



2018 HARC SCHOLARSHIP REPORT

Reducing harm from medication errors and venous thromboembolism (VTE) using effective electronic clinical decision support tools and quality improvement science methodology

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A report summarising a HARC study tour, 2018-2019



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- Pascal Metrics
- Johns Hopkins Hospital
- The Armstrong Institute for Patient Safety and Quality
- Massachusetts General Hospital
- Brigham and Women's Hospital
- National Blood Clot Alliance
- The Institute for Safe Medication Practice
- UC Davis Medical Center
- Dignity Health

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I would also like to give special mention to Ms Nina Muscillo and Dr Harvey Lander from the CEC, and Dr Peter Kennedy from eHealth NSW for their consistent mentorship, support and encouragement throughout my HARC experience and career more broadly.

1. Executive Summary and Recommendations

Medication errors and venous thromboembolism (VTE) are significant causes of preventable harm for patients in hospital¹. The aim of this project was to explore effective strategies for reducing harm from medication errors and VTE with a focus on the use of electronic solutions and quality improvement science methodology. Internationally, electronic solutions such as clinical decision support tools have been effective in improving the safe use of medications and compliance with VTE prevention processes. The widespread roll-out of electronic health records and prescribing systems across NSW hospitals has prompted a paradigm shift in the conversation about patient safety and reliable care.

While some electronic functionality to improve safety has been activated in NSW hospitals including the implementation of an electronic VTE risk assessment tool developed by the CEC and eHealth NSW, further work is required to optimise the potential of such functionalities in improving medication safety and VTE prevention.

By connecting with international world-leaders and centres of excellence in these areas, this project aimed to provide insight into user-centred and human factors design of electronic solutions; and methodologies and strategies for the effective implementation of such solutions.

This report provides a summary of key learnings and recommendations gained from a study tour which was supported by the Hospitals Alliance for Research Collaboration (HARC) Scholarship Program. The scholarship itinerary included:

- Attendance at the Cerner Health Conference and completion of a Human Factors course at the Armstrong Institute for Patient Safety and Quality
- Visits and interactions with leading experts at the National Center for Human Factors in Healthcare - MedStar Health, Pascal Metrics, the Johns Hopkins Hospital, Massachusetts General Hospital, Brigham and Women's Hospital, the National Blood Clot Alliance, the Institute for Safe Medication Practice, UC Davis Medical Center and Dignity Health

Key learnings and recommendations will inform and enhance the CEC's work in the areas of medication safety and VTE prevention.

¹ Maynard G. Preventing hospital-associated venous thromboembolism: a guide for effective quality improvement, 2nd ed. Rockville, MD: Agency for Healthcare Research and Quality; August 2016. AHRQ Publication No. 16-0001-EF.

Recommendations

Recommendation 1: *Review and incorporate learnings including tools and resources gained from the study tour into the CEC's Medication Safety Programs*

A range of useful learnings including tools and resources were identified through the study tour pertaining to medication safety more broadly and VTE prevention. These resources, which are referenced throughout the report, should be considered for use as part of ongoing work at state level and where relevant, shared with LHD/SHN-based leads for use as part of local implementations.

Recommendation 2: *Incorporate learnings with respect to electronic VTE risk assessments into any future redesigns and implementations of the NSW electronic VTE solutions*

Important learnings with respect to the design and implementation of electronic VTE solutions in the eMR should be considered as part of any future work to optimise the NSW electronic VTE solution.

These include:

- The need for simple and usable designs (i.e. minimal data fields for completion)
- Incorporation of tools into admission order sets²
- Linkage of risk assessment and prophylaxis components through standardised order sets
- Use of opt-out approaches or forcing functions to promote uptake
- Use of workflow M pages to improve visibility over the completion status of VTE risk assessment and prescribing
- Fostering of strong leadership and culture around VTE prevention to support implementation efforts
- Use of data, monitoring and feedback to drive improvement including the application of 'nudge' theory to improve individual performance
- Extraction and analysis of VTE prophylaxis administration data from the electronic medical record to identify additional opportunities for improving compliance with best practice guidelines
- Use of a collaborative-style implementation methodology to scale implementations

Recommendation 3: *Support Local Health Districts and Specialty Health Networks (LHDs/SHNs) to implement a strategy similar to MeasureVention to improve VTE prophylaxis prescribing and where possible, support the surveillance of potentially inappropriate prophylaxis through electronic algorithm-based dashboards*

The use of MeasureVention was a key initiative at Dignity Health in improving compliance with evidence-based VTE prevention. MeasureVention is a daily rounding process by designated staff (e.g. floor nurses, in-charge nurses, and pharmacists) involving review of mechanical and prophylaxis prescribed for patients. Where prophylaxis is deemed inappropriate, care teams are alerted to the need for follow-up action to comply with evidence-based guidelines. As many NSW sites would be familiar with the 5x5

² Admission order sets are a pre-determined group of relevant orders presented to prescribers upon admitting a patient. Admission order sets may be specialty/condition specific (e.g. general surgery admission order sets). At the Johns Hopkins Hospital, VTE is embedded as a component within admission order sets. If the VTE component has not been completed, the order set cannot be signed off. At other sites (e.g. Dignity Health), the VTE component of the admission order set is not enforced with a hard stop or forcing function i.e. the order set can be signed off without completing the VTE section. At present, admission order sets are not commonly used in NSW at present.

Antimicrobial Audit which is a similar intervention that has been promoted by the CEC's Antimicrobial Stewardship Program, the translatability and scalability of MeasureVention to improve VTE prophylaxis prescribing is expected to be largely feasible. It is recommended that the CEC VTE Prevention Program leverages learnings from the use of MeasureVention internationally and the 5x5 Antimicrobial Audit to create resources that will support the application of this intervention for VTE prevention. MeasureVention could be feasibly incorporated within pharmacist ward rounds and/or adopted by dedicated staff (e.g. VTE stewardship pharmacists, nursing and medical staff).

Where possible, the CEC should also advocate for and collaborate with key agencies such as eHealth NSW to develop algorithm-based dashboards that support the identification of at-risk patients potentially receiving suboptimal or inappropriate prophylaxis.

Recommendation 4: *Promote the systematic consideration of human factors and application of human factors methods as part of patient safety incident investigations, proactive risk assessments, and the initial design and continuous improvement of workflows/systems/solutions*

Although the availability of human factors expertise and resources in NSW Health are not widespread, it is recommended that the CEC and the broader NSW Health system consider how:

- human factors could be incorporated into patient safety incident investigations, proactive risk assessments and the initial design and continuous improvement of workflows/systems/solutions
- human factors capability could be uplifted within the NSW Health system
- partnerships with organisations that have human factors expertise could be strengthened

2. Literature Review

The literature review undertaken for this project was focused on electronic decision support solutions for improving VTE prevention and medication safety. A wide variety of keywords to cover essential themes related to the project's aims such as human factors, user-centred design, and implementation science were used as part of the search strategy. Relevant key findings from the literature review are summarised in the table below.

PUBLICATION	OBJECTIVE	METHODS	RELEVANT FINDINGS/CONCLUSION
<p>Maynard G. Preventing hospital-associated venous thromboembolism: a guide for effective quality improvement, 2nd ed. Rockville, MD: Agency for Healthcare Research and Quality; August 2016. AHRQ Publication No. 16-0001-EF.</p>	<p>Provides guidance on the implementation of VTE prevention best practices to ensure they are reliably delivered.</p>	<p>This guide targets failure modes in the process of preventing VTE in the inpatient setting and provides improvement teams with field-tested strategies and tools to enhance their chances of success.</p>	<ul style="list-style-type: none"> • Essential elements needed to achieve meaningful improvement in VTE prevention include an empowered, interdisciplinary team, supported by the institution, to standardise processes, monitor and measure VTE processes and outcomes, implement institutional policies, and educate providers and patients. • The guideline advocates for standardised VTE order sets, embedded through forcing functions in the eMR.
<p>Amland RC, Dean BB, Yu H-T, Ryan H, Orsund T, Hackman JL, et al. Computerised clinical decision support to prevent venous thromboembolism among hospitalized patients: proximal outcomes from a multiyear quality improvement project.</p>	<p>Evaluate the impact of implementing a healthcare technology driven clinical decision support (CDS) system to prevent venous thromboembolism (VTE) among hospitalized patients.</p>	<p>The study involved implementation and evaluation of a VTE Clinical Decision Support (CDS) solution at Truman Medical Center over three distinct phases:</p> <ol style="list-style-type: none"> 1. nursing driven workflow with the program's Discern Advisor 2. Computer Physician Order Entry (CPOE) with providers conducting risk screening and prophylaxis ordering via the Discern Advisor; and 	<ul style="list-style-type: none"> • Computerised VTE Clinical Decision Support (CDS) utilisation achieved 78.4% patients assessed within 24 hr from admission, 64.0% patients identified at risk, and 47.7% patients at risk for VTE with an initiated VTE interdisciplinary plan of care. • Compared to baseline, patients benefitting from VTE CDS were 35% less likely to have a VTE. • The VTE rate declined from 0.954 per 1000 patient days to 0.434 comparing baseline to full [computerised] VTE CDS.

