Protocol

Title:	**SToP: Venous Thromboembolism Screening in the Trauma Population — A Randomized Vanguard Trial**
Location:	Intermountain Medical Center (IMC), Trauma Services
Sponsor:	Intermountain Research and Medical Foundation
Principal Investigator:	Sarah Majercik, MD, MBA
Study Team:	Annika Bickford, PA-C Joseph Bledsoe, MD Mark Stevens, MD Tom White, MD Don VanBoerum, MD Sarah Aldridge, NP Jody Carter, APC Chip DuRoss, PA-C, MPAS Scott Gardner, PA-C Aaron Pugh, PA-C Brittany Gerali, PA-C Andy Avery, PA-C Steve Granger, MD Scott Stevens, MD Scott Woller, MD Greg Elliott, MD

Purpose of the Study:

This is a prospective, randomized vanguard trial of trauma patients admitted to the trauma surgery service at IMC who are deemed to be at high risk for venous thromboembolism (VTE). Once identified and enrolled, subjects will be randomized to receive bilateral lower extremity duplex ultrasound (DUS) surveillance (see Appendix A) versus no surveillance. We will compare the two groups with regard to deep vein thrombosis (DVT) and pulmonary embolism (PE) rates, both during the index hospitalization and at 90 days post-discharge. To our knowledge, this is the first prospective, randomized study of its kind to occur since the widespread use of low molecular weight heparins (LMWH) for VTE chemoprophylaxis in trauma patients. The results of this trial will help to assess the feasibility of performing a definitive (likely multi-institutional) trial in the

future.

Hypothesis/Research Questions:

This study will determine the rate of VTE (DVT and PE) in high-risk trauma patients who have surveillance for lower extremity DVT versus those who do not have surveillance. It will also determine the rate of DVT propagation to the popliteal vein or higher by 14 days after discharge in high-risk trauma patients found to have isolated distal DVT.

Background and Significance:

Venous thromboembolism (VTE), comprised of DVT and PE, is a common complication of hospitalized patients. VTE affects an estimated 900,000 people in the U.S annually, and leads to about 300,000 deaths. [1] Major trauma patients are at an exceptionally high risk for developing DVT and PE. Without chemoprophylaxis, DVT incidence in trauma patients is as high as 58% in the lower extremities, with 18% of those being proximal [2]. Despite advances in VTE chemoprophylaxis and treatment with LMWH and methods of detection, VTE remains a significant source of morbidity and mortality in the trauma population.

Current guidelines recommend against routine screening for DVT with DUS in major trauma patients. [4] The evidence supporting this guideline, however, is not strong and continues to be sorely debated. Assessing a four-year prophylaxis and screening protocol, Adams et al. found that 86% of DVTs found on DUS are clinically silent, justifying the importance of routine surveillance in high-risk trauma patients. Additionally, they found that only 21% of VTE patients received enoxaparin within 48 hours of admission, illustrating the high incidence of delayed time to adequate chemoprophylaxis and the importance of this timing on risk assessment. [5] Napolitano et al. also identified four risk factors that place trauma patients at an increased risk of silent DVTs and propagation to PE, and suggested regular DUS in these patients. [6] Another approach was taken by Malhotra et al., who studied the cost-effectiveness of a DVT surveillance program in critically injured trauma patients. With a protocol of twice weekly DUS screening, they found a higher rate of DVT, a lower rate of PE, and concluded that their protocol was cost-effective based on quality adjusted life years saved. [7] On the contrary, Cipolle and colleagues found that despite decreasing DUS screening in major trauma patients, rate of PE was unchanged, concluding that strict adherence to a prophylaxis regimen was more important than surveillance. [8] They did recommend, however, regular DUS scans in patients they identified as high-risk, and when there was a delay to enoxaparin administration of greater than 48 hours. Schwarcz assessed the value of DUS surveillance in high-risk trauma patients and concluded that, in the setting of adequate chemoprophylaxis with enoxaparin, its utility is limited. [9]

In debating the utility of DUS in patients receiving prophylaxis with LMWH, one must acknowledge the emerging evidence questioning the current standard of LWMH dosing. Fixed twice-daily enoxaparin dosing for all patients has been found to result in subtherapeutic anti-Xa levels and thus may not constitute adequate prophylaxis. Data exists suggesting that a one-size-fits-all approach is inferior to a weight-based regimen using enoxaparin for VTE prophylaxis in trauma patients. [10] [11] As illustrated by the conflicting and poor retrospective data cited above, more evidence and prospective data is needed regarding the impact of DUS surveillance in trauma patient outcomes.

When assessing which trauma patients might warrant DUS screening, a risk assessment tool must be applied. The most common risk factors identified in the literature include age, ISS, specific underlying conditions, spinal cord injury, long bone and pelvic fractures. [7] [8] [9] [10] Two validated VTE risk assessment tools exist for hospitalized patients, one by Caprini and one by Maynard and Stein. [12] [13] Neither of these scoring systems, however, have been validated in the trauma patient population.

The risk assessment profile (RAP) score, developed by Greenfield in 1997, [14] has been validated retrospectively in two analyses, and may be more applicable to assessing the trauma patient population. [13] [15]

At IMC, our trauma service has adopted an aggressive VTE prophylaxis protocol that involves risk-stratifying patients upon admission. Currently, only high-risk patients for VTE in whom enoxaparin is contraindicated undergo regularly scheduled bilateral lower extremity DUS as surveillance for DVT. We hypothesize that high-risk trauma patients, regardless of chemoprophylaxis, who undergo scheduled DUS surveillance for lower extremity DVT will have a lower rate of symptomatic DVT, DVT propagation, and symptomatic or fatal pulmonary embolism (PE) than those who do not have screening.

