Guidelines for Improving Safety and Quality

Elliott R. Haut, MD, PhD, FACS

Vice Chair of Quality, Safety, & Service

Associate Professor of Surgery, Anesthesiology & Critical Care Medicine, Emergency Medicine, Health Policy & Management

@elliotthaut

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Disclosures

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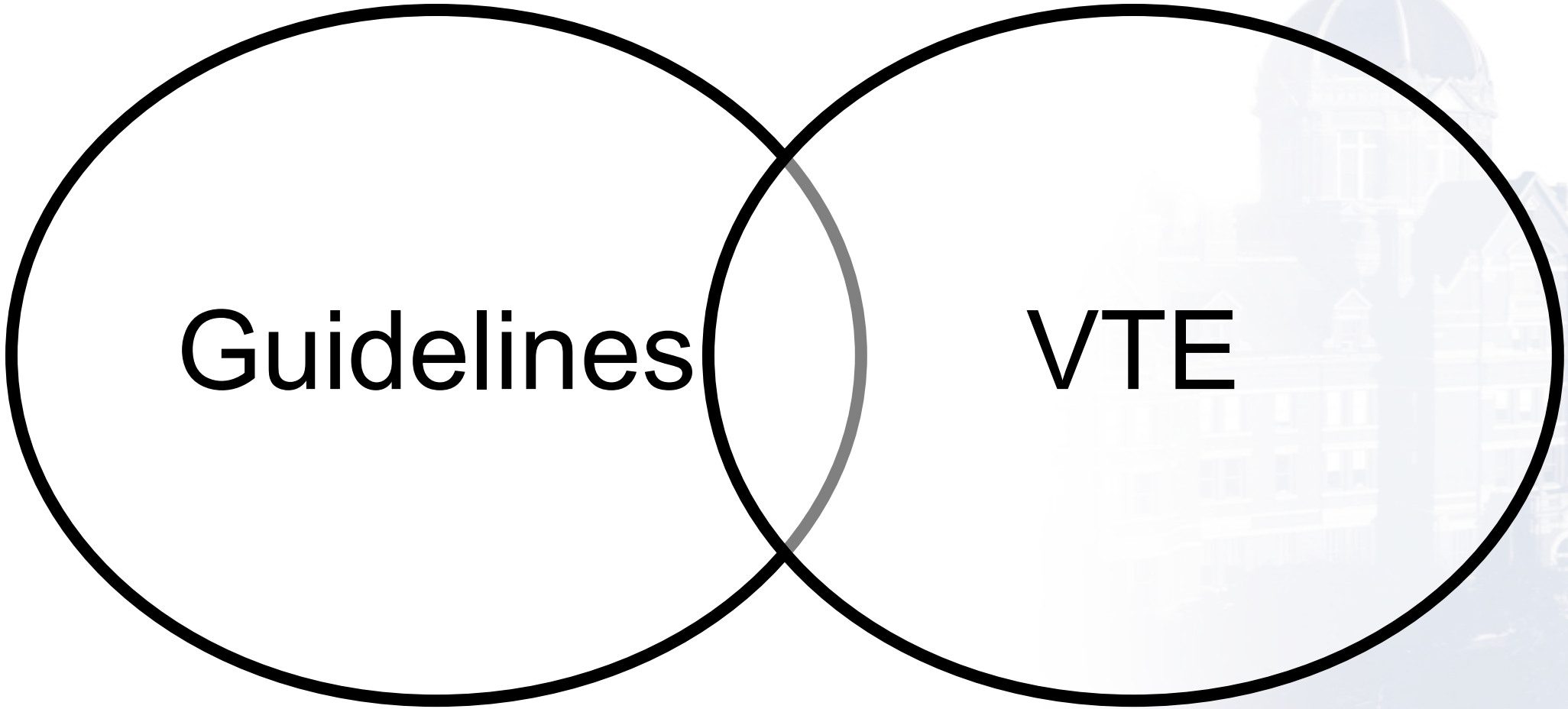
- Board member of the National Blood Clot Alliance (NBCA) - unpaid

My Agenda for Today





EAST Practice Management Guidelines and the Perpetual Quest for Excellence

Elliott R. Haut, MD, PhD, FACS

President, Eastern Association for the Surgery of Trauma

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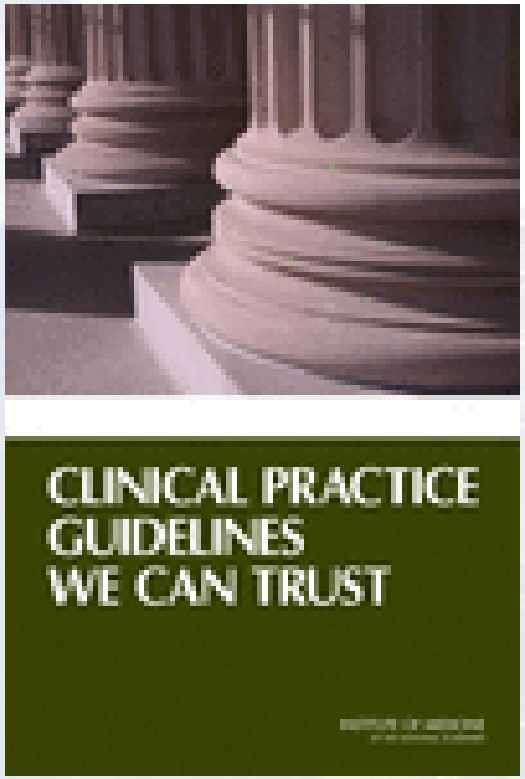
How can we make trustworthy guidelines?

- Request from Congress
- Develop standards for rigorous, trustworthy guidelines

How can we make trustworthy guidelines?

