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VTE COLLABORATIVE TEAM CASE STUDY

Graduate Management Project

Case Study: The Venous Thromboembolism Collaborative Team at the Johns Hopkins Hospital

Prepared By

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Abstract

In an effort to combat new regulatory requirements as well as improve the quality of patient care in their facility, the Johns Hopkins Hospital formed a multi-disciplinary Venous Thromboembolism (VTE) Collaborative in 2005. By implementing a computer based decision support system, the VTE Collaborative was able to implement a tool to screen patients upon admission to the hospital and to assist providers in choosing appropriate prophylaxis for patients based on associated risk. To date, Johns Hopkins Hospital has reduced the incidence of VTE from 2.39% of admissions in 2004 to 1.31% in 2008. This change in incidence represents a reduction of over 330 patients per year who do not acquire a VTE during their stay and a potential cost savings of over $1.2 Million annually. This study profiles the VTE Collaborative efforts in their fight against these preventable conditions.

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Introduction

On September 15th, 2008, the acting Surgeon General of the United States announced a "Call to Action" on the prevention and treatment of Deep Vein Thrombosis and Pulmonary Embolism (O'Riordan, 2008). This Call to Action highlights the public health concerns and the risk factors associated with the medical conditions in an effort to increase public awareness as well as to encourage healthcare providers to initiate processes for prevention. The National Institutes for Health, the National Quality Forum, the Centers for Medicare and Medicaid Services, and the Joint Commission are all heavily involved in the prevention of these conditions and have started developing standards for new reporting measures. The involvement of all of these organizations indicates a strong consensus that something needs to be done to prevent these conditions in hospitals nationwide.

This case study profiles the efforts of the Johns Hopkins Hospital (JHH) Venous Thromboembolism (VTE) Collaborative team and what they have done to combat Deep Vein Thrombosis (DVT) and Pulmonary Embolisms (PE). Initially formed in 2005, this team has been working towards a solution to increase VTE screening for inpatients at the hospital as well as give appropriate prophylaxis for patients based on risk category in an effort to reduce incidence and promote prevention in the facility. Through the use of evidence based medicine as well as a Collaborative of medical and administrative staff, the team developed a computer based decision support system to aid with both screening and prophylaxis of this often preventable medical condition. The resulting schema are provided in this paper for potential adoption in other hospital settings.

Background

Deep vein thrombosis is a medical condition in which the blood clots in one or more places in the body due to a variety of risk factors. A pulmonary embolism, the more fatal of the two, is also a clotting condition in which a portion of the initial blood clot travels through the blood stream and can block pulmonary arteries, which can often lead to death (The Surgeon General, 2008). Venous Thromboembolism (VTE) is a term used to describe any thromboembolic event that occurs within the venous system to include both DVT and PE (Fitzmaurice & McManus, 2002).

Based on two studies completed in Worcester Massachusetts and Olmsted County Minnesota, the incidence rate of VTE is approximately 1 in 1000. Using the results of these studies, the Surgeon General estimates that there are between 250,000 and 600,000 new cases of VTE each year in the United States (The Surgeon General, 2008). These preliminary studies indicate a high incidence rate and a low rate of prevention and appropriate prophylaxis. As a result, there has been a significant initiative within the medical community to develop programs to establish best practices and minimize the incidence rate.

The implications of acquiring VTE during a hospital stay not only put the patient at a higher risk for further medical problems, but can also be very costly for both patients and hospitals. According to a study conducted by Ollendorf, Vera-Llonch, and Oster (2002) on patients who obtained a VTE following orthopedic surgery, the mean length of stay for hospital patients was more than twice as long as for patients who did not obtain a VTE. The study also found that the mean total costs of inpatient care was almost twofold higher for patients with VTE versus those without (Ollendorf et al., 2002).

Several of the most important medical decision bodies in the United States, to include the Centers for Medicare and Medicaid Services, the Joint Commission, and the National Quality Forum have all joined the fight against VTE. With the goal of prevention, several groups have introduced either new legislation or compliance requirements that will eventually force hospitals and other medical facilities to consider the risk of VTE in daily practice.

In 2006, the Centers for Medicare and Medicaid Services (CMS) began investigating ways to reduce "never events" in hospitals as reported by the National Quality Forum (Centers for Medicare and Medicaid Services, 2006). According to the CMS never events, like surgery on the wrong body part or mismatched blood transfusion, cause serious injury or death to beneficiaries, and result in increased costs to the Medicare program to treat the consequences of the error (Centers for Medicare and Medicaid Services, 2006). Through the use of its Inpatient Prospective Payment System, CMS now restricts the payment of extra costs associated with certain medical conditions (Centers for Medicare and Medicaid Services, 2008a). The cost of care associated with treatment of preventable medical conditions acquired within a hospital can drastically increase operating costs.

On August 4, 2008, CMS released its latest list of hospital acquired conditions for which it would no longer pay (Centers for Medicare and Medicaid Services, 2008b). Acquiring a VTE in association with total-hip replacement and total knee replacement is now considered a never event, and hospitals have to pay for the additional care associated with acquiring the condition . In a speech given to the National Coalition to prevent Deep Vein Thrombosis, Dr. Thomas Valuck of CMS stated that although these were two very specific procedure types, CMS is currently in the process of expanding its payment rules for all DVTs and PEs acquired for hospital stays (Valuck, 2009).

As Ollendorf et al. noted in their study, the length of stay for patients can nearly double if a VTE is acquired during their stay (Ollendorf et al., 2002). Their study noted that patients who received a DVT during their stay spent an average of 11.5 days in the hospital and patients that acquired a PE during their stay spent 12.4 days on average for their inpatient stay. Their study also noted that the average length of stay for patients after undergoing a major procedure was 5.4 days, a difference of about 7 extra days within the facility (Ollendorf et al., 2002). If a CMS rule declaring VTE a never event is passed, the prevention of DVT and PE within hospitals will be at the forefront of quality intervention measures across the country.

The Joint Commission and the National Quality Forum (NQF) have been working jointly to develop hospital-reportable quality measures. Since 2004, the Joint Commission and the NQF have jointly worked on researching and developing prevention standards for VTE risk within hospitals (Dunn, P. & Hill, C. D., 2004). As a result of their extensive research, the Joint Commission released and the National Quality forum endorsed two public reporting standards in 2006 (Corrigan, 2006). These two basic measures include the percent of surgery patients with recommended prophylaxis ordered and the percent of surgery patients who receive appropriate prophylaxis within 24 hours prior to and after surgery (SG Call to Action, 2008). Collecting and reporting these data will increase awareness of hospitals that are not performing to established quality standards.

Several studies have shown that the implementation of a computer-based decision support system (CDSS) for the prevention of VTE can not only influence physician behavior in the appropriate preventative treatment and prophylaxis of VTE, but can also significantly reduce the risk of acquiring the condition and improve compliance with regulatory guidelines. Computer-based decision support systems are defined as "any software designed to directly aid

in clinical decision making in which characteristics of individual patients are matched to a computerized knowledge base for the purpose of generating patient specific assessments or recommendations that are then presented to clinicians for consideration" (Hunt et al., 1998, p. 1339). Hunt et al. found that computer-based decision support systems can increase performance for preventative care, drug dosing and other aspects of medical care (Hunt et al., 1998).

Between 1997 and 1999, Durieux et al. conducted a study of the effectiveness of a CDSS implemented for screening and appropriate prophylaxis of VTE in an orthopedic surgery department (Durieux et al., 2000). In this study, a CDSS for VTE was added into a provider order entry system. The VTE CDSS took patient information already in the system, aligned the risk factors and gave the provider a recommendation for the appropriate treatment and prophylaxis of the patient. The authors found that physician compliance with VTE guidelines increased by 12% after CDSS adoption.

In a second study, Kucher et al. from Brigham and Women's hospital in Boston, used a CDSS linked to a patient database to identify patients at risk for VTE (Kucher et al., 2005). In this study, the CDSS utilized a randomized selection of patients and screened them for appropriate risk. If the patients were not on prophylaxis, the program would alert the doctor of a recommendation for appropriate care. Researchers found that the risk of VTE within 90 days after treatment was reduced by 41% with the use of the CDSS (Kucher et al., 2005).

VTE Prevention Efforts at Johns Hopkins Hospital

In late 2004 and early 2005, increased regulatory pressure on hospitals to evaluate various anticoagulation measures prompted JHH to start looking into VTE rates and compliance. With over 33,000 inpatient admissions per year, the risk of patients acquiring VTE poses a substantial patient care and financial risk to the hospital. Under the direction of the Johns

Hopkins Quality Improvement Council, patient chart audits were conducted for some of the high-risk departments to validate adherence to compliance with evidence-based medicine supporting prevention measures based on the appropriate risk to patients. The compliance measures were taken directly from the American College of Chest Physicians standards of care guidelines published in 2004 (Geerts et al., 2004). After completing a random chart audit of several high-risk areas within the facility, the quality council concluded that risk assessment and appropriate prophylaxis given to patients was very poor throughout, with no department having over 53% compliance.