Significance:

VTE has been deemed a major threat by the US Surgeon General and the Centers for Medicare and Medicaid Services (CMS). Hospitals are under pressure to reduce or even eliminate VTE, or risk financial repercussions. The current ACCP guidelines do not differentiate high-risk trauma patients from lower-risk patients in the recommendations against routine DUS screening. Haut et al. identified significant variability in opinion and protocols among trauma surgeons and hospitals regarding regular screening for DVT, and found that the VTE rate may be more a function of surveillance bias than of the quality of care. [3] At our trauma service at IMC, our DVT rate is currently about 3%, [16] which has been deemed “too high” according to Intermountain

Healthcare and national targets. Most (approximately 85%) of the DVTs that we diagnose are clinically silent and are found during DUS surveillance of high risk patients.

If we were to discontinue routine DUS surveillance of the highest risk trauma patients, our DVT rate would certainly decrease. It is not at all clear, however, that this would translate to better overall patient outcomes, e.g., less PE, less major bleeding episodes, less mortality. It is very important to answer this question in a prospective, randomized fashion, as this has never been done since the advent of LMWH use for chemoprophylaxis.

Recruitment:

Subjects will be recruited from the trauma surgery service at IMC. This project involves direct patient contact and the collection of protected health information (PHI). The measures to protect PHI include:

1. The original subject data files and study data collection forms will be kept in a secure, locked cabinet in the Shock Trauma ICU at IMC, accessible only by study personnel. Electronic data files will be stored on a password-protected Intermountain Healthcare computer in a locked office.
2. Each subject in the research study will be assigned a unique identification number.
3. There will be no third party disclosure of patient identifying information.

Research Subjects:

Inclusion Criteria:

1. Inpatient status on IMC trauma surgery service, admitted within 24 hours of injury.
2. Age ≥18 at the time of injury
3. Meets the definition of high-risk for VTE according to current IMC trauma service guidelines (see Appendix A)

Exclusion Criteria:

1. Patient age <18 years at the time of admission to the hospital
2. Pregnancy
3. Prisoners
4. Patients with a life expectancy of less than 30 days
5. Patients with a known hypercoagulable state including:
    a. Factor V Leiden
    b. Protein C and S deficiencies
    c. Dysfibrogenemia of any sort
    d. Active cancer

e. Antiphospholipid antibody syndrome
f. History of DVT or PE within past 6 months
g. Myeloproliferative disorders

6. Patients on therapeutic anticoagulation who do not have their agent held upon admission to the hospital.
7. Patient elects to opt-out of the study

Methods/Procedures:

This is a prospective, randomized study with outcomes determined by blinded event adjudication (PROBE). Patients will be screened upon admission to the hospital, and enrolled within 24 hours from admission. Subjects will then be randomized to either the surveillance arm or the no surveillance arm. Subjects enrolled in the surveillance arm will undergo bilateral DUS on post-injury days 1, 3, 7, and every 7 days thereafter until discharge from the hospital. Subjects in the no surveillance arm will have routine hospital care on the trauma service, with no DUS performed unless symptomatic for DVT. (See Appendix B) Trauma physicians and advanced practice clinicians (APCs) will perform daily history and physical examinations targeted at eliciting symptoms and signs of potential VTE in all subjects.

All subjects enrolled in both arms of the study will have appropriate VTE prophylaxis provided (enoxaparin 30mg SQ every 12 hours if BMI<30, enoxaparin 0.5mg/kg SQ every 12 hours if BMI>30) according to the current IMC trauma service guidelines. VTE chemoprophylaxis will be started upon admission, or when deemed clinically safe according to the trauma service protocols. If chemoprophylaxis is not begun right away (because of solid organ injury, traumatic brain injury, etc.), those subjects will receive mechanical prophylaxis according to the trauma service guidelines.

Asymptomatic DVT in the surveillance group will be determined on the day of the DUS, prior to hospital discharge. Symptomatic DVT and PE during hospitalization in both groups will be pursued using the Wells score as guidance for DVT diagnosis and using objective imaging as diagnostic confirmation. 90 day follow-up of all subjects will be performed by reviewing medical records in the Intermountain Healthcare computerized medical record to look for evidence of VTE. All outcomes will be adjudicated by a panel of independent physician adjudicators blinded as to whether the patients were randomized to surveillance or not.

All subjects diagnosed with acute proximal DVT or PE will be treated with therapeutic doses of anticoagulants while in the hospital and after discharge, as appropriate. Subjects who are diagnosed with isolated calf DVT while in the hospital will have a follow up DUS on day 14 after

the initial diagnosis to check for thrombus propagation, per current ACCP guidelines. Patients in whom thrombus propagates to the proximal deep veins will receive therapeutic anticoagulation unless contraindicated, according to the usual standard of care. See Appendix B for a flow chart that depicts treatment decisions throughout the study.

In order to investigate our hypothesis, this study will compare outcome variables between the surveillance and the non-surveillance groups.

Randomization:
Randomization will be performed by the randomization module in the REDcap system. Subjects will be randomized to either the screening group or a non-screening group.

Informed Consent:
Potential subjects will be approached by the investigators or by authorized members of the study team in the ICU. They will be given a form that briefly explains the study and, if they desire, by signing at the bottom of the form, they may opt out of the study. Patients will be given as much time to consider participation as they need and they will be able to ask questions about the study.

Risks:
Participation in this study poses minimal risks. There are no risks associated with the duplex ultrasound procedure.

Benefits:
We do not know if this study will directly benefit subjects. Most DVT that we diagnose is clinically silent and is found with DUS imaging. Being evaluated with DUS may benefit subjects if it helps us to see DVT that we would not otherwise know is there, so we can treat it.