<p>Journal of Healthcare Quality. 2014; 37:221-331.</p>		<p>3. additional flags in the system during the order entry process to alert the physician that the patient's risk level has not been assessed.</p>	<ul style="list-style-type: none"> • CDS systems with embedded algorithms, alerts, and notification capabilities enable physicians at the point of care to utilise guidelines and make impactful decisions to prevent VTE.
<p>Galanter, WL, Thambi, M, Rosencranz, H, Shah, B, Falck, S, Lin, F, Nutescu, Lambert, B. Effects of clinical decision support on venous thromboembolism risk assessment, prophylaxis, and prevention at a university teaching hospital. American Journal of Health System Pharmacy. 2010; 67:1265-1273.</p>	<p>Evaluate the implementation of a mandatory VTE risk assessment in a health system's electronic medical record (EMR) and clinical decision-support (CDS) system to measure its effect on the use of pharmacologic prophylaxis and the occurrence of VTE and bleeding events.</p>	<p>A commercially available CDS system was used in designing the automated CDS intervention. During computerised order entry, the system delivered alerts prompting clinician risk assessment and also delivered alerts under circumstances suggesting less-than-optimal prophylaxis. Rates of pharmacologic prophylaxis, clinically diagnosed hospital-acquired VTE, and hospital-acquired bleeding events were measured during one year before and one year after implementation.</p>	<ul style="list-style-type: none"> • Without increasing the risk of bleeding, a CDS system requiring clinicians to document VTE risk assessment in the electronic medical record (EMR) promoted improved rates of pharmacological prophylaxis at any time during an admission and a decreased risk of VTE in general medical patients.
<p>Beeler, PE, Eschmann, E, Schumacker, A, Studt, J-D, Amann-Vesti, B, Blaser, J. Impact of electronic reminders on venous thromboprophylaxis after admissions and transfers. Journal American Medical Informatics Association. 2014; 21:297-303</p>	<p>Analyse the effect of electronic reminders on thromboprophylaxis rates in wards to which patients were admitted and transferred. The latter was of particular interest since patient handoffs are considered to be critical safety issues.</p>	<p>This was a prospective study involving two study periods in the six departments of a university hospital, three of which were randomly assigned to the intervention group displaying reminders during the second period. At 6 h after admission or transfer, the algorithm checked for prophylaxis orders within 0-30 h of the patient's arrival, increasing the specificity of the displayed reminders.</p>	<ul style="list-style-type: none"> • Overall, the rate of prophylaxis significantly increased in the intervention group from 69.2% to 74.3% ($p < 0.0001$). • No significant changes were observed in the control group. • Postponing prophylaxis checks to 6 h after admissions and transfers reduced the number of reminders by 62% and thereby minimized the risk of alert fatigue. • The reminders improved awareness of VTE prevention in both admission and transfer wards. This approach may contribute to

			better quality of care and safer patient handoffs.
<p>Jenkins, I, O'Bryan, T, Holdych, J & Maynard, G. Impact of a Multicenter, Mentored Quality Collaborative on Hospital-Associated Venous Thromboembolism. Journal of Hospital Medicine. 2018. DOI 10.12788/jhm.2942</p>	<p>Reduce hospital-acquired VTE (HA-VTE) with a scalable quality improvement collaborative.</p>	<p>This study was a prospective, unblinded, open-intervention study with historical controls. A centrally supported collaborative implementing standardised VTE risk assessment and prophylaxis. Protocols were developed with 9 "pilot" sites, which received individualised mentoring. Finished protocols were disseminated to 26 "spread" sites, which received improvement webinars without mentoring. Active surveillance for real-time correction of suboptimal prophylaxis was funded in pilot sites and encouraged in spread sites. Planning and minimal improvement work began in 2011; most implementation occurred in 2012 and 2013.</p>	<ul style="list-style-type: none"> • Protocol-appropriate prophylaxis rates and The Joint Commission measure compliance both reached 97% in 2014, up from 70% to 89% in 2012 and 2013. • Five thousand three hundred and seventy HA-VTEs occurred during 1.16 million admissions. Four hundred twenty-eight fewer HA-VTEs occurred in 2014 than in 2011 (relative risk 0.78; 95% confidence interval, 0.73-0.85). HA-VTEs fell more in pilot sites than spread sites (26% vs 20%). The rates of adverse events were reduced or unchanged. • Overall, collaborative efforts were associated with improved prophylaxis rates and fewer HA-VTEs.
<p>Roberts, LN, Durkin, M & Arya, R. Annotation: Developing a national programme for VTE prevention. British Journal of Haematology. 2017; 178:162–170</p>	<p>Review the implementation and outcomes of the National Venous Thromboembolism Prevention Programme launched in England, in 2010. The central objective of the programme was to reduce morbidity and mortality from preventable deep vein thrombosis and pulmonary embolism through introduction of a comprehensive systematic approach. The cornerstone of the programme was the introduction of mandatory</p>	<p>The study involved review of process and outcome data aiming to evaluate the impact of the programme. The programme was ambitious in design, mandating VTE risk assessment of all adult patients on admission to an acute hospital utilising a national VTE risk assessment tool. Hospitals were required to report VTE risk assessment rates centrally, with a financial incentive to be applied (the</p>	<ul style="list-style-type: none"> • The percentage of patients admitted to an acute NHS hospital who underwent risk assessment for VTE at launch of mandatory reporting was 46.7%. There has been a sustained increase in these rates, with the initial target of 90% first met in November 2011 and maintained at 96% (December 2014). Between hospital variance in risk assessment rates reduced over time: the median hospital rate at launch in July 2010 was 51% (interquartile range [IQR] 27–71%) and improved to 93% (IQR 91–96%) by March 2012.

	<p>documented risk assessment for venous thromboembolism, supported by national thromboprophylaxis guidance.</p>	<p>Commissioning for Quality Innovation payment [CQuIN]) to achieve a pre-specified target (90% at launch). National guidance and a quality standard defining best practice in VTE prevention were published concurrently.</p>	<ul style="list-style-type: none"> The National VTE Prevention Programme in England resulted in a sustained increase in VTE risk assessment rates with corresponding increase in low molecular weight heparin (LMWH) use. VTE prevention continues to be a national clinical priority and the various elements of the systems based approach are embedded in the standard NHS contract. There is early evidence of significant reductions in hospital-associated thrombosis and its associated mortality following implementation of the programme.
<p>Haut, ER et al. Improved Prophylaxis and Decreased Rates of Preventable Harm With the Use of a Mandatory Computerized Clinical Decision Support Tool for Prophylaxis for Venous Thromboembolism in Trauma. 2012. The Archives of Surgery. 147:901-906</p>	<ul style="list-style-type: none"> To improve compliance with best practice prophylaxis for VTE in hospitalised trauma patients, a mandatory computerized provider order entry–based clinical decision support tool was implemented. The system required completion of checklists of VTE risk factors and contraindications to pharmacologic prophylaxis. With this tool, a patient’s risk stratification level and recommend appropriate prophylaxis could be determined. To evaluate the effect of the mandatory computerized provider order entry–based clinical decision support tool on compliance with prophylaxis 	<p>Retrospective cohort study (from January 2007 through December 2010) at a large University-based adult trauma center. The primary outcome measure was the proportion of patients who were ordered risk appropriate guideline-suggested VTE prophylaxis. The secondary outcome measure was the proportion of patients with any preventable VTE (defined as VTE in a patient not ordered guideline-appropriate VTE prophylaxis), pulmonary embolism, and/or deep vein thrombosis.</p>	<ul style="list-style-type: none"> Compliance with guideline-appropriate prophylaxis increased from 66.2% to 84.4% (P<.001). The rate of preventable harm from VTE decreased from 1.0% to 0.17% (P=.04). Implementation of a mandatory computerised provider order entry–based clinical decision support tool significantly improved compliance with VTE prophylaxis guidelines in hospitalized adult trauma patients. This improved compliance was associated with a significant decrease in the rate of preventable harm, which, was defined as VTE events in patients not ordered appropriate prophylaxis.

	guidelines for venous thromboembolism (VTE) and VTE outcomes among admitted adult trauma patients.		
Baysari M, Richardson L, Zheng WY, Westbrook J. Implementation of Electronic Medication Management Systems in hospitals – A literature scan. Sydney: ACSQHC; 2016	<p>The Guide outlines what hospitals need to do when implementing electronic medication management (EMM) systems, to avoid potential systemic problems that could lead to medication or other mishaps.</p> <p>The Commission engaged the Centre for Health Systems & Safety Research at the Australian Institute of Health Innovation, Macquarie University, to undertake a literature scan to inform the development of this third edition of the Guide.</p>	<p>The research questions asked were:</p> <ul style="list-style-type: none"> • What are the safety issues when implementing and using computerised systems with electronic prescribing in hospitals? • What factors contribute to successful implementation and use of computerised systems with electronic prescribing in hospitals? • How do policy and regulations impact on the uptake and use of computerised systems with electronic prescribing? <p>The review included 77 papers selected from a cohort of over 2000 papers and documents. The search parameters included published research, case studies, commentaries and news articles that focused on the implementation of electronic medication management systems in hospitals.</p>	<p>The conclusions of the literature scan regarding the implementation of EMM systems in hospitals are summarised as follows:</p> <ul style="list-style-type: none"> • Safety risks may be mitigated by ensuring system implementations are well planned, designed and integrated into workflows, and by limiting the use of ‘hybrid’ (paper/electronic) approaches. • Documents were fairly consistent in the factors they identified as contributing to successful implementation of EMM systems. These included adequate planning involving clinicians, appropriate training, a user-friendly system, strong leadership and effective communication. • Governments may be able to encourage successful implementation and use of EMM systems by: <ul style="list-style-type: none"> ○ providing incentives to organisations for system adoption and use ○ educating providers and the public ○ providing guidelines to standardise some components of systems, such as basic decision support, while allowing local customisation for other components.
Australian Commission on Safety and Quality in Health Care. Electronic	<i>The Electronic Medication Management Business Requirements</i> (the Requirements)	The Requirements were brought together from published and unpublished information sources, and	The document states that CDS should be:

<p>Medication Management Systems Business Requirements. An addendum to Electronic Medication Management Systems: A guide to safe implementation. Sydney: ACSQHC; 2018.</p>	<p>are an annexe to <i>Electronic Medication Management Systems: A guide to safe implementation</i> published by the Australian Commission on Safety and Quality in Health Care (the Commission) in 2017.</p> <p>The Requirements aim to support hospitals and health service organisations to procure and assess electronic medication management (EMM) systems.</p>	<p>validated by an expert panel. The Commission has incorporated other EMM business requirements arising from the Australian context, including medication safety priorities, technical standards and national infrastructure initiatives.</p>	<ul style="list-style-type: none"> • Appropriate and applicable to Australian medication practice • Available and active during the prescribing process • Available during medication administration • Automatically re-run whenever new medicines or changed medicines are ordered for a patient • Intelligently hyperlinked, so that reference material is available without the need for the prescriber to leave the prescribing function. <p>Reference information could include:</p> <ul style="list-style-type: none"> • A local formulary • Locally configured pharmacy-supplied information – for example, treatment options • <i>Therapeutic Guidelines*</i> • <i>Australian Medicines Handbook</i> • MIMS Australia • Hospital policies • Information on pharmacokinetics or pharmacodynamics • External websites or online resources.
<p>Australian Commission on Safety and Quality in Health Care. Electronic medication management systems: a guide to safe implementation. 3rd</p>	<p>The guide supports the safe and effective implementation and use of electronic medication management (EMM) systems in Australian health service organisations. The potential for harm because of poorly implemented EMM systems should be recognised and minimised through diligence in product</p>	<p>The guide is informed by:</p> <ul style="list-style-type: none"> • A scan of the publicly available literature (up to July 2016) • A review of publicly available tender requirements for EMM systems • Experience from implementing EMM systems in Australia 	<p>The guide contains a broad range of guidance on EMM implementation including at the various stages pre and post implementation.</p>

<p>edition. Sydney: ACSQHC; 2017.</p>	<p>selection, work practice change and end-to-end implementation.</p>	<ul style="list-style-type: none"> • Consultation with stakeholders with experience in medication safety. 	
<p>Australian Commission on Safety and Quality in Health Care. National guidelines for on-screen display of medicines information. Sydney: ACSQHC; 2017</p>	<p>These guidelines are intended for those developing, assessing, procuring and implementing IT systems for medication management and electronic prescribing to:</p> <ul style="list-style-type: none"> • Understand how design contributes to patient safety • Apply the recommendations during software development and iteration • Evaluate systems during procurement. 	<p>A wide range of stakeholders contributed to the review process, including pharmacists, doctors, nurses, consumers, and experts in the field of IT usability and user interface design.</p> <p>These guidelines comprise recommendations for clear, unambiguous, standardised on-screen presentation of medicines information. A rationale accompanies each recommendation and is based on examples where error has occurred in both handwritten and electronic prescriptions.</p>	<p>The guidelines make design recommendations covering a range of areas including:</p> <ul style="list-style-type: none"> • Medicine names • Text, abbreviations and symbols • Numbers and units of measure • General information display • Consumer-facing medicines information

3. HARC Scholarship Study Tour

3.1 Conference Attendance - Cerner Health Conference (CHC) 2018

The Cerner Health Conference (CHC) was held from 8-11th October 2018 in Kansas City, Missouri. The annual conference brings together nearly 14 000 health care industry leaders, practitioners and Cerner associates from across the globe. CHC 2018 was selected for this HARC itinerary as the Cerner electronic medical record (eMR) is the predominant eMR used across the NSW public health system.

A range of sessions were attended across the conference and conversations with international colleagues including Cerner staff took place, however those considered most valuable and relevant to the project's scope are summarised below.

CHC 2018 Learnings - VTE Prevention

Conference Presentation	
Session Title	Proper Prophylaxis: Strategies for VTE Advisor Success, One Health Network's Journey
Presenter/s	Brian McCamble <i>Medical Informatics Clinician & Senior Emergency Medicine Physician Assistant</i> Lewis Berman <i>Associate Chief Medical Information Officer & Attending Physician, Pulmonary-Critical Care Medicine</i>
Key Learnings & Reflections	<ul style="list-style-type: none"> • This presentation outlined One Health Network's experience with implementing Cerner's VTE Advisor at Danbury/New Milford Hospitals and Norwalk Hospital. • Prior to implementing the VTE Advisor, the hospitals used tools which required manual selection of risk factors and contraindications, and were not linked to prophylaxis ordering. This resulted in unreliable completion of risk assessments and appropriate prophylaxis prescribing. Refer to slides 15 to 25 of the slide deck. • A multidisciplinary team was convened to implement Cerner's VTE Advisor. • The VTE Advisor was introduced to ensure that all patients are assessed for VTE risk using an opt-out approach and to improve the linkage between treatment and documented risk assessment. • The VTE Advisor algorithm uses Padua scoring for Medical patients, Caprini scoring for Surgical patients and American College of Chest Physicians (ACCP) Guidelines 9th edition prescribing recommendations. • The VTE design configuration is outlined on slides 32 to 40. • Upon opening a patient's chart, the VTE Advisor is presented to particular clinicians (i.e. the admitting/attending/resident/fellow, not the consultant) via an order that is pre-checked in every inpatient PowerPlan.

- Some risk factors are pre-selected based on existing documentation, however the risk factors can be unselected at the provider's discretion.
- During question time, presenters were asked if poor electronic documentation of problem lists/diagnoses minimised pre-selection and increased the burden of manual selection to satisfy the Advisor. The presenters indicated that while this may result in some extra manual documentation, clinicians had not raised this as an issue.
- This is likely because, if at any point the risk factors indicate that the patient is at high risk, the advisor will automatically jump to the "select recommendations" section. Generally all the high risk patients can be easily isolated in the first step. It is the moderate risk ones which require identification (and documentation) of risk factors (as per the Padua/Caprini scores) to assess their risk.
- It should also be noted that documenting risk factors in the VTE Advisor does not feed them into the problem list.
- There is potential for customization of the VTE Advisor mainly with the prescribing recommendations section.
- Establishing the order catalogue was resource intensive and laborious. This involved mapping out all possible patient scenarios and corresponding prescribing recommendations in consultation with local clinical experts. Over 2000 scenarios were mapped out for this implementation.
- Maintaining the order catalogue to ensure that prescribing recommendations remain current and in line with best practice can also be resource intensive.
- From an implementation viewpoint, the presenters recommended that incorporating VTE Advisor education into other Cerner eMR education is preferable over providing separate education on the VTE Advisor.
- Overall, implementation has been relatively successful but has had its challenges. VTE Advisor use ranged from 76.11% to 82.74% between March and July at Norwalk, and 55.48% to 59.55% at Danbury/New Milford. The difference is likely due to Danbury/New Milford Hospital being new to Cerner and clinical decision support tools, whereas Norwalk Hospital has used Cerner and similar tools previously.
- There has been some feedback from clinicians that the Advisor is not intuitive, particularly when first being used.
- At the time of the presentation, the hospitals did not have outcome data to determine whether use of the VTE Advisor had reduced rates of hospital-acquired VTE due to an insufficient implementation period. They will collect such data in the future.
- The presenters were asked if the VTE Advisor re-triggered at particular time points. They indicated that the Advisor re-triggered during transfers of care (e.g. when the patient is being transferred from a ward to ICU), however the Advisor is not sophisticated enough to re-trigger based on clinical changes in the patient.

	<ul style="list-style-type: none"> During question time, an audience member from another US facility shared that they had not been successful with implementing the Advisor with completion rates of 30%.
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Conference Presentation	
Session Title	Navigating the care plan: St. John Health Systems, Ascension & Stonybrook Medicine
Presenter/s	Shelly Rupp, MSN, RN <i>Clinical Informatics Specialist, St. John Health Systems, Ascension</i> Laura Schwarz, BSN RN-BC <i>Sr. Instructional Support Analyst, Clinical Transformation, Stony Brook Medicine</i> Lori Allshouse, BSEE, CPHIMS <i>Program Manager, Clinical Informatics</i>
Key Learnings & Reflections	<ul style="list-style-type: none"> This presentation described St John Health Systems, Stonybrook Medicine and Sharp Health Care’s experiences with designing and implementing electronic care planning. While there were several valuable learnings from this session, one relevant learning relates to the use of interdisciplinary plans of care as a mechanism for promoting VTE risk assessment and management. The Stonybrook workflow (described on slides 20-24) consists of the following: admission orders are placed → a task fires for the RN to initiate the Interdisciplinary Plan of Care (IPOC) → if it is not initiated within 6 hours, an overdue alert notification pops up each time the chart is opened until the IPOC is initiated. The Orders section includes a number of elements including ‘Plans’, ‘Suggested Plans’, ‘Medication History’ and ‘Reconciliation History’ (slide 22). It is the platform from which plans and other actions are initiated. Suggested Plans: A rule suggests relevant Plans in the Orders section based on documentation, clinical events or diagnoses. In the example cited on slide 22, a ‘Risk of Venous Thromboembolism IPOC’ Plan is suggested. The Plan contains pre-checked outcomes/indicators/interventions. In this example, the following interventions are pre-checked: ‘Assess Risk of VTE’, ‘VTE Mechanical Interventions’, and ‘VTE Pharmacological Intervention’. The user is not able to modify the selections until the suggested Plan is either initiated or accepted.