- “Clinical Practice Guidelines We Can Trust”
- Includes 8 standards
- Published in 2011
- http://www.iom.edu/Reports/2011/Clinical-Practice-Guidelines-We-Can-Trust.aspx



Graham, et al. IOM, 2011

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Benefits of Guidelines

JAMA
The Journal of the American Medical Association

IOM Sets Out "Gold Standard" Practices for Creating Guidelines, Systematic Reviews

- Reduce inappropriate practice variation
- Speed translation of research into practice
- Improve care, safety, and quality
- Reduce disparities
- Cut costs

Kuehn, JAMA 2011

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Institute of Medicine (IOM) Standards for Trustworthiness

1. Transparent process
2. Conflicts of interest
3. Guideline development group composition
4. Systematic reviews
5. Evidence quality and recommendation strength
6. Articulating recommendations
7. External review
8. Updating

Ranshoff, JAMA 2013

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Grading of Recommendations Assessment, Development and Evaluation

- G grading of
- R recommendations
- A assessment
- D development
- E evaluation

www.gradeworkinggroup.org

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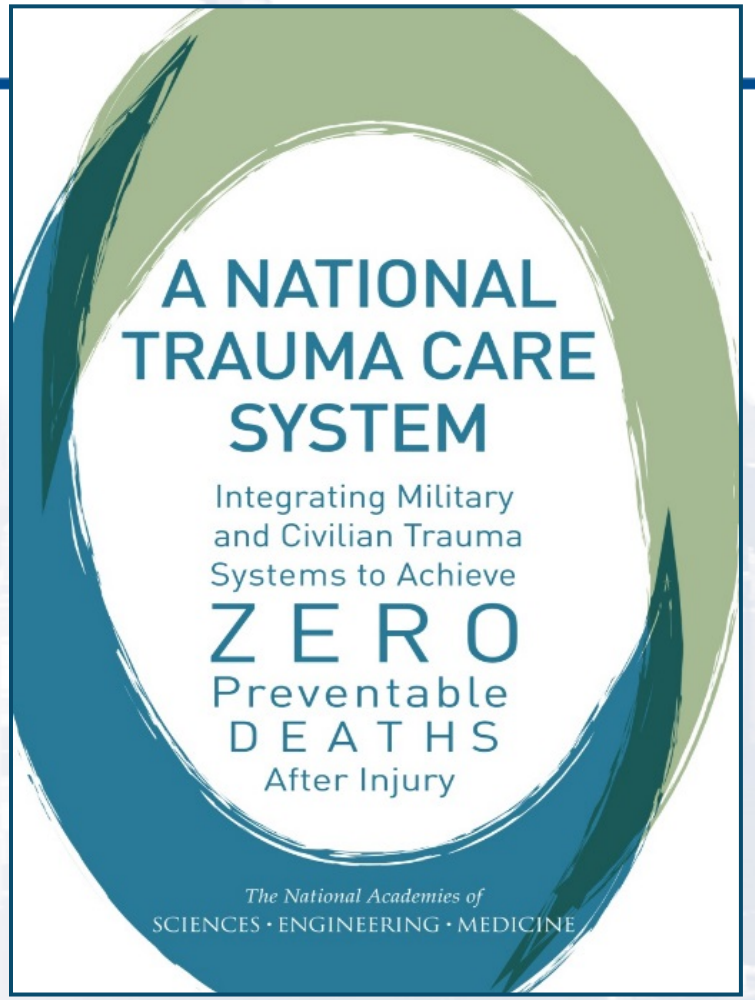
> 100 international organizations endorse GRADE

A National Trauma Care System

- Integrating Military and Civilian Trauma Systems to Achieve ZERO Preventable DEATHS After Injury



nas.edu/TraumaCare

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Military Trauma Care's Learning Health System: The Importance of Data Driven Decision Making

Elliott R. Haut, M.D., Ph.D. (Johns Hopkins University School of Medicine and the Johns Hopkins Bloomberg School of Public Health)
N. Clay Mann, Ph.D., M.S. (University of Utah School of Medicine)
Russ S. Kotwal, M.D., M.P.H. (Uniformed Services University of the Health Sciences and Texas A&M Health Science Center)

Commissioned by the National Academies of Sciences, Engineering, and Medicine Committee on Military Trauma Care's Learning Health System and Its Translation to the Civilian Sector

Haut, NASEM 2016

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Practice Management Guidelines as a Framework for Improving Care

Clinical medicine changes rapidly, requiring physicians to spend many hours just trying to keep up with the most current care expectations. Clinicians have countless resources to choose from and often unable to keep up the astounding amount of published data on which to base evidence-based clinical decisions. This rapid growth in medical literature drove the evidence-based medicine movement to help busy clinicians apply the best evidence when making clinical

The importance of dissemination cannot be underestimated. A guideline that no one reads, adopts, and uses is not beneficial to patients. The rapid dissemination of PMGs via the routine publishing in mainstream peer-reviewed setting is necessary, but may not be sufficient to change practice. More rapid sharing of new scientific knowledge is spreading faster due to the world of social media. Many publishers are taking note of alternative individual article-level

Haut, NASEM 2016

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The Optimal Use of Integrated Data

- "This case represents an appropriate use of a learning health system to ensure seamless transitions of care between care teams, resulting in the best possible outcome for a severely injured patient."
  - "A real-time clinical decision support tool prompts the field medic to……"
  - "Analysis of all the data and active surveillance of decision support tools by the MCC computer and EMS physician lead to……."
  - "……..in accordance with an evidence-based clinical practice guideline that summarizes the medical literature on the topic."

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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.”

