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SPS RECOMMENDED BUNDLES

To jump to a specific bundle, simply click on the link below:

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SPS Recommended Bundle

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Hospital Acquired Condition: ADE

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I. Background

ADE (Adverse Drug Events) is the 8th largest contributor to harm caused across the SPS network. These events include levels 6-9 or F-I. In 2011, approximately 15 children were harmed each month across the Phase I SPS hospitals. The team formed in May of 2012 to develop strategies consistent with high reliability concepts to reduce harm caused by ADEs.

II. Bundle Strategies - Overview

Develop Delivery System Intervention Bundle

1. Identifying High Harm Events
2. Review and catalog last 20 F & higher / 6-9 (NCC MERP Scale) ADE Events
3. Identify which medication delivery system the failure occurred
    a. Ordering
    b. Pharmacy
    c. Administration
    d. Monitoring
4. Determine top 1-2 factors that are common across those events (ie. Phase, Drug, Location, Failure mode, etc.)
5. Develop & Report 2-3 interventions (Hospital Specific Bundle)
6. Track impact on Hospital's 6-9 events

III. Bundle Elements – Evidence

Grade of body evidence: LOW

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IV. Bundle Elements – Standards of Care

To be developed at future data

Bundle Element	Standards of Care
Identifying High Harm Events	
Review and catalog last 20 F & higher / 6-9 (NCC MERP Scale) ADE Events	
Identify which medication delivery system the failure occurred	
Determine top 1-2 factors that are common across those events	
Develop & Report 2-3 interventions (Hospital Specific Bundle)	
Track impact on Hospital's 6-9 events	

V. Measurement- Bundle Reliability

Measurement	Formula	Recommendations	Reporting Period
Delivery System Intervention Bundle	Number of audits totally compliant with system failure bundle / Number of audits completed* x 100	*Apply formula to your hospital bundle elements.	Monthly

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VI. Tools

We have asked hospitals for some of their spotlight tools, and have highlighted a few in this folder. The highlighted categories are: Bundle Measure Methodology, PDSAs and Interventions, Risk Assessment, Training, and Failure Analysis.

Please click here to view the SHINE report.

VII. References

1. Franceschi, A., M. Tuccori, et al. (2004). "Drug therapeutic failures in emergency department patients. A university hospital experience." *Pharmacol Res 49(1): 85-91.*

2. Gandhi, T. K., S. B. Bartel, et al. (2005). "Medication safety in the ambulatory chemotherapy setting." Cancer 104(11): 2477-2483.

3. Kane-Gill, S. L., J. Jacobi, et al. (2010). "Adverse drug events in intensive care units: Risk factors, impact, and the role of team care." Critical Care Medicine 38(6 SUPPL.): S83-S89.

4. Tham, E., H. M. Calmes, et al. (2011). "Sustaining and spreading the reduction of adverse drug events in a multicenter collaborative." Pediatrics 128(2): e438-445.

5. Zandieh, S. O., D. A. Goldmann, et al. (2008). "Risk factors in preventable adverse drug events in pediatric outpatients." Pediatr 152(2): 225-231.

6. Unpublished, non-peer-reviewed consensus documents – CHCA, CDC

VII. Revision History

I. Version	Primary Author(s)	Description of Version	Date Completed
Version 1	Katie Hilbert	Initial Draft	7-Nov-2012
Version 2.0	Jason Bailey	Addition of sections III, IV & V	5 Feb 2013

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SPS Recommended Bundle

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Hospital Acquired Condition: VTE

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I. Background & Team

Venous thromboembolism (VTE) is the 2nd largest contributor to harm caused across the SPS network. In 2015, there were 951 VTE events comprising 16% of all Serious Harm Events within the network. The VTE team formed in May of 2012 to develop strategies consistent with high reliability concepts to reduce harm caused by VTEs. Participating hospitals created methods for screening patients at risk and developed systems for event detection. This raised situational awareness and created scaffolding upon which to build a risk reduction strategy. In 2016 the VTE operational definition was revised based on feedback received from engaged stakeholders and content specific experts. The revised 2016 SPS VTE operational definition works toward recording all events of harm from hospital-acquired venous thromboembolism classified as either central venous catheter (CVC) related or non-CVC related, and correlating metrics were established. In addition patients who experienced harm from hospital acquired VTE were included regardless of age.