CHC Solutions Gallery	
Topic	VTE Advisor – UK version
Person/s	Harriet Couper <i>Senior Solution Advisor, Sales Alignment Organisation, Cerner Corporation UK</i>

Key Learnings & Reflections

- The VTE risk advisor is launched on open chart when a patient is first admitted.
- A column on the doctors worklist also highlights the status of a VTE risk assessment (completed or not), as well as the risk on completion (high or low). The VTE risk assessment can be launched from this column as well.
- Alternatively, the form can be launched from within the patient’s record (either from an adhoc forms folder or by being pinned as a drop down option in a workflow Mpage).
- A ward ‘whiteboard view’ contains a ‘VTE’ column which indicates the VTE status for each patient (i.e. if VTE risk has been assessed and managed using the Advisor).
- The rule prompts completion of the VTE risk assessment on admission when first launching the patient record. At first, the alert can be bypassed. If bypassed, another alert will fire 6 hours post admission enforcing the completion of the risk assessment before being able to do anything else in the record. Clinicians are given an option to override the VTE risk assessment tool in emergency cases.
- A re-assessment task is also automatically set to fire for 24 hours post admission.
- The UK version of the VTE Advisor is similar to the NSW electronic version in the sense that it is a PowerForm and relies on the selection of VTE risk factors and bleedings risks to stratify the patient into a risk category. Unlike the NSW tool which is based on the 3 bucket model (lower, moderate and higher risk), the UK VTE Advisor stratifies patients into ‘low’ or ‘high’ risk of thrombosis and bleeding.
- Once a clinician has determined the patient’s thrombosis and bleeding risks, they are prompted to order prophylaxis using an appropriate order set³ which can be accessed within the tool. However if the tool is not completed and the prescriber attempts to order medication via the orders platform outside of the tool, the system will still allow this.
- The UK VTE risk advisor is based on UK guidelines and driven from a single order set. The order catalogue is also a UK one with a UK drug formulary; Cerner has not heard concerns about the resources required to maintain it.
- NB. A new version of the US VTE Advisor is being developed which may look quite different to the current version.

CHC Solutions Gallery

Topic	Miscellaneous learnings to improve electronic VTE prevention in NSW
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³ Order sets (sometimes referred to as PowerPlans) are a passive form of decision support which provide prescribers with a pre-determined, standardised and evidence-based set of all relevant orders for a specific condition (e.g. medications and laboratory orders).

Person/s	Various individuals at the CHC Solutions Gallery
Key Learnings & Reflections	<ul style="list-style-type: none"> • <i>Potential to display relevant results in a PowerForm:</i> A major usability issue associated with the current NSW electronic VTE PowerForm is that clinicians are unable to access information in other parts of the eMR which may be relevant for completing a VTE risk assessment while the PowerForm is open. Functionality demonstrated at the Solutions Gallery suggests that there may be potential to pull through relevant results into a PowerForm (Figure 1). It would be worth exploring whether this is possible with NSW Cerner functionality. • <i>Using workflow M-pages and worklists to create prompts for VTE prevention, and improve its integration within clinician workflows:</i> Previous evaluations of the NSW electronic VTE risk assessment tool have highlighted the need for improved prompting mechanisms and integration within workflow. Workflow M-pages and worklists provide clinicians with a high level overview of relevant patient information in one screen (refer to Figures 2-4). These functionalities can assist clinicians with streamlining their workflows, and managing and prioritising tasks. If the use of medical workflow M-pages and worklists is being considered for NSW, incorporating 'VTE status' (see Figure 4) may improve timely compliance with VTE prevention processes. From a broader medication safety perspective, consideration could also be given to incorporating other medication-related tasks such as medication reconciliation.

CHC 2018 Learnings – General Medication Safety

Conference Presentation	
Session Title	Medication safety: building high reliability with smarter tools and analysis
Presenter/s	Emily C. Webber, MD, FABPM, CMIO Kelley Wells, RPh, Director of Clinical IS
Key Learnings & Reflections	<ul style="list-style-type: none"> • This presentation discussed the relationship between health IT and patient safety using medication safety examples. • The presenters described use of the Failure Modes and Effects Analysis (FMEA) which highlighted gaps in medications and allergies components in the Cerner eMR. The FMEA was used prior implementation to detect potential errors. Implementation was delayed to address identified gaps. • Strategies for reducing dose range checking (DRC) alerting were shared: <ul style="list-style-type: none"> ○ Remove minimum drug-dose alerts ○ Remove weight-based content when not necessary (much of adult content) ○ Remove unusual dose premise ○ Identify if high alerting and high override drugs are correct for clinical practice <ul style="list-style-type: none"> ▪ Do PowerPlans suggest a dose that would alert in DRC? ▪ Has practice changed in the last 10 years?

	<ul style="list-style-type: none"> ○ Make a maximum of 125% of the highest dose recommended ○ Establish a consistent process for assessment and correction of DRC <ul style="list-style-type: none"> ▪ Seek provider members of the “MAM” (Medication alert management) ▪ Include integration of medication safety and error review process ▪ Target high risk drugs ○ “Clean up” appearance of DRC discern alert ○ DRC becomes physician facing
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Conference Presentation	
Session Title	Managing high-risk infusions across Ireland's neonatal ICUs
Presenter/s	<p>Orla Sheehan, RN, MSc <i>NICU Workstream Lead Health Service Executive</i></p> <p>Brian Cleary, BSc, MSc, RPH <i>Medications Workstream Lead Health Service Executive/Rotunda Hospital</i></p>
Key Learnings & Reflections	<ul style="list-style-type: none"> • This presentation discussed the implementation of a NICU medication safety bundle to minimise NICU high risk infusion related errors. • Prior to implementation, errors occurred with high risk drugs such as morphine, dopamine, insulin and heparin primarily due to the complexity of the infusion preparation process and the following factors: <ul style="list-style-type: none"> ○ Manual prescribing of neonatal infusions ○ Reconstitution and/or dilution of medications using multiple variations of the rule of 6 ○ Manual, handwritten labelling of infusions ○ Volume based programming of infusion pumps without dose error reduction software • Introduction of the Medication Safety Bundle standardised the display of infusion information including preparation instructions through the electronic generation of pre-printed labels. Once generated, these labels containing pre-printed information extracted from the eMR, are signed by the prescriber and administering nurse, and affixed to infusion bags and syringe labels. • Following implementation of the Medication Safety Bundle, infusion errors particularly those associated with incorrect or incomplete labelling were reduced. • This presentation provided an example of how the eMR can be used to support patient safety through improved information display and process reliability.

Conference Presentation	
Session Title	Improve safety and usability with new medication order enhancements

Presenter/s	Brenda L. Dodson, Pharm.D. <i>Clinical Integration Architect</i>
Key Learnings & Reflections	<ul style="list-style-type: none"> • This presentation discussed build configuration modifications to improve the safety and usability of medication ordering: <ul style="list-style-type: none"> ○ build changes (using C-type dispensible synonyms) to streamline the conversion of medications during the reconciliation process (i.e. reducing the number of clicks when converting an unreconciled order to an inpatient order) ○ synonym level code set filtering to allow prescribers to only choose routes that are relevant for the medication order ○ restricting to PowerPlan specific order sentences (e.g. ED orders are once only medications. If a prescriber forgets to choose an order sentence before signing, only order sentences specific to that PowerPlan (i.e. in this ED example, an order sentence for a once only dose) are presented. • Prior to implementation, errors occurred with high risk drugs such as morphine, dopamine, insulin and heparin primarily due to the complexity of the infusion preparation process and the following factors: <ul style="list-style-type: none"> ○ Manual prescribing of neonatal infusions ○ Reconstitution and/or dilution of medications using multiple variations of the rule of 6 ○ Manual, handwritten labelling of infusions ○ Volume based programming of infusion pumps without dose error reduction software • Introduction of the Medication Safety Bundle standardised the display of infusion information including preparation instructions through the electronic generation of pre-printed labels. Once generated, these labels containing pre-printed information extracted from the eMR, are signed by the prescriber and administering nurse, and affixed to infusion bags and syringe labels. • Following implementation of the Medication Safety Bundle, infusion errors particularly those associated with incorrect or incomplete labelling were reduced. • This presentation provided an example of how the eMR can be used to support patient safety through improved information display and process reliability.