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

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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

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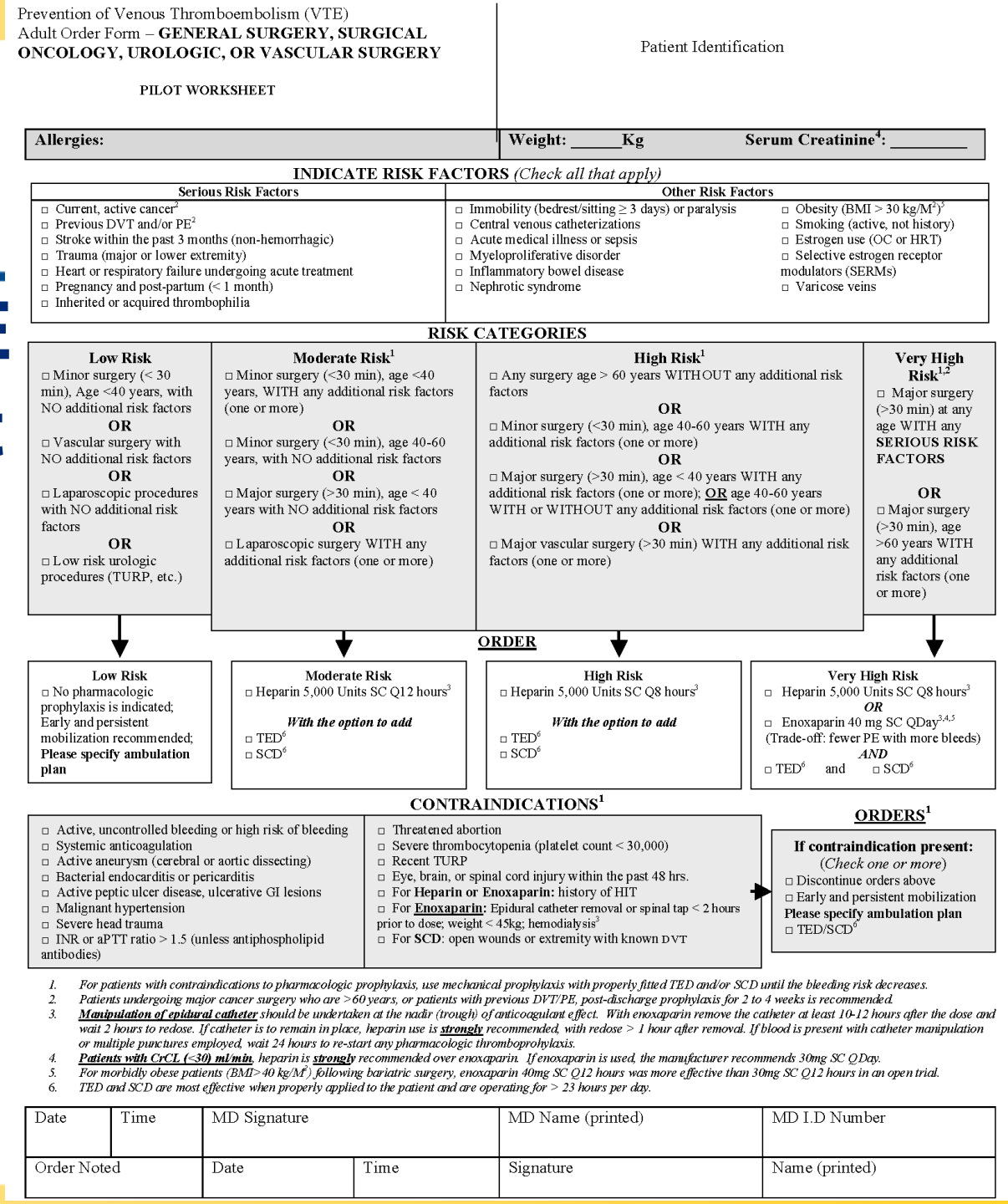
Improving VTE Prophylaxis at The Johns Hopkins Hospital

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[4]: _____**

INDICATE RISK FACTORS *(Check all that apply)*

Serious Risk Factors	Other Risk Factors	
□ Current, active cancer[2]	□ Immobility (bedrest/sitting ≥ 3 days) or paralysis	□ Obesity (BMI > 30 kg/M²)[3]
□ Previous DVT and/or PE[2]	□ Central venous catheterizations	□ Smoking (active, not history)
□ Stroke within the past 3 months (non-hemorrhagic)	□ Acute medical illness or sepsis	□ Estrogen use (OC or HRT)
□ Trauma (major or lower extremity)	□ Myeloproliferative disorder	□ Selective estrogen receptor modulators (SERMs)
□ Heart or respiratory failure undergoing acute treatment	□ Inflammatory bowel disease	
□ Pregnancy and post-partum (< 1 month)	□ Nephrotic syndrome	□ Varicose veins
□ Inherited or acquired thrombophilia		

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[3]
With the option to add
□ TED[6]
□ SCD[6]

High Risk
□ Heparin 5,000 Units SC Q8 hours[3]
With the option to add
□ TED[6]
□ SCD[6]

Very High Risk
□ Heparin 5,000 Units SC Q8 hours[3]
OR
□ Enoxaparin 40 mg SC QDay[3,4,5]
(Trade-off: fewer PE with more bleeds)
AND
□ TED[6] and □ SCD[6]

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[3]
- □ 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[6]

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 thromboprohylaxis.*
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)

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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