Process bundles target the pathophysiology of thrombus formation. Virchow described the risk factors for thrombosis as stasis of venous blood flow, hypercoagulability and endothelial injury. We believe reduction of these risk factors for both catheter and non-catheter related bundles are the keystone of the bundles aimed at harm prevention. Using data obtained from the SPS network as well as external evidence in the medical literature the VTE team has identified those bundle elements that when reliably implemented are highly likely to result in decreased harm to hospitalized children.

As a result, SPS is stratifying bundle elements based on their level of evidence to assist hospitals in prioritizing their efforts at designing and implementing evidence-based bundles for for all aviator HACs:

- *Standard Element:* Strong evidence suggests that implementation of this element is associated with significant decrease in patient harm; **all SPS hospitals should implement and measure reliability of this element.**
- *Recommended Element*: Preliminary data and clinical expert opinion support the implementation of this element; **SPS hospitals should strongly consider implementing this element.**

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II. Bundle Elements-Overview

1. **Non-CVC VTE**
    a. **Non-CVC VTE: general anesthesia for > 1 hour**
2. *CVC-VTE : To be determined*

Screening for Non-CVC VTE Risk

Screen all patients ≥ 12 years for VTE risk. *For patients ≥18 years please follow adult guidelines either ACCP 2012 thrombosis guidelines [1] or affiliated adult institution VTE guidelines.)*

Screening should be performed (minimally): on admission, pre- and post-operatively, and upon transfer to a different level of care.

SPS Standard Elements for Screening: VTE Risk Factors

- Mobility status
    - Baseline: Usual state of ambulation
    - Altered: A temporary inability to ambulate freely: bathroom privileges, pivot to chair, etc. (Corresponds to Braden Q Scale, Mobility 1-3, Activity 1-2)
- Personal history of thrombosis
- Thrombophilia
    - Inherited deficiency of protein S, C or antithrombin, factor V Leiden or prothrombin gene mutation.
- Critically ill (currently in an intensive care unit)
- Active cancer/malignancy
- Recent Surgery within the past 30 days
- Estrogen therapy: currently taking or within the past 2 weeks

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SPS Recommended Elements for Screening: VTE Risk Factors

- Acute systemic inflammation/infection
- Major trauma requiring admission to an intensive care unit
- Obesity
  - BMI > 95th percentile in patients < 18 years of age
  - BMI >30 in patients > 18 years of age
- Burns:
  - Increased VTE risk has been associated with total body surface area burns >50-65% in adults.
- Severe Dehydration
- Protein-losing disorder
  - Examples: nephrotic syndrome, protein losing enteropathy (PLE), draining chylous effusion etc.
- Cyanotic heart disease or low-flow states
- Family history of VTE in a 1st degree relative

VTE Prevention Intervention Based on VTE Risk Assessment

	Low Risk	At risk		High Risk
Mobility Status	Baseline	Baseline	Altered	Altered
Number of VTE Risk Factors	0	1 or more	0-1	2 or more
Interventions: *with no contraindications present*				
o Encourage highest degree of mobility	Yes	Yes	Yes	Yes
o SCD	-	Yes	Yes	Yes
o Anticoagulation	-	-	-	Yes

VTE Prevention Intervention for Patients Undergoing General Anesthesia

- Age >12 AND
- Anesthesia duration >1 hour

SCDs should be placed prior to the induction of general anesthesia and for the duration of a procedure/surgery anticipated to be greater than 1 hour.

