MD, MS; David W. Baker, MD, MPH

JAMA. doi:10.1001/jama.2013.280048
Published online October 7, 2013.

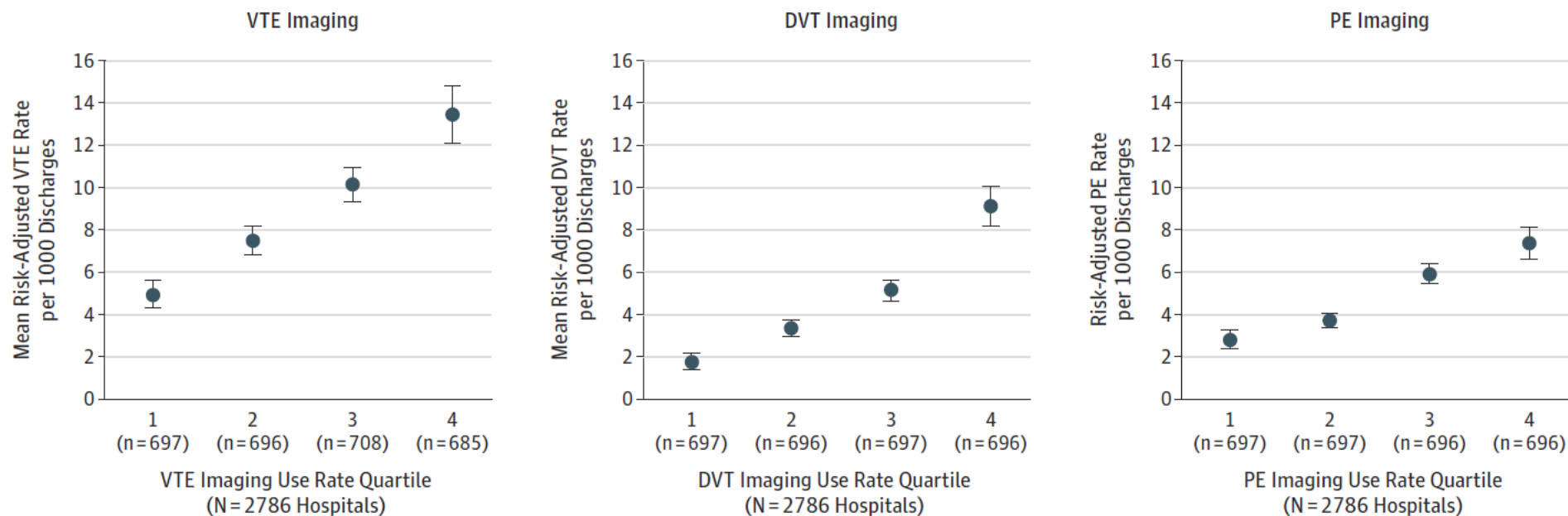
Bilimoria, JAMA 2013

Surveillance Bias in VTE Reporting in Surgery

- 2,786 hospitals
- 954,526 Medicare patients ≥ 65 years
- 11 major operations
 - AAA, CABG, craniotomy, colectomy, cystectomy, esophagectomy, gastric bypass, lung resection, pancreatic resection, proctectomy, total knee arthroplasty

Surveillance Bias in VTE Reporting in Surgery

Figure 3. Mean Risk-Adjusted Event Rates by Imaging Use Rate Quartile



Bilimoria, JAMA 2013

Can a Systems Approach Improve VTE Prevention and Outcomes



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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.”

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



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MEDICINE

Improving VTE Prophylaxis at The Johns Hopkins Hospital

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

BMJ 2012;344:e3935

BMJ

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 Holzmüller *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		Patient Identification	
PILOT WORKSHEET			
Allergies: _____		Weight: _____ Kg	Serum Creatinine ⁴ : _____
INDICATE RISK FACTORS (Check all that apply)			
Serious Risk Factors <input type="checkbox"/> Current, active cancer ¹ <input type="checkbox"/> Previous DVT and/or PE ² <input type="checkbox"/> Stroke within the past 3 months (non-hemorrhagic) <input type="checkbox"/> Trauma (major or lower extremity) <input type="checkbox"/> Heart or respiratory failure undergoing acute treatment <input type="checkbox"/> Pregnancy and post-partum (< 1 month) <input type="checkbox"/> Inherited or acquired thrombophilia		Other Risk Factors <input type="checkbox"/> Immobility (bedrest/sitting ≥ 3 days) or paralysis <input type="checkbox"/> Central venous catheterizations <input type="checkbox"/> Acute medical illness or sepsis <input type="checkbox"/> Myeloproliferative disorder <input type="checkbox"/> Inflammatory bowel disease <input type="checkbox"/> Nephrotic syndrome <input type="checkbox"/> Obesity (BMI > 30 kg/M ²) <input type="checkbox"/> Smoking (active, not history) <input type="checkbox"/> Estrogen use (OC or HRT) <input type="checkbox"/> Selective estrogen receptor modulators (SERMs) <input type="checkbox"/> Varicose veins	
RISK CATEGORIES			
Low Risk <input type="checkbox"/> Minor surgery (< 30 min), Age < 40 years, with NO additional risk factors OR <input type="checkbox"/> Vascular surgery with NO additional risk factors OR <input type="checkbox"/> Laparoscopic procedures with NO additional risk factors OR <input type="checkbox"/> Low risk urologic procedures (TURP, etc.)	Moderate Risk¹ <input type="checkbox"/> Minor surgery (< 30 min), age < 40 years, WITH any additional risk factors (one or more) OR <input type="checkbox"/> Minor surgery (< 30 min), age 40-60 years, with NO additional risk factors OR <input type="checkbox"/> Major surgery (> 30 min), age < 40 years with NO additional risk factors OR <input type="checkbox"/> Laparoscopic surgery WITH any additional risk factors (one or more)	High Risk¹ <input type="checkbox"/> Any surgery age > 60 years WITHOUT any additional risk factors OR <input type="checkbox"/> Minor surgery (< 30 min), age 40-60 years WITH any additional risk factors (one or more) OR <input type="checkbox"/> 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 <input type="checkbox"/> Major vascular surgery (> 30 min) WITH any additional risk factors (one or more)	Very High Risk^{1,2} <input type="checkbox"/> Major surgery (> 30 min) at any age WITH any SERIOUS RISK FACTORS OR <input type="checkbox"/> Major surgery (> 30 min), age > 60 years WITH any additional risk factors (one or more)
ORDER			
Low Risk <input type="checkbox"/> No pharmacologic prophylaxis is indicated. Early and persistent mobilization recommended. Please specify ambulation plan	Moderate Risk <input type="checkbox"/> Heparin 5,000 Units SC Q12 hours ¹ <i>With the option to add</i> <input type="checkbox"/> TED ³ <input type="checkbox"/> SCD ³	High Risk <input type="checkbox"/> Heparin 5,000 Units SC Q8 hours ¹ <i>With the option to add</i> <input type="checkbox"/> TED ³ <input type="checkbox"/> SCD ³	Very High Risk <input type="checkbox"/> Heparin 5,000 Units SC Q8 hours ¹ OR <input type="checkbox"/> Enoxaparin 40 mg SC QDay ^{3,4,5} (Trade-off: fewer PE with more bleeds) AND <input type="checkbox"/> TED ³ and <input type="checkbox"/> SCD ³
CONTRAINDICATIONS¹			
<input type="checkbox"/> Active, uncontrolled bleeding or high risk of bleeding <input type="checkbox"/> Systemic anticoagulation <input type="checkbox"/> Active aneurysm (cerebral or aortic dissecting) <input type="checkbox"/> Bacterial endocarditis or pericarditis <input type="checkbox"/> Active peptic ulcer disease, ulcerative GI lesions <input type="checkbox"/> Malignant hypertension <input type="checkbox"/> Severe head trauma <input type="checkbox"/> DNR or aPTT ratio > 1.5 (unless antiphospholipid antibodies)		<input type="checkbox"/> Threatened abortion <input type="checkbox"/> Severe thrombocytopenia (platelet count < 30,000) <input type="checkbox"/> Recent TURP <input type="checkbox"/> Eye, brain, or spinal cord injury within the past 48 hrs. <input type="checkbox"/> For Heparin or Enoxaparin: history of HIT <input type="checkbox"/> For Enoxaparin: Epidural catheter removal or spinal tap < 2 hours prior to dose; weight < 45kg; hemodialysis ⁶ <input type="checkbox"/> For SCD: open wounds or extremity with known DVT	
		ORDERS¹ If contraindication present: (Check one or more) <input type="checkbox"/> Discontinue orders above <input type="checkbox"/> Early and persistent mobilization Please specify ambulation plan <input type="checkbox"/> TED/SCD ³	

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 QDay.