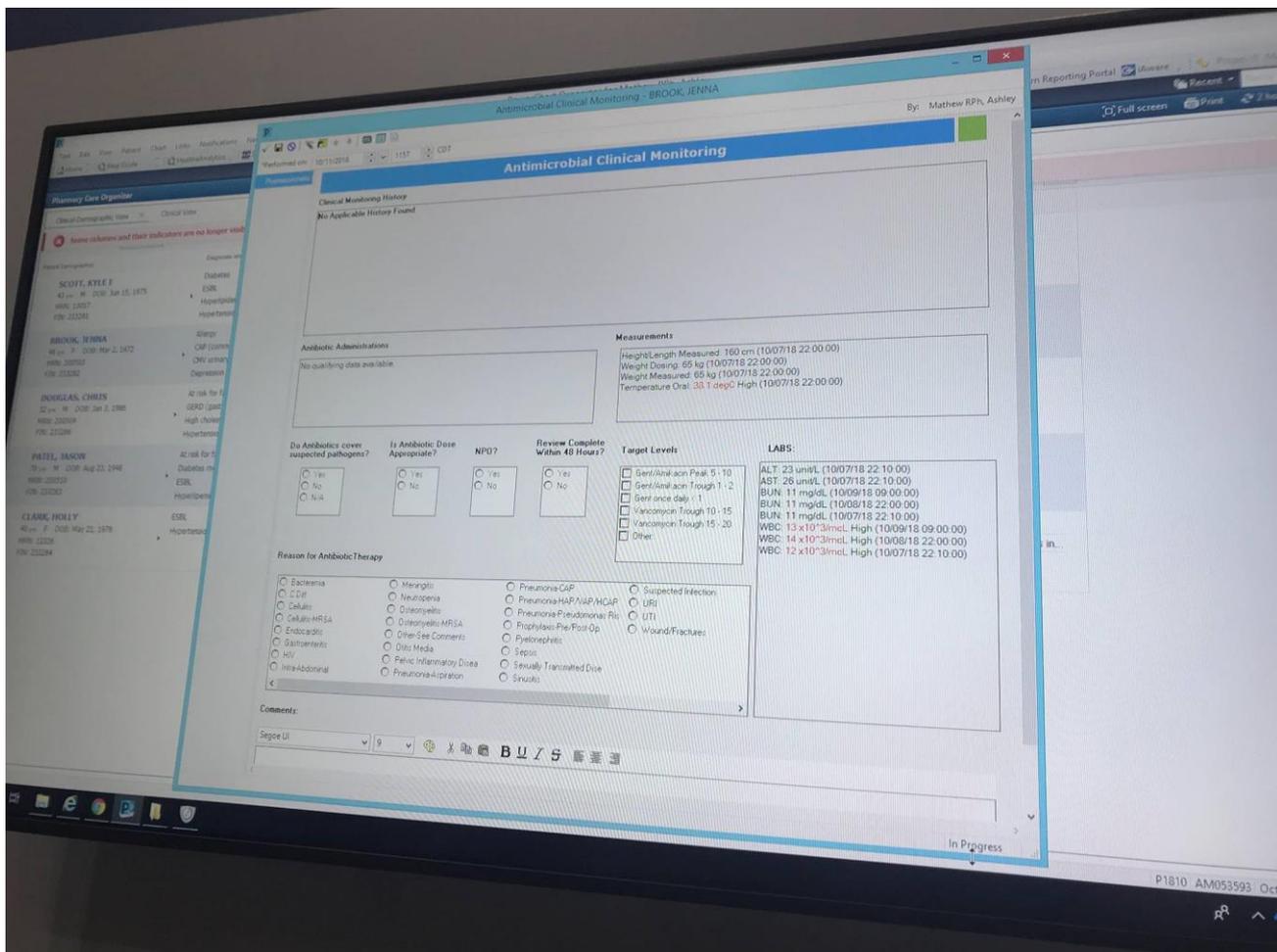


Figure 1. Example showing lab results displayed on a PowerForm.

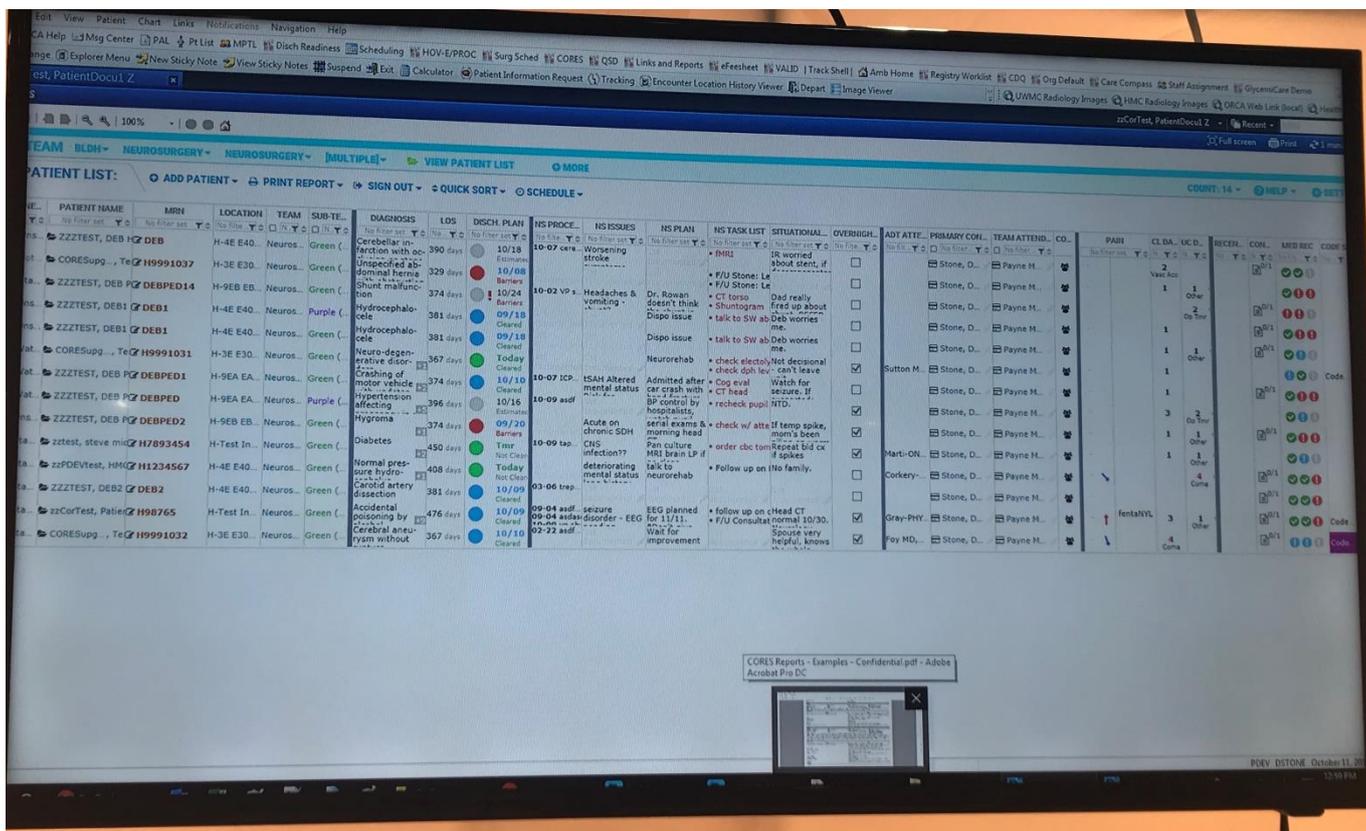


Figure 2. Example - medical workflow M-page (from a non-Cerner vendor) showing key information for each patient on the clinician's list.

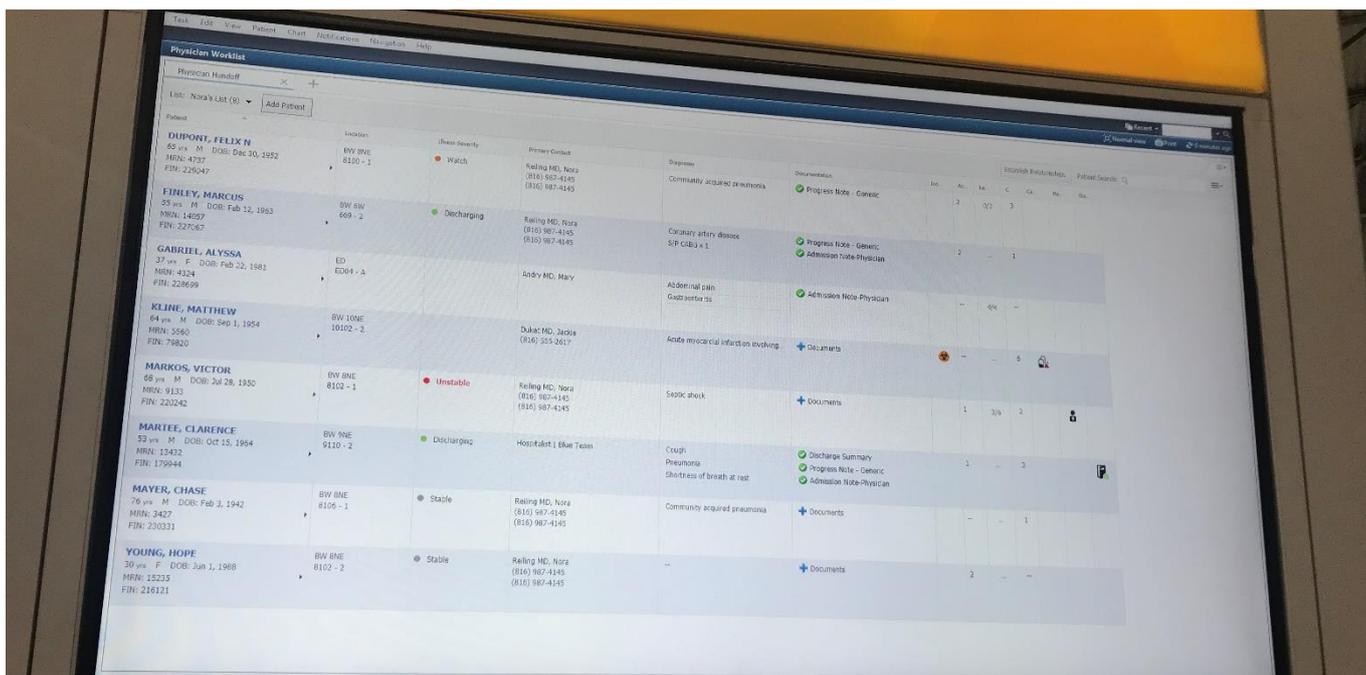


Figure 3. Example - Physician Worklist showing key information.