Based on the results of the chart audit and the expected future requirements for national reporting, the Quality Council formed the VTE Collaborative to investigate and develop solutions to improve these conditions at the hospital. The JHH VTE Collaborative was charged with developing a way to accurately risk stratify patients, educating medical providers to give appropriate prophylaxis when indicated, and increasing VTE awareness and prevention methods across the facility. With the main goals of reducing the incidence of VTE across the hospital, the multi-disciplinary team spent the next several years developing and implementing various initiatives.

Based on previous studies showing the effectiveness of implementing a CDSS for VTE prophylaxis and screening, the VTE Collaborative developed a CDSS for VTE screening at JHH that built on the Hospital's existing Provider Order Entry (POE) system. The Collaborative created a CDSS platform within the POE system because of its wide spread use among providers within the facility to input admission orders. Thus, the first step in the development of the CDSS was to meet and discuss system requirements with POE programmers. Although the POE staff were able to develop a basic platform for the VTE order set, the main part of the programming

for the program was the actual flow of the risk assessment and prophylaxis. Because of the complexity of risk in various clinical situations, the VTE Collaborative worked with the clinical leadership and frontline staff to develop schemes appropriate to the type of procedure or patient being seen.

The resulting schema are largely based upon evidenced based medicine guidelines as outlined by the American College of Chest Physicians (Geerts et al., 2004). To date, a total of 11 schemes have been developed. Figure 1 shows an example VTE prophylaxis scheme for the general trauma department. Additional schemes that have been created can be viewed in Appendix A. After each scheme was developed and beta tested it was activated in the POE system and a series of educational events for the medical staff of each affected unit was provided. A complete list of the units currently active with a POE order set for VTE upon admission can be seen in Appendix B.

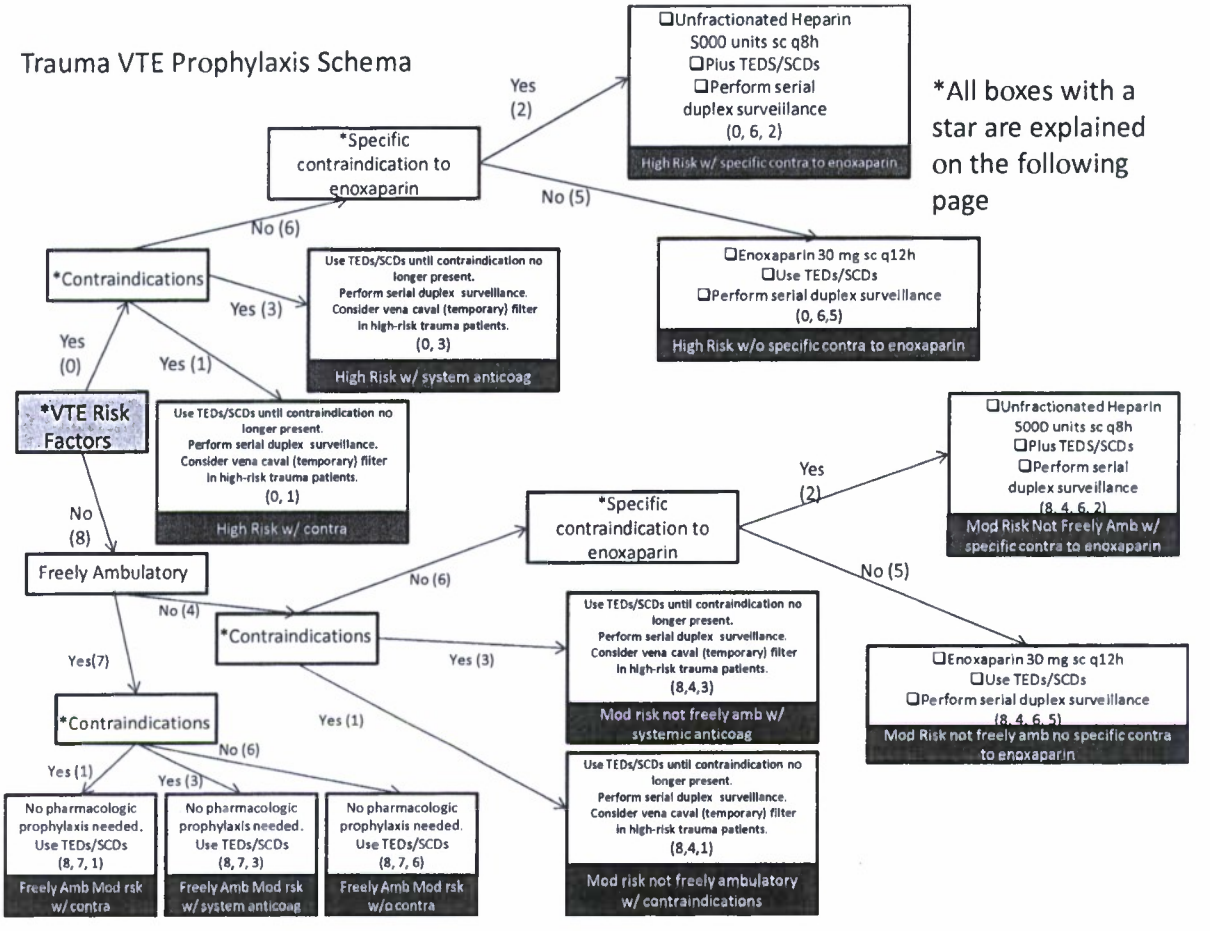

Figure 1. Example VTE Prophylaxis Scheme - Trauma

The CDSS product uses the patient information that has been previously entered into POE to populate basic information, such as patient age, weight, etc. The CDSS prompts the provider to answer a series of questions and the system automatically figures out the appropriate risk category of the patient. Once risk level has been determined, the provider chooses an appropriate prophylaxis for the patient. The provider has the option to choose an appropriate prophylaxis and also has the option to opt out if they do not feel prophylaxis is necessary. A screenshot of the CDSS in POE can be seen in Appendix C.

As part of the overall development, an analytical database was developed to look at the data by department to see how each department is performing. The key reason for developing

this database was not only to be able to extract data from the POE CDSS that was created, but also to provide reports to the leadership of the institution concerning VTE prophylaxis and risk assessment compliance at all levels for the use in continuous quality improvement. To date, automated reports have been developed to assess risk stratification within 24 hours and prophylaxis compliance levels for the facility. All reports also come with a delinquent list for patients that do not meet the requirements of the program, which is in turn used for quality improvement and continuing education for medical units. An example of a report produced for risk stratification compliance can be seen in Appendix D.

The Department of Medicine is by far the largest department identified in this study. With over 13,000 inpatient visits in 2008, the department had more than triple the amount of inpatients than other departments. Because of the volume of patients, reducing the risk of VTE in this department was critical. Looking at their trend over 2008, the Department of Medicine consistently stratified patients for risk over 90% of their visits, with a mean for the year of 95.55%, indicating that on average, over 95% of patients admitted to this department are screened for risk of VTE prior to their admission.

The next important measure to look at when analyzing the reduction in incidence for this department is the compliance with appropriate prophylaxis. Although the preliminary results in the reduction of incidence indicate the department is doing well in assigning appropriate prophylaxis, on average, the department is only giving appropriate proplylaxis to approxametly 72% of patients. Figure 3 below shows the Department of Medicine compliance with appropriate prophylaxis from May-Dec 2008.