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

Does Improving Prophylaxis Change Outcomes?

- We thought we were increasing quality and improving patient care
- But could we show hard data?
- **YES**
- Johns Hopkins Trauma Surgery Example

Does Improving Prophylaxis Change Outcomes? The JHH Trauma Example

BUILDING A SURGICAL EXPERTISE IN INFORMATICS

Improved Prophylaxis and Decreased Rates of Preventable Harm With the Use of a Mandatory Computerized Clinical Decision Support Tool for Prophylaxis for Venous Thromboembolism

Elliott R. Haut, MD; Brandyn D. Lau, MPH; Franca S. Kraenzlin, MHS; Deborah B. Hobson, BSN; Peggy S. Kraus, PharmD, CACP; Howard T. Carolan, MPH, MBA; Adil H. Haider, MD, MPH; Christine G. Holzmueller, BLA; David T. Efron, MD; Peter J. Pronovost, MD, PhD; Michael B. Streiff, MD

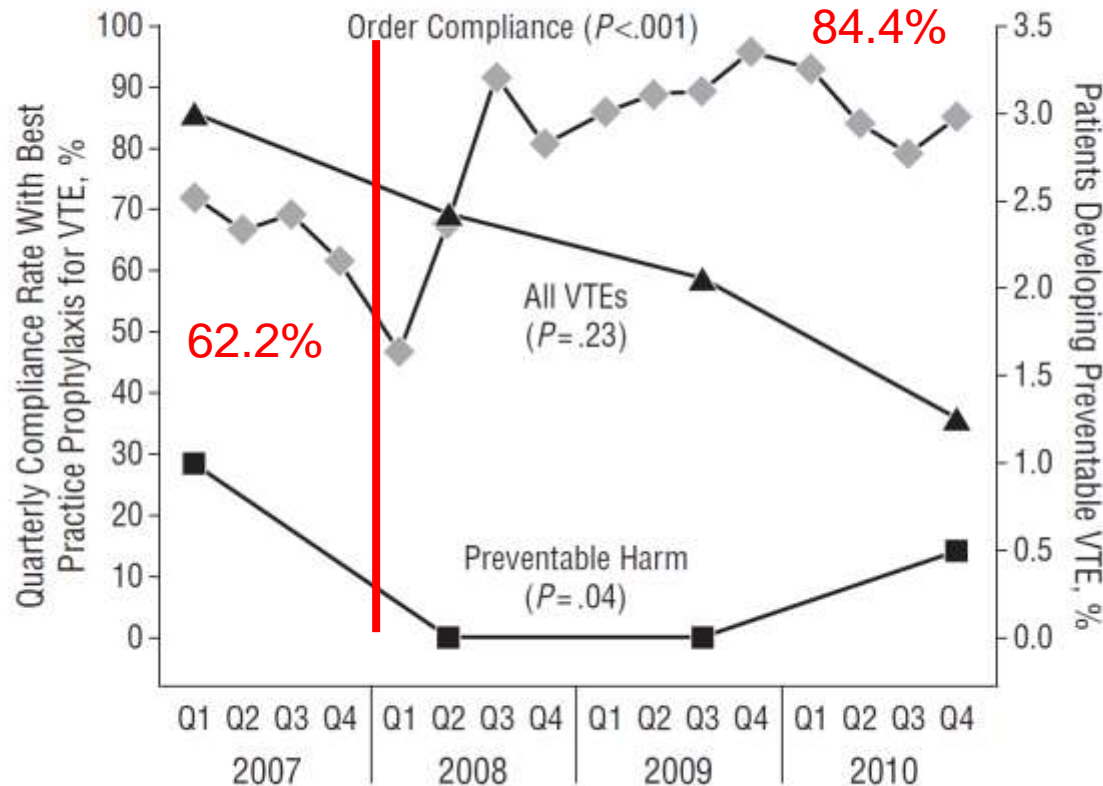
Arch Surg. 2012;147(10):901-907

Haut, Arch Surg 2012

Does Improving Prophylaxis Change Outcomes?

- Single Trauma Center
- Pre/Post Intervention Study
- 1-year PRE vs. 3-years POST
- Retrospective data collection
- IRB approved

Does Improving Prophylaxis Change Outcomes?

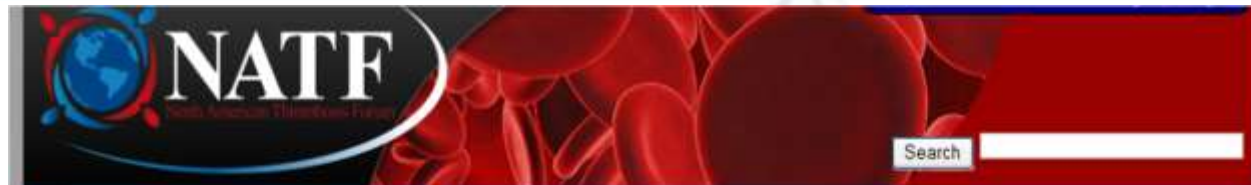


Significant increase in VTE prophylaxis

Significant drop in preventable harm from VTE

- 1.0% vs. 0.17% (p=0.04)

VTE Prophylaxis- Computerized Decision Support



DVTeamCare™ Hospital Award

Tell Us How You Fight
DVT

**DVTEAM™ CARE
HOSPITAL AWARD
WINNER**

**The Johns Hopkins
Hospital**

DVTeamCare™ Hospital Award

Award Nomination Deadline October 15, 2010

www.natfonline.org

Latest News and Updates

**Consensus Statement:
Call To Action On**

The North American Thrombosis Forum is proud to have been selected by Eisai, Inc. to help develop the DVTeamCare(TM) Hospital Award. The DVTeamCare™ Hospital Award is a new award providing national recognition to hospitals that have made significant commitment to preventing DVT and its potentially fatal complications. NATF has been engaged to identify judges for the award, who also developed appropriate criteria.* The applications from the 22 hospitals nominated for the 2009 DVTeamCare™ Hospital Award are currently being reviewed by a three-judge panel was selected by NATF. Winners will be announced shortly

Preventing Hospital-Acquired Venous Thromboembolism

A Guide for Effective Quality Improvement



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

Three Examples of Effective Implementation and Clinical Decision Support

The following are examples of effective order set design and implementation. They illustrate the central importance of implementation and clinical decision support techniques across disparate hospital settings and VTE risk assessment models.

The **Johns Hopkins** collaborative team used the “translating research into practice” (TRIP) model to implement mandatory VTE risk assessment and risk-appropriate prophylaxis.⁵ The TRIP model is consistent with the principles presented throughout this guide. Important steps included summarizing the evidence from a centralized steering group; identifying barriers through pilot testing, good measurement, and feedback; and reinforcing appropriate prophylaxis through staff engagement, education, regular evaluation, good clinical decision support in order sets, and layered interventions to reinforce the protocol.⁶