SPS Standard Interventions

- **Mobility**: encourage highest degree of mobility, ideally ambulation, for patients >/= 3 times a day
- **Sequential Compression Devices (SCD)** unless contraindicated
    1. While in bed
    2. Prior to the induction of general anesthesia and for the duration of a procedure/surgery if anticipated to be greater than 1 hour.

Contraindications:

- Distal/Peripheral IV Access: i.e. IV in foot
- Suspected or existing acute deep vein thrombosis
- Skin conditions affecting extremity (e.g., dermatitis, burn)
- Acute fracture- okay to use device on unaffected extremity
- No appropriate SCD size available
- Lower extremity conditions which result in significant pain with compression (ex. Solid tumor, veno-occlusive episode in sickle cell disease)

SPS Recommended Interventions

- **Anticoagulation**: Strongly consider prophylactic anticoagulation of high risk patients if the patient has altered mobility and 2 or more VTE risk factors present (see VTE intervention based on risk assessment unless contraindicated).

Prophylactic anticoagulation: utilize a form of low molecular weight heparin or subcutaneous unfractionated heparin. If a patient is already on other forms of anticoagulation (i.e. warfarin or direct oral anticoagulants) no additional prophylactic anticoagulation is needed. Aspirin or other antiplatelet therapy is not considered VTE prophylaxis.

Contraindications:

- Intracranial hemorrhage
- Acute stroke/ brain ischemia
- Ongoing and uncontrolled bleeding
- Uncorrected coagulopathy
- Incomplete spinal cord injury with suspected or known para-spinal hematoma
- Allergy to UFH or enoxaparin (i.e. heparin induced thrombocytopenia)
- Platelet count < 50,000/mcl
- Epidural anesthesia
- The patient is likely to require an invasive procedure within 24 hours of starting anticoagulation
- Congenital bleeding disorder
- Uncontrolled severe hypertension
- Intracranial mass

III. Bundle Elements – Evidence Reviewed

Screening Bundle Element	Level of Evidence CDC*/SPS**	Evidence Cited (Numbers refer to Reference Section)
Standard Elements		
Screen for VTE Risk	CDC Modified: IB	[2, 3]
Elements for Screening		
Mobility status	CDC Modified: IB	[4, 5]
Personal history of thrombosis	CDC Modified: IB	[6, 7]
Thrombophilia	CDC Modified: IB	[8-10]
Critically ill (in the intensive care unit)	CDC Modified: IB	[5, 6, 11]
Active cancer/malignancy	CDC Modified: IB	[6, 8, 12-19]
Recent surgery within the past 30 days.	CDC Modified: IB	[8, 17, 20, 21]
Estrogen therapy	CDC Modified: IB	[4, 22]
Recommended Elements		
Acute systemic inflammation/infection	CDC Modified: IB	[4, 6, 8, 11-13, 23]
Major trauma	CDC Modified: IB	[7, 8, 17, 24, 25]
Obesity	CDC Modified: IB	[22, 26-28]
Burns (>50-65% total body surface area)	CDC Modified: II	[29, 30]
Severe dehydration	CDC Modified: II	
Protein-losing disorder	CDC Modified: IB	[14, 17, 31]

Screening Bundle Element	Level of Evidence CDC*/SPS**	Evidence Cited (Numbers refer to Reference Section)
Cyanotic heart disease or low-flow states	CDC Modified: IB	[14, 21]
Family history of VTE in a 1st degree relative	CDC Modified: IB	[14]

Prevention Bundle Element	Level of Evidence CDC*/SPS**	Evidence Cited (Numbers refer to Reference Section)
Standard Elements		
Encourage highest degree of ambulation/mobility for patients (≥3 times a day)	CDC Modified: IB	[4, 5]
If altered mobility use sequential compression devices while in bed unless contraindicated.	CDC Modified: IB	[32-43]
Use sequential devices prior to the induction of anesthesia and the duration of the procedure if the procedure is anticipated to last >1 hour.	CDC Modified: IB	[44]
Recommended Elements		
Strongly consider, in addition to sequential compression devices, using anticoagulation for very high risk patients based on risk stratification if the patient has altered mobility and 2 or more VTE risk factors present (see VTE screening	CDC Modified II	[1, 41, 45]

Prevention Bundle Element	Level of Evidence CDC*/SPS**	Evidence Cited (Numbers refer to Reference Section)
elements), unless anticoagulation is contraindicated.		