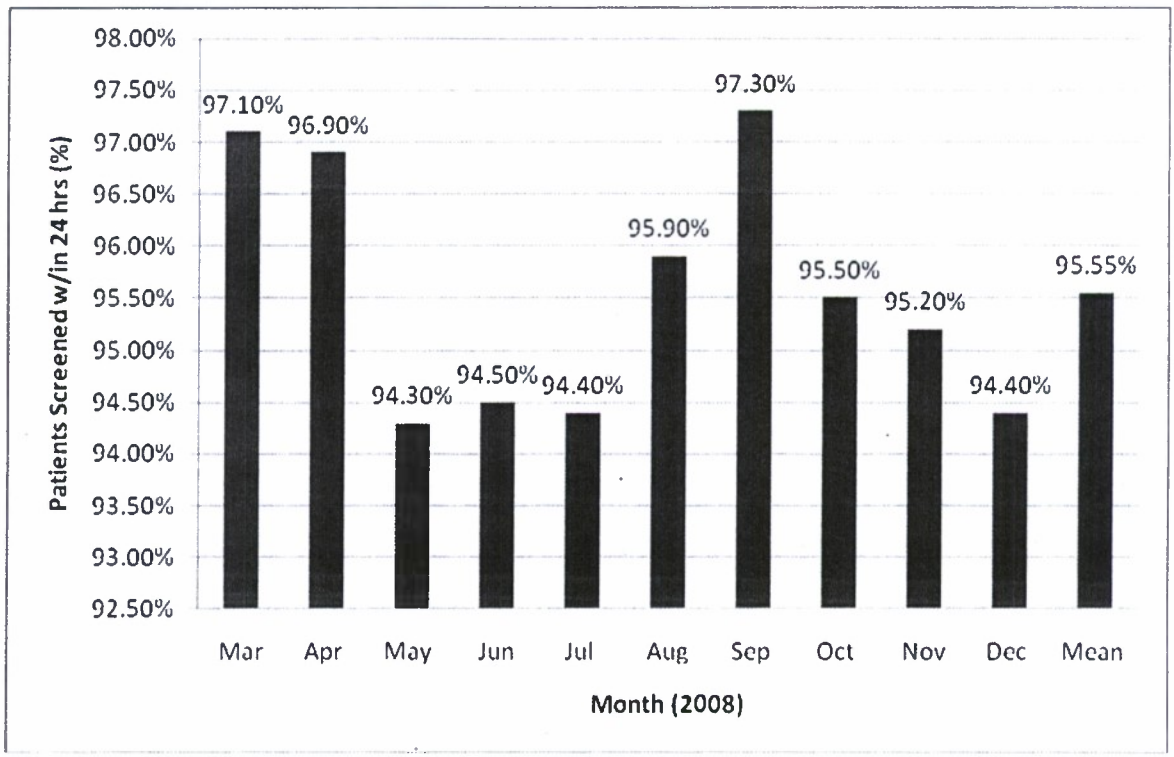

Figure 2. Department of Medicine VTE Risk Screening Within 24 Hours.

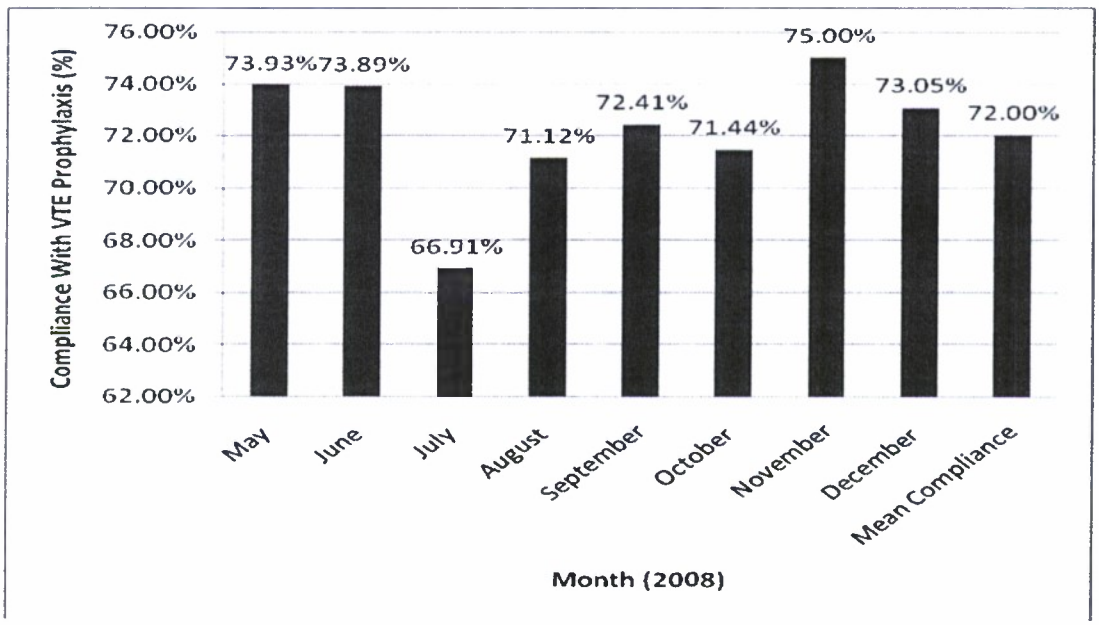

Figure 3. Department of Medicine Compiance With Appropriate Prophylaxis

Prior to the VTE Collaboratie initiatives, there were few, if any procedures in plaee to screen patients for VTE risk and assign appropriate prophylaxis. If there were tools in place, there was no way to measure performance. Although the Department of Medicine only has an average of 72% complianee with appropriate prophylaxis, the department saw a decrese in incidence of 13.29 people per thousand between 2004 and 2008, the department had a reduction of 13.29 people per thousand. It ean only be assumed that the implementation of the CDSS and other VTE prevention efforts had a significant impact on this reduetion.

Methods and Procedures

Although the database analysis tool assesses complianee for providers and various departments, statistieal performance evaluation of the VTE initiative has not yet been performed. This ease study fills thc void and evaluates data to analyze the impaet of the VTE Collaboration efforts. The main researeh question of this study is to determine whether or not thc efforts of the VTE Collaborative have had a signifieant impact on the incidence of VTE at Johns Hopkins.

The data used in this study were extraeted from the Datamart system at JHH. Datamart is a data rcpository where all final patient information is stored, to inelude all eoding and finaneial data assoeiated with each patient visit. All inpatient reeords from 2004 and 2008, with the exception of Inpatient Psychiatry and Inpatient Pediatries, were used in the study for a total of 32,698 patients in 2004 and 33,605 paticnts in 2008. Because prevention efforts began in 2005, 2004 data were used as a baseline to test for results. 2008 data were used beeause it was thc most eurrent eomplete year at thc time this study was eompleted.

After the final data set was obtained, a query was eompleted to search for reeords eontaining any Current Proeedure Teehnology (CPT) codes that relate to VTE or PE. The eodes included in the query are listed in Appendix E. Once these rccords were identified, sorted into

their respective inpatient departments, and screened for duplicate data, the raw incidence rate was calculated for each department by dividing the total number of people who were diagnosed with DVT or PE by the total amount of patients seen in the department per year. Once the raw incidence was calculated, the data for each department were converted into an incidence per thousand rate to standardize the data for comparison across departments. The incidence rates by department are shown below in Table 1.

Table 1

Incidence per 1000 by Department

Departmennt	2004	2008
Medicine	28.97	15.68
OBGYN	9.88	4.51
Adult trauma	14.05	5.42
Cardiac surgery	28.27	31.63
Neurology	16.88	8.35
General surgery	21.74	12.73
Onc/Endo surgery	11.72	10.33
Thoracic	17.58	13.22
Transplant	35.83	19.49
Urology	6.90	3.54
Plastics	9.85	6.23
Oncology	61.82	22.85
Neurosurgery	15.46	12.51
ENT/OTO	2.77	5.89
Orthopedic surgery	11.15	7.90
PM&R	51.23	22.22

Based on the data above, there appears to be a significant reduction on the incidence rate of VTE since adoption of the CDSS at Johns Hopkins. However, in order to determine if there has been a statistically significant impact in the reduction of VTE, the incidence rates from 2004 and 2008 were analyzed using a single factor analysis of variance to test for a difference in the

means. The null hypothesis for this test is that there is no difference in the means of the two samples. The results of the analysis of variance can be seen in Table 2 below.

Results

Based on the results of the analysis of variance, the null hypotheses cannot be rejected at the .05 alpha level. It is important to note however, that the results of this test were very close. A p-value of 0.06 indicates that there is a strong possibility that the underlying data are significant and that more research should be conducted in this area when more data are available or other covariates can be considered. Because the data were broken out into department by year, and there were only 16 departments analyzed, there were only 32 total data points analyzed, which further reduces the power of the analysis.

Table 2

Analysis of Variance Results

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*
Between Groups	626.6621	1	626.6621	3.813449	0.060227
Within Groups	4929.884	30	164.3295		
Total	5556.546	31			

Discussion

Although the null hypothesis in this study could not be rejected, indicating no significant difference in the means pre and post CDSS implementation, the overall results of the VTE Collaborative efforts are still commendable. With over 33,000 inpatients a year, a reduction of approximately 1.31% of total incidence across the hospital equates to over 330 patients a year who do not acquire a VTE during their inpatient stay. The overall incidence rate for the facility

dropped from 23.95 per thousand in 2004 to 13.12 per thousand in 2008. These results alone show significant progress in the reduction of incidence at this hospital.

Lowering the incidence within JHH may also have significantly positive financial implications. As the overall incidence rate has decreased, so have the cost implications for JHH. Table 3 compares 2004 versus 2008 VTE incidence rates and derives the potential number of patients with VTE based on the number of 2008 inpatient discharge number. Multiplying JHH's average inpatient bed cost of $475 by the additional days in the hospital and the number of patients provides a total cost for VTE that has been avoided of over $1.2 million dollars. This figure is for treatment alone and docs into account the opportunity cost of potential new patients filling beds and generating more revenue for the hospital.