The information gained from this research may help future patients and will contribute to knowledge regarding ultrasound surveillance in high risk trauma patients. Answering this research question is important as it may lead to less PE, fewer major bleeding episodes, and less mortality for patients in the future.

Compensation:
Subjects will not be compensated.

Data Collection:

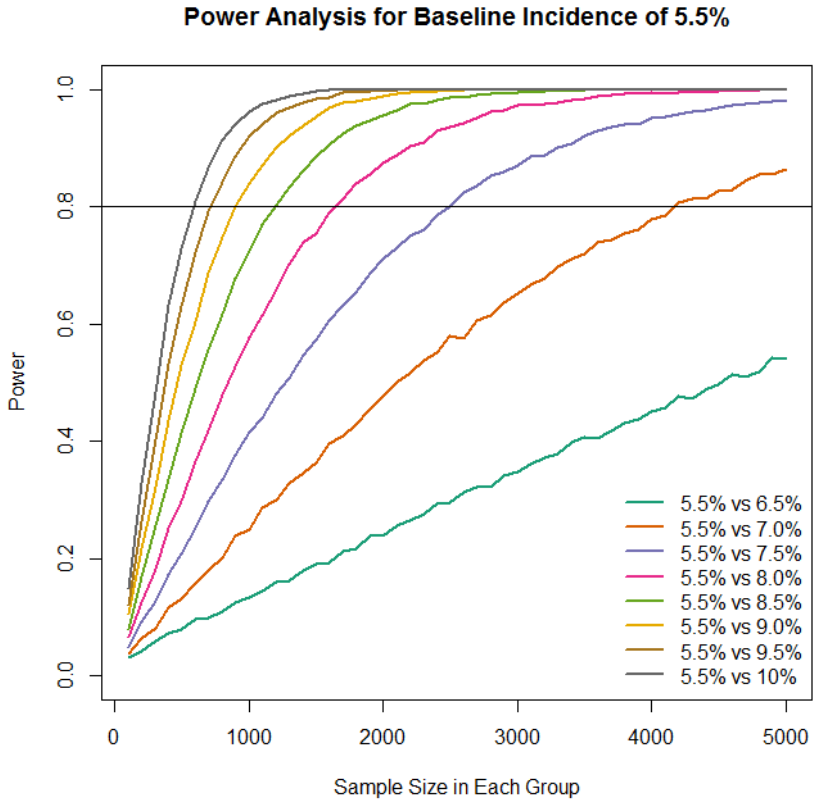
The following variables will be collected for all subjects in both arms of the study in a secure, computerized database (REDcap):

1. Patient demographics
2. Past medical/surgical/family/social history
3. Mechanism of injury
4. Injuries sustained and Injury Severity Score (ISS)
5. All items in the Caprini DVT risk assessment model (See Appendix C)—this information will be used for descriptive purposes and as a means of comparing the two study groups.
6. All items in the Risk Assessment Profile (RAP) for VTE (See Appendix D)—this information will be used for descriptive purposes and as a means of comparing the two study groups.
7. VTE pharmacoprophylaxis agent, dose, time from admission to first dose, interruptions in pharmacoprophylaxis and for what reason
8. Mechanical prophylaxis modality used
9. Asymptomatic DVT in surveillance group with location
10. Symptomatic DVT/PE with location during hospitalization and at 90 days
11. DVT propagation with location during hospitalization and at 14 days
12. Major and clinically relevant bleeding during hospitalization and at 90 days (see Appendix E).
13. All cause mortality during hospitalization and at 90 days

Data Analysis/Statistics:

A historic baseline incidence of the composite outcome of major bleeding events plus proximal DVT on the trauma service is about 5.5%. We expect that in the no surveillance group, the incidence of the composite outcome will be higher. We are not entirely sure how much higher, which is one of the reasons for performing this vanguard trial. The below power analysis reflects that. Based on this power analysis, we would need to enroll at least 1000 subjects in each arm to discern a true difference, perhaps more, depending on the difference in events between the two groups. It is unreasonable given current financial and time constraints to do this definitively at a single center.

Based on historical trauma service admissions of 3000 per year, we estimate that 65-75% of admitted patients will qualify for the study, and 50-75% of those will agree to enroll. Thus, we estimate that over the course of one year, we could enroll about 300 patients per arm. This number of patients should be sufficient to help us determine the feasibility of a definitive, likely multi-institutional future trial.



A chi-squared test will be calculated to compare the rate of VTE between the surveillance group and the no surveillance group

Effect Size	**Minimum Sample Size per Group**
6.5% (+1.0%)	Doesn't achieve 80% power at n=5000 per group
7.0% (+1.5%)	4,200
7.5% (+2.0%)	2,500
8.0% (+2.5%)	1,600
8.5% (+3.0%)	1,200
9.0% (+3.5%)	900
9.5% (+4.0%)	700
10.0% (+4.5%)	600

Funding:
We have applied for a research grant through the Intermountain Research and Medical Foundation.