Improving VTE Prophylaxis Administration with Targeted Performance Feedback



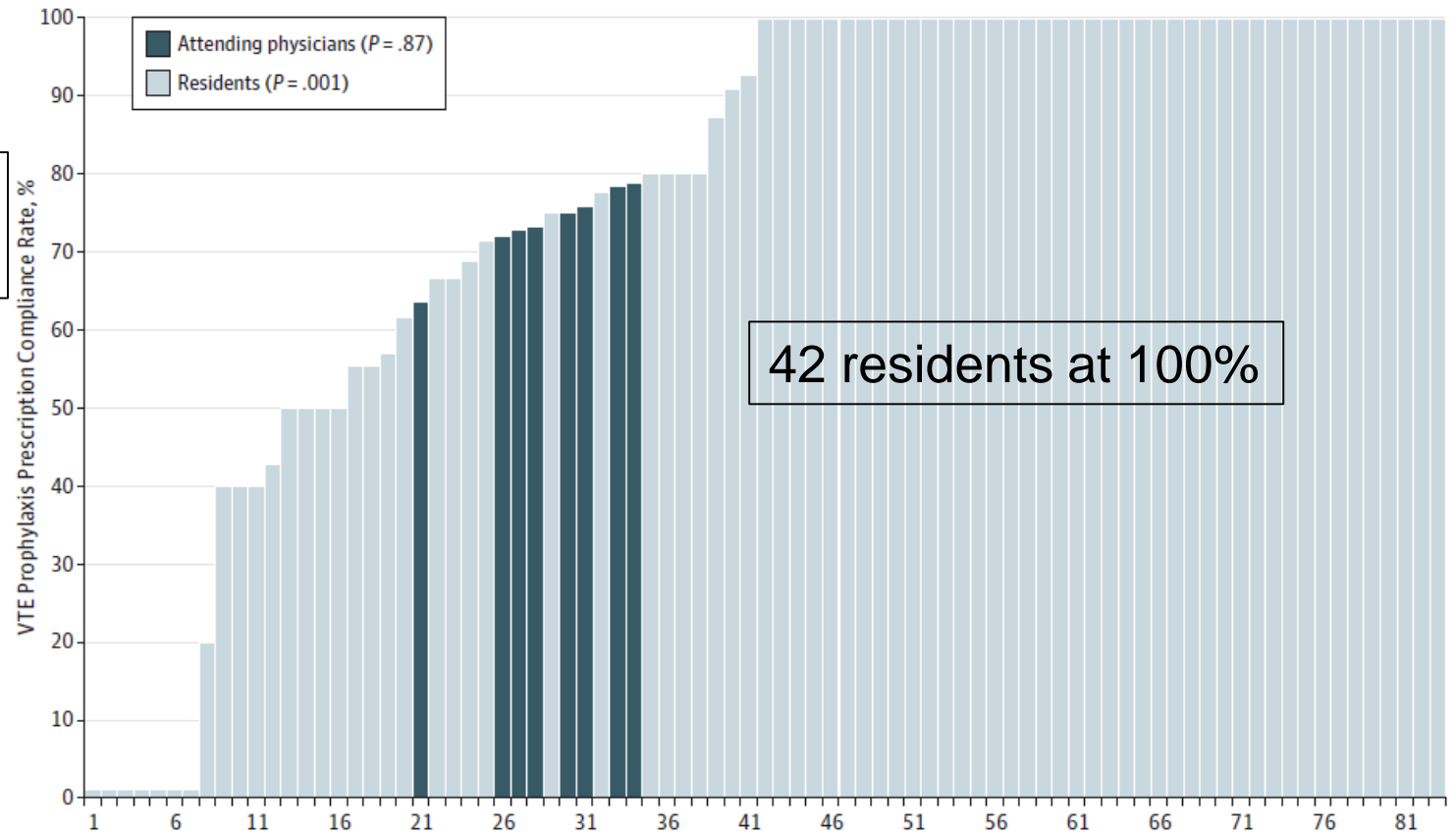
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M E D I C I N E

The Role of Health Informatics

- Harness the power of analytics
- Bringing performance data to individual providers and units
- Can competition drive improvements?

Trauma Attending & Resident Prophylaxis

Figure. Risk-Appropriate Venous Thromboembolism (VTE) Prophylaxis Prescription Compliance Rates



Lau, JAMA-Surg 2015

87.7%
Sept

93.3%
October

96.3%
November

Surgery Resident Feedback Improves VTE Prophylaxis



Lau, Ann Surg 2015

Missed Doses of VTE Prophylaxis



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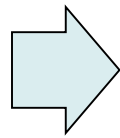
@elliottthaut

A Big Assumption

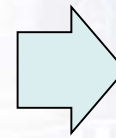
- As physicians, we assume that medication orders we place are consistently delivered
- But is that truly the case?
- Does prescription = administration?

Steps to Optimal Pharmacologic VTE Prophylaxis

Provider
Prescription



Nurse
Administration



Patient
Acceptance

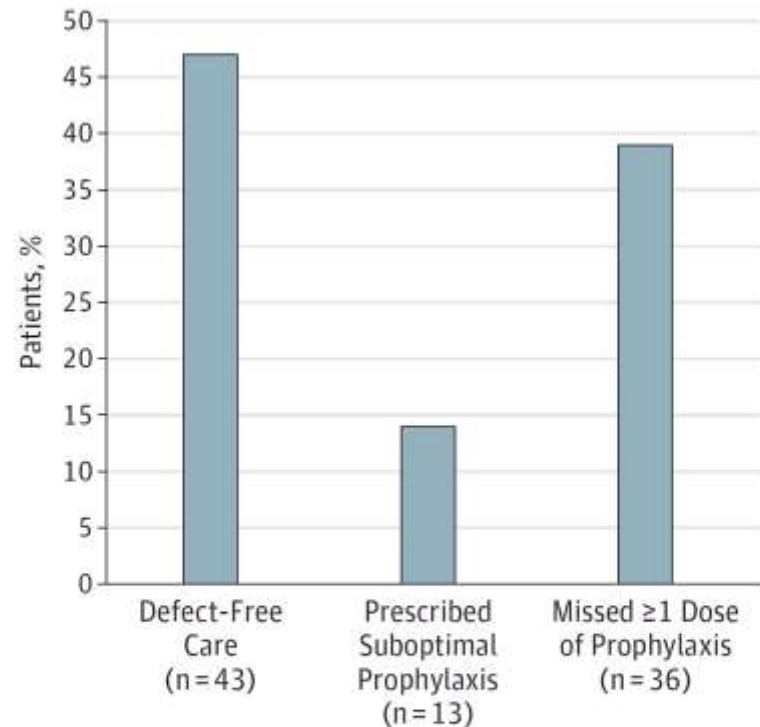
Do Missed VTE Prophylaxis Doses Matter?

- **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% ($p < 0.01$)

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%]).

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

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



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

Kenneth M. Shermock, Brandyn D. Lau, Elliott R. Haut, Deborah B. Hobson, Valerie S. Ganetsky, Peggy S. Kraus, Leigh E. Efrid, Christoph U. Lehmann, Brian L. Pinto, Patricia A. Ross, Michael B. Streiff

Shermock, PlosOne 2013

What's the Real Story Behind Missed Doses?

- “Hidden Barriers to Delivery of Pharmacologic Venous Thromboembolism Prophylaxis”
 - SURVEY “I have the clinical knowledge and experience to determine if it is necessary to administer DVT/PE prophylaxis injections to patients.”
 - AGREE 87%/79% medicine/surgery
 - FOCUS GROUP INTERVIEWS “We make the clinical decision all the time as to whether a patient needs VTE prophylaxis every day, based on how much the patient is ambulating.”

Our PCORI Project



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

Johns Hopkins University

State

Maryland

Year Awarded

2013

Funding Announcement

Assessment of Prevention, Diagnosis, and Treatment Options

Project Budget

\$1,499,194

Project Period

3 years

<http://www.pcori.org/research-in-action/improving-patient-nurse-communication-prevent-life-threatening-complication>

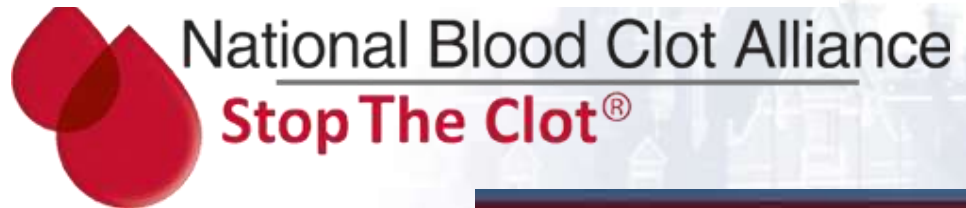


Our PCORI Objectives

- 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**

<http://www.pcori.org/research-in-action/improving-patient-nurse-communication-prevent-life-threatening-complication>

Our PCORI Collaborators / Key Stakeholders



Patient and Family Advisory Council

<http://www.pcori.org/research-in-action/improving-patient-nurse-communication-prevent-life-threatening-complication>

PCORI Website “Research in Action”



Patient-Centered Outcomes Research Institute

[BLOG](#)[CAREERS](#)[NEWSROOM](#)[SUBSCRIBE](#)[CONTACT](#)[ABOUT US](#)[FUNDING OPPORTUNITIES](#)[RESEARCH & RESULTS](#)[GET INVOLVED](#)[MEETINGS & EVENTS](#)

Research & Results

[OUR PROGRAMS](#)[RESEARCH WE SUPPORT](#)[HOW WE SELECT RESEARCH TOPICS](#)[RESEARCH METHODOLOGY](#)[PCORNET: THE NATIONAL PATIENT-CENTERED CLINICAL RESEARCH NETWORK](#)[RESEARCH IN ACTION](#)[COLLABORATING WITH OTHER RESEARCH FUNDERS](#)

Improving Patient-Nurse Communication to Prevent a Life-Threatening Complication



Hospitalized patients are at increased risk for potentially fatal blood clots in their legs and lungs; a Baltimore team is exploring how to ensure wider use of preventive measures.