Table 3.

Financial Impact of VTE Incidence Reduction at JHH

Year	Incidence	2008 Discharges	Patients With VTE	Additional In-Patient Days	Additional Cost
2004	2.39%	33605	803	5622	$2,670,505.34
2008	1.31%	33605	440	3082	$1,463,749.79
Difference	1.08%	n/a	363	2541	$1,206,755.55

Recommendations

Although JHH's initial results arc promising, a significant amount of work remains to ensure the VTE initiativc moves forward. The VTE Collaborative should continue to focus on quality improvement by working with departments to improve their compliance. Maynard noted similar compliance levels in his hospital after the initial CDSS was put in place (Maynard, 2009).

Through trend analysis and continuous quality improvement initiatives, he was able to increase compliance and further reduce incidence rates at his facility.

The primary recommendation is to expand JHH's VTE efforts to ensure completion of the analysis tool for trend analysis and quality improvement. Once the analysis database is complete for all units, additional education efforts could be completed by the VTE Collaborative. In order to close the gap to ensure further compliance, the VTE Collaborative should plan to introduce quality improvement measures for each department to improve compliance and maximize performance. Eventually, real-time data may be available for the VTE team to use in educating providers while the patients are still at the facility. Ideally the VTE team members may be able to see if patients are getting the appropriate prophylaxis and could to intervene if necessary to ensure appropriate care.

The second recommendation is for the various inpatient departments at the hospital to adopt VTE compliance metrics into their dashboard reporting system. All of the departments at Johns Hopkins use dashboard reporting to show compliance with various quality indicators. The use of this system could give the leadership of the various departments throughout the facility an increased visibility of the compliance among their departments and could contribute to increased compliance throughout the hospital. As part of the analysis database, monthly reports could be generated to show unit, department, and facility-wide compliance. The transparency of data among the different departments would also be helpful with reporting requirements from regulatory agencies. Although no guidelines currently exist, when regulatory measures are published, JHH may already have a way to track performance throughout the hospital and convey improvement.

This initiative also provides a basis for further research as more data becomes available. Further research could be done to specifically show if there has been an impact by department and by specific service. Once data are obtained for each service, not only could a comparison by service performed but a more powerful study with the same design as this study could also be completed.

As there are over 33,000 visits per year, and data can be obtained for each of these patients, another possibility is to develop a regression model to determine appropriate risk factors for VTE. Although there is a significant amount of literature currently available on this topic, conducting this type of analysis can add to the current body of literature to either validate or disprove some of the current knowledge.

A fourth recommendation is to investigate some areas of the hospital in greater depth. Specific areas of concern are the Cardiac Surgery and the Ear Nose and Throat/Otolaryngology Departments. Both of these departments actually incurred an increase in incidence rates since the implementation of the CDSS. As more accurate data becomes available for these two departments, further research is needed to determine the root cause of these increases.

The last recommendation is to develop a capability to be able to provide provider specific compliance feedback. Currently, the analysis tool only reports by service, not by specific provider. If there is a way for provider-specific data to be obtained, it will enable the collaborative members to give educational feedback to other medical professionals within the facility and further increase the awareness and the potential prevention possibilities through the use of the CDSS.

Conclusion

Deep vein thrombosis and pulmonary embolism are two very dangerous conditions that can be prevented with the proper attention and prophylaxis. Regulatory bodies across the country have undertaken large studies and have started paying close attention to these two conditions from a patient safety perspective. With almost every major regulatory body introducing new requirements surrounding acquiring these conditions in an inpatient setting, prevention is critical to the success of any hospital both for financial liability and quality of patient care purposes.

The JHH VTE Collaborative was formed to combat increasing regulatory pressures as well as low rates of compliance within the hospital. By implementing a computer based decision support system, providers across the hospital now have a tool to appropriately risk stratify patients for VTE as well as prescribe the appropriate prophylaxis. The hospital has also seen a decrease in VTE incidence of over 13 people per thousand since the formation of the VTE Collaborative . Furthermore, by promoting awareness and hosting hospital-wide awareness campaigns, the Collaborative continues to work to spread knowledge of VTE and the implications of correctly treating appropriate risk.

The JHH VTE Collaborative is an excellent example of what can be accomplished when a motivated group of multi-disciplinary staff members from across a large medical institution combine efforts and work towards a common goal. Although there is still a lot of work to do with completing the implementation, the collaborative is well on its way to reducing the risk of acquiring VTE risk in patients at the facility. These efforts serve as a great model for other facilities hoping to implement similar processes. With the combined support of hospital leadership, quality improvement experts and other key leaders within an institution, these

accomplishments can be attained at virtually any medical facility in the country in an effort to reduce the rates of Deep Vein Thrombosis and Pulmonary Embolism in our population.