References:

1. Raskob GE, Silverstein R, Bratzler DW, Heit JA, White RH. Surveillance for deep vein thrombosis and pulmonary embolism: recommendations from a national workshop. Am J Prev Med. 2010 Apr;38(4 Suppl):S502-9.
2. Geerts, WH, Code KI, Jay RM, Chen E, Szalai JP. A prospective study of venous thromboembolism after major trauma. N Engl J Med. 1994 Dec 15;331(24):1601-6.
3. Haut ER, Schneider EB, Patel A, Streiff MB, Haider AH, Stevens KA, Chang DC, Neal ML, Hoeft C, Nathens AB, Cornwell EE 3rd, Pronovost PJ, Efron DT. Duplex ultrasound screening for deep vein thrombosis in asymptomatic trauma patients: a survey of individual trauma surgeon opinions and current trauma center practices. J Trauma. 2011 Jan;70(1):27-33.
4. Guyatt GH, Akl EA, Crowther M, Gutterman DD, Schünemann HJ. Antithrombotic Therapy and Prevention of Thrombosis, 9th ed: American College of Chest Physicians Evidence- Based Clinical Practice Guidelines CHEST 2012; 141(2)(Suppl):7S–47S.
5. Adams RC, Hamrick M, Berenguer C, Senkowski C, Ochsner MG. Four Years of an Aggressive Prophylaxis and Screening Protocol for Venous Thromboembolism in a Large Trauma Population. J Trauma. 2008 Aug;65(2):300-6.
6. Napolitano LM, Garlapati VS, Heard SO, Silva WE, Cutler BS, O'Neill AM, Anderson FA Jr, Wheeler HB. Asymptomatic deep venous thrombosis in the trauma patient: is an aggressive screening protocol justified? J Trauma. 1995 Oct;39(4):651-7.
7. Malhotra AK, Goldberg SR, McLay L, Martin NR, Wolfe LG, Levy MM, Khiatani V, Borchers TC, Duane TM, Aboutanos MB, Ivatury RR. DVT Surveillance Program in the ICU: Analysis of Cost-Effectiveness. PLoS One. 2014 Sep 30;9(9):e106793 . doi: 10.1371/journal.pone.0106793.
8. Cipolle MD, Wojcik R, Seislove E, Wasser TE, Pasquale MD. The role of surveillance duplex scanning in preventing venous thromboembolism in trauma patients. J Trauma. 2002 Mar;52(3):453-62.

9. Schwarcz TH, Quick RC, Minion DJ, Kearney PA, Kwolek CJ, Endean ED. Enoxaparin treatment in high-risk trauma patients limits the utility of surveillance venous duplex scanning. J Vasc Surg. 2001 Sep;34(3):447-52.
10. Bickford A, Majercik S, Bledsoe J, Smith K, Johnston R, Dickerson J, White T. Weight-based enoxaparin dosing for venous thromboembolism prophylaxis in the obese trauma patient. Am J Surg. 2013 Dec;206(6):847-51
11. Constantini TW, Min E, Box K, Tran V, Winfield RD, Fortlage D, Doucet J, Bansal V, Coimbra R. Dose adjusting enoxaparin is necessary to achieve adequate venous thromboembolism prophylaxis in trauma patients. J Trauma Acute Care Surg. 2013 Jan;74(1):128-33.
12. Caprini JA. Thrombosis risk assessment as a guide to quality patient care. Dis Mon 2005; 51: 70-78.
13. Maynard G, Stein J. Designing and implementing effective venous thromboembolism prevention protocols: lessons from collaborative efforts. J Thromb Thrombolysis 2010;29:159-66.
14. Greenfield LJ, Proctor MC, Rodriguez JL, et al. Posttraumatic thromboembolism prophylaxis. J Trauma 1997;42:100-3.
15. Hegsted D, Gritsiouk Y, Schlesinger P, Gardiner S, Bugler KD. Utility of the risk assessment profile for risk stratification of venous thrombotic events for trauma patients. Am J Surg. 2013 May;205(5):517-20.
16. Intermountain Medical Center Trauma Registry (TraumaBase 7, Conifer, Colorado). Accessed 5/12/15.

APPENDIX

Appendix A: Factors that Identify Trauma Patients as High Risk for VTE

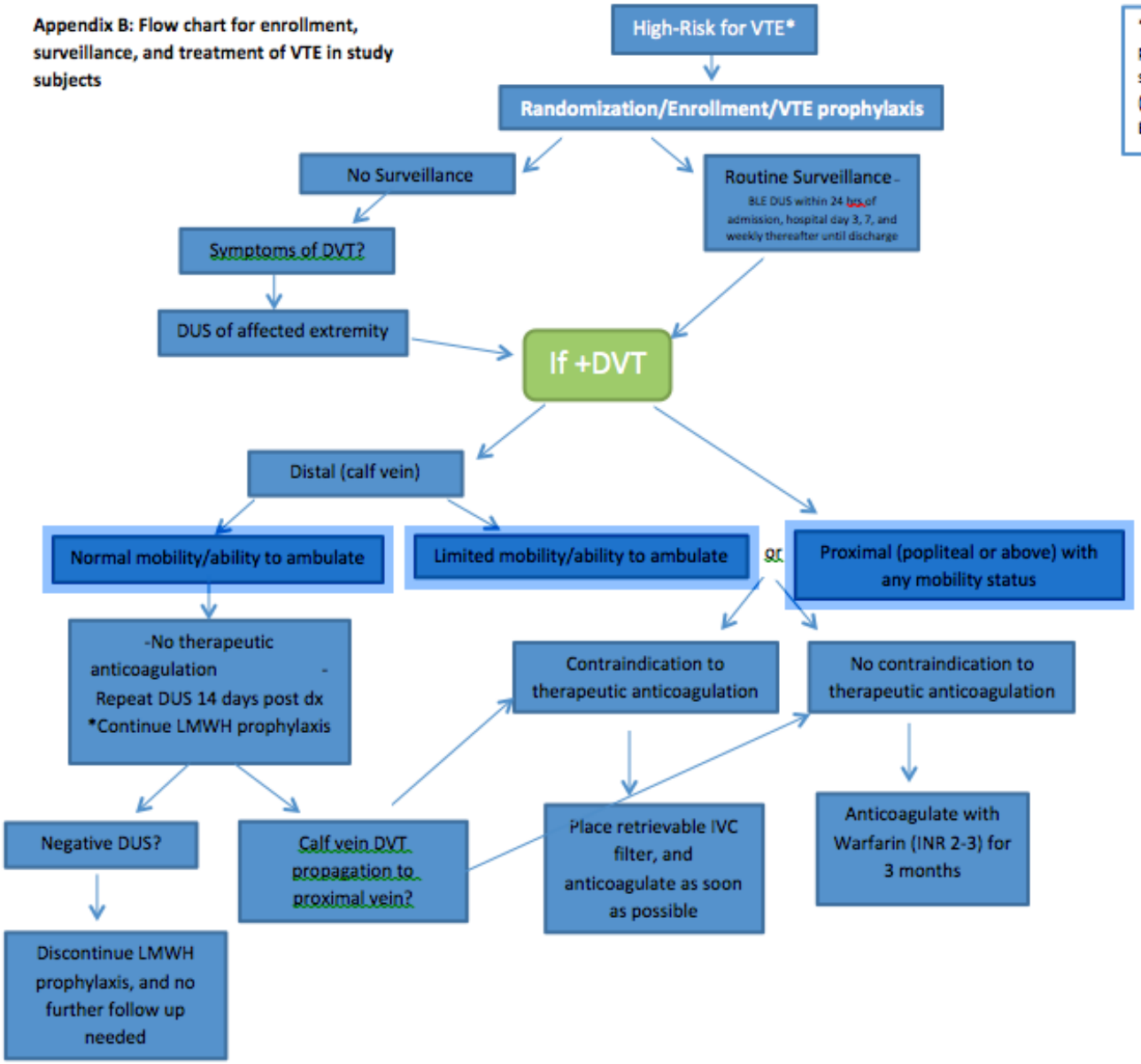
From Intermountain Medical Center Trauma Program Guideline for Venous Thromboembolism, revised 2013.