*CDC Modified Recommendation Category

- IA - A strong recommendation supported by high to moderate quality† evidence suggesting net clinical benefits or harms.
- IB - A strong recommendation supported by low quality evidence suggesting net clinical benefits or harms or an accepted practice (e.g., aseptic technique) supported by low to very low quality evidence.
- IC - A strong recommendation required by state or federal regulation.
- II - A weak recommendation supported by any quality evidence suggesting a tradeoff between clinical benefits and harms.

**SPS Evidence

- Scenario 1: Reliably implementing element is associated with statistically significant improvement.
- Scenario 2: Failing to implement element is associated with statistically significant failure to improve along with the system.
- Scenario 3: In cases where all hospitals implement, implementing an element without measuring reliability of the element is associated with statistically significant failure to improve along with the system.

Scenario 4: Reliably implementing element is not associated with statistically significant improvement; however, literature supports adoption of element as an SPS Standard.

IV. VTE detection – must use at least two methods

Method	Comments
Pharmacy Records	This system would be highly sensitive for identifying patients but not specific, i.e. lots of patients on anticoagulants who do not have a VTE or are on it for VTE prophylaxis. In addition, a patient with an acute VTE with a contraindication to anticoagulation would be missed. Challenges include identifying who would sift through all that data to decide which patients were on anticoagulation for VTE and an alternative method to identify those patients with VTE who are not anticoagulated.
ICD-10 Codes	Highly insensitive and not time sensitive. Should not be used in isolation.
Hem/Onc Consult	Very sensitive and specific but only if a Hematology consult was mandated by the institution. In those institution's that do mandate a consult and that have a good method for collecting this data, it is an excellent method. It would not be

	applicable to institutions that do not require a consult from hematology for VTE patients.
EMR Trigger	An EMR trigger linked to an element in the EMR (a note, the MAR, a radiological test) would be an outstanding way to identify patients, however only if such a trigger can be developed and only if the trigger would then link to a database or to someone who would collect the data.
Radiological Records	This method could be highly specific and sensitive if the VTE diagnosis could be flagged and then go to a database or to notify a data manager to enter the data in a database.

V. Measurement – Bundle Reliability

Measurement	Formula	Standards	Reporting Period
VTE risk screening and prevention interventions.	Number of audits totally compliant with SPS Prevention Bundle Elements/ Number of audits completed* x 100	• Your bundle reliability data should include **all** the SPS Standard elements • SPS strongly encourages hospitals to also include the SPS Recommended Elements. • Hospitals can choose to include additional elements. Please note that including too many (>5) elements may confuse and overwhelm care providers so proceed with caution. • Measure your bundle as ALL or None [46]. See Reference #43 for IHI description of All on None. • Minimum of 20 audits per month. If procedures are fewer than 20, then include all procedures.	Monthly