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Appendix A

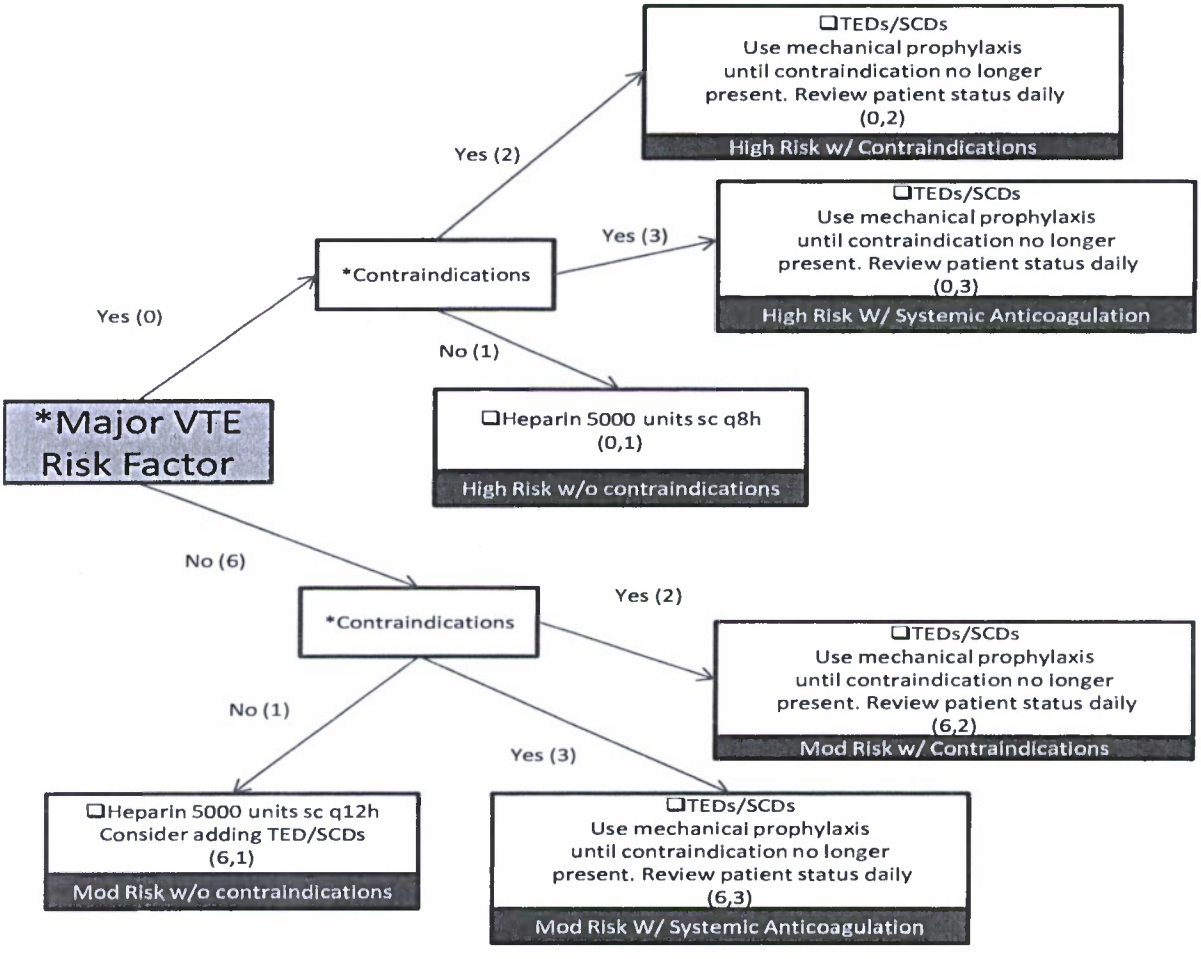


Figure A1. General Medicine Scheme

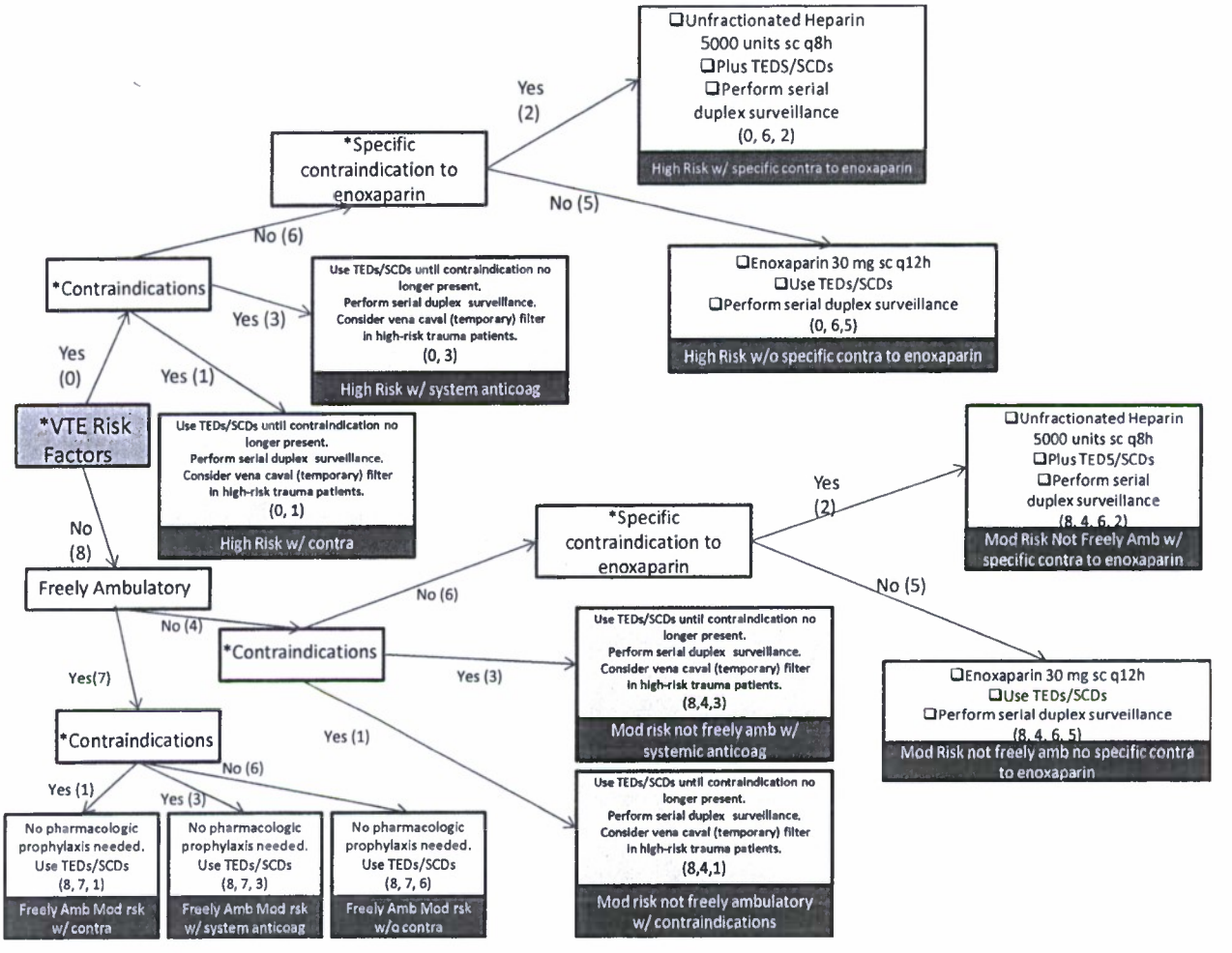
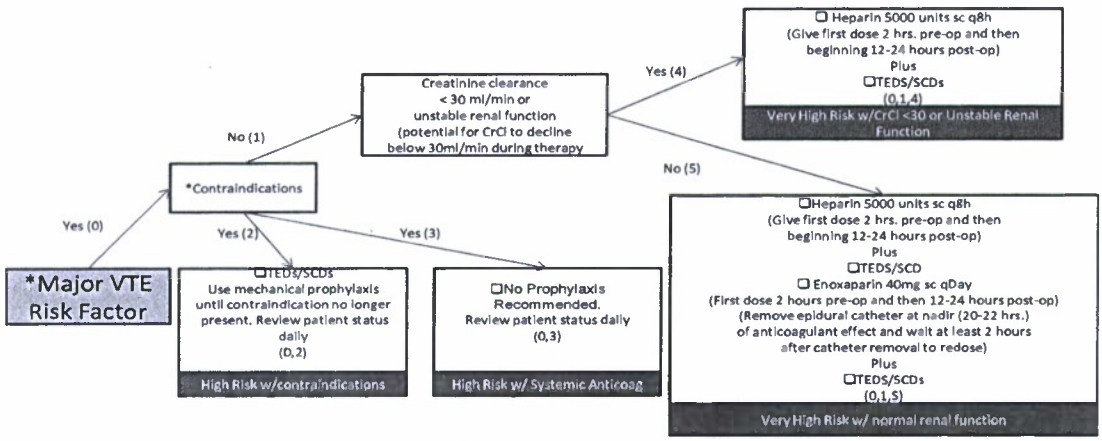


