



Preventing Blood Clots in Hospitals

Improvement Collaborative Report
National Recommendations and
Improvement Toolkit



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National Medication Safety Improvement Programme
HSE Quality Improvement Division

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Building a
Better Health
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Foreword

Shortly before the first learning session for this improvement collaborative, I shared with two of my colleagues that my brother-in-law developed a pulmonary embolism following surgery. One colleague shared that her uncle had recently also developed a pulmonary embolism while his leg was immobilised following a fracture. The third colleague's uncle died from a pulmonary embolism associated with surgery. The statistics tell us that blood clots are common and our experience backs this up.

Most blood clots happen during or in the 90 days after a hospital stay and many can be prevented. We also know that informed patients and healthcare professionals can recognise the signs and symptoms and take action to minimise the harm from a blood clot.

This collaborative gave us an opportunity to bring teams from hospitals around the country together to learn, share, test and improve blood clot prevention for patients in hospital. Two patient representatives contributed to our collaborative learning sessions, sharing their experience of blood clots they and their families have had, the fears of recurrence and challenges of treatments. Their involvement in project coaching and visiting hospitals to raise awareness among patients and staff contributed greatly to the collaborative.

At each learning session, I was impressed by the interest, enthusiasm and energy the hospital teams brought to tackling this issue. There is no shortage of motivation to improve. The success of the teams is really admirable, particularly facing the challenge of fitting quality improvement into their work schedules.

As a result of the quality improvement work these teams carried out, we now have one-third more patients receiving the right blood clot prevention across 22 hospitals, affecting 34,000 patients. Most of these hospitals are continuing their improvement work in this area or have plans to do so in the near future.

Hospitals have an obligation and an opportunity to deliver high quality care and reduce patient harm. In this report, we aim to assist hospitals to build on the experience gained throughout the collaborative project of what it really takes to improve blood clot prevention in practice, in context and in Irish hospitals.

We have continued to work with patient representatives since the collaborative ended and are delighted to make our co-produced patient alert cards available to hospitals. Empowering patients to recognise blood clots will aid prompt diagnosis and treatment to prevent further damage.

We are also very pleased to address this area in our HSE performance management system, with a key performance indicator as part of the HSE Service Plan 2019. Together with other measurements, this will provide hospitals with insight into their rates of in-hospital blood clots and the effect of improvement efforts.

This collaborative has brought out some of the best of what our health services can do, to learn and engage patients and staff and really improve patient safety. We hope this report and recommendations, together with the key performance indicator and patient alert cards, will help hospitals further protect and inform patients to minimise harm from blood clots.

Dr Philip Crowley

National Director, HSE Quality Improvement Division



Ciara Kirke and Dr Philip Crowley, HSE Quality Improvement Division launching the report

Executive summary

Background

Venous thromboembolism (VTE) refers to a blood clot or thrombus occurring in the deep veins, usually of a leg (deep vein thrombosis, DVT) and/or which has fragmented and travelled to the lungs (pulmonary embolism, PE). Approximately 11,000 Irish people may be affected by VTE every year and 9% of all deaths are VTE-related. Recurrence affects approximately 30% of survivors and post-thrombotic complications are common.

63% of all VTE is hospital-acquired, occurring during or in the 90 days after hospitalisation. 70% of hospital-acquired VTE is potentially preventable with appropriate VTE prophylaxis.

Optimum prevention of VTE requires risk assessment of every in-patient early after the decision to admit them to hospital and the choice of the appropriate VTE prophylaxis for that patient. VTE prophylaxis can consist of one, both or neither of injections or tablets of blood thinners (anticoagulants), compression stockings and compression devices. Approximately 60-80% of hospital in-patients will need VTE prophylaxis while they are in hospital, with the choice of prophylaxis dependent on their VTE risk, bleeding risk, weight, renal function and any contra-indications to prophylaxis. Following discharge, patients are at risk for a further 90 days and need to be informed about the signs and symptoms and what to do if they occur.