VI. References

1. Kahn SR, Lim W, Dunn AS, Cushman M, Dentali F, Akl EA, Cook DJ, Balekian AA, Klein RC, Le H, Schulman S, Murad MH, and American College of Chest P. Prevention of VTE in nonsurgical patients: Antithrombotic Therapy and Prevention of Thrombosis, 9th ed: American College of Chest Physicians Evidence-Based Clinical Practice Guidelines. Chest 2012;141:e195S-226S.
2. Mahajerin A, Webber EC, Morris J, Taylor K, and Saysana M. Development and Implementation Results of a Venous Thromboembolism Prophylaxis Guideline in a Tertiary Care Pediatric Hospital. Hosp Pediatr 2015;5:630-636.
3. Raffini L, Trimarchi T, Beliveau J, and Davis D. Thromboprophylaxis in a pediatric hospital: a patient-safety and quality-improvement initiative. Pediatrics 2011;127:e1326-1332.
4. Sharathkumar AA, Mahajerin A, Heidt L, Doerfer K, Heiny M, Vik T, Fallon R, and Rademaker A. Risk-prediction tool for identifying hospitalized children with a predisposition for development of venous thromboembolism: Peds-Clot clinical Decision Rule. J Thromb Haemost 2012;10:1326-1334.
5. Mahajerin A, Branchford BR, Amankwah EK, Raffini L, Chalmers E, van Ommen CH, and Goldenberg NA. Hospital-associated venous thromboembolism in pediatrics: a systematic review and meta-analysis of risk factors and risk-assessment models. Haematologica 2015;100:1045-1050.
6. Sandoval JA, Sheehan MP, Stonerock CE, Shafique S, Rescorla FJ, and Dalsing MC. Incidence, risk factors, and treatment patterns for deep venous thrombosis in hospitalized children: an increasing population at risk. J Vasc Surg 2008;47:837-843.
7. Hanson SJ, Punzalan RC, Arca MJ, Simpson P, Christensen MA, Hanson SK, Yan K, Braun K, and Havens PL. Effectiveness of clinical guidelines for deep vein thrombosis prophylaxis in reducing the incidence of venous thromboembolism in critically ill children after trauma. J Trauma Acute Care Surg 2012;72:1292-1297.
8. Monagle P, Adams M, Mahoney M, Ali K, Barnard D, Bernstein M, Brisson L, David M, Desai S, Scully MF, Halton J, Israels S, Jardine L, Leaker M, McCusker P, Silva M, Wu J, Anderson R, Andrew M, and Massicotte MP. Outcome of pediatric thromboembolic disease: a report from the Canadian Childhood Thrombophilia Registry. Pediatr Res 2000;47:763-766.
9. Tormene D, Simioni P, Prandoni P, Franz F, Zerbinati P, Tognin G, and Girolami A. The incidence of venous thromboembolism in thrombophilic children: a prospective cohort study. Blood 2002;100:2403-2405.
10. Nowak-Gottl U, Junker R, Kreuz W, von Eckardstein A, Kosch A, Nohe N, Schobess R, Ehrenforth S, and Childhood Thrombophilia Study G. Risk of recurrent venous thrombosis in children with combined prothrombotic risk factors. Blood 2001;97:858-862.
11. Branchford BR, Mourani P, Bajaj L, Manco-Johnson M, Wang M, and Goldenberg NA. Risk factors for in-hospital venous thromboembolism in children: a case-control study employing diagnostic validation. Haematologica 2012;97:509-515.
12. Anderson FA, Jr. and Spencer FA. Risk factors for venous thromboembolism. Circulation 2003;107:I9-16.
13. Oschman A and Kuhn RJ. Venous thromboembolism in the pediatric population. Orthopedics 2010;33:180-184.
14. Wright JM and Watts RG. Venous thromboembolism in pediatric patients: epidemiologic data from a pediatric tertiary care center in Alabama. J Pediatr Hematol Oncol 2011;33:261-264.
15. Andrew M, David M, Adams M, Ali K, Anderson R, Barnard D, Bernstein M, Brisson L, Cairney B, DeSai D, and et al. Venous thromboembolic complications (VTE) in children: first analyses of the Canadian Registry of VTE. Blood 1994;83:1251-1257.