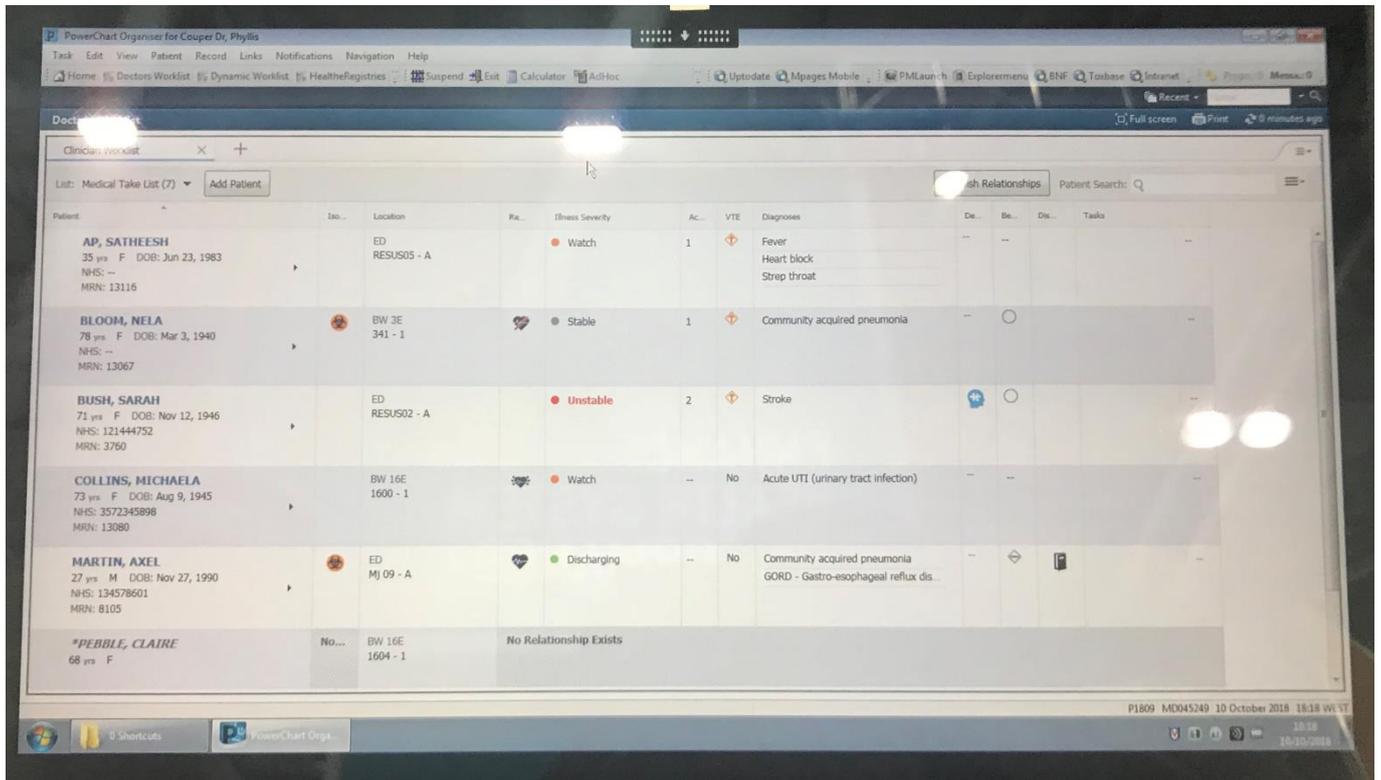


Figure 4. Example - Doctor Worklist showing key information including VTE status (this is the workflow for the UK version of the VTE Advisor).

3.2 Site Visit – MedStar Health National Center for Human Factors in Healthcare, Washington DC

About the Visit

The [MedStar Health National Center for Human Factors in Healthcare](#) is a large human factors program embedded within MedStar Health which provides core services in applied research, usability, safety and education. The Center aims to ‘improve the safety, efficiency, and quality of healthcare through innovative application of the science of human factors and system safety’ (Figure 5).



Figure 5. National Center for Human Factors in Healthcare’s vision, mission and approach.

This visit involved meetings with key personnel including the Founding Director, Dr Terry Fairbanks, the Director of Usability Services, Dr Lawrence Wolpert, System Clinical Safety Program Operations Managers, Mary Herold and Travis Mitchell, Postdoctoral Research Fellow, Dr Rachel Wynn and a tour of the Simulations Lab by Kevin Bradshaw.

Key Learnings and Reflections

- The Center consists of multidisciplinary expertise including human factors scientists, safety system engineers, informatics experts, health services researchers and clinicians.
- Among its services, the Center offers human factors consults that include data gathering, safety hazard analysis and reporting to influence and implement change. For example, hospitals may request consults for a human factors investigation reviews when incidents occur. Generally, a team of three to four staff members will be selected to undertake the review; the mix of expertise deployed depends on the case at hand, however may include a nurse or doctor, human factors experts and safety engineers.
- The Human Factors Center collaborates closely with MedStar Health Institute for Quality and Safety to change the way error is perceived i.e. human error is normal, therefore rather than blaming individuals a system approach to error is promoted through the identification of systematic vulnerabilities and creating environments that are least likely to result in errors.
- In terms of the Applied Research, the Center conducts research on how the electronic medical record is used and can be optimised.
- The Center provides usability testing at all stages of the development process with a focus on evaluating medical devices and health IT products.

- The usability team has expertise in: interviews and focus groups, heuristic evaluation, risk analysis, labelling comprehension, formative evaluations, validation studies and FDA-compliant reporting.
- Although the Center is embedded within MedStar Health, usability testing services are provided to MedStar Health and external clients from the healthcare industry. The demand for such services is largely driven by FDA requirements for conducting usability testing on devices prior to market release as outlined in '[Applying Human Factors and Usability Engineering to Medical Devices](#)'.
- System Clinical Safety Program Operations Managers, Mary Herold and Travis Mitchell discussed examples of Medication Event Reviews. Contributing factors to errors and opportunities for improvement (i.e. recommendations) may be identified through shadowing and seeking input from end users. While methods used as part of these reviews are similar to those used in NSW (e.g. Root Cause Analysis, quality improvement methodology), the use of dedicated personnel to conduct such reviews in a systematised manner was noted and could have application in NSW.
- The Center also features a simulation lab which is used to support the training of health care professionals and students.
- Overall, the systematic consideration of human factors as part of incident investigations was an important learning from this site visit, however, the applicability of this learning in NSW may be limited by lack of available human factors expertise and resources.

3.3 Pascal Metrics

About the Visit

This site visit involved an afternoon meeting with Drew Ladner, President and CEO of [Pascal Metrics](#) and Vice President, Susanne Miller. The meeting involved a presentation and discussion.

Key Learnings and Reflections

- Pascal Metrics allows for real time incident monitoring to detect harm based on the Institute of Healthcare Improvement (IHI) Global Trigger Tool. This is achieved through the application of machine learning to data within the electronic medical record.
- Positive triggers are notified to 'reviewers' for further investigation and clinical review.
- The ability to detect harm in real-time is advantageous as it allows for more timely intervention. In addition, it is a more robust method for quantifying the extent of system-wide harm unlike voluntary incident reporting systems which are compromised by significant under-reporting.
- A pilot of the Pascal Metrics solution is scheduled to take place at selected NSW hospitals in 2019. While there are major advantages with detecting harm in real-time, it will be important to monitor resource and operational implications such as:
 - From a time and cost perspective, what are the resource implications associated with investigating triggers once notified?
 - Who should triggers be notified to within existing organisational structures e.g. patient safety managers? What skills and expertise are required to effectively investigate and act on triggers? Is upskilling required?
 - What processes including the articulation of roles and responsibilities may be required within existing organisational structures to ensure that triggers are addressed effectively?

- Other than supporting responsive risk management in real-time, how will learnings from the detection of harm inform quality improvement activities at a systems level? Is it possible to build upper and lower limits into charts generated to aid with differentiating between common and special cause variation?
- How will overall benefits be measured over time including reductions in all-cause harm, length of stay, readmissions, cost savings and other relevant metrics?

3.4 Johns Hopkins Hospital, Baltimore

About the Visit

The Johns Hopkins Hospital in Baltimore is a world-renowned centre of excellence and has made significant leaps in the area of VTE Prevention.

This was a one day visit to the Johns Hopkins Hospital which consisted of meetings with key personnel from the VTE prevention team including A/Prof Elliott Haut (Vice Chair of Quality and Safety & Associate Professor of Surgery, Anesthesiology and Critical Care Medicine, Emergency Medicine and Health Policy & Management), Peggy Kraus (Clinical Pharmacy Specialist, Anticoagulations Management Service), Femi Owodunni (Post Doctoral Fellow), Dauryne Shaffer (Nurse Educator – Surgery, VTE Collaborative), Brandon Lau (Assistant Professor of Radiology and Radiological Science and Health Sciences Informatics) and Medication Safety Pharmacists, Rosemary Duncan and Meghan Rowcliffe. The visit also included a tour of the hospital by surgical resident, Amber Kernodle.