Previous research suggests wide variation in rates of appropriate VTE prophylaxis (i.e. where the patient receives the VTE prophylaxis indicated in guidelines) in Ireland ranging from 29.7% of adult medical in-patients in one study to 92% in another study following improvement initiatives. The OECD has rated VTE prevention protocols as the patient safety intervention with the most favourable impact/cost ratio.

The Improvement Collaborative

This collaborative invited all public acute and maternity hospitals providing care to adult patients to nominate a project team (typically a doctor, nurse and pharmacist) to participate in four one-day learning sessions and to undertake a quality improvement project in their hospital to identify, test and implement initiatives to optimise VTE prophylaxis for in-patients. 27 hospitals participated fully, with attendance at learning sessions from a further 6 hospitals. Data from 22 hospitals (n=2260) and from a post-collaborative survey (27 hospitals) was analysed centrally.

What We Learned

This report shares learning from the collaborative, including which factors contributed to high levels of appropriate prophylaxis and to improvement.

There was a higher level of appropriateness observed in orthopaedic and post-partum patients than in medical and surgical non-orthopaedic patients at baseline.

The primary outcome of the collaborative was to increase the percentage of patients with appropriate prophylaxis. Appropriateness increased from a median of 61% to 81%, a one-third increase. This equates to 34,000 more patients receiving the appropriate prevention annually in these hospitals.

Achieving and sustaining high appropriateness of VTE prophylaxis requires the presence of multiple measures to support VTE prophylaxis. Factors associated with improvement include having a VTE prevention protocol, patient, nurse and pharmacist education about VTE, processes where nurses/midwives and/or pharmacists routinely check VTE prophylaxis, clinical pharmacy services and nurse practice development support. Having the VTE protocol in an accessible location is likely to be helpful, along with pre-printed prescriptions.

Improvement is aided by trueness to the quality improvement method (Model for Improvement), particularly to the use of PDSA cycles.

This report summarises the learning from the collaborative and provides a toolkit to facilitate hospitals with further improvement, including patient alert cards which have been piloted in seven hospitals.

Hospitals Must Ensure that:

- Oversight for monitoring and improving VTE prevention is assigned to the appropriate governance committee and is an agenda item at meetings at least twice a year.
- An adequately resourced multi-disciplinary team is supported to carry out quality improvement to reduce hospital-acquired VTE.
- A VTE prevention protocol is in place, accessible and staff are aware of it.

- The protocol is followed for each in-patient as soon as possible after the decision to admit is made, and correct prophylaxis received asap and within 24 hours.
- Tools and processes which have been found to be effective are in place, e.g. independent check(s) of prophylaxis, education for staff and patients and prompts/alerts, e.g. pre-printed prescriptions.
- Each in-patient receives information about any VTE prophylaxis they are receiving, their risk of VTE for 90 days after hospitalisation, the signs and symptoms of VTE and what to do if they occur, facilitated by providing the Patient Alert Card.
- Responsibilities are assigned for following the VTE prevention protocol and prescribing prophylaxis, independently checking prophylaxis and ensuring patients receive information prior to discharge.
- Monitoring of key metrics takes place at least quarterly and is reviewed at the appropriate governance committee. This includes a new national key performance indicator, together with measuring the percentage of patients with appropriate prophylaxis and monitoring whether patients are receiving alert cards.
- Hospital-acquired VTE is reported and managed in accordance with the HSE Incident Management Framework, including open disclosure.
- Hospital-acquired VTE is listed as a risk on the hospital's risk register.

What is VTE?

Venous thromboembolism (VTE) refers to a blood clot or thrombus occurring in the venous system or veins of the body. Blood clots occur when blood clumps together in a blood vessel, which blocks or reduces the blood flow through that vessel.