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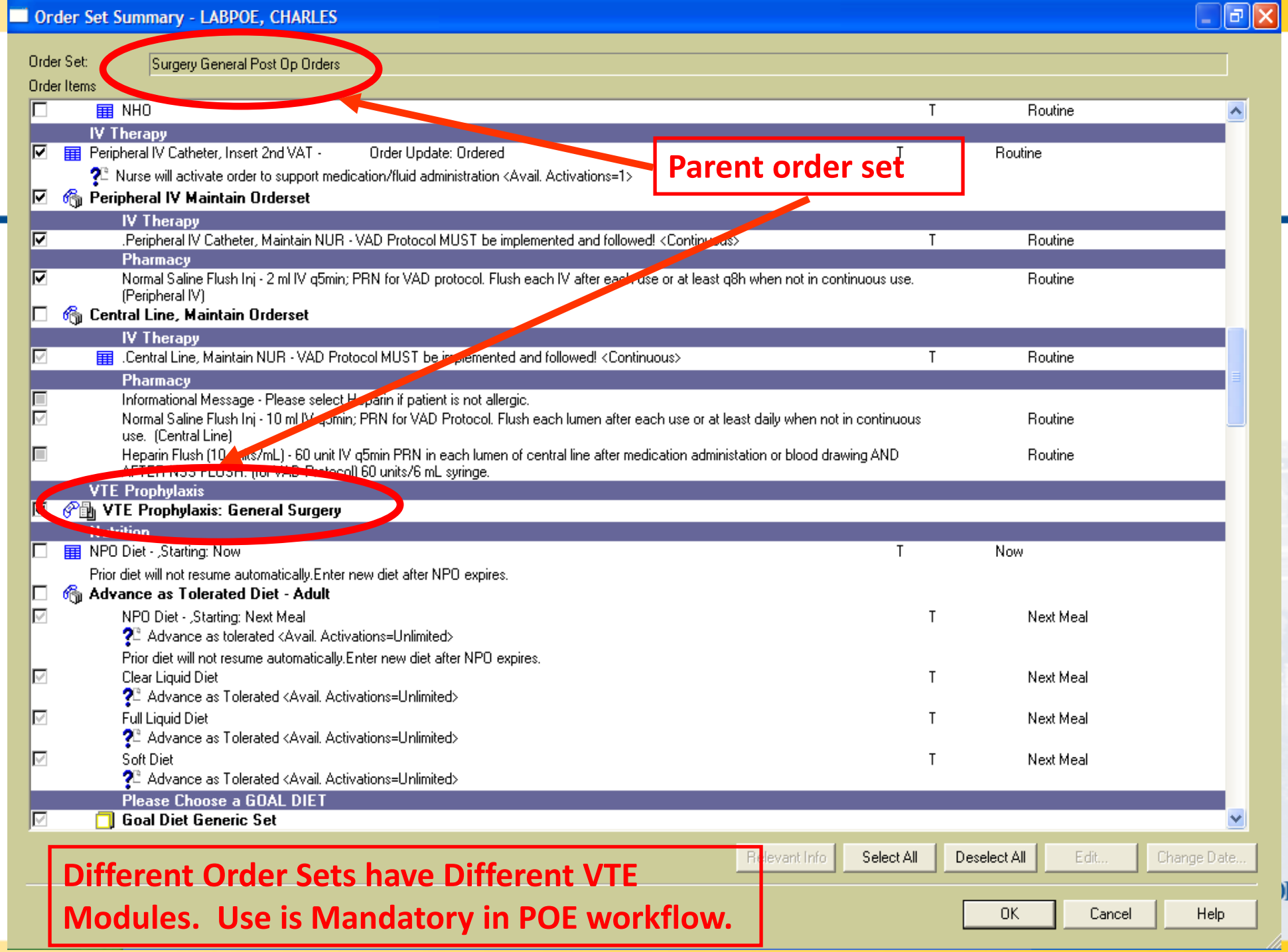
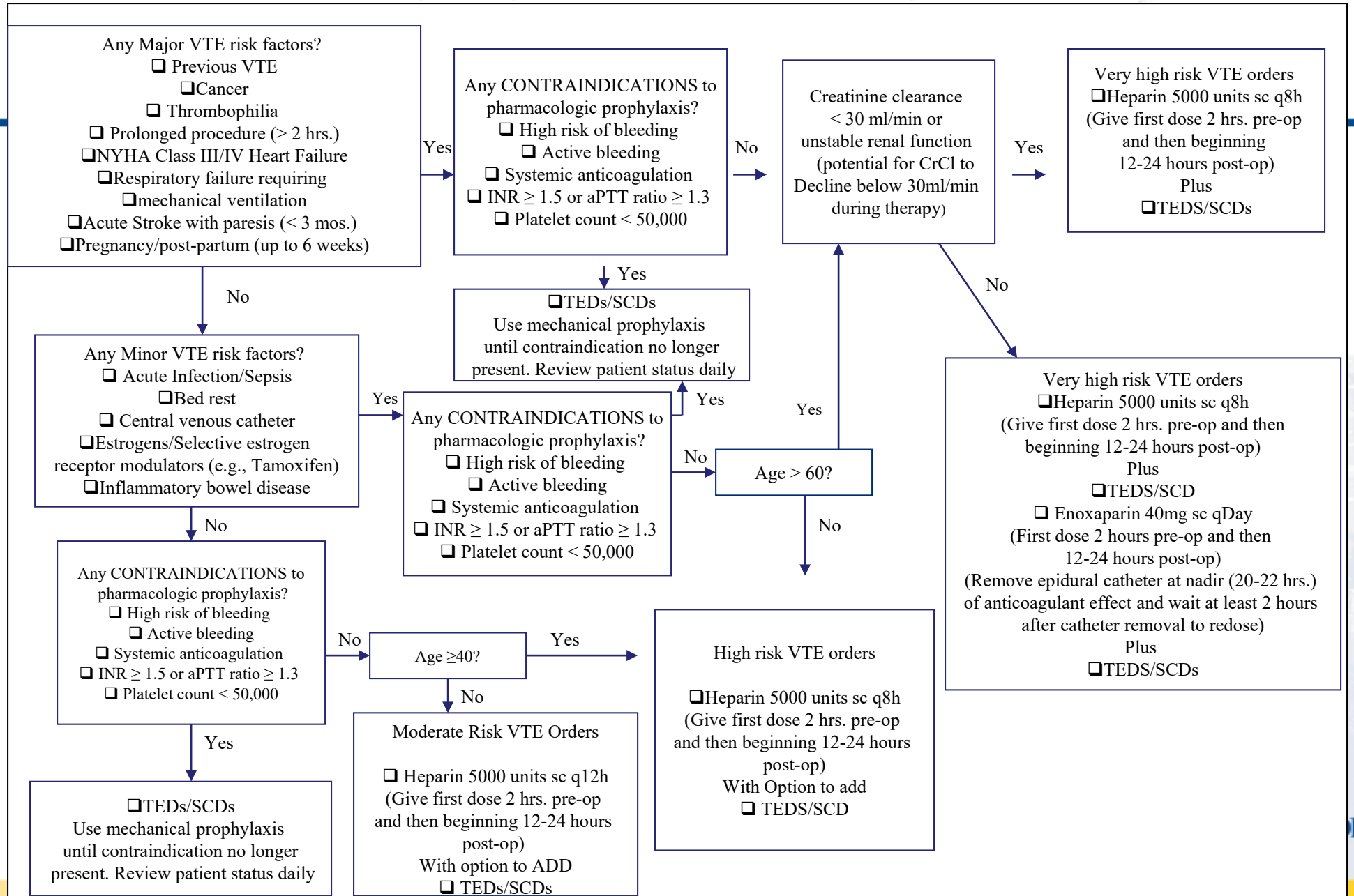
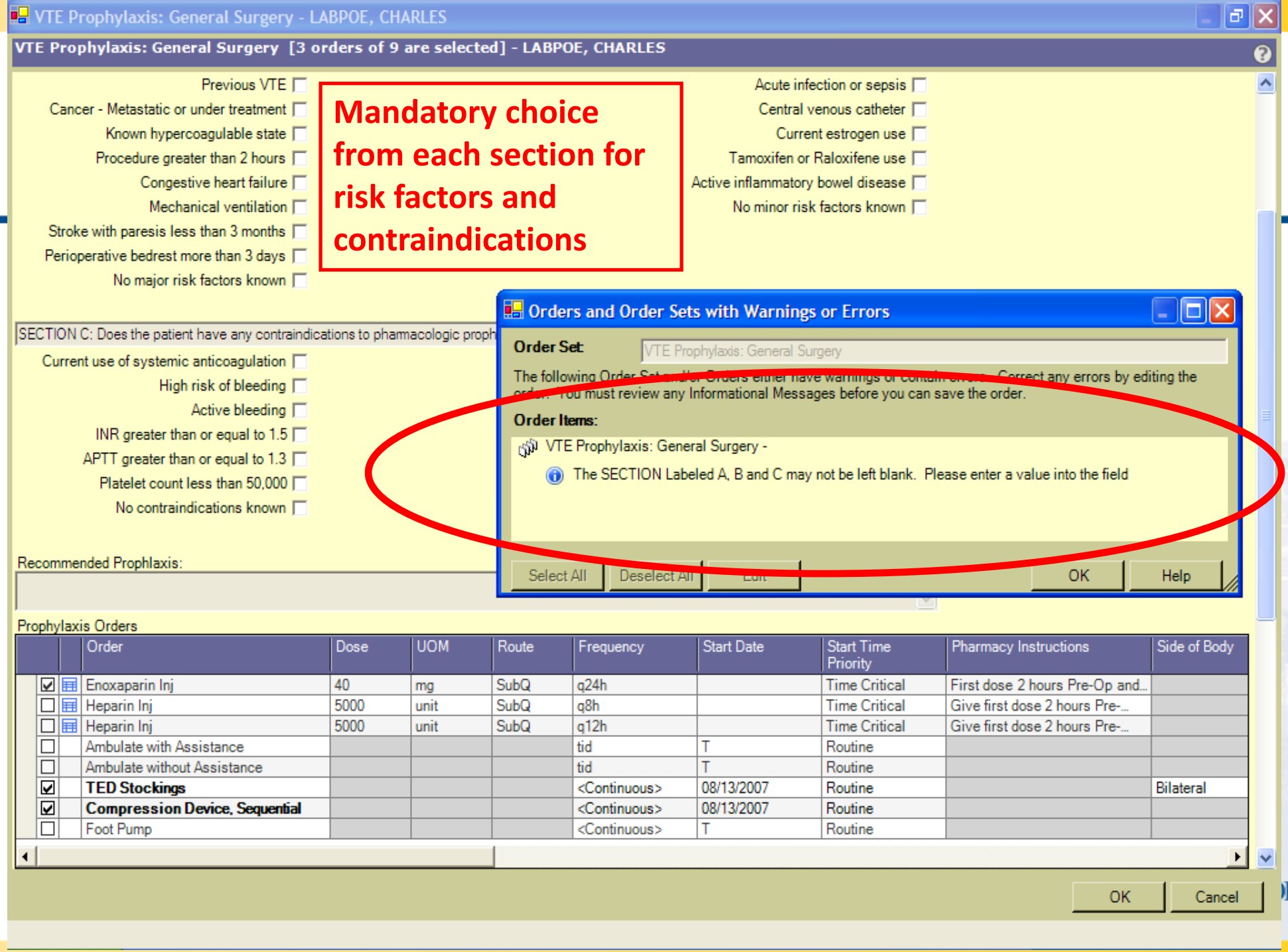