Figure A2. Trauma Scheme



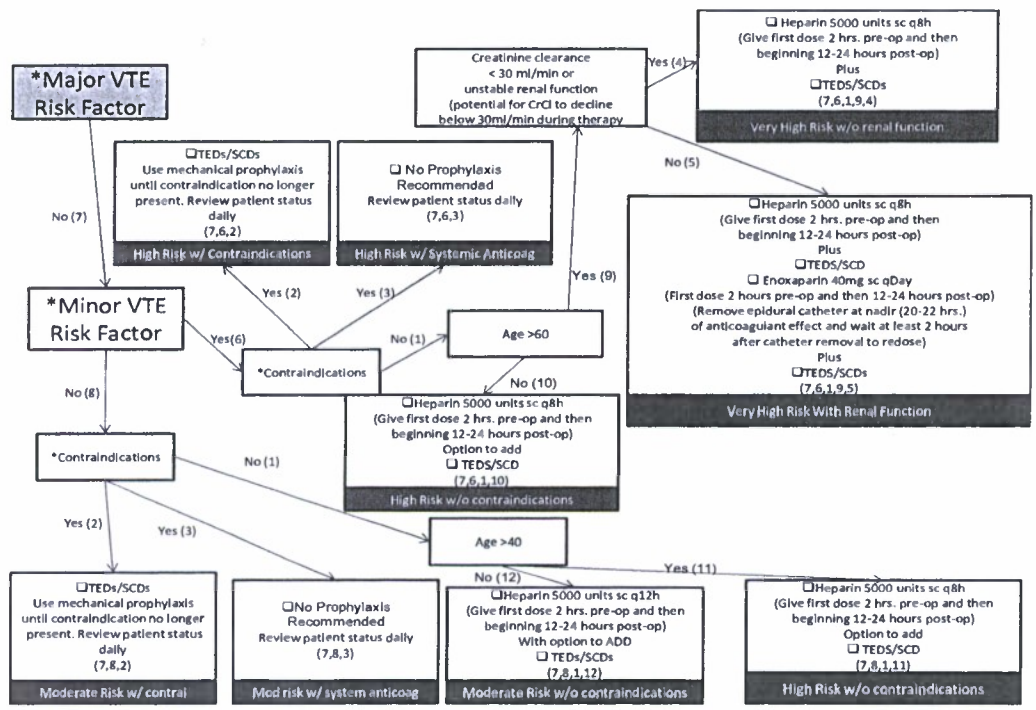


Figure A3. General Surgery Scheme

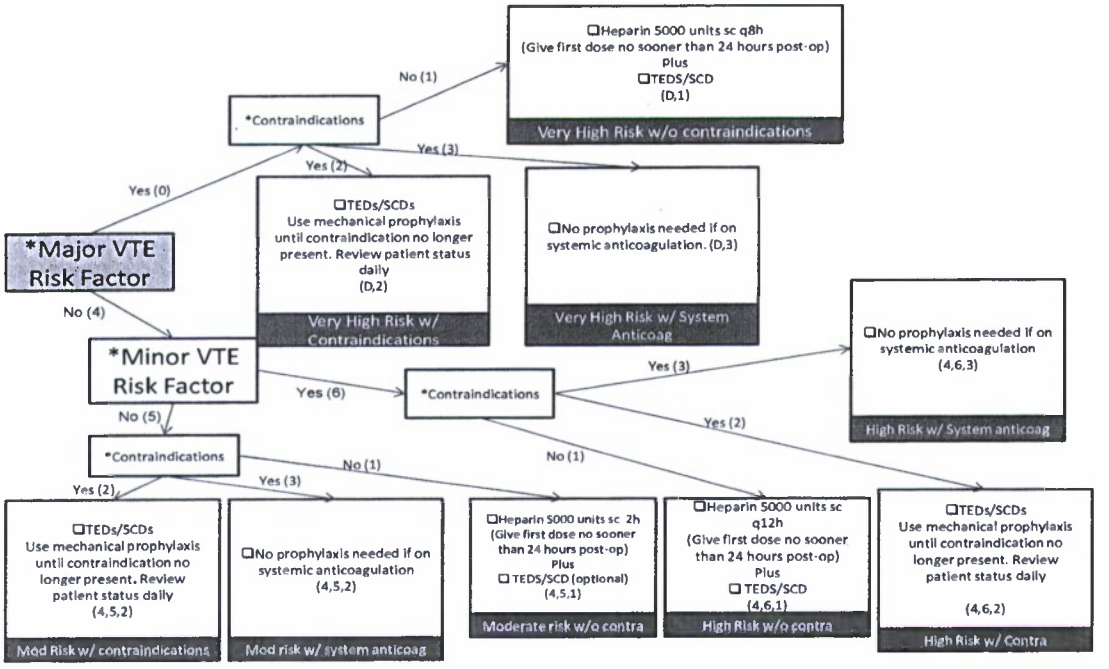


Figure A4. Cardiac Surgery Scheme

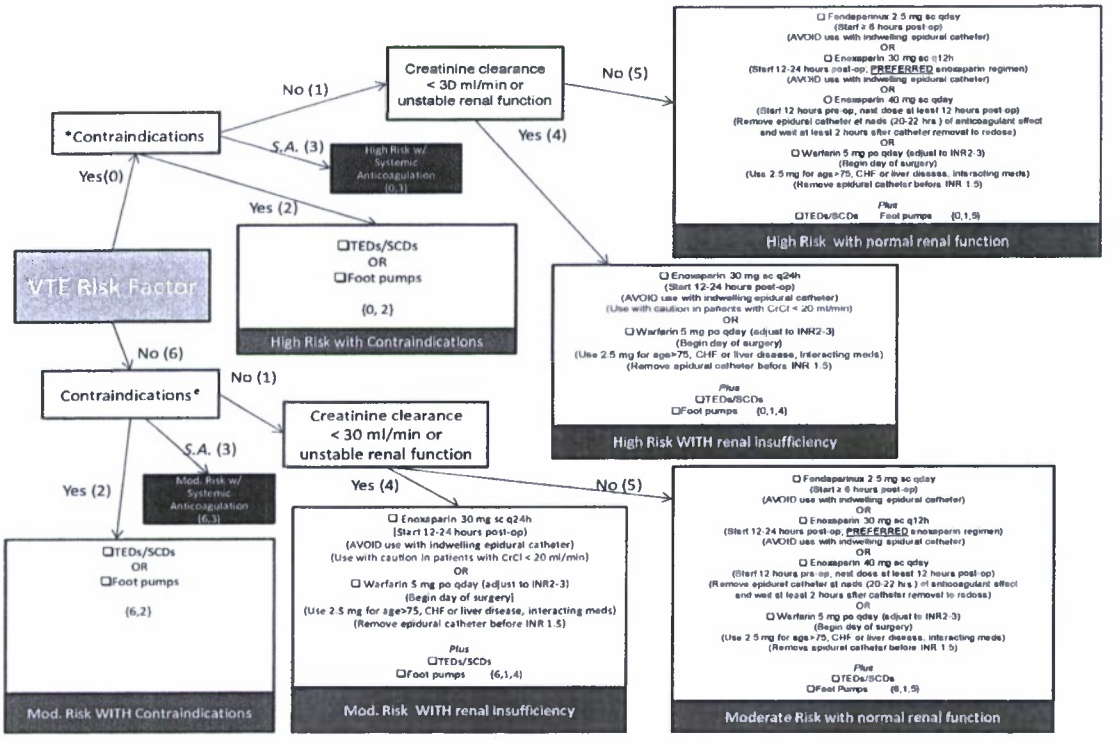


Figure A5. Orthopedic Hip/Knee Replacement Scheme

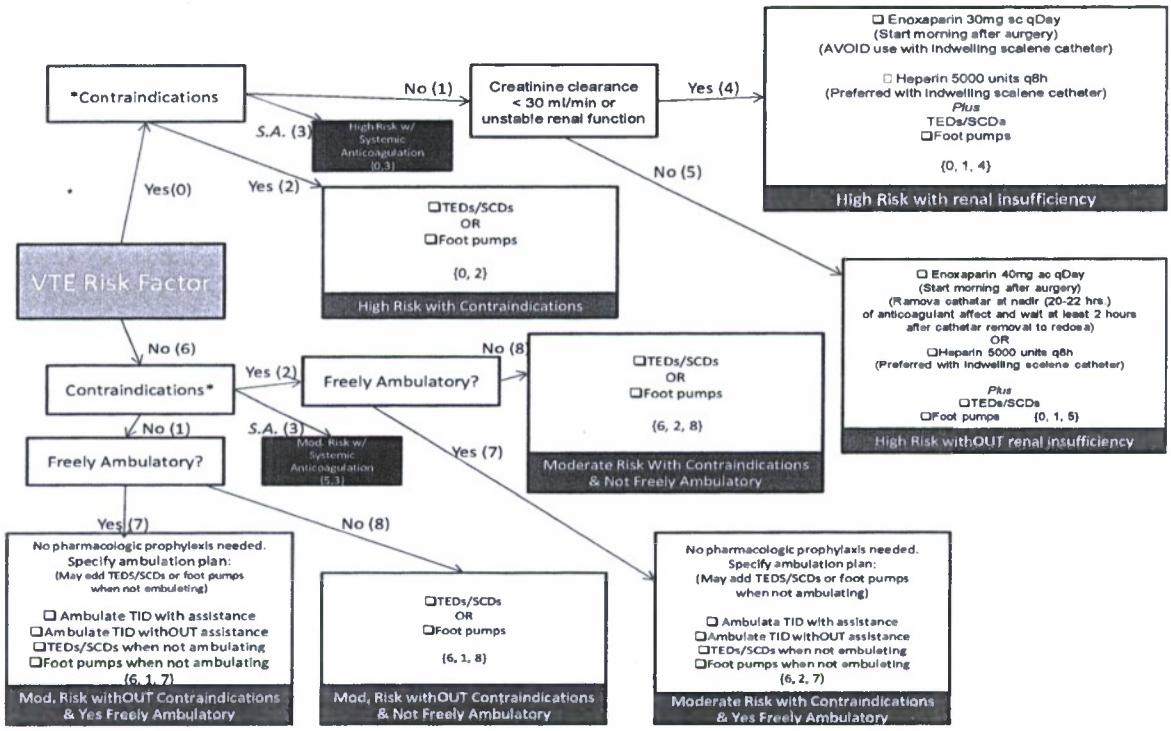


Figure A6. Orthopedic shoulder arthroplasty, knee or shoulder arthroscopy, hand surgery or ankle fracture scheme.