Baltimore, MD—Susan Kulik, DNP, MBA, RN was at her job as a surgical nurse at Johns Hopkins University Hospital in Baltimore when she slipped on a patch of wet floor and fractured her hip. The hospital admitted her right away for surgery to insert pins to stabilize her fractured bones.

The morning after the surgery, Kulik woke around 7 a.m., unable to breathe. “I got very dizzy and scared,” Kulik says. “I thought I was going to die. It was an awful feeling.”

A blood clot had formed in a vein deep in Kulik’s leg, then broken off and traveled to her lung, where it blocked blood flow. This condition, venous thromboembolism (VTE), includes the formation of blood clots in deep veins and pulmonary embolism, in which a clot ends up in the lungs.

“I got very dizzy and scared ... I thought I was going to die. It was an awful feeling.”
Susan Kulik

AT A GLANCE

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

Principal investigator:
Elliott R. Haut, MD, PhD
Johns Hopkins University

Goal: To increase patient understanding and improve

What VTE Education Do Patients Really Want? Results from a Delphi Survey



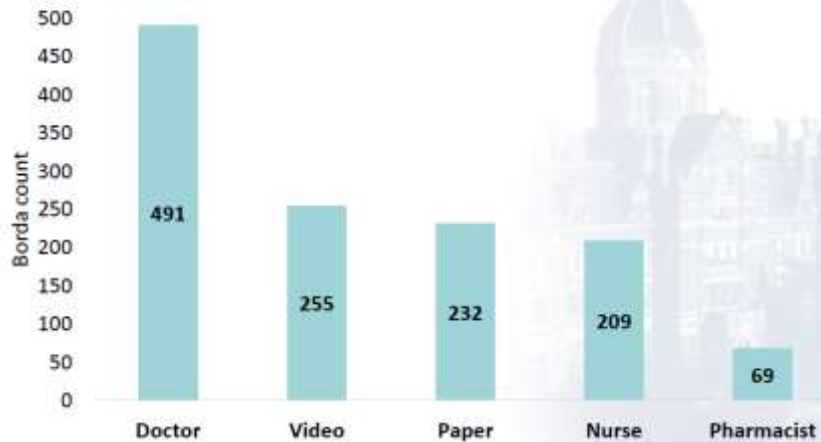
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Modified Delphi Method

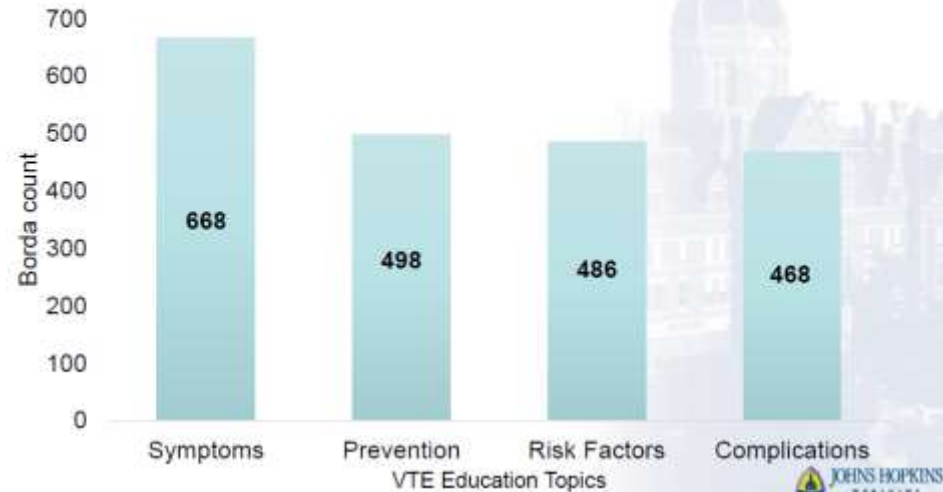
- Iterative process involving surveys, feedback and revisions
- Engaged patients and family members
- Recruited via email and/or social media (websites, Facebook, Twitter) through respective organizations
- > 400 respondents

What Do Patients Want?

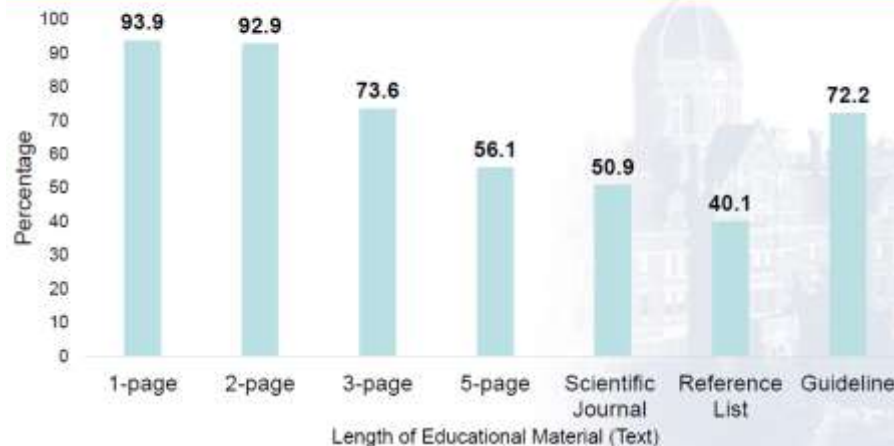
How Do Patients Want To Learn About VTE?



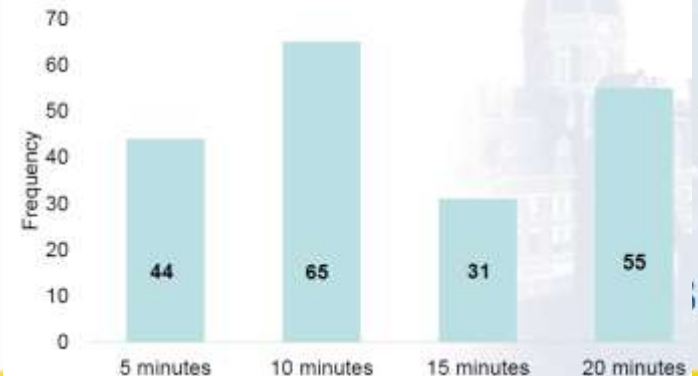
What Do Patients Want to Learn about VTE



How Much Are Participants Willing to Read?



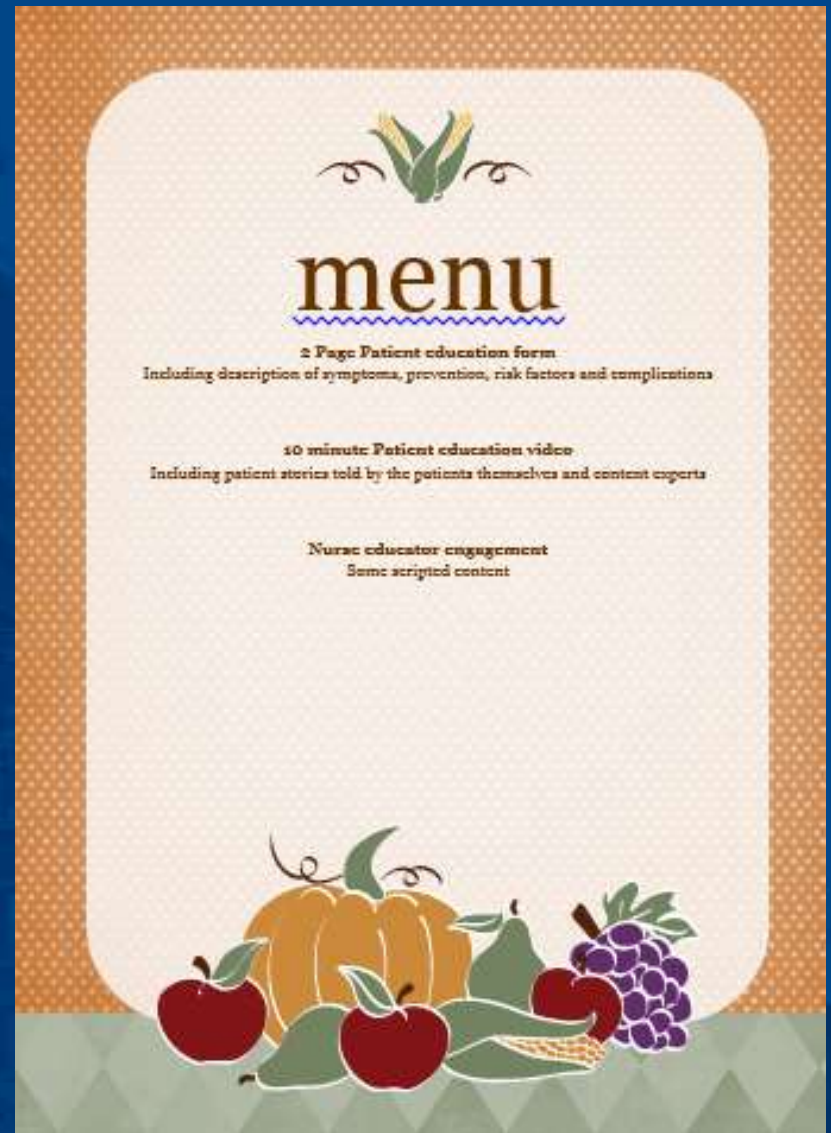
Preferred Length Of Video?