A blood clot will initially form within the deep veins, usually in the legs but can also occur in the groin or arm. These blood clots are called a **Deep Vein Thrombosis or DVT**. If somebody has a DVT, they will usually have one or more signs or symptoms. These include:

- Pain or tenderness in the calf or thigh
- Warmth, redness or discolouration
- Swelling of the leg, foot or ankle

The clot causing a DVT can fragment and travel to the lungs. Once a clot breaks off and travels it is known as an embolus. The clot can block a lung artery and this is known as a **Pulmonary Embolism (PE)**. PE is extremely serious and may damage the lung and cause damage throughout the body due to a lack of oxygen, and can cause death. The signs and symptoms of PE include:

- Shortness of breath or rapid breathing
- Chest pain, particularly if breathing deeply
- Rapid heart rate
- Coughing up blood

DVT and PE are collectively known as venous thromboembolism, VTE.

Harm from blood clots

DVT can result in short- and long-term pain, debility and post-thrombotic syndrome. Patients require treatment with therapeutic doses of anticoagulants or blood thinners, with risk of adverse effects including bleeding.

Early diagnosis and treatment limits the damage to the leg from the DVT, reduces the risk that the clot will travel to the lungs and become a PE and reduce the risk of long-term complications. If the

DVT travels to the lungs and becomes a PE, restricting blood flow to the lungs, serious damage can occur suddenly, with early fatality in up to 15% of patients¹.

In addition to the initial blood clot, 3 in 10 people will develop at least one further blood clot².

Post-thrombotic syndrome affects approximately 50% of people in the first year despite treatment with blood thinners³, with 5-10% of patients severely affected⁴. Symptoms may persist chronically, including pain, swelling and heaviness in the legs, with skin and venous changes including ulcers.

Hospitalisation

Hospitalisation increases the risk of blood clots through the presence of one or more of Virchow's triad of factors leading to thrombosis; vascular endothelial damage (e.g. due to trauma or surgery), stasis of blood flow (due to immobility), and hypercoagulability of blood (e.g. due to inflammation).

Hospital in-patients have individual risk profiles for developing blood clots. A VTE risk assessment identifies which risks are present and whether the overall risk is high enough that the patient needs VTE prophylaxis. A template for preparing a local VTE prevention protocol is provided in Appendix 1. **VTE prophylaxis** (or blood clot prevention) consists of injections or tablets of blood thinners (anticoagulants) and/or compression stockings or compression devices. A small number of people will also need prevention continued after they are discharged from hospital, e.g. some high-risk pregnant women or high-risk people with a leg cast.

Many but not all blood clots can be prevented

Even with appropriate risk assessment and prevention, some people will still get blood clots. About 30% of hospital-acquired blood clots will occur despite appropriate VTE prophylaxis.

Harm from prevention or treatment of blood clots

A preventative (low) dose of blood thinners is used to prevent blood clots in hospital in-patients whose risk of VTE is judged to outweigh their risk of bleeding associated with the blood thinner.

¹ Konstantinides SV et al. Eur Heart J. 2014;35:3033-3069

² Carrier M et al. Ann Intern Med. 2010;152(9):578-89

³ Roumen-Klappe EM et al. Thromb Haemost. 2005;(94(4):825-30

⁴ Baldwin MJ et al. J Thrombo Haemost. 2013;11(5):795

For every 1000 medical in-patients (excluding those with stroke) receiving preventative doses of blood thinners, 4 PEs will be prevented and 1 major bleeding event will occur⁵.

Compression stockings or intermittent compression devices (pumps which compress the calf and/or foot intermittently to avoid blood pooling in the veins) are also used for some patients at risk of VTE. Again, there are contra-indications to their use, where patients are at risk of harm from the compression stockings. When in use, measures need to be taken to ensure patient's skin remains intact and that pressure ulcers do not develop.

Why do we need to prevent VTE?

The problem

It is estimated that 11,000 Irish people develop a blood clot (VTE, venous thromboembolism) every year⁶. 9% of all deaths are VTE-related.