Key Learnings and Reflections

- The Johns Hopkins Hospital has undertaken a significant program of work over approximately the past 15 years to improve VTE prevention outcomes. Key elements of their work include:
 - Strong culture, leadership and multidisciplinary efforts to promote VTE prevention
 - The implementation of a mandatory electronic clinical decision support tool for VTE (which incorporates both risk assessment and prophylaxis ordering components) embedded within admission order sets i.e. the order set cannot be finalised until the VTE component has been completed (it should be noted that different order sets e.g. trauma, medical have different VTE modules relevant to that specialty/patient group). This is an important learning as in NSW, a major challenge impacting the uptake of the electronic VTE risk assessment tool has been its lack of seamless integration within workflows which is compounded by passive and minimally visible prompts for completing the VTE risk assessment task. Considering how the provision of care can be consolidated into standardised ‘order sets’ may improve the reliable completion of VTE prevention processes and other important clinical tasks.
 - Optimising the use of data from the eMR to evaluate performance and drive improvement. Examples include:
 - Extracting data on non-administered doses of VTE and designing appropriate interventions to improve administration rates e.g. education programs for nursing staff on the importance of VTE prophylaxis and a project involving patient-centered communication strategies to improve VTE prophylaxis administration rates in the hospital. Using real-time alerts, the team is identifying patients who miss ordered

doses of prophylaxis, and then facilitating conversations with those patients about VTE risks and prevention. To date, VTE metrics defined for NSW have largely focused on VTE risk assessment, prophylaxis prescribing and hospital-acquired VTE rates. As the increasing volume of electronic medication management system implementations is facilitating more automated methods of data extraction, there may be potential to consider defining and acting on VTE prophylaxis administration metrics in NSW. This may require collaboration between improvement experts, informaticians, data scientists and VTE clinical leads.

- Providing surgical residents with individualised performance feedback in the form of scorecards showing their appropriate prescribing rates compared to peers i.e. the application of behavioural science and nudge theory to data.
- The widespread use of the technology including electronic prescribing, robots and other automating technologies to facilitate medication management at the Johns Hopkins Hospital was evident during the visit. Meetings with Medication Safety pharmacists revealed a number of important learnings which may have applicability in NSW particularly as NSW hospitals increasingly design and implement technologies and functionalities to facilitate medication management. These include:
 - The role of Medication Safety pharmacists in assessing the safety of technologies and functionalities using structured methods and tools such as severity and occurrence coding scales and the Failure Mode and Effects Analysis (FMEA). An example shared was the use of the FMEA to identify and mitigate failure modes prior to implementation of a chemotherapy robot. The calculated Risk Priority Number (RPN) and Risk Hazard Index (RHI) were compared before and after identification of potential system changes.
 - The role of Medication Safety pharmacists/experts in collaborating with application specialists and vendors to ensure the safe design of electronic medication management functionalities and workflows both at state and LHD level. While Medication Safety pharmacists exist in the NSW public health system, this is a relatively small workforce. In saying this, there may be opportunities to upskill and formally promote the role of Medication Safety pharmacists in contributing to electronic medication management system and workflow designs by:
 - engaging SHPA and other professional bodies to support the development of Medication Safety pharmacists in the area of health IT safety
 - engaging relevant stakeholders such as the Clinical Excellence Commission and NSW Therapeutic Advisory Group to enhance the availability of tools/methods that guide decisions around system and workflow designs by Medication Safety personnel and Drug and Therapeutics Committees
 - reviewing governance structures and processes for the implementation and continuous improvement of eMeds and considering how Medication Safety pharmacists could be involved at both state and LHD level
 - The use of the Leapfrog tool to evaluate electronic prescribing systems for their safety using a series of simulated patients and medication orders.
 - It would be worthwhile reviewing health IT safety resources developed by the ECRI Institute which aim to promote best practice and applying lessons learnt:
<https://www.ecri.org/hit/library>

3.5 Improving Patient Safety with Human Factors Methods Armstrong Institute for Patient Safety and Quality Workshop

About the Workshop

This was a two day course convened by the Armstrong Institute for Patient Safety and Quality on improving patient safety with human factors methods. The course was delivered by:

- Nicole Mollenkopf, a pharmacist and patient safety specialist working with the Health IT Safety Group at the Johns Hopkins Armstrong Institute for Patient Safety and Quality. Nicole works closely with human factors engineers and other health care professionals to address medication safety-related issues in the use of automation and information technology. She is currently working with human factors engineers and psychologists to study the medication reconciliation process in outpatient oncology clinics.
- Yushi Yang, a Human Factors Specialist on the Patient Safety operations team. Yushi applies a sociotechnical systems approach to addressing complexities in healthcare using ethnography, contextual inquiry, data visualisation and usability engineering.

Workshop Objectives

1. Define the Human Factors
2. Explain how Human Factors can be used within high risk industries such as healthcare
3. Apply Human Factors methods to proactively identify contributing factors of broken systems
4. Develop an approach to fix identified factors in a broken system with the goal of reducing human errors and improving organisational performance

Key Learnings and Reflections

- Human factors methods can be used to improve patient safety. Human factors assist with:
 - understanding people via physical and cognitive ergonomics
 - understanding how humans interact with systems via macroergonomics
 - identifying and minimising mismatch and error through usability testing, work system analysis and proactive and retrospective error identification methods
- Basic principles/tenets of human factors in design include:
 - Fitting the design to the person, not the person to the design
 - Designing systems to make it difficult to do the wrong thing or make an error
- Although the discipline and use of human factors to improve patient safety and design are becoming increasingly popular in pockets of the NSW Health system, there is significant potential to apply human factors methods to enhance the design and implementation of tools, processes and systems. Examples may include:
 - The application of cognitive ergonomics in understanding error types that users/clinicians may make during decision-making due to the way in which they interpret and remember information, and cognitive limitations. This could have particular utility:
 - proactively e.g. when designing decision support tools and systems
 - retrospectively e.g. when identifying contributing factors during root cause analyses of major incidents

- The application of physical ergonomics to prevent workplace injuries and improve efficiency. Examples of application could include:
 - when procuring or designing Workstation on Wheels (WOWs) and associated workflows
 - conducting a link analysis which evaluates the relationships between objects, people, the environment etc when designing clinical care areas and layouts
- The application of macroergonomics to optimise overall health system design including organizational structures, policies and processes. Examples could include:
 - The use of the Systems Engineering Initiative for Patient Safety (SEIPS) model which incorporates the Structure-Process-Outcome (SPO) model of healthcare quality or work system analysis and design when designing workflows, implementing new/revising processes and technologies, and analysing errors (patient safety incident investigations).
- Applying usability evaluation (e.g. heuristic evaluation and usability testing) to ensure that the design of tools, systems and processes are safe, usable and align with best practice design principles e.g. Nielsen's Design Principles. As poor design can lead to errors, applying usability evaluation is particularly relevant for organisations such as the Clinical Excellence Commission, the Agency for Clinical Innovation and eHealth NSW when developing clinician resources including paper and electronic clinical decision support tools.
- The application error identification tools such as failure mode effects analysis (FMEA) and root cause analysis (RCA) to understand errors, contributing factors and opportunities for redesign.

3.6 Massachusetts General Hospital

About the Visit

This brief visit to Massachusetts General Hospital involved a meeting with hematologist, Dr Rachel Rosovsky.

Key Learnings and Reflections

Dr Rosovsky shared her work⁴ about the development of pulmonary embolism response teams (PERTs) to provide rapid, individualized and evidence based care for patients with acute PE.

Although learnings from this meeting are not directly within the scope of the research project, it is interesting to investigate whether this model of care has been implemented or if not, has potential to be implemented in NSW hospitals.

⁴ Rosovsky, R et al. 2018. Pulmonary Embolism Response Team Inpatient Structure, Outpatient Follow-up, and Is it the Current Standard of Care? Clin Chest Med 39 (2018) 621-630

3.7 Brigham and Women's Hospital

About the Visit

This brief visit to Brigham and Women's Hospital involved a meeting with Anticoagulation Services Pharmacy Manager, Katelyn Sylvester.

Key Learnings and Reflections

- This visit provided insight into what a pharmacist-led anticoagulation services clinic could look like. Key functions of the service include:
 - Establishment of thrombosis committee which meets monthly to oversee various aspects including anticoagulation drugs on formulary
 - Ensuring that PTT levels are measured on time
 - Monitoring PTT levels to ensure they are in range
- Brigham and Women's Hospital's eMR contains VTE decision support in the form of an order set. Unlike other tools which require clinicians to select risk factors, information about risk factors and risk categories (higher, moderate and lower) are displayed to the user in the order set as onscreen reference text. The user is required to read this information, determine and select a risk level (higher, moderate, lower) then prescribe prophylaxis by selecting an option presented within the order set.

3.8 The National Blood Clot Alliance

About the Visit

This section of the trip involved a one hour phone interview with Randy Fenninger, the CEO of the National Blood Clot Alliance.

Key Learnings and Reflections

- The National Blood Clot Alliance (NBCA) is a non-profit, voluntary health organisation dedicated to VTE prevention: <https://www.stoptheclot.org/>
- The organization aims to empower the patient voice in the fight against VTE.
- Their website contains many useful resources including information for consumers and healthcare professionals, and patient stories.

3.9 The Institute for Safe Medication Practice

About the Visit

This brief visit involved a meeting with ISMP Executive Vice President, Dr Allen Vaida and Vice President, Susan Paparella.

Key Learnings and Reflections

The main focus of this conversation was VTE prevention and medication safety in the context of electronic medication management. Resources shared by the ISMP team and relevant key learnings/reflections are documented in the table below.