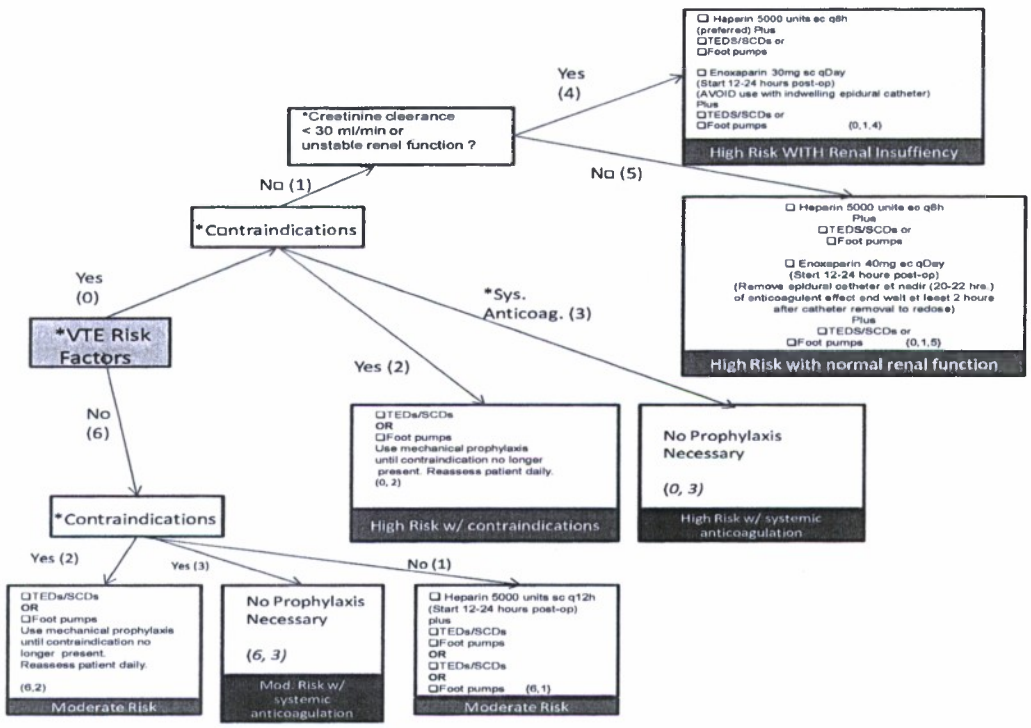


Figure A7. Orthopedic Spine Surgery Scheme

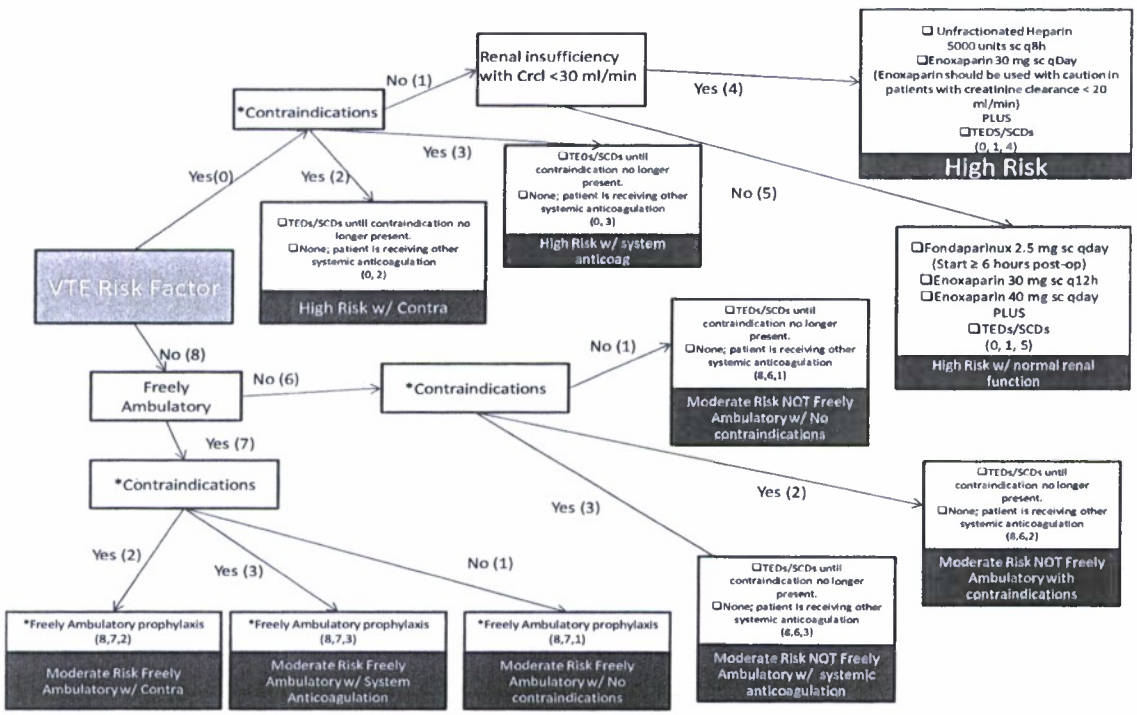


Figure A8. Orthopedic Trauma Scheme

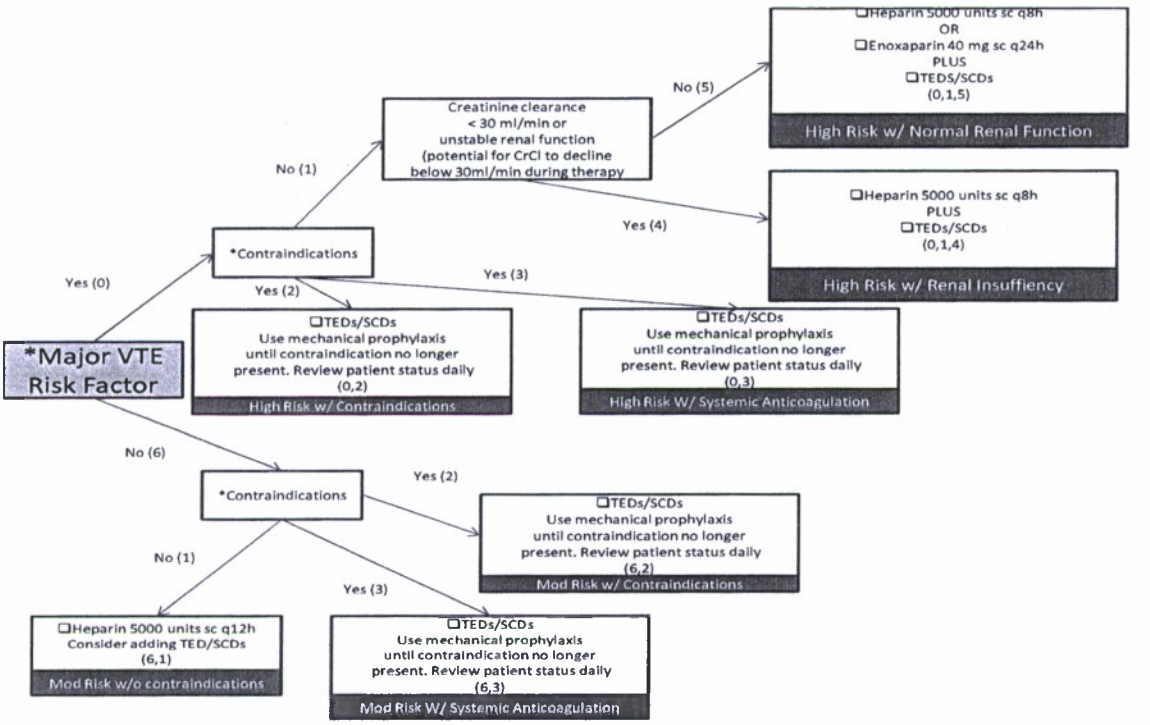


Figure A9. Neurology VTE Scheme

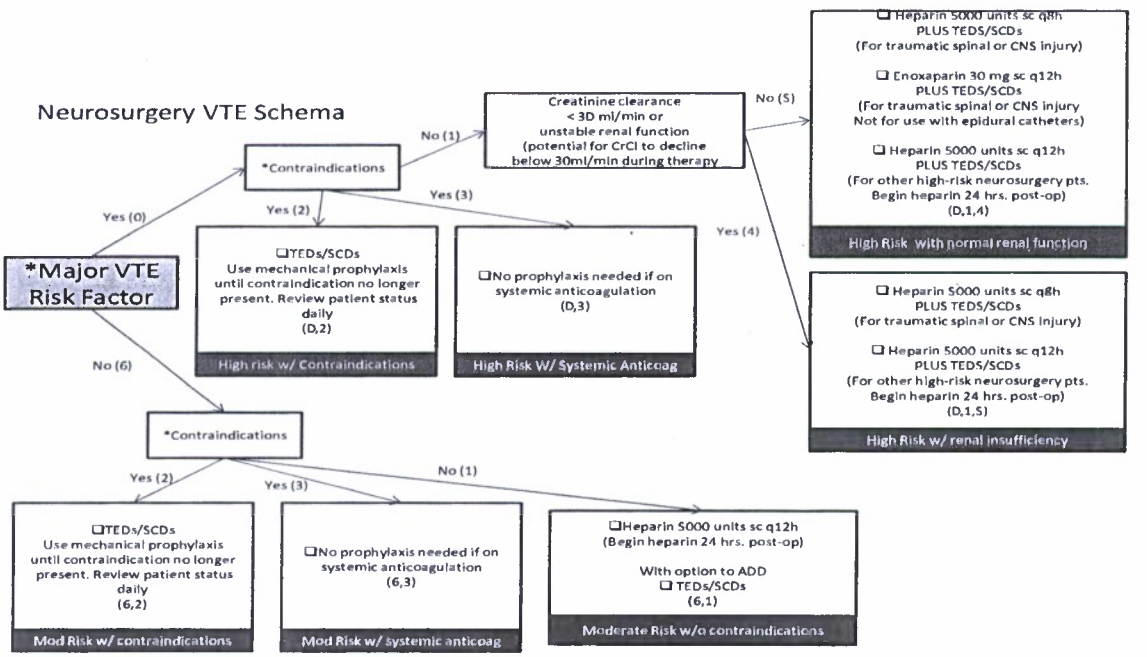


Figure A10. Neurosurgery VTE Scheme

Appendix B

List of Participating Clinical Units

Department of Medicine
ACS Barker
ACS Janeway
ACS Longcope
ACS Thayer
Assistant Chief Serv
Cardiology
Endocrinology
Gastroenterology
General Medicine
Hospitalist Service
Infectious Diseases
Internal Medicine
Pulmonary
Renal Diseases
Rheumatology