16. Athale U, Siciliano S, Thabane L, Pai N, Cox S, Lathia A, Khan A, Armstrong A, and Chan AK. Epidemiology and clinical risk factors predisposing to thromboembolism in children with cancer. Pediatr Blood Cancer 2008;51:792-797.
17. Takemoto CM, Sohi S, Desai K, Bharaj R, Khanna A, McFarland S, Klaus S, Irshad A, Goldenberg NA, Strouse JJ, and Streiff MB. Hospital-associated venous thromboembolism in children: incidence and clinical characteristics. J Pediatr 2014;164:332-338.
18. O'Brien SH, Klima J, Termuhlen AM, and Kelleher KJ. Venous thromboembolism and adolescent and young adult oncology inpatients in US children's hospitals, 2001 to 2008. J Pediatr 2011;159:133-137.
19. Lipay NV, Zmitrovich AI, and Aleinikova OV. Epidemiology of venous thromboembolism in children with malignant diseases: a single-center study of the Belarusian Center for Pediatric Oncology and Hematology. Thromb Res 2011;128:130-134.
20. Humes DJ, Nordenskjold A, Walker AJ, West J, and Ludvigsson JF. Risk of venous thromboembolism in children after general surgery. J Pediatr Surg 2015;50:1870-1873.
21. Manlhiot C, Brandao LR, Schwartz SM, Sivarajan VB, Williams S, Collins TH, and McCrindle BW. Management and Outcomes of Patients with Occlusive Thrombosis after Pediatric Cardiac Surgery. J Pediatr 2016;169:146-153.
22. Meier KA, Clark E, Tarango C, Chima RS, and Shaughnessy E. Venous thromboembolism in hospitalized adolescents: an approach to risk assessment and prophylaxis. Hosp Pediatr 2015;5:44-51.
23. van Ommen CH, Heijboer H, Buller HR, Hirasing RA, Heijmans HS, and Peters M. Venous thromboembolism in childhood: a prospective two-year registry in The Netherlands. J Pediatr 2001;139:676-681.
24. Hanson SJ, Punzalan RC, Greenup RA, Liu H, Sato TT, and Havens PL. Incidence and risk factors for venous thromboembolism in critically ill children after trauma. J Trauma 2010;68:52-56.
25. Thompson AJ, McSwain SD, Webb SA, Stroud MA, and Streck CJ. Venous thromboembolism prophylaxis in the pediatric trauma population. J Pediatr Surg 2013;48:1413-1421.
26. Halvorson EE, Ervin SE, Russell TB, Skelton JA, Davis S, and Spangler J. Association of Obesity and Pediatric Venous Thromboembolism. Hosp Pediatr 2016;6:22-26.
27. Rana AR, Michalsky MP, Teich S, Groner JI, Caniano DA, and Schuster DP. Childhood obesity: a risk factor for injuries observed at a level-1 trauma center. J Pediatr Surg 2009;44:1601-1605.
28. Vu LT, Nobuhara KK, Lee H, and Farmer DL. Determination of risk factors for deep venous thrombosis in hospitalized children. J Pediatr Surg 2008;43:1095-1099.
29. Pannucci CJ, Osborne NH, and Wahl WL. Creation and validation of a simple venous thromboembolism risk scoring tool for thermally injured patients: analysis of the National Burn Repository. J Burn Care Res 2012;33:20-25.
30. Faucher LD and Conlon KM. Practice guidelines for deep venous thrombosis prophylaxis in burns. J Burn Care Res 2007;28:661-663.
31. Spentzouris G, Scriven RJ, Lee TK, and Labropoulos N. Pediatric venous thromboembolism in relation to adults. J Vasc Surg 2012;55:1785-1793.
32. Allenby F, Boardman L, Pflug JJ, and Calnan JS. Effects of external pneumatic intermittent compression on fibrinolysis in man. Lancet 1973;2:1412-1414.
33. Cahan MA, Hanna DJ, Wiley LA, Cox DK, and Killewich LA. External pneumatic compression and fibrinolysis in abdominal surgery. J Vasc Surg 2000;32:537-543.
34. Comerota AJ, Chouhan V, Harada RN, Sun L, Hosking J, Veermansunemi R, Comerota AJ, Jr., Schlappy D, and Rao AK. The fibrinolytic effects of intermittent pneumatic compression: mechanism of enhanced fibrinolysis. Ann Surg 1997;226:306-313; discussion 313-304.
35. Kosir MA, Schmittinger L, Barno-Winarski L, Duddella P, Pone M, Perales A, Lange P, Brish LK, McGee K, Beleski K, Pawlak J, Mammen E, Sajahan NP, and Kozol RA. Prospective double-arm study of fibrinolysis in surgical patients. J Surg Res 1998;74:96-101.