Order Set Summary - LABPOE, CHARLES
Order Set:
Surgery General Post Op Orders
Order Items
NHO T Routine
IV Therapy
Peripheral IV Catheter, Insert 2nd VAT - Order Update: Ordered T Routine
Nurse will activate order to support medication/fluid administration <Avail. Activations=1>
Peripheral IV Maintain Orderset
IV Therapy
.Peripheral IV Catheter, Maintain NUR - VAD Protocol MUST be implemented and followed! <Continuous> T Routine
Pharmacy
Normal Saline Flush Inj - 2 ml IV q5min; PRN for VAD protocol. Flush each IV after each use or at least q8h when not in continuous use. (Peripheral IV) Routine
Central Line, Maintain Orderset
IV Therapy
.Central Line, Maintain NUR - VAD Protocol MUST be implemented and followed! <Continuous> T Routine
Pharmacy
Informational Message - Please select Heparin if patient is not allergic.
Normal Saline Flush Inj - 10 ml IV q5min; PRN for VAD Protocol. Flush each lumen after each use or at least daily when not in continuous use. (Central Line) Routine
Heparin Flush (10 units/mL) - 60 unit IV q5min PRN in each lumen of central line after medication administation or blood drawing AND AFTER NSS FLUSH. (for VAD Protocol) 60 units/6 mL syringe. Routine
VTE Prophylaxis
VTE Prophylaxis: General Surgery
Nutrition
NPO Diet - ,Starting: Now T Now
Prior diet will not resume automatically.Enter new diet after NPO expires.
Advance as Tolerated Diet - Adult
NPO Diet - ,Starting: Next Meal T Next Meal
Advance as tolerated <Avail. Activations=Unlimited>
Prior diet will not resume automatically.Enter new diet after NPO expires.
Clear Liquid Diet T Next Meal
Advance as Tolerated <Avail. Activations=Unlimited>
Full Liquid Diet T Next Meal
Advance as Tolerated <Avail. Activations=Unlimited>
Soft Diet T Next Meal
Advance as Tolerated <Avail. Activations=Unlimited>
Please Choose a GOAL DIET
Goal Diet Generic Set
Parent order set
Relevant Info
Select All
Deselect All
Edit...
Change Date...
OK
Cancel
Help
Different Order Sets have Different VTE Modules. Use is Mandatory in POE workflow.