63% of all blood clots are hospital-acquired⁶, occurring during or in the 90 days after hospitalisation. Irish HIPE data shows at least one additional diagnosis (i.e. not present on admission) of VTE was experienced by a mean of 8 adult medical and surgical in-patients per 1000 discharges⁷, or 183 in-patients per month on average (Jan 2012-Oct 2017), with lower rates for paediatric and maternity in-patients.

Diagnosing and treating VTE accounts for 0.4-3.8% of public hospital budget spend in 28 European Union countries⁸. In Australia, VTE-related costs including lost productivity are estimated at \$1.7 billion a year, increasing to \$20 billion when costs associated with disability and premature death are included⁹.

70% of healthcare-associated VTE is potentially preventable with appropriate VTE prophylaxis¹⁰. Ensuring that patients are risk assessed and receive the appropriate prevention, or prophylaxis, is key to reducing the numbers of patients developing hospital-acquired VTE. The OECD rated VTE prevention protocols as the patient safety intervention with the most favourable impact/cost ratio⁸.

⁵ Lederle. *Ann Intern Med.* 2011;155:602-615

⁶ Cohen et al. *Thromb Haemost* 2007;98:756-764

⁷ HSE analysis of HIPE data, 2018 (unpublished)

⁸ OECD *The Economics of Patient Safety* 2017

⁹ Access Economics. *The burden of venous thromboembolism in Australia.* May 2008

¹⁰ Barco. *Thromb Haemost* 2016 Apr;115(4):800-8

Following discharge, patients are at increased risk of VTE for a further 90 days. Most patients are not aware of this risk, the signs and symptoms and what to do if they occur.

Potential to improve

Three Irish hospitals participated in the international ENDORSE study¹¹. 59% of adult surgical patients were found to be at risk of VTE and 64% of these patients received appropriate prophylaxis. 43% of adult medical patients were found to be at risk and 47% of these patients received appropriate prophylaxis.

Eleven Irish hospitals participated in the PREVENT-VTE¹² trial. At baseline, 29.7% of adult medical in-patients judged to be at risk of VTE received injections of blood thinning medication.

Evidence of improvement

Many Irish hospitals have published reports documenting VTE prevention initiatives, e.g.

- A multi-component intervention of education, posters, guidelines in the prescribers' guide and in drug charts and a pre-printed prophylaxis box in the prescription chart increased appropriate prophylaxis in at-risk medical in-patients from 39% to 57% ($p < 0.001$)¹³,
- An educational intervention improved prescription of prophylaxis in at-risk medical in-patients from 48% to 63% ($p = 0.041$)¹⁴,
- A medical admission reminder resulted in a sustained increase in appropriate prophylaxis (37.5% in 2006, 75% in 2009 and 86% in 2012) in adult medical in-patients¹⁵,
- A redesigned drug chart with a prompt to assess VTE risk prior to prescribing medicines in hospitalised cancer patients increased appropriateness of prophylaxis from 38% to 89%¹⁶
- A non-significant increase from 58.5% to 71% in compliance with guidelines ($p = 0.09$) after the introduction of a drug chart with a VTE prophylaxis section¹⁷
- The PREVENT-VTE study found no improvement in eleven hospitals with a multiple sticker intervention in adult medical in-patients
- Implementation of an intervention involving a computerised risk assessment tool, ThromboCalc¹⁸ resulted in 92% compliance with risk assessment at delivery in the Rotunda hospital. The Rotunda has received multiple awards for this tool and its implementation.

¹¹ Murphy O et al. *Ir Med J.* 2012 May;105(5):140-3

¹² Adamali H et al. *Ir Med J.* 2013 Nov-Dec; 106(10):302-5

¹³ Lyons O et al. *Ir Med J.* 2013 Sep;106(8):235-8

¹⁴ Kent BD et al. *Ir J Med Sci* (2011) 180:163-166

¹⁵ Osman Ahmed E et al. *Ir J Med Sci.* 2012 Sept; 181:S220-220

¹⁶ Coleman N et al. *Ir Med J.* 2014 Jun; 107(6):188

¹⁷ Cunningham R et al. *Ir J Med Sci* (2015) 184:469-474

What could improve VTE prevention?