Any one of these factors identifies a patient as high risk:

1. Pre-Injury Risk Factors
    a. Obesity (BMI > 30)
    b. Age > 40 years
    c. History of VTE
    d. History of malignancy
    e. Any known hypercoagulable state

2. Injury-Related Risk Factors
    a. Major venous injury
    b. Spinal cord injury
    c. Spinal fracture
    d. Major operative procedure of any kind
    e. Pelvic fracture
    f. Lower extremity fracture
    g. Hemorrhagic shock
    h. Moderate or severe head injury (GCS <13 at presentation)
    i. ISS > 9
    j. Central venous line

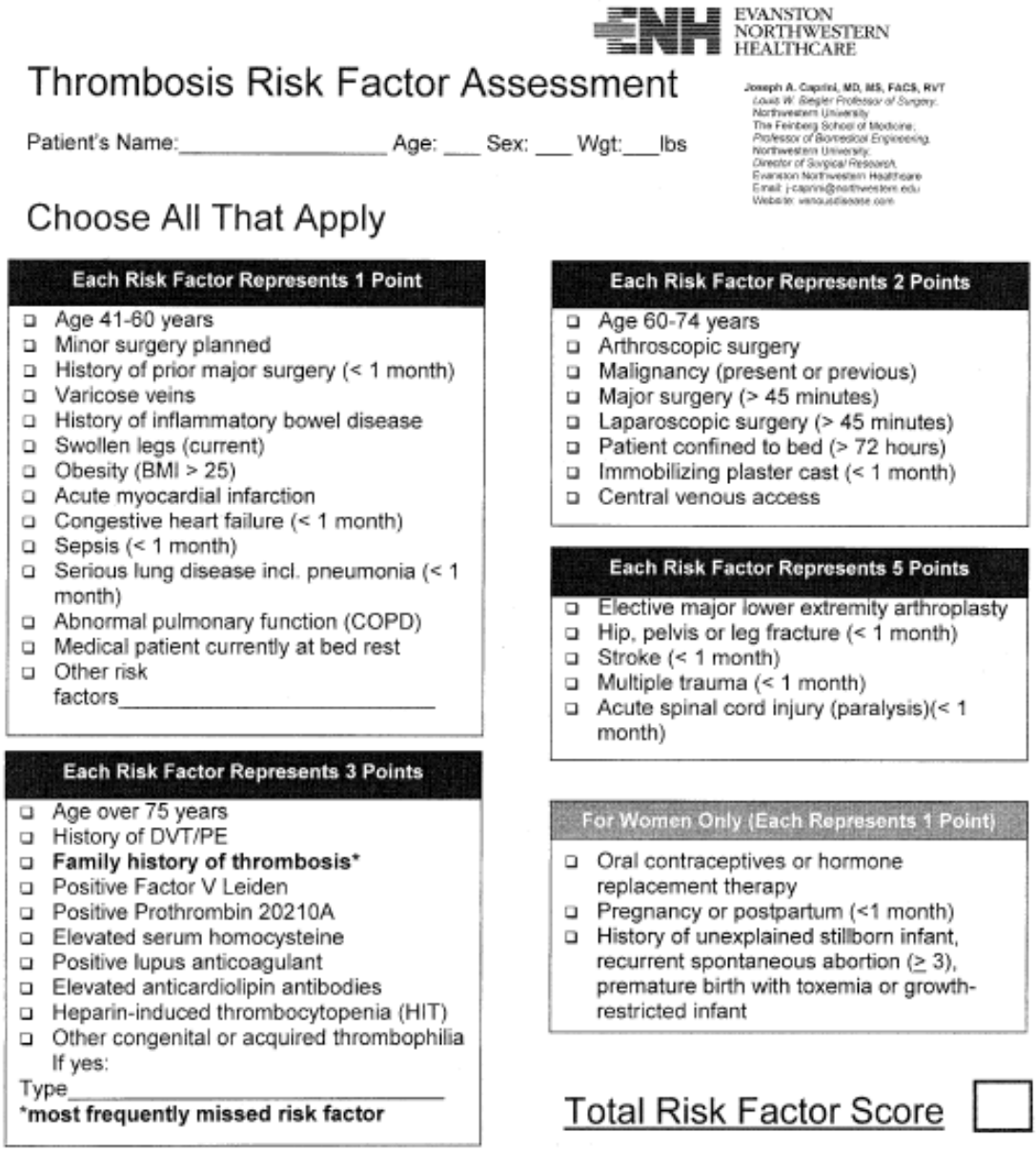
Appendix B: Flow chart for enrollment, surveillance, and treatment of VTE in study subjects