36. Macaulay W, Westrich G, Sharrock N, Sculco TP, Jhon PH, Peterson MG, and Salvati EA. Effect of pneumatic compression on fibrinolysis after total hip arthroplasty. Clin Orthop Relat Res 2002:168-176.
37. O'Brien TE, Woodford M, and Irving MH. The effect of intermittent compression of the calf on the fibrinolytic responses in the blood during a surgical operation. Surg Gynecol Obstet 1979;149:380-384.
38. Tarnay TJ, Rohr PR, Davidson AG, Stevenson MM, Byars EF, and Hopkins GR. Pneumatic calf compression, fibrinolysis, and the prevention of deep venous thrombosis. Surgery 1980;88:489-496.
39. Arabi YM, Khedr M, Dara SI, Dhar GS, Bhat SA, Tamim HM, and Afesh LY. Use of intermittent pneumatic compression and not graduated compression stockings is associated with lower incident VTE in critically ill patients: a multiple propensity scores adjusted analysis. Chest 2013;144:152-159.
40. Barrera LM, Perel P, Ker K, Cirocchi R, Farinella E, and Morales Uribe CH. Thromboprophylaxis for trauma patients. Cochrane Database Syst Rev 2013;3:CD008303.
41. Handoll HH, Farrar MJ, McBirnie J, Tytherleigh-Strong G, Milne AA, and Gillespie WJ. Heparin, low molecular weight heparin and physical methods for preventing deep vein thrombosis and pulmonary embolism following surgery for hip fractures. Cochrane Database Syst Rev 2002:CD000305.
42. Ho KM and Tan JA. Stratified meta-analysis of intermittent pneumatic compression of the lower limbs to prevent venous thromboembolism in hospitalized patients. Circulation 2013;128:1003-1020.
43. Kakkos SK, Caprini JA, Geroulakos G, Nicolaides AN, Stansby GP, Tsolakis IA, and Reddy DJ. Can combined (mechanical and pharmacological) modalities prevent fatal VTE? Int Angiol 2011;30:115-122.
44. Clements RH, Yellumahanthi K, Ballem N, Wesley M, and Bland KI. Pharmacologic prophylaxis against venous thromboembolic complications is not mandatory for all laparoscopic Roux-en-Y gastric bypass procedures. J Am Coll Surg 2009;208:917-921; discussion 921-913.
45. Monagle P, Chan AK, Goldenberg NA, Ichord RN, Journeycake JM, Nowak-Gottl U, Vesely SK, and American College of Chest P. Antithrombotic therapy in neonates and children: Antithrombotic Therapy and Prevention of Thrombosis, 9th ed: American College of Chest Physicians Evidence-Based Clinical Practice Guidelines. Chest 2012;141:e737S-801S.
46. Resar R, Griffin FA, Haraden C, and TW N. Using Care Bundles to Improve Health Care Quality. IHI Innovation Series white paper. Cambridge, Massachusetts: Institute for Healthcare Improvement 2012;(Available on www.IHI.org).

VII. Revision History

I. Version	Primary Author(s)	Description of Version	Date Completed
Version 1	Katie Hilbert	Initial Draft	9 Nov 2012
V2.0	Jason Bailey	Addition of section III, IV & V	4 Feb 2013
V3.0	Char Witmer, Daniela Davis, Brian Branchford, Julie Jaffray, Darcy Doellman, Leslie Raffini, Sheila Hanson, Neil Goldenberg, Chadi Zeinati, Lisa Battista	Revised entire document to match SPS VTE rework 2016	24 Oct 2016