Resource	Comments including key learnings and reflections
Pennsylvania (PA) Patient Safety Authority: http://patientsafety.pa.gov/	Articles written based on the mandatory medical error reporting system in PA (PA PSRS) can be searched via the advisories tab. The articles cover many medication safety topics including VTE.
ISMP Assess-ERR tool: https://www.ismp.org/resources/assess-err-worksheets	This is a system-based tool which supports the investigation of system-based issues that contribute to medication errors. The tool contains worksheets which assist with error report investigations of medication errors or near-misses. There may be potential to promote use of these resources by medication safety personnel and incorporate aspects into NSW Health incident reporting systems.
Failure Mode and Effects Analysis (FMEA) for Anticoagulants: https://www.ismp.org/sites/default/files/attachments/2018-02/FMEAofAnticoagulants.pdf	This is an example of a FMEA completed on anticoagulants. The content may be useful for consideration as part of the CEC High Risk Medicines program.
Medication Safety Officers Society: http://www.medsafetyofficer.org/	Membership is free and provides quarterly calls and notices of programs as well as a list serve with other MSOs.
Resources for Computerised Physician Order Entry (CPOE) testing <ul style="list-style-type: none"> Schiff et al. 2015. Computerised physician order entry-related medication errors: analysis of reported errors and 	A number of resources were shared which support testing of CPOE systems. In the article provided, 'use cases' or test scenarios were derived from existing medication error reports to test system vulnerabilities. There is potential to apply this approach including testing scenarios to electronic medication management systems in NSW.

<p>vulnerability testing of current systems: https://qualitysafety.bmj.com/content/24/4/264</p> <ul style="list-style-type: none"> • Testing scenarios associated with the above study • An ISMP listing of testing scenarios 	
<p>ISMP Guidelines for Safe Electronic Communication of Medication Information: https://www.ismp.org/resources/guidelines-safe-electronic-communication-medication-information</p>	<p>Electronic medication management systems have resulted in significant changes in how medications are prescribed, dispensed, and administered. This guideline provides guidance on the communication of medication information to avoid potential technology-induced medication errors. The guideline recommends strategies for the safe display and presentation of medication information in various electronic formats based on specific health IT-associated design features intended to mitigate the risk of medication errors.</p> <p>There is potential to incorporate guidance in this document into existing state and local electronic medication management design processes.</p>
<p>Interactive FMEA tool on IHI website: http://www.ihl.org/resources/Pages/Tools/FailureModesandEffectsAnalysisTool.aspx</p>	<p>This is an interactive FMEA tool which could be used to proactively risk assess processes.</p>
<p>Guidelines for the Optimizing Safe Subcutaneous Insulin Use in Adults https://www.ismp.org/guidelines/subcutaneous-insulin</p>	<p>The content of this guideline may be useful for consideration as part of the CEC High Risk Medicines program.</p>
<p>Guidelines for Safe Practice for Adult IV Push Medications https://www.ismp.org/guidelines/iv-push. ISMP Newsletter survey on IV push practice issues to be published Nov 1, 2018.</p>	<p>The content of this guideline may be useful for consideration as part of the CEC Medication Safety programs.</p>
<p>ECRI Partnership for IT Patient Safety: https://www.ecri.org/HITPartnership/Pages/default.aspx</p>	<p>The Partnership sets health IT safety priorities and makes recommendations. The content of this resource may be useful in informing the strategic direction of health IT safety efforts at state and local level.</p>

Safety-related questions when adding new drugs to the formulary

The following safety-related questions for consideration by drug and therapeutics committees when adding new drugs to the formulary were provided by the ISMP team:

- Is this a high-alert drug or in a high-alert drug category? (ISMP's list of high-alert drugs can be found at: <http://www.ismp.org/Tools/highalertmedications.pdf>).
- Is there a potential for error with this drug (in addition to look- and sound-alike drug names and known labeling and packaging problems)? Utilise the *ISMP Medication Safety Alert! Acute Care Edition*, Food and Drug Administration (FDA) MEDWATCH data, as well as other safety literature to review previously reported issues with particular drugs/drug classes. If possible, bring the actual outer product package, along with the vial, syringe, etc. to the meeting so that look-alike or ambiguous drug packaging and labeling can be readily identified.
- What are suggested safety strategies that should be employed, such as the need for restricted prescribing, preprinted order sets, standardized dosing, special storage, auxiliary labeling, laboratory or clinical monitoring, or an independent double-check process? Are staff prepared for manage additional monitoring?
- Would the safe use of this medication require specific technology-based user alerts in the pharmacy computer system, bar-code point-of-care (BPOC) systems, compounding systems, automated dispensing systems (ADCs), smart pumps, and CPOE systems?
- Should additional and ongoing staff competency assessments be maintained for all practitioners prescribing, dispensing, or administering the product?
- Failure Mode and Effects Analysis (FMEA) tools can be used to support these important formulary decisions.

3.10 UC Davis Medical Center and Dignity Health

About the Visit

This three day visit was hosted by Dr Gregory Maynard, a world leading VTE expert whose work has been instrumental in the development of the NSW VTE Prevention Program. Key components of the visit included:

- Meetings with various experts including regarding VTE prevention, opioid stewardship, sepsis, transfusion and blood product safety and infectious diseases
- A tour of the hospital
- Attendance at huddles, and safety and quality meeting
- A teleconference with Dignity Health regarding their VTE work

Key Learnings and Reflections

Due to the length of this visit, a broad range of topics were covered. Only key learnings/reflections related to VTE prevention have been documented in this report. Outside of this report, key learnings and resources pertaining to other topics have been individually communicated to relevant CEC and eHealth NSW staff for consideration as part of ongoing work.

Below are key learnings from this site visit:

- *Pre-printed or eMR VTE assessment and order sets:* these order sets have been designed to include VTE assessments and appropriate prophylaxis orders. Prescribers are required to 'opt-out' rather than 'opt in' (i.e. the order set is presented to prescribers who must actively opt-out of it if they do not wish to complete it). The order set is initiated on admission, transfers to ICU or where there are changes in conditions from low risk to moderate/high risk.
- *MeasureVention:* this is a daily rounding process by designated staff e.g. floor nurses, in-charge nurses, directors) involving review of mechanical and prophylaxis prescribed for patients. Where prophylaxis is deemed inappropriate, care teams are alerted to the need for follow-up action to comply with evidence-based guidelines. Action to rectify the order or document why evidence-based care has not been prescribed must be taken within a designated time period. This method strongly parallels 5x5 Antimicrobial Audit currently implemented across many NSW hospitals. In addition, the intervention may be a worthwhile activity for VTE stewardship pharmacists (or similar) where they exist.
- *Protocols for the application of mechanical prophylaxis by nursing staff without a physician's order:* although the role of nursing staff is varied with respect to VTE prophylaxis in NSW, formalising the roles of nurses through establishment of nurse-initiated protocols may be worth exploring in the NSW context.
- *Pharmacy review:* pharmacists are empowered to review orders for patients to ensure that prophylaxis is ordered and appropriate as part of daily reviews/rounds. This includes the appropriate administration of warfarin and anticoagulant doses before and after surgery. Review of prophylaxis orders by pharmacists is supported by an electronic dashboard identifying risk-stratified patients based on an algorithm. The algorithm is informed by the medication administration record or an automated alert which identifies active VTE prophylaxis orders for

each patient on the ward i.e. “green” (therapeutic or prophylactic anticoagulant ordered), “yellow” (mechanical prophylaxis is the sole method of prophylaxis ordered), or “red” (no prophylaxis ordered). These are coupled with other data points such as lab contraindications to anticoagulants, the electronically documented VTE risk level from the ordering physician, and other factors that can influence prophylaxis choices. VTE surveillance dashboards aid pharmacists with prioritising patients for review and intervention.

- *Monitoring and feedback:* nursing and medical performance with regards to prophylaxis ordering is regularly monitored and fed back for improvement purposes. This also includes reporting of days since the last hospital acquired VTE on each nursing unit.
- *Peer to peer education:* peer to peer education around VTE prevention is provided by nursing and medical champions to fellow peers.
- *Implementation of a collaborative⁵:* This involved a centrally supported collaborative for the phased implementation of a standardised VTE risk assessment and prophylaxis protocol in 9 pilot sites, then 26 sites. The protocol was made available within an admission order set within the Cerner eMR system (without a hard-stop or forcing function). Rather than selecting individual risk factors, the prescriber is required to select an overall risk category. The importance of designing simplified tools was emphasised in conversations with VTE experts at this site. Whilst more complex tools involving selection of individual risk factors may improve the granularity/specificity of the risk assessment process, too much complexity may compromise usability and uptake, therefore negating any potential benefit afforded by detailed tools. It was recommended that VTE risk assessment tools should be as simple as possible so as to promote uptake. Other key elements of the collaborative included improvement webinars and active surveillance for real-time rectification of inappropriate prophylaxis.
- *Strong leadership and culture around VTE prevention:* The importance of strong leadership and culture around VTE prevention was a major learning from this visit. The establishment of VTE teams to oversee implementations and leadership of senior VTE champions have played significant role in the successful implementation of VTE initiatives.

⁵ Jenkins, I, O’Bryan, T, Holdych, J & Maynard, G. 2018. Impact of a Multicenter, Mentored Quality Collaborative on Hospital-Associated Venous Thromboembolism. Journal of Hospital Medicine DOI 10.12788/jhm.2942

4. Conclusion

This report provides a summary of key learnings gained from a study tour which was supported by the Hospitals Alliance for Research Collaboration (HARC) Scholarship Program. Based on these learnings, the following recommendations are proposed:

Recommendation 1: *Review and incorporate learnings including tools and resources gained from the study tour into the CEC's Medication Safety Programs*

Recommendation 2: *Incorporate learnings with respect to electronic VTE risk assessments into any future redesigns and implementations of the NSW electronic VTE solutions*

Recommendation 3: *Support Local Health Districts and Specialty Health Networks (LHDs/SHNs) to implement a strategy similar to MeasureVention to improve VTE prophylaxis prescribing and where possible, support the surveillance of potentially inappropriate prophylaxis through electronic algorithm-based dashboards*

Recommendation 4: *Promote the systematic consideration of human factors and application of human factors methods as part of patient safety incident investigations, proactive risk assessments, and the initial design and continuous improvement of workflows/systems/solutions*

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