What Do Patients Want?



Patient VTE Education Menu



What Do Patients Want?

Paper Form (2-pages)



The Johns Hopkins Hospital Patient Information

**How Do I Prevent Blood Clots?
Venous Thromboembolism (VTE)
Deep Vein Thrombosis (DVT)
Pulmonary Embolus (PE)**

Original: Date
05/31/2014
Department: VTE
Collaborative/Surgery

**What is a blood
clot or Venous
Thrombo-
embolism (VTE)?**

Blood clots are called Venous Thromboembolism (VTE). There are 2 main types:

- Deep Vein Thrombosis (DVT) is a clot in a deep vein, usually an arm or leg
- Pulmonary Embolism (PE) is a clot that has broken off and traveled to the lungs. This can cause death.

- www.hopkinsmedicine.org/armstrong/bloodclots

**They spoke,
we listened**

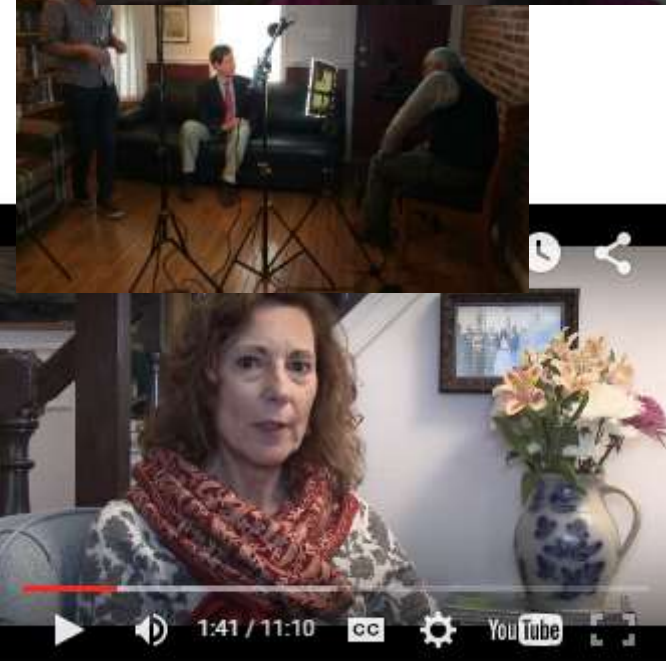
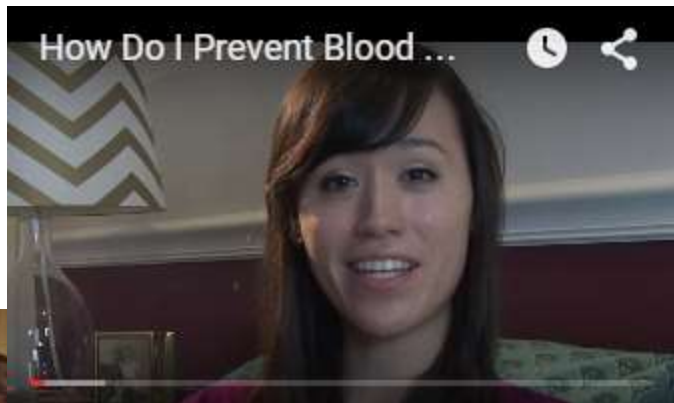
What Do Patients Want? Video

- Patients wanted
 - 10 minute video
 - Physicians, nurses and patients talking
- Screened for JHH PFAC
 - Changes based on group feedback

**They spoke,
we listened**

<http://bit.ly/bloodclots>

<http://bit.ly/bloodclots> Video



What Do Patients Want?

Patient Education 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)



STYLE & FASHION
Your Top 7 Men's
Style Questions for
Fall, Answered



EATING & DRINKING
Europe (Finally)
Wakes Up to Superior
Coffee



ADVENTURE & TRAVEL
A Weekend Away in
Southern England's
Wine Country



RUMBLE SEAT
[Subaru Forester:](#)
[Function Over Form](#)

[LIFE](#) | [HEALTH](#) | [THE INFORMED PATIENT](#)

Blood Clot Prevention Is Higher Priority at Hospitals

Many patients don't receive anticoagulating drugs; nurses don't always give them

"Everyone assumed that once we got doctors to order the right medications, the rest would magically fall into place," says Dr. Haut. "It turns out that was very naive thinking. The nurse administration and patient acceptance phases are just as critical."

Dr. Haut is now leading a new project funded by the nonprofit Patient-Centered Outcomes Research Institute that includes training sessions for nurses about improving communication with patients and a special admission package for patients about taking an active role in clot prevention. Hopkins turned to some patients who have suffered blood clots to review the materials, talk to nurses, and tell their own stories in [a video to convey the dangers of clots](#).

<http://on.wsj.com/1M18Aqu>

Hospitals are intensifying inpatient care to prevent potentially fatal blood clots. WSJ's Laura Landro and Johns Hopkins' Dr. Elliott Haut join Tanya Rivero on Lunch Break. Photo: Getty



By [LAURA LANDRO](#)

Aug. 3, 2015 2:20 p.m. ET

13 COMMENTS

Acknowledgements



@elliotthaut ehaut1@jhmi.edu

- Hopkins VTE Website (with paper forms)
 - <http://www.Hopkinsmedicine.org/Armstrong/bloodclots>
- Patient Education Video
 - <http://bit.ly/bloodclots>
- Wall Street Journal article
 - <http://on.wsj.com/1M18Aqu>
- PCORI Research in Action
 - <http://www.pcori.org/research-in-action/improving-patient-nurse-communication-prevent-life-threatening-complication>

EXTRA SLIDES
Will NOT be Discussed



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Focus on VTE Prevention in Trauma



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Inferior Vena Cava (IVC) Filters for VTE Prophylaxis in Trauma



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Should we Place Prophylactic Inferior Vena Cava (IVC) Filters?

Conflicting Guidelines

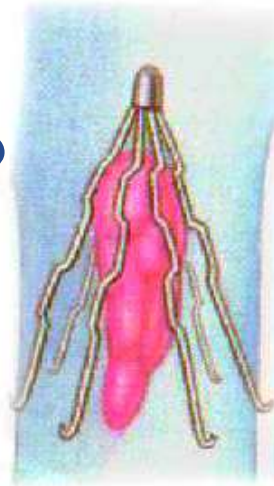


vs.



Rogers, J Trauma 2002
Gould, CHEST 2012

Should we Place Prophylactic Inferior Vena Cava (IVC) Filters?