General Surgery VTE Prophylaxis




VTE Prophylaxis: General Surgery - LABPOE, CHARLES
VTE Prophylaxis: General Surgery [3 orders of 9 are selected] - LABPOE, CHARLES
Previous VTE
Cancer - Metastatic or under treatment
Known hypercoagulable state
Procedure greater than 2 hours
Congestive heart failure
Mechanical ventilation
Stroke with paresis less than 3 months
Perioperative bedrest more than 3 days
No major risk factors known
Mandatory choice from each section for risk factors and contraindications
Acute infection or sepsis
Central venous catheter
Current estrogen use
Tamoxifen or Raloxifene use
Active inflammatory bowel disease
No minor risk factors known
SECTION C: Does the patient have any contraindications to pharmacologic proph
Current use of systemic anticoagulation
High risk of bleeding
Active bleeding
INR greater than or equal to 1.5
APTT greater than or equal to 1.3
Platelet count less than 50,000
No contraindications known
Orders and Order Sets with Warnings or Errors
Order Set:
VTE Prophylaxis: General Surgery
Correct any errors by editing the
You must review any Informational Messages before you can save the order.
Order Items:
VTE Prophylaxis: General Surgery -
The SECTION Labeled A, B and C may not be left blank. Please enter a value into the field
Select All
Deselect All
Edit
OK
Help
Recommended Prophlaxis:
Prophylaxis Orders
Order
Dose
UOM
Route
Frequency
Start Date
Start Time Priority
Pharmacy Instructions
Side of Body
Enoxaparin Inj 40 mg SubQ q24h Time Critical First dose 2 hours Pre-Op and...
Heparin Inj 5000 unit SubQ q8h Time Critical Give first dose 2 hours Pre-...
Heparin Inj 5000 unit SubQ q12h Time Critical Give first dose 2 hours Pre-...
Ambulate with Assistance tid T Routine
Ambulate without Assistance tid T Routine
TED Stockings <Continuous> 08/13/2007 Routine Bilateral
Compression Device, Sequential <Continuous> 08/13/2007 Routine
Foot Pump <Continuous> T Routine
OK
Cancel

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

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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

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Does Improving Prophylaxis Change Outcomes?

- YES

- 2 examples
  - Johns Hopkins Trauma Surgery
  - Johns Hopkins Internal Medicine

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

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Does Improving Prophylaxis Change Outcomes? The JHH Trauma Example

- Single Center (Johns Hopkins Hospital)
- Pre/Post Intervention Study
- 1-year PRE vs. 3-years POST
- Retrospective data collection
- IRB approved

Haut, Arch Surg 2012

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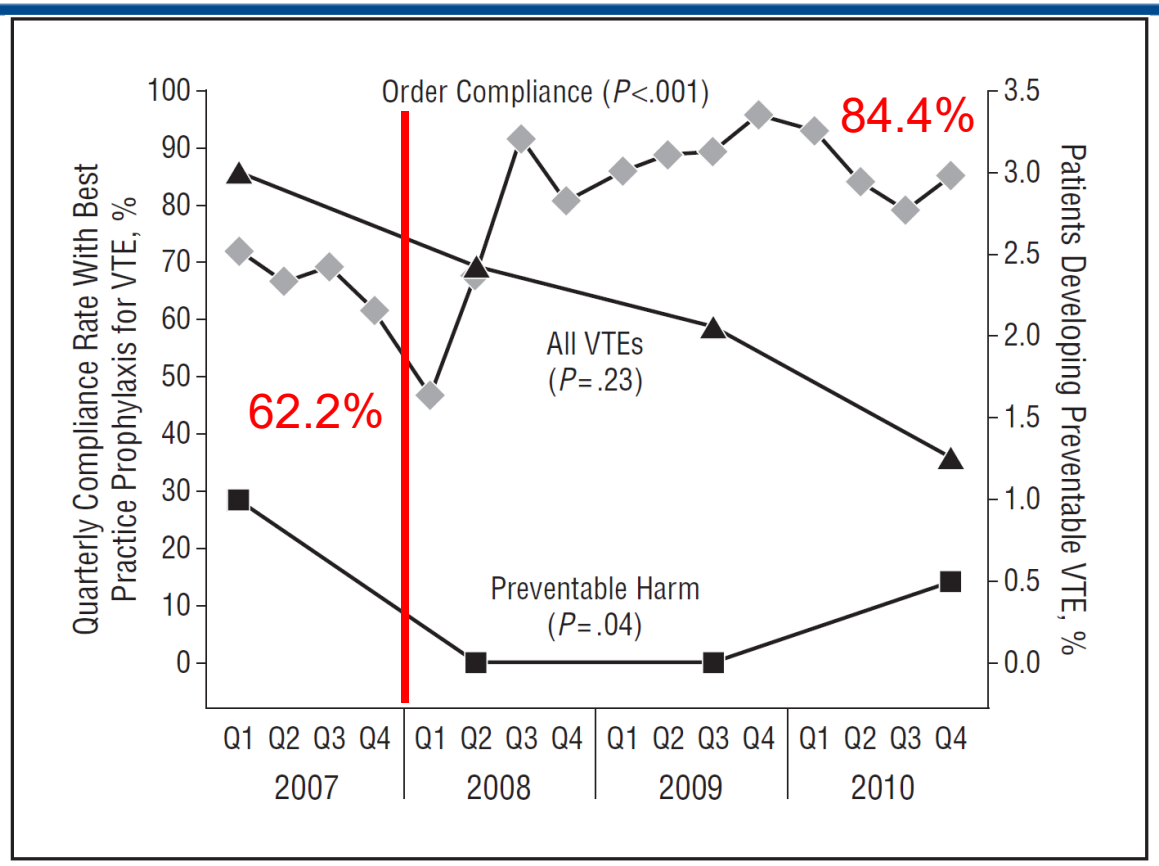
Does Improving Prophylaxis Change Outcomes? The JHH Trauma Example