Many studies and initiatives have been reported internationally aiming to improve hospital-acquired VTE prevention. A Cochrane review¹⁹ concluded that multifaceted interventions with an alert, or education particularly in combination with an alert, were likely to increase the appropriateness of prophylaxis.

The Agency for Healthcare Research and Quality guidance for preventing hospital-acquired VTE²⁰ recommends:

- Ensure institutional support, arrange governance and engage all stakeholders
- Review previous efforts and assemble the improvement team
- Analyse processes and their reliability
- Review the evidence and agree a VTE prevention protocol
- Implement the protocol, with principles including:
 - Keep it simple for the end user
 - Design reliability into the process
 - Do not interrupt workflow
 - Pilot and small-scale first
 - Monitor and measure
- Layer interventions

“Reliability does not happen by accident; it has to be planned... Standardising and simplifying a process make it easy for people to do the right thing²¹”

Frankel et al, Institute for Healthcare Improvement

¹⁸ O'Shaughnessy F et al. Acta Obstetrica et Gynecologica Scandinavica 2017

¹⁹ Kahn SR et al. Cochrane Library of Systematic Review 2018

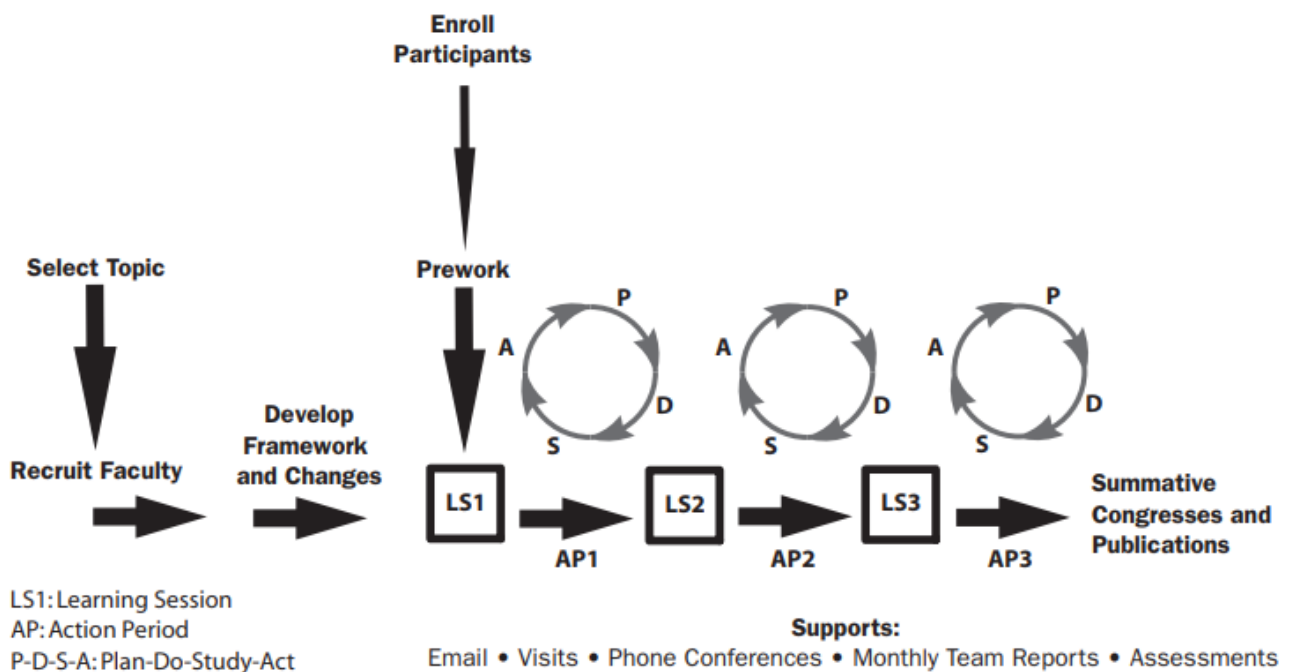
²⁰ AHRQ. Preventing Hospital-Acquired VTE. 2015