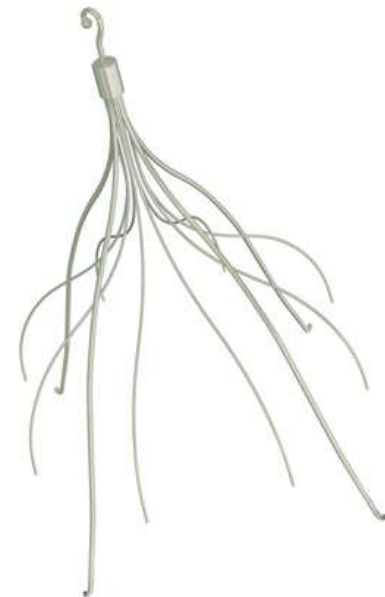
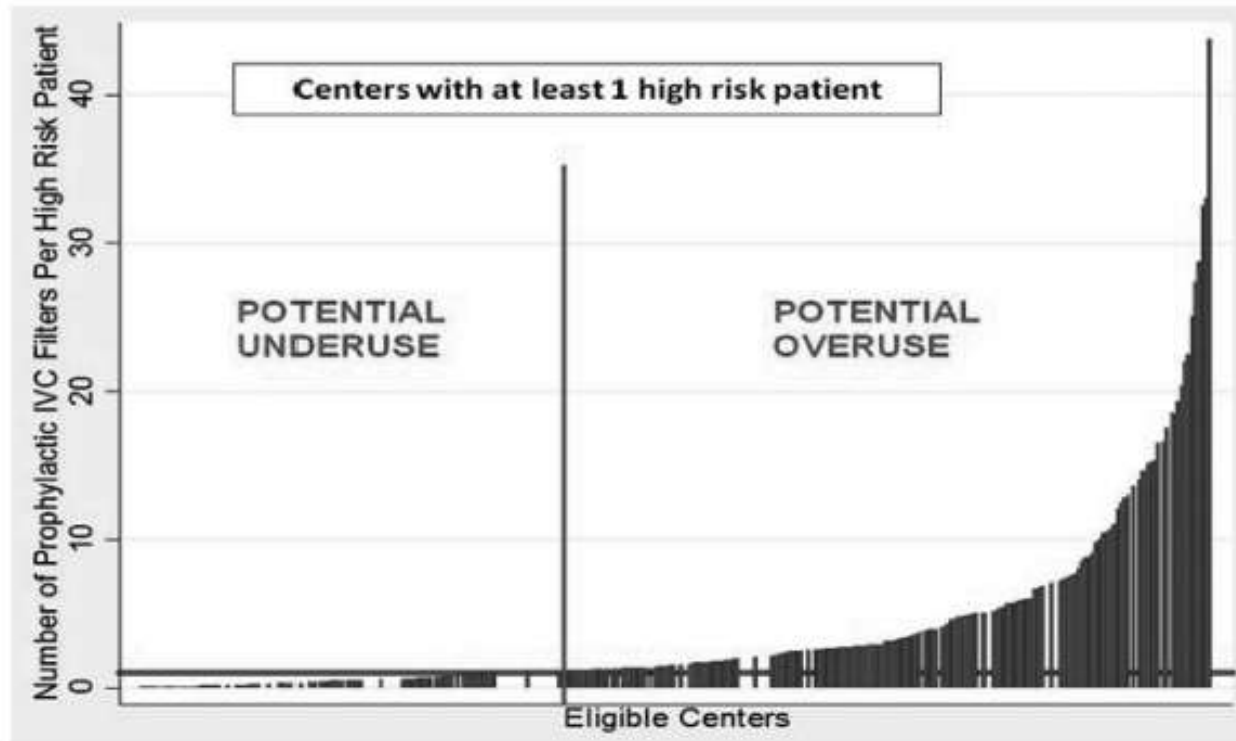


- Conflicting Guidelines
- EAST “At this time, we recommend consideration of IVC filter insertion in patients without a documented DVT or PE who meet high-risk criteria and cannot be anticoagulated.” (Rogers J Trauma 2002)
- ACCP “For major trauma patients, we suggest that an IVC filter should not be used for primary VTE prevention (Grade 2C).” (Gould 2012 CHEST)

Variation in Prophylactic Inferior Vena Cava (IVC) Filter Use

Unwarranted National Variation in the Use of Prophylactic Inferior Vena Cava Filters After Trauma: An Analysis of the National Trauma Databank

Lesly A. Dossett, MD, MPH, Raeanne C. Adams, MD, and Bryan A. Cotton, MD, MPH, FACS



Should we Place Prophylactic Inferior Vena Cava (IVC) Filters?

Practice Patterns and Outcomes of Retrievable Vena Cava Filters in Trauma Patients: An AAST Multicenter Study

- 599 patients at 21 Trauma Centers
- Very low retrieval rate (22%)
- “The practice patterns of retrievable IVC filter use should be re-examined.”

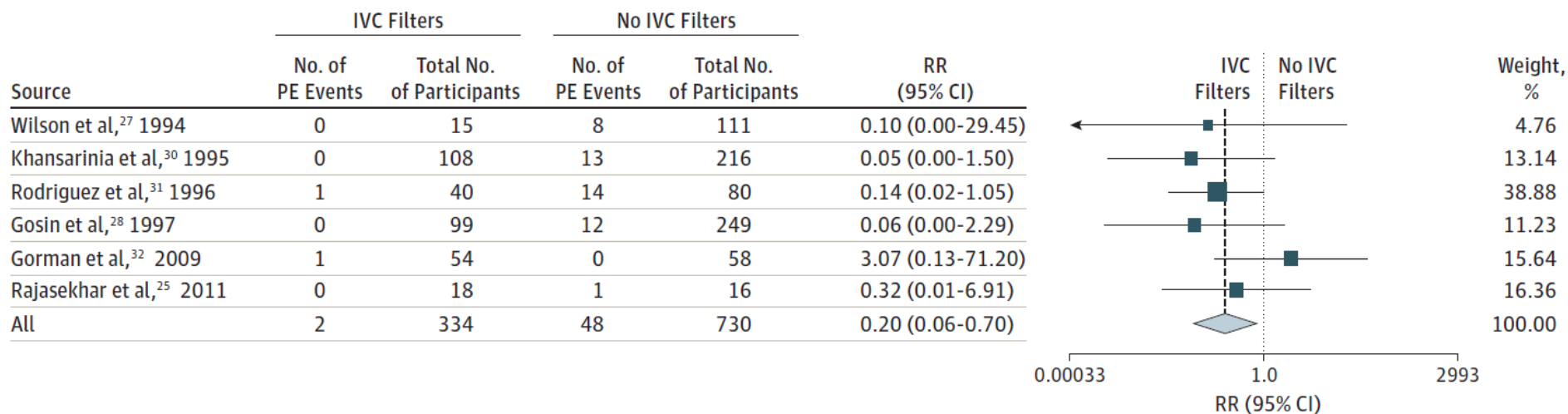
Karmy-Jones, J Trauma 2007



Should we Place Prophylactic Inferior Vena Cava (IVC) Filters?

- Number Needed to Treat (NNT) to prevent one PE is 109

Figure 2. Forest Plot of Relative Risk (RR) of Pulmonary Embolism (PE) With Use of Inferior Vena Cava (IVC) Filters vs No IVC Filters in Trauma Patients



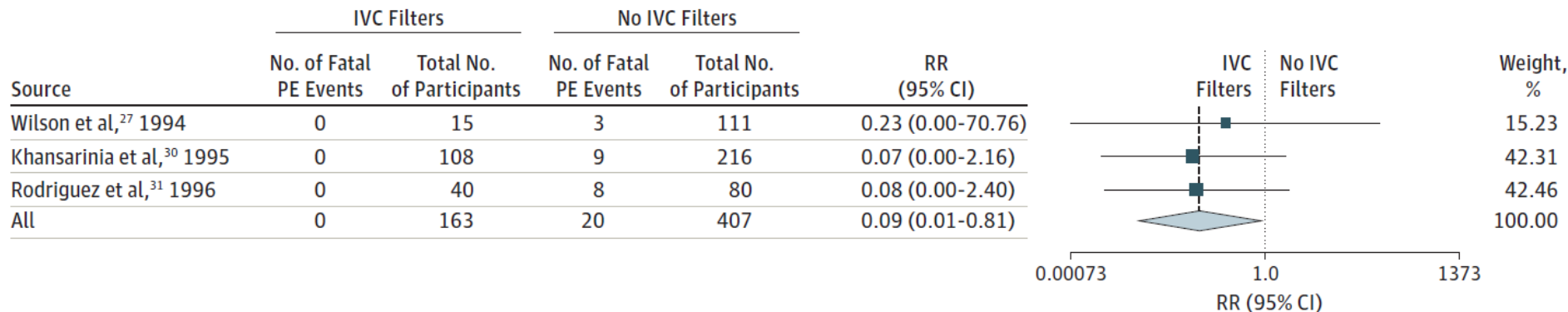
Weights are calculated from random-effects analysis. Dashed line indicates the overall weighted point estimate (0.20); diamond, same overall weighted point

estimate (95% CI). Shadow size varies relative to weight assigned to each study. Overall $I^2 = 0\%$ ($P = .48$). Test of $RR = 1$ ($z = 2.52$; $P = .01$).