- Significant increase in VTE prophylaxis
- Significant drop in preventable harm from VTE
  - 1.0% vs. 0.17% (p=0.04)

Haut, Arch Surg 2012

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Does Improving Prophylaxis Change Outcomes? The JHH Medicine Example

- Retrospective Review (PRE v. POST)
- Patients : 1,000 PRE v. 942 POST
- Patients prescribed Optimal Prophylaxis
  - 65.6% v. 90.1% ($p<0.0001$)
- Patients prescribed NO prophylaxis
  - 23.6% v. 4.4% ($p<0.0001$)

Zeidan, Am J Hematology 2013

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Does Improving Prophylaxis Change Outcomes? The JHH Medicine Example

TABLE IV. Clinical Outcomes

	Preimplementation $N = 1{,}000$	Postimplementation $N = 942$	*P*-value
Total VTE episodes	25 (2.5%)	7 (0.7.%)	0.0022
Preventable harm from VTE	11(1.1%)	0 (0)	0.001
Total in-house VTE	5 (0.5%)	5 (0.5%)	1.0000
Total 30-day post-discharge VTE	9 (1.1%)	2 (0.3%)	0.0300
Total 90-day post-discharge VTE	20 (2.7%)	2 (0.3%)	0.0003
Fatal PE	2 (0.2%)	1 (0.1%)	1.000

Zeidan, Am J Hematology 2013

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ZERO Preventable VTE – A Realistic Goal

TABLE IV. Clinical Outcomes

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Zeidan, Am J Hematology 2013

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VTE Prophylaxis- Computerized Decision Support

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NATF
North American Thrombosis Forum

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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

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

Latest News and Updates

Consensus Statement: Call To Action On

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Preventing Hospital-Acquired Venous Thromboembolism

A Guide for Effective Quality Improvement

AHRQ
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]

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CDC Healthcare-Associated VTE Prevention Challenge Champions

2015 CDC HA-VTE PREVENTION CHALLENGE CHAMPION

ORGANIZATION:

The Johns Hopkins Hospital | Baltimore, Maryland

PATIENT POPULATION:

- 50,000 inpatient admissions in 2014
- 951 staffed beds

The Johns Hopkins Venous Thromboembolism Collaborative: Multidisciplinary Team Approach to Achieve Perfect Prophylaxis

Michael B. Streiff, MD, FACP[1,2,3*], Brandyn D. Lau, MPH, CPH[3,4,5,6], Deborah B. Hobson, BSN[3,4,7], Peggy S. Kraus, PharmD, CACP[8], Kenneth M. Shermock, PharmD, PhD[1,8,9], Dauryne L. Shaffer, MSN, CCRN[4,7], Victor O. Popoola, MBBS, MPH, ScM[4], Jonathan K. Aboagye, MBChB, MPH[4], Norma A. Farrow, MD[4], Paula J. Horn, PharmD, BCACP[10], Hasan M. Shihab, MBChB, MPH[4], Peter J. Pronovost, MD, PhD, FCCM[3,6,11,12], Elliott R. Haut, MD, PhD, FACS[3,4,6,11,13]

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Can a Systems Approach Improve VTE Diagnosis?

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Pulmonary Embolism
Evidence-Based Diagnostic Guideline

Pulmonary Embolism (ED & OP)

Clinical likelihood of diagnosis

- Low
  - PERC
  - If PERC fails → Wells
- Moderate
  - Wells, D-dimer
  - Wells >4 or (+) D-Dimer for CTA
- High → CTA

Outcomes

- CTA imaging yield
- Clinical effectiveness in ED
- Hospital admissions
- Longitudinal outcomes
- Cost of care