* Major operative procedure, pelvic fracture, LE fracture, shock, spinal fracture, TBI (GCS<13), ISS>9, central line, BMI>30 and preinjury factors

Appendix C: Caprini Risk Factor Assessment

From "Thrombosis Risk Assessment as a Guide to Quality Patient Care", Joseph Caprini, MD, 2005. Available online at: http://williams.medicine.wisc.edu/caprini_score.pdf



EVANSTON NORTHWESTERN HEALTHCARE

Thrombosis Risk Factor Assessment

Joseph A. Caprini, MD, MS, FACS, RVT
Louis W. Siegler Professor of Surgery,
Northwestern University
The Feinberg School of Medicine;
Professor of Biomedical Engineering,
Northwestern University;
Director of Surgical Research,
Evanston Northwestern Healthcare
E-mail: j-caprini@northwestern.edu
Website: venousdisease.com

Patient's Name:_____ Age: ___ Sex: ___ Wgt:___lbs

Choose All That Apply

Each Risk Factor Represents 1 Point

- ❑ Age 41-60 years
- ❑ Minor surgery planned
- ❑ History of prior major surgery (< 1 month)
- ❑ Varicose veins
- ❑ History of inflammatory bowel disease
- ❑ Swollen legs (current)
- ❑ Obesity (BMI > 25)
- ❑ Acute myocardial infarction
- ❑ Congestive heart failure (< 1 month)
- ❑ Sepsis (< 1 month)
- ❑ Serious lung disease incl. pneumonia (< 1 month)
- ❑ Abnormal pulmonary function (COPD)
- ❑ Medical patient currently at bed rest
- ❑ Other risk factors_____

Each Risk Factor Represents 2 Points

- ❑ Age 60-74 years
- ❑ Arthroscopic surgery
- ❑ Malignancy (present or previous)
- ❑ Major surgery (> 45 minutes)
- ❑ Laparoscopic surgery (> 45 minutes)
- ❑ Patient confined to bed (> 72 hours)
- ❑ Immobilizing plaster cast (< 1 month)
- ❑ Central venous access

Each Risk Factor Represents 3 Points

- ❑ Age over 75 years
- ❑ History of DVT/PE
- ❑ **Family history of thrombosis***
- ❑ Positive Factor V Leiden
- ❑ Positive Prothrombin 20210A
- ❑ Elevated serum homocysteine
- ❑ Positive lupus anticoagulant
- ❑ Elevated anticardiolipin antibodies
- ❑ Heparin-induced thrombocytopenia (HIT)
- ❑ Other congenital or acquired thrombophilia

If yes:
Type_____
***most frequently missed risk factor**

Each Risk Factor Represents 5 Points

- ❑ Elective major lower extremity arthroplasty
- ❑ Hip, pelvis or leg fracture (< 1 month)
- ❑ Stroke (< 1 month)
- ❑ Multiple trauma (< 1 month)
- ❑ Acute spinal cord injury (paralysis)(< 1 month)

For Women Only (Each Represents 1 Point)

- ❑ Oral contraceptives or hormone replacement therapy
- ❑ Pregnancy or postpartum (<1 month)
- ❑ History of unexplained stillborn infant, recurrent spontaneous abortion (≥ 3), premature birth with toxemia or growth-restricted infant

Total Risk Factor Score ☐

Appendix D: Risk Assessment Profile (RAP)

From Greenfield LJ, Proctor MC, Rodriquez JL, et al. Posttrauma thromboembolism prophylaxis. *J Trauma* 1997; 42:100-3.

Variable	Points
Underlying Condition	
Obesity	2
Malignancy	2
Abnormal Coagulation	2
History of Thromboembolism	3
Iatrogenic Factors	
Femoral Central Line >24 hrs	2
Transfusion, >4 units in 24 hrs	2
Surgery lasting >2 hrs	2
Repair or ligation of major vascular injury	3
Injury-related Factors	
Chest AIS > 2	2
Abdomen AIS >2	2
Head AIS > 2	2
Spinal Fracture	3
GCS <8 for >4 hrs	3
Complex lower extremity fracture	4
Pelvis fracture	4
Spinal Cord injury, paraplegia or quadriplegia	4
Age (yrs)	
≥40 but <60	2
≥60 but <75	3
≥75	4