Should we Place Prophylactic Inferior Vena Cava (IVC) Filters?

- Number Needed to Treat (NNT) to prevent one fatal PE is 1099

Figure 3. Forest Plot of Relative Risk (RR) of Fatal Pulmonary Embolism (PE) With Use of Inferior Vena Cava (IVC) Filters vs No IVC Filters in Trauma Patients



Weights are calculated from random-effects analysis. Dashed line indicates the overall weighted point estimate (0.20); diamond, same overall weighted point

estimate (95% CI). Shadow size varies relative to weight assigned to each study. Overall $I^2 = 0\%$ ($P = .94$). Test of $RR = 1$ ($z = 2.14$; $P = .03$).

Should we Place Prophylactic Inferior Vena Cava (IVC) Filters?

- Paper used MTQIP data - 803 patients
- Mortality- No difference
- DVT higher w/ IVCF (OR 1.83, 1.15-2.93)
- Unadjusted PE rate higher w/ IVCF

Prophylactic Inferior Vena Cava Filter Placement Does Not Result in a Survival Benefit for Trauma Patients

Mark R. Hemmila, MD, Nicholas H. Osborne, MD,* Peter K. Henke, MD,* John P. Kepros, MD,†
Sujal G. Patel, MD,‡ Anne H. Cain-Nielsen, MS,* and Nancy J. Birkmeyer, PhD**

Hemmila, Ann Surg 2015

Can we Increase IVC Filter Removal?

Improved recovery of prophylactic inferior vena cava filters in trauma patients: The results of a dedicated filter registry and critical pathway for filter removal

59%

Frederick B. Rogers, MD, MS, FACS, Steven R. Shackford, MD, FACS, Jo Ann Miller, BSN, RN, CCRN, Daniel Wu, DO, Amelia Rogers, BSA, and Angela Gambler, MBA, Lancaster, Pennsylvania

Are retrievable vena cava filters placed in trauma patients really retrievable?

87%

W. R. Leeper^{1,5} · P. B. Murphy^{1,6} · K. N. Vogt¹ · T. J. Leeper¹ · S. W. Kribs² · D. K. Gray^{1,3} · N. G. Parry^{1,3,4,5}

VTE Prophylaxis in Traumatic Brain Injury (TBI)



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What is Optimal VTE Prophylaxis in Traumatic Brain Injury (TBI)?

- An Example Case:
 - You are the Trauma ICU attending and recently admitted a poly-trauma patient with:
 - TBI (small intraparenchymal contusion)
 - Flail chest
 - Pelvic fracture (no hematoma)
 - Bilateral femur fractures
 - What do you order to help prevent thromboembolism (VTE)?

Balance of Risk vs. Benefit

Pharmacologic Prophylaxis

TBI Worse

More Neurosurgical Interventions

Worse functional outcome

NO Pharmacologic Prophylaxis

VTE Event

FULL Anticoagulation

Worse functional outcome

What is Optimal VTE Prophylaxis in Traumatic Brain Injury (TBI)?

- American College of Surgeons Trauma Quality Improvement Program (ACS-TQIP)
- “Best Practices in the Management of Traumatic Brain Injury”

<https://www.facs.org/quality-programs/trauma/tqip/best-practice>



ACS TQIP
BEST PRACTICES IN
THE MANAGEMENT
OF TRAUMATIC
BRAIN INJURY



AMERICAN COLLEGE OF SURGEONS
Inspiring Quality:
Highest Standards, Better Outcomes



ACS-TQIP recommendations for VTE Prophylaxis in TBI



Key Messages

- Patients with TBI are at high risk for venous thromboembolism (VTE), with rates as high as 20-30%
- VTE prophylaxis should be considered within the first 72 hours following TBI in most patients. Earlier initiation of pharmacologic prophylaxis (<72 hours) appears to be safe in patients at low risk for progression of intracranial bleeding and have a stable repeat head CT scan
- Placement of a prophylactic inferior vena cava (IVC) filter should be considered in patients at high risk for progression of intracranial hemorrhage who cannot receive pharmacologic prophylaxis, including those with lower extremity long bone fractures or pelvic fractures in addition to TBI

Table 3. Modified Berne-Norwood Criteria

Low risk	Moderate risk	High risk
No moderate or high risk criteria	Subdural or epidural hematoma > 8 mm Contusion or intraventricular hemorrhage > 2 cm Multiple contusions per lobe Subarachnoid hemorrhage with abnormal CT angiogram Evidence of progression at 24 hrs	ICP monitor placement Craniotomy Evidence of progression at 72 hrs
Initiate pharmacologic prophylaxis if CT stable at 24 hrs	Initiate pharmacologic prophylaxis if CT stable at 72 hrs	Consider placement of an IVC filter*

VTE in Injured Children

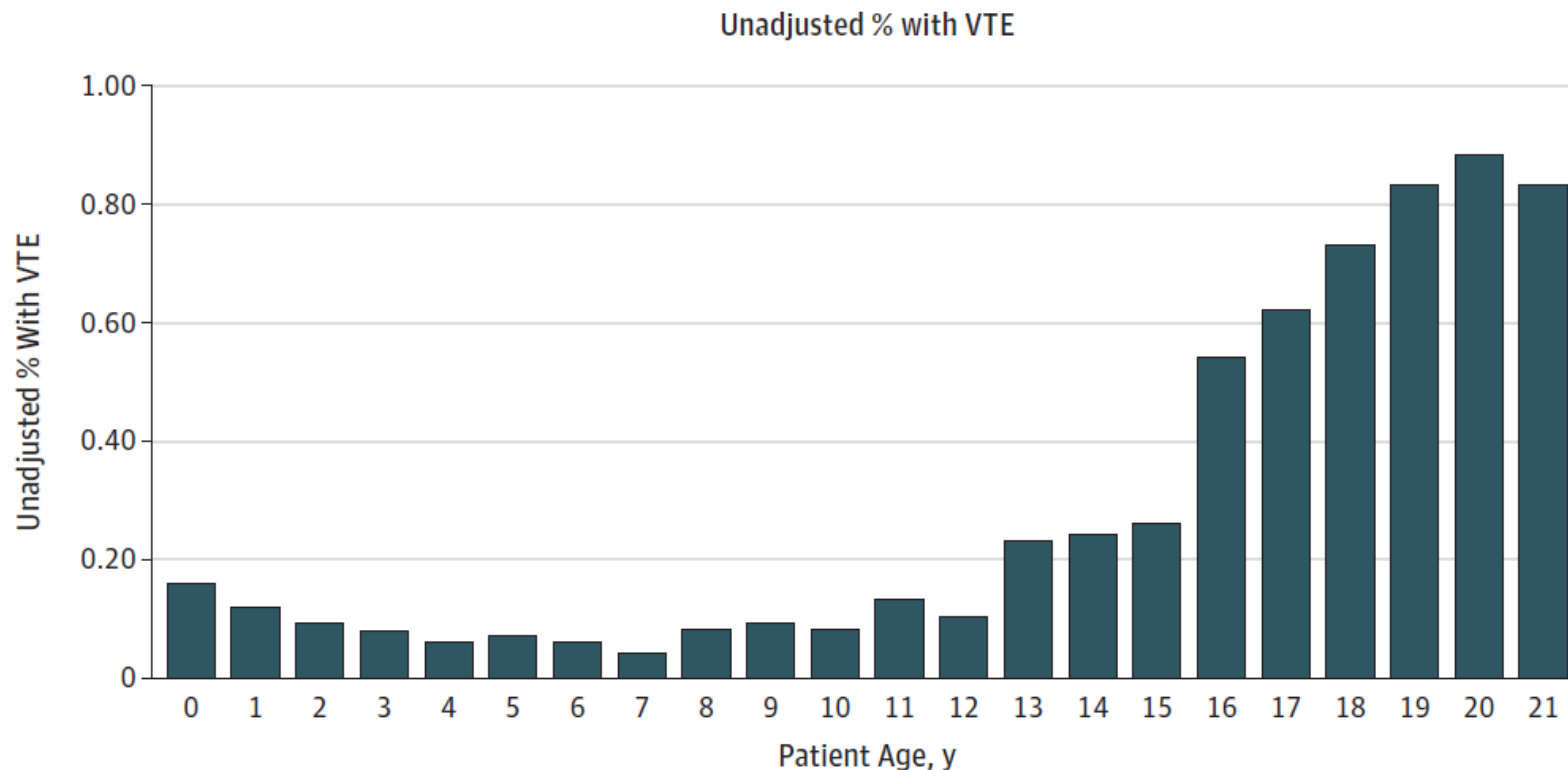


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When Do Children Become Adults?