²¹ Frankel A, Haraden C, Federico F, Lenoci-Edwards J. A Framework for Safe, Reliable, and Effective Care. White Paper. Cambridge, MA: Institute for Healthcare Improvement and Safe & Reliable Healthcare; 2017

The Preventing VTE in Hospitals Improvement Collaborative

What did we do and how did we do it?

The Institute for Healthcare Improvement's Breakthrough Collaborative Series²² provides a proven methodology for conducting quality improvement projects on a shared topic at multiple sites. The HSE Quality Improvement Division had previously used this methodology to collaboratively improve pressure ulcer prevention in residential and hospital settings and to improve and standardise gentamicin management in hospitals, with very positive results.



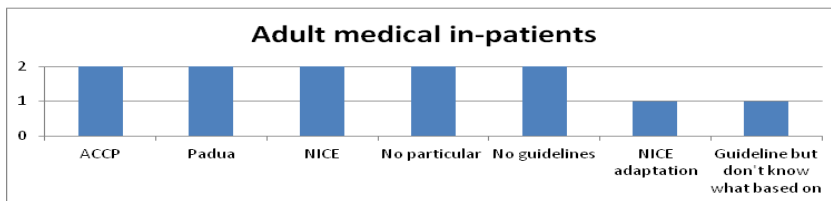
In preparation for the collaborative, a pilot project with Beaumont Hospital, a literature review and a survey were carried out. An Advisory Group (Appendix 5) met on a number of occasions before and during the collaborative.

There is an Irish guideline for VTE prevention in pregnant and post-partum women²³ and a suggested guideline for thromboprophylaxis post-total hip or knee replacement²⁴. For other groups

²² The Breakthrough Series: IHI's Collaborative Model for Achieving Breakthrough Improvement. IHI Innovation Series white paper. Boston: Institute for Healthcare Improvement; 2003. (Available on www.IHI.org)

²³ Institute of Obstetricians and Gynaecologists, RCPI and HSE Clinical Care Programme in Obstetrics and Gynaecology and Irish Haematology Society. Clinical Practice Guideline. Venous Thromboprophylaxis in Pregnancy. Nov 2013

of patients, Irish hospitals determine which guidance they use. The survey determined that hospital sites (n=21) used a variety of guidelines for VTE prevention, or had no defined guidelines locally. Both US (ACCP) and UK (NICE) guidance was in use, as well as Irish guidance in some but not all maternity hospitals. For adult medical patients there was the widest variety of guidance in use.



Producing a national clinical guideline for VTE prevention was not feasible in the timeline of the collaborative. Because of this and because many hospitals had established guidance in use, hospitals were required to agree guidance locally. This process was aided by teaching about the risk assessment tools available and their relative merits and provision of a sample VTE prevention protocol template (Appendix 1) which combined Padua scoring for medical patients with NICE guidance for surgical patients.

All public acute and maternity hospitals providing care to adult patients were invited via their Chief Executive Officer, Director of Nursing and Midwifery, Chief Pharmacist and Clinical Director to nominate a team to participate in the collaborative in May 2016. The structure of the improvement team and hospital support was devised with reference to factors known to improve the likelihood of success in quality improvement, the Model for Understanding Success in Quality²⁵. This included:

- A sponsor: a senior management team member with clinical responsibilities, to support and champion the project
- The improvement team: a multidisciplinary team of three healthcare professionals (e.g. a doctor, nurse and pharmacist), to attend learning sessions, carry out measurement and improvement work
- A wider project team: as appropriate to include subject-matter, process and quality improvement expertise, including a haematologist or lead consultant and quality improvement (QI) coach