Preliminary data at Johns Hopkins courtesy of Pamela Johnson

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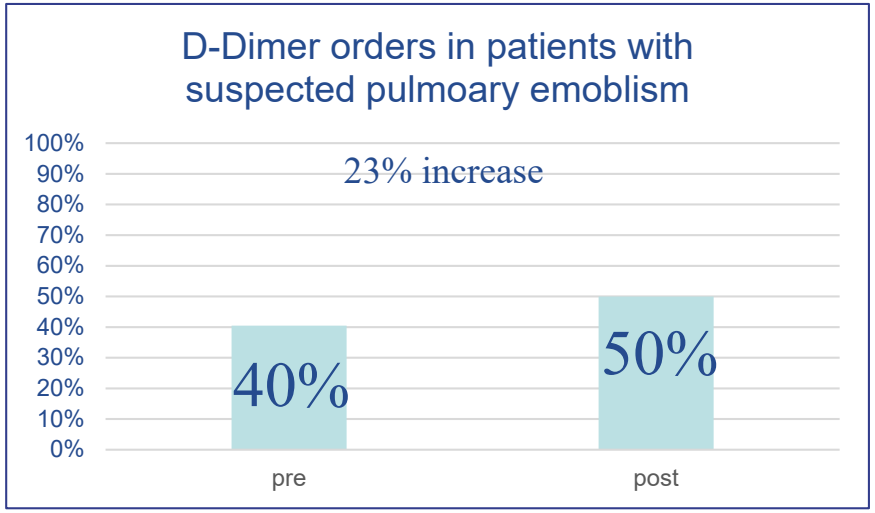
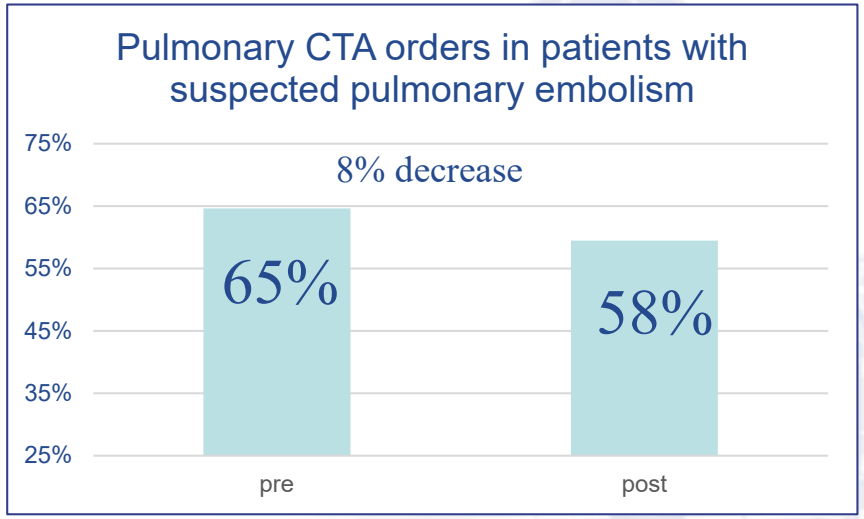
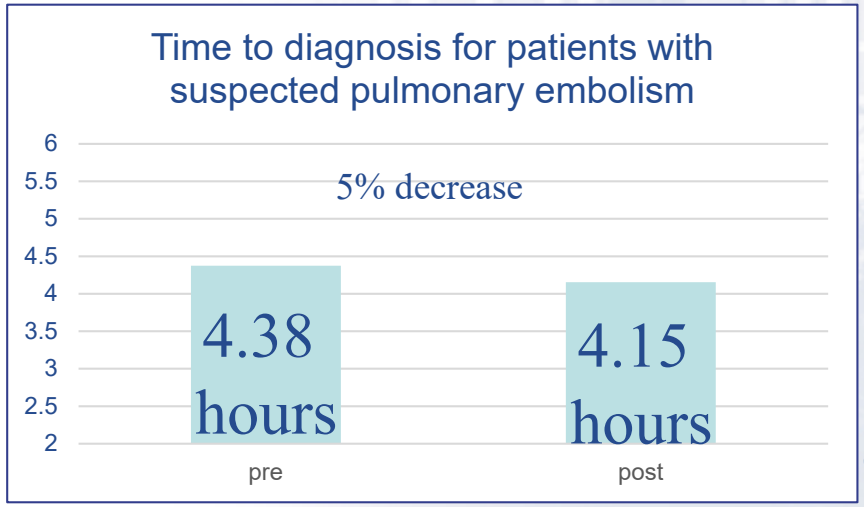
Pulmonary Embolism
Evidence-Based Diagnostic Guideline







Preliminary data at Johns Hopkins courtesy of Pamela Johnson

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Delayed and/or Missed Diagnoses of PE

National Blood Clot Alliance
Stop The Clot®

ABOUT CLOTS PATIENT STORIES HEALTH PROFESSIONALS NEWS GET INVOL

Home / Patient Stories / In Memory of Jamie Lee Gravley: His Blood Clot Story

IN MEMORY OF JAMIE LEE GRAVLEY: HIS BLOOD CLOT STORY

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Tags: 20 Something, Blood Clot, Chest Pain, Deep Vein Thrombosis, DVT, Misdiagnosed, PE, Pulmonary Embolism, Tonsillectomy, Pulled Muscle

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MY DOCTOR SAID I WAS FINE, MY INTUITION SAVED MY LIFE: CHRISELDA'S STORY

During my first pregnancy at 15 years old, I started to have intense burning and numbness on my left side groin and hip region that my OB/GYN stated was normal pregnancy pain. After giving birth, I followed up with my primary doctor and neurologist. All of my doctor's visits concluded with no diagnosis. My second pregnancy caused the pain to intensify to the point that walking, sitting, and laying on my side were extremely painful. Again, my OB/GYN brushed off my concern, so I adjusted to the new level of pain and carried on with life. At this point, I knew something had to be wrong, but no one would listen to me.

Tags: Blood Clot, Factor V Leiden, FVL

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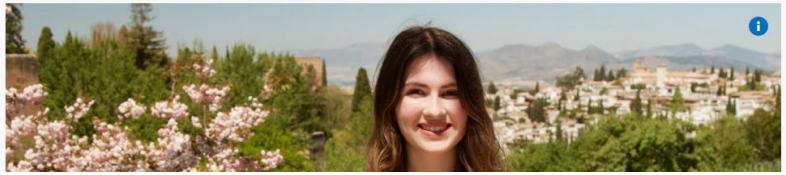
By Brendan Kennedy Investigative Reporter
Fri., Aug. 30, 2019 | 18 min. read

Article was updated Oct. 10, 2019



DEEP VEIN THROMBOSIS

The Ride of My Life: Kim's Story of Deep Vein Thrombosis and Pulmonary Embolism

How taking a road trip set the stage for one woman's journey with deadly vein clots — and what you can learn from it.

By Sandra Gordon Medically Reviewed by Michael Cutler, DO, PhD
Last Updated: October 29, 2018

Medically Reviewed

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By Everyday Health Guest Contributor For My Health Story
October 7, 2015

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MARCH 29, 2018
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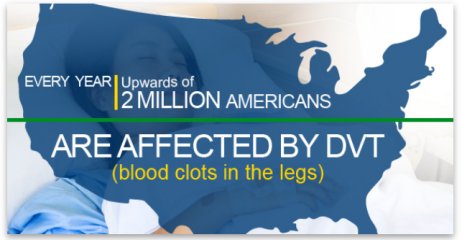

By the bioMérieux Connection Editors

Meeting John Scirica in August of 2012, it would be hard to accept that he was 64-years-old, let alone that he was near death from a rare case of bilateral pulmonary embolism. The condition left the pulmonary arteries in both of his lungs blocked from blood clots that very likely traveled there from his leg.

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For More Info

@elliotthaut (Twitter) or ehaut1@jhmi.edu

- Hopkins VTE Website
  - http://www.Hopkinsmedicine.org/Armstrong/bloodclots

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