Figure. Unadjusted and Adjusted Risk of Venous Thromboembolism (VTE) After Trauma Across Patient Age



Van Arendonk, JAMA Surgery 2013

When Do Children Become Adults?

- Adjusted OR 1.96 (95%CI 1.53-2.52) for 13-15 year olds
- Adjusted OR 3.77 (95%CI, 3.00-4.75) for 16-21 years
- 0-12 year olds as reference

Does VTE Occur in Injured Children?

- Risk Predication Model for VTE in Children

Figure 2. Calculation of a Patient's Points Total and the Predicted Probability of Venous Thromboembolism (VTE) Given the Points Total

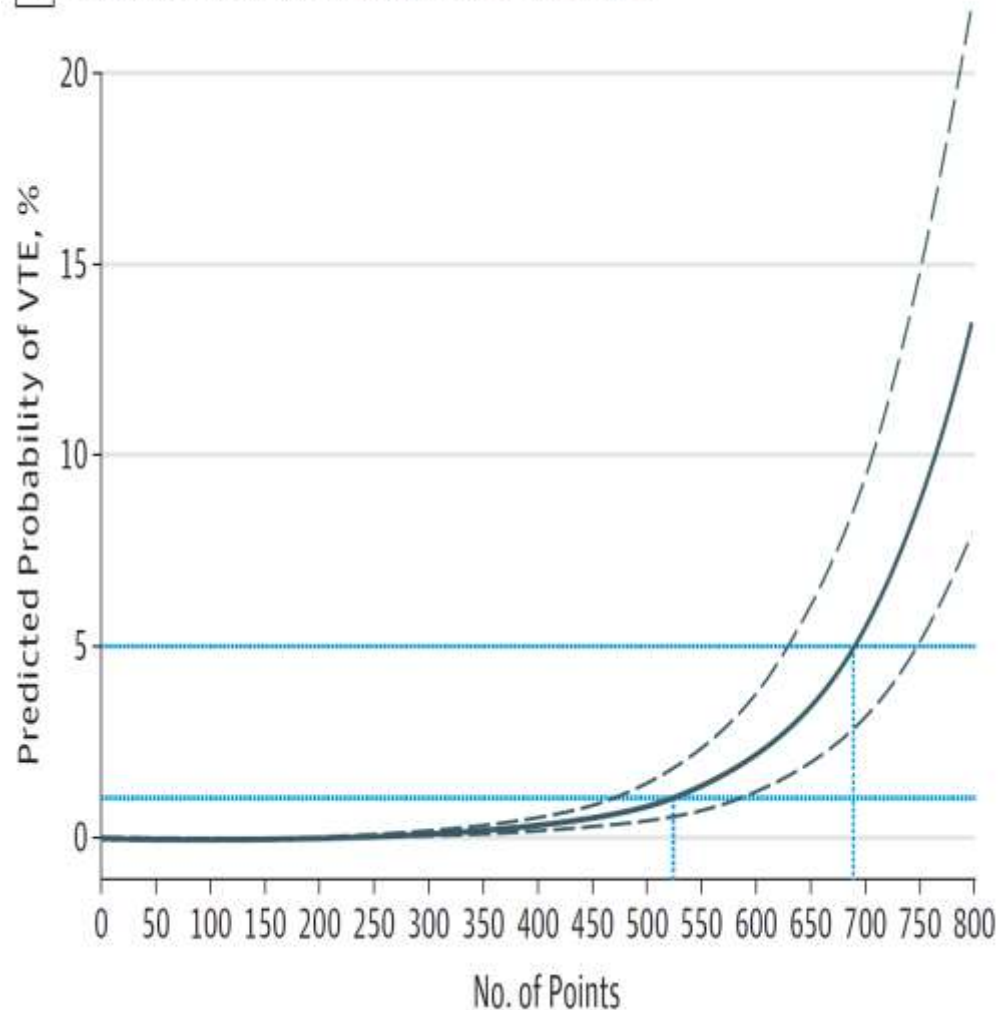
A Calculation of a patient's points total

Characteristic	Points	
	Model 3	Model 3I
GCS score		
Mild, 13-15	+0	+0
Moderate, 9-12	+40	+29
Severe, 3-8	+34	+101
Age category, y		
0	+94	+94
1-9	+0	+0
10-12	+78	+78
13-15	+120	+120
16-17	+147	+146
Female sex	+4	+4
Male sex	+0	+0
Intubation	+97	+143
Admission to ICU	+171	+186
Transfusion of blood products	+58	+57
Central venous catheter placement	+61	+61
Pelvic fracture	+33	+32
Lower-extremity fracture	+36	+37
Major surgery	+150	+149
Intubation AND admission to ICU	NA	-51
GCS category moderate AND admission to ICU	NA	+10
GCS category severe AND admission to ICU	NA	-70

Does VTE Occur in Injured Children?

- Risk Predication Model for VTE in children
- Implications for Prophylaxis?

B Predicted probability of venous thromboembolism



Future of VTE Prophylaxis in Trauma



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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?

What is on the Horizon?

- Precision medicine / targeted prevention

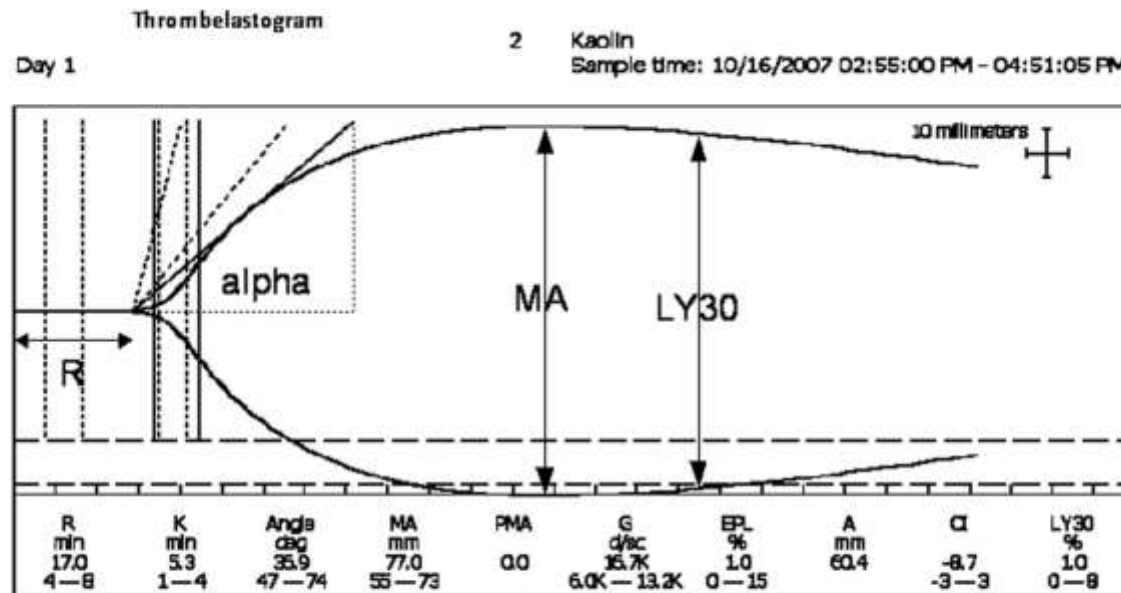


Fig. 2. A sample TEG tracing showing various parameters. The initial time to clot formation (R) is measured in minutes. Alpha angle represents the rate at which the clot is strengthening. MA measured in millimeters and represents the maximum clot strength. The percentage of clot LY30 after MA represents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

Van, J Trauma 2009

The Future of VTE Prevention?

What is on the Horizon?

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?

What is on the Horizon?

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?

What is on the Horizon?

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.”

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

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

Acknowledgements



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- Hopkins VTE Website (with paper forms)
 - <http://www.Hopkinsmedicine.org/Armstrong/bloodclots>
- Patient Education Video
 - <http://bit.ly/bloodclots>
- Wall Street Journal article
 - <http://on.wsj.com/1M18Aqu>
- PCORI Research in Action
 - <http://www.pcori.org/research-in-action/improving-patient-nurse-communication-prevent-life-threatening-complication>