Department of Surgery
GI Surgery
Halsted Residents
Halsted Trauma
Plastics
Surgical Oncology/Endocrine
Thoracic Surgery
Trauma
Vascular Surgery

Department of Orthopedics
Ortho Trauma
Orthopedics
Adult Ortho Spine

Appendix C

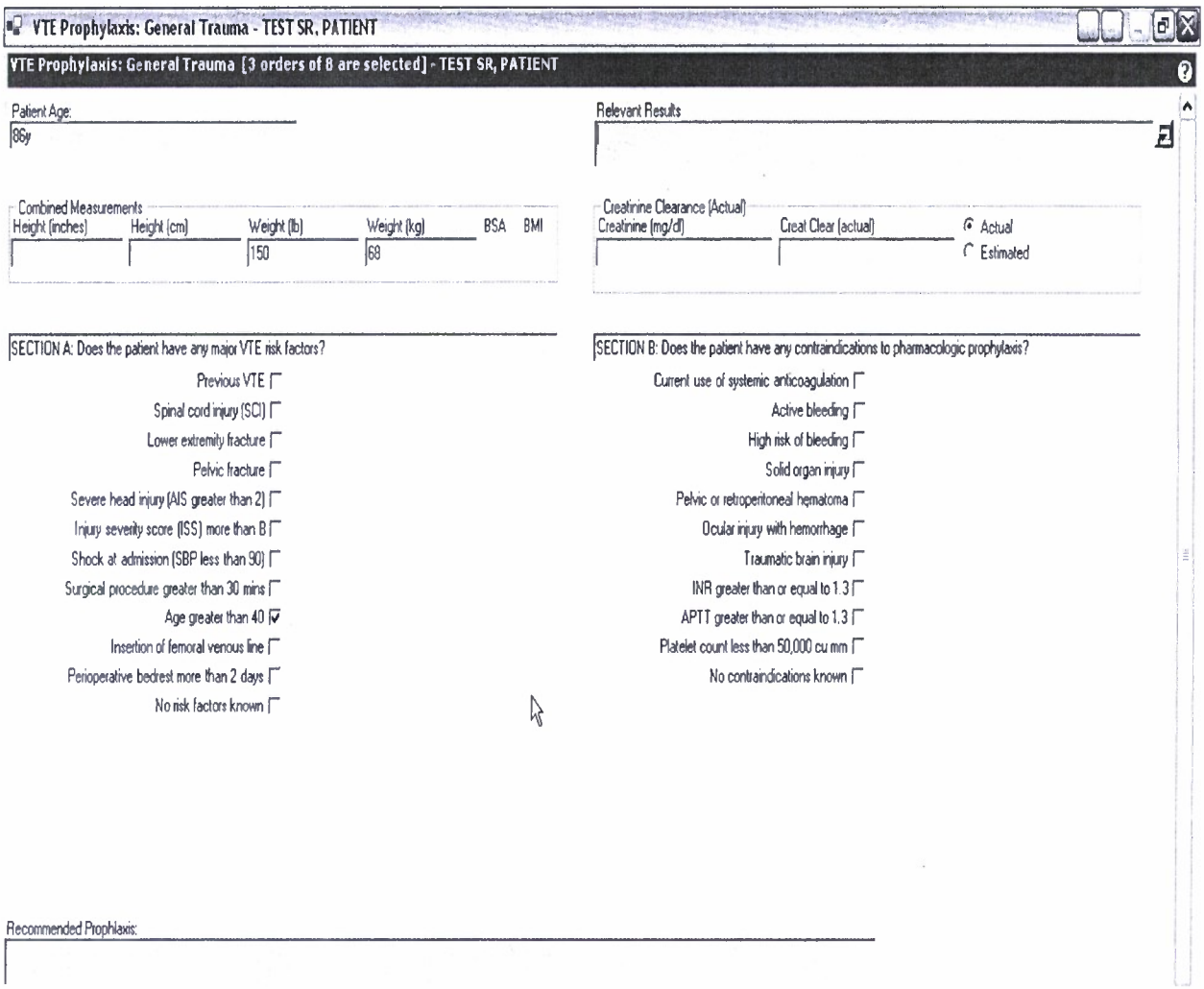


Figure C1. Provider Order Entry VTE CDSS Screen Shot

Appendix D

Johns Hopkins Medicine

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Visit Volume Stats (VTE) - 200807(Datasource: POE)

JHH Service	Admission Count	Scrn W/24hrs	% Scrn W/24hrs	Scrn aft/24hrs	% Scrn aft/24hrs	Total Screened	% Total Screened	Total Not Scrn	% Total Not Scrn
MED									
ACS Barker	113	110	97.3%	0	0.0%	110	97.3%	3	2.7%
ACS Janeway	106	106	100.0%	0	0.0%	106	100.0%	0	0.0%
ACS Longcope	102	102	100.0%	0	0.0%	102	100.0%	0	0.0%
ACS Thayer	121	121	100.0%	0	0.0%	121	100.0%	0	0.0%
Assistant Chief Serv	8	7	87.5%	0	0.0%	7	87.5%	1	12.5%
Cardiology	200	199	99.5%	0	0.0%	199	99.5%	1	0.5%
Endocrinology	15	0	0.0%	0	0.0%	0	0.0%	15	100.0%
Gastroenterology	88	87	98.9%	0	0.0%	87	98.9%	1	1.1%
Geriatrics	8	0	0.0%	0	0.0%	0	0.0%	8	100.0%
Hospitalist Service	117	116	99.1%	0	0.0%	116	99.1%	1	0.9%
Infectious Diseases	73	71	97.3%	0	0.0%	71	97.3%	2	2.7%
Internal Medicine	88	88	100.0%	0	0.0%	88	100.0%	0	0.0%
Pharmacology	5	0	0.0%	0	0.0%	0	0.0%	5	100.0%
Pulmonary	102	95	93.1%	0	0.0%	95	93.1%	7	6.9%
Renal Diseases	34	34	100.0%	0	0.0%	34	100.0%	0	0.0%
Rheumatology	11	11	100.0%	0	0.0%	11	100.0%	0	0.0%
MED	**1,191**	**1,147**	**96.3%**	**0**	**0.0%**	**1,147**	**96.3%**	**44**	**3.7%**
NRO									
Neuro Research	12	3	25.0%	0	0.0%	3	25.0%	9	75.0%
Neurology	56	54	96.4%	0	0.0%	54	96.4%	2	3.6%
Neurology, Epilepsy	22	4	18.2%	0	0.0%	4	18.2%	18	81.8%
Neurology, Ped	24	0	0.0%	0	0.0%	0	0.0%	24	100.0%
Neurology, Stroke	37	36	97.3%	0	0.0%	36	97.3%	1	2.7%
NRO	**151**	**97**	**64.2%**	**0**	**0.0%**	**97**	**64.2%**	**54**	**35.8%**
ORT									
Adult Ortho Spine	40	40	100.0%	0	0.0%	40	100.0%	0	0.0%
Ortho Trauma	3	3	100.0%	0	0.0%	3	100.0%	0	0.0%
Orthopedics	66	66	100.0%	0	0.0%	66	100.0%	0	0.0%
ORT	**109**	**109**	**100.0%**	**0**	**0.0%**	**109**	**100.0%**	**0**	**0.0%**
OTO									
Dental Surgery	1	1	100.0%	0	0.0%	1	100.0%	0	0.0%
Otolaryngology	73	62	84.9%	0	0.0%	62	84.9%	11	15.1%
OTO	**74**	**63**	**85.1%**	**0**	**0.0%**	**63**	**85.1%**	**11**	**14.9%**
REH									
Rehabilitation	50	50	100.0%	0	0.0%	50	100.0%	0	0.0%
REH	**50**	**50**	**100.0%**	**0**	**0.0%**	**50**	**100.0%**	**0**	**0.0%**

Figure D1. Analysis tool VTE screening compliance report

Appendix E

Table E1

ICD-9 Codes Included in Study

ICD-9 Codes	Code Description
451	Phlebitis and thrombophlebitis
451.11	Femoral vein (deep) (superficial)
451.19	Other
451.2	Of lower extremities
451.81	Iliac Vein
451.82	Of superficial veins of u9per extremities
451.83	of deep veins of upper extremities
451.84	of upper extremities, unspecified
451.9	of unspecified site
453	other venous embolism and thrombosis
453.2	of vena cava
453.8	of renal vein
415.11	Iatrogenic pulmonary embolism and infarction