Appendix E: Definition of Major and Clinicall Relevant Bleeding

Table 1. Definition of Major and Clinically Relevant Bleeding.*

Major bleeding
Bleeding associated with a fall in hemoglobin of 2 g per deciliter or more
Bleeding that led to a transfusion of 2 or more units of packed red cells or whole blood†
Bleeding that involved a critical organ (intracranial, intraocular, intraspinal, retroperitoneal, or pericardial)
Bleeding that contributed to death
Clinically relevant bleeding
Any bleeding compromising hemodynamics
Any bleeding leading to hospitalization
Subcutaneous hematoma larger than 25 cm^2, or 100 cm^2 if there was a traumatic cause
Intramuscular hematoma documented by ultrasonography
Epistaxis that lasted for more than 5 minutes, was repetitive (i.e., two or more episodes of bleeding more extensive than spots on a handkerchief within 24 hours), or led to an intervention (e.g., packing or electrocoagulation)
Gingival bleeding occurring spontaneously (i.e., unrelated to eating or tooth brushing) or lasting for more than 5 minutes
Hematuria that was macroscopic and was spontaneous or lasted for more than 24 hours after instrumentation (e.g., catheter placement or surgery) of the urogenital tract
Macroscopic gastrointestinal hemorrhage, including at least one episode of melena or hematemesis, if clinically apparent with positive results on a fecal occult-blood test
Rectal blood loss, if more than a few spots on toilet paper
Hemoptysis, if more than a few speckles in the sputum and not occurring within the context of pulmonary embolism
Any other bleeding type considered to have clinical consequences for a patient — such as medical intervention, the need for unscheduled contact (visit or telephone call) with a physician, or temporary cessation of a study drug — or associated with pain or impairment of activities of daily life

* Any one or more of the criteria met the definition of either major or clinically relevant bleeding.
† A red-cell unit was defined as the quantity of red cells obtained from or corresponding to approximately 500 ml of whole blood.

Büller HR, Cohen AT, Davidson B, et al. Idraparinux versus standard therapy for venous thromboembolic disease. N Engl J Med. 2007;357:1094–1104.

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BIOGRAPHICAL SKETCH

Provide the following information for the Senior/key personnel and other significant contributors.
Follow this format for each person. **DO NOT EXCEED FIVE PAGES.**

NAME: Sarah Dawn Majercik

eRA COMMONS USER NAME (credential, e.g., agency login): SMAJERCIK

POSITION TITLE: Co-Director, Trauma Research, Trauma and Surgical Critical Care

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.)*

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	Completion Date MM/YYYY	FIELD OF STUDY
Harvard College, Cambridge, MA	A.B.	06/1993	History of Science
University of Vermont, Burlington, VT	M.D.	05/1997	Medicine
Brown University, Providence, RI	n/a	06/2002	General Surgery Residency
Washington University, St. Louis, MO	M.B.A.	05/2007	Finance

A. Personal Statement

I am a clinical general, trauma, and critical care surgeon at Intermountain Medical Center (IMC), an ACS-verified Level I trauma center. I also serve as the co-director of research for the trauma service at IMC. Since starting in this role in 2011, I have gained expertise in conducting clinical trauma research, and I have led the trauma research group and all projects that have been done in our division. Further, I have generated multiple peer-reviewed publications since my arrival at IMC.

I have more than thirteen years of clinical experience with traumatically-injured patients. I have extensive experience with enrolling trauma patients into research studies, most recently as an investigator in a randomized double blind controlled trial of weight-based versus standard dosing of enoxaparin for venous thromboembolism (VTE) prophylaxis in the trauma population. I am the PI of several Intermountain Research and Medical Foundation funded grants, one of which focuses on hypercoagulability as measured by thromboelastography in patients with solid organ injury. This application is a logical extension of my interest in coagulation and VTE in the trauma population.

From 2008-2011, my research career was interrupted by a corporate position in a medical device company. This was done because of family obligations. When I returned to trauma surgery/surgical critical care, I immediately embarked upon new research projects.

B. Positions and Honors

Positions and Employment

2002-2005 Assistant Professor of Surgery, Brown University, Providence, RI
2005-2007 Clinical Assistant Professor of Surgery, University of Missouri, Columbia, MO
2007-2008 Assistant Professor of Surgery, Brown University, Providence, RI
2008-2010 Medical Director, Becton Dickinson, Sandy, UT
2011- Trauma and Critical Care Surgeon, Co-Director of Trauma Research, Intermountain Medical Center, Salt Lake City, UT

Professional Certifications and Memberships

2002- Diplomate, American Board of Surgery (exp. 9/2024)
2003- Fellow, American College of Surgeons
2013- Member, Southwestern Surgical Congress
2014- Member, American Association for the Surgery of Trauma
2015- Member, Eastern Association for the Surgery of Trauma

Honors

1997 James Demeules award for excellence in surgical research, University of Vermont
2002 Haffenreffer award for excellence in medical sciences, Brown University
2005 Harold and Joyce Wood Fellowship, Olin School of Business, Washington University
2014 Peter C. Canizaro award, American Association for the Surgery of Trauma

C. Contribution to Science

1. The incidence of major trauma in the elderly is increasing globally. Mortality after trauma is significantly higher for patients over the age of 60 for any given injury severity. My earliest research work addressed the issue of cervical spine fractures in the elderly. Specifically, these papers examined the effect of different treatment modalities (halo-vest immobilization, hard collar immobilization, or surgical fixation) on outcomes in this population. This work resulted in a change in how cervical spine fractures in the elderly were treated at my home institution, and the manuscripts have been extensively cited in the medical literature. I was the PI or co-investigator on these papers.
    a. **Majercik S**, Biffl WL, Tashjian RZ, Harrington DT, Cioffi W. Halo vest immobilization in the elderly: a death sentence. *Journal of Trauma* 2005; 59(2): 350-357.
    b. Tashjian RZ, **Majercik S,** Biffl WL, Cioffi WG. Halo-vest immobilization increases early morbidity and mortality in elderly odontoid fractures. *Journal of Trauma* 2006; 60(1): 199-203.