²⁴ HSE Trauma and Orthopaedic Surgery National Clinical Programme. Suggested Guideline for Thromboprophylaxis post Total Hip Arthroplasty (THA) and Total Knee Arthroplasty (TKA). Available on www.hse.ie

²⁵ Kaplan H et al. The Model for Understanding Success in Quality (MUSIQ): building a theory of context in healthcare quality improvement. *BMJ Qual Saf* 2012 Jan;21(1):13-20

- Defining local governance, including which committee the project would report measurement and progress to

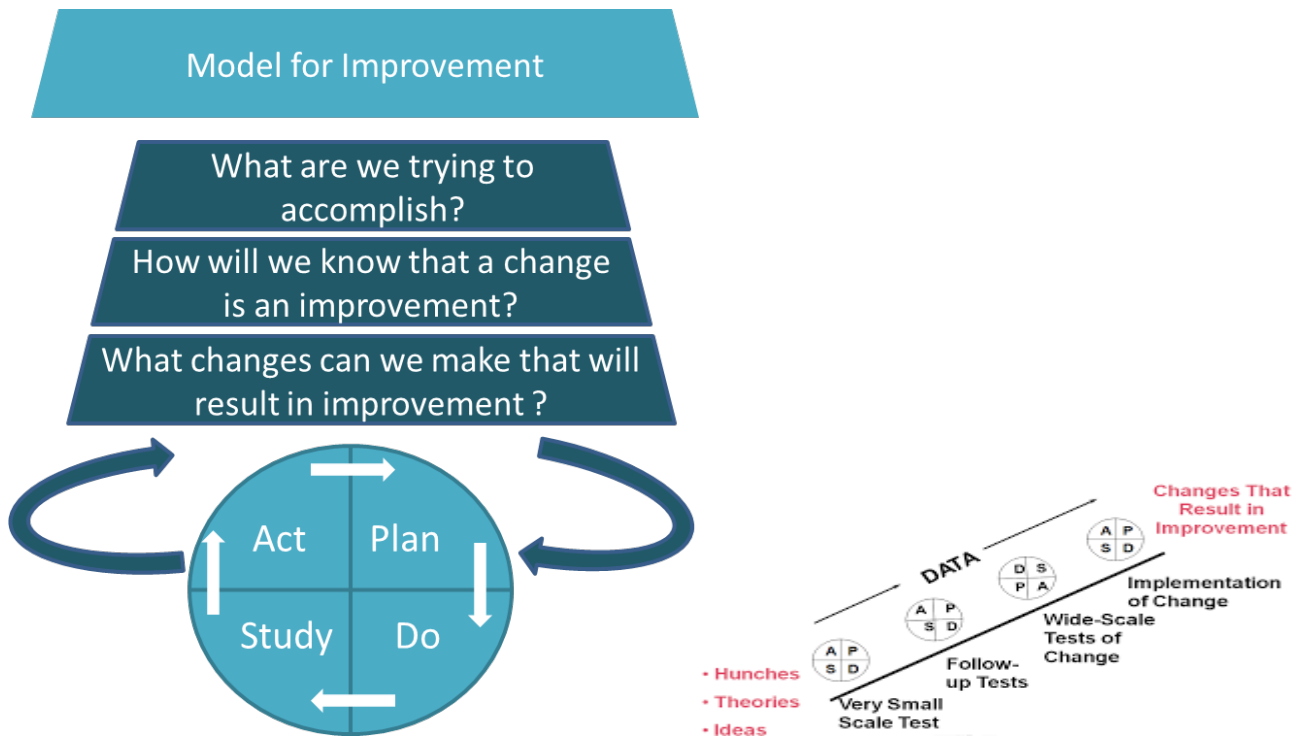
Four one-day learning sessions took place in September and November 2016, February and May 2017 and a finale conference in September 2017. At the learning sessions, quality improvement and VTE prevention training