2. Risk stratification is necessary to predict outcomes after trauma. There is currently no validated mortality prediction model for injured patients that can be calculated immediately after injury in the emergency department. The Intermountain Risk Score (IMRS) is a tool that was developed at Intermountain Healthcare to evaluate individual mortality risk based on admission laboratory values, age, and gender. My work using the IMRS was the first time that the score was used to calculate mortality in trauma patients. It was found to be highly predictive of mortality in moderate and high-risk groups of males and females at both 30 days and one year after injury in a large historical cohort. As a corollary, I studied the red cell distribution width (RDW) as an independent predictor of mortality in trauma patients. I found that higher RDW is correlated with an increased risk of mortality in a historic cohort of patients. I was the PI on both of these studies. Currently, I am analyzing data on a one year, prospective validation of the use of the IMRS in trauma patients. Results of this study should be available in the next six months.
    a. **Majercik S,** Knight S, Horne BD. The Intermountain risk score predicts mortality in trauma patients. *J Crit Care* 2014; 29:882.
    b. **Majercik S,** Fox J, Knight S, Horne BD. Red cell distribution width is predictive of mortality in trauma patients. *J Trauma Acute Care Surg* 2013;74:1021-6.
    c. **Majercik S.** Re: Red Cell distribution width is predictive of mortality in trauma patients. *J Trauma Acute Care Surg* **2013** Aug;75(2):346.

3. Rib fractures are a common injury, occurring in over 10% of patients who present to trauma centers. They can also be very disabling, with about 50% of patients who suffer significant rib injury reporting chronic pain and/or chest wall deformity, often precluding full-time employment. Traditional therapy of rib fractures consists of aggressive pain management, pulmonary toilet, and mechanical ventilatory support as needed. In the past decade, there has been increased interest in the surgical stabilization of rib fractures, especially in patients with the most complex injuries. It is not yet considered the standard of care for treatment, with many surgeons citing a lack of compelling data as a reason for not adopting the procedure. At Intermountain Medical Center, we are at the clinical forefront of surgical rib fracture repair. I have worked as the PI on several projects reporting our experience, ranging from a 2012 poster to several publications and national presentations on the topic. The results of my work have been important in increasing the visibility and adoption of the procedure at trauma centers throughout the United States.
    a. **Majercik S**, Wilson E, Gardner S, Granger S, VanBoerum DH, et al. In-hospital outcomes and costs of surgical stabilization versus nonoperative management of severe rib fractures. J Trauma Acute Care Surg. 2015 Oct;79(4):533-9. PubMed PMID: 26402525.
    b. **Majercik S**, Cannon Q, Granger SR, Van Boerum DH, White TW. Regarding: Long-term patient outcomes after surgical stabilization of rib fractures. Am J Surg. 2015 Jul;210(1):199-200. PubMed PMID: 26072282.

c. **Majercik S**, Cannon Q, Granger SR, VanBoerum DH, White TW. Long-term patient outcomes after surgical stabilization of rib fractures. Am J Surg. 2014 Jul;208(1):88-92. PubMed PMID: 24507379.

4. Venous thromboembolism (VTE) is a source of major morbidity and mortality in trauma patients. The trauma population is unique in that patients are at major risk for bleeding early on in their hospital course, and then rapidly switch over to being at major risk for thrombosis. VTE prophylaxis has been extensively studied in trauma, yet optimal dosing and surveillance regimens are still not known. In the area of VTE prophylaxis in trauma patients, I am a part of several ongoing and completed projects. The first was a prospective, observational study of the efficacy of weight-based enoxaparin dosing in the obese trauma population. In this study, we measured anti-Xa levels to assess the efficacy of enoxaparin, and to adjust the dose as necessary. [10] The second, ongoing project is a prospective, randomized, control trial of standard versus weight-based enoxaparin dosing in all adult trauma patients, with VTE events as the primary endpoint. The third ongoing prospective, observational trial examines the thromboelastography coagulation profile in the first several days after trauma in a population with solid organ (spleen, liver, kidney, brain) injury.
    a. Bickford A, **Majercik S**, Bledsoe J, Smith K, Johnston R, et al. Weight-based enoxaparin dosing for venous thromboembolism prophylaxis in the obese trauma patient. Am J Surg. 2013 Dec;206(6):847-51, discussion 851-2. PubMed PMID: 24070664.

Complete list of published works in MyBibliography:
http://www.ncbi.nlm.nih.gov/sites/myncbi/collections/bibliography/48834237/

D. <u>Research Support</u>

Ongoing Research Support

Intermountain Research and Medical Foundation 12/01/2012-present
Weight Based Enoxaparin VTE Prophylaxis in Trauma Patients
Role: Co-Investigator

Intermountain Research and Medical Foundation 7/1/13-present
VALIDation of Bedside Ultrasound of the Muscle Layer Thickness of the Quadriceps in the Critically Ill Patient: The VALIDUM Study. A multi-institutional study of the utility of using ultrasound of the quadriceps muscle to diagnose sarcopenia in the critically ill patient.
Role: Site PI

Intermountain Research and Medical Foundation 06/1/2014-present
Determining the incidence of perioperative hypercoagulability using thromboelastography in the colorectal cancer population
Role: Co-Investigator

Intermountain Research and Medical Foundation 06/1/2014-present
Prospective observation study of post-injury hypercoagulability in patients with blunt solid organ injury, by serial measurements with thromboelastography
Role: PI

Completed Research Support

The Deseret Foundation 01/01/12-2/01/14
Traumatic Brain Injury: Early Imaging and Treatment Affecting Rehabilitation Outcomes
Role: Co-PI (co-PI's Mark Stevens, MD and Joel MacDonald, MD)

The Deseret Foundation 05/1/2012-9/1/2015
The Effects of Hypobaric Conditions on Traumatic Pneumothoraces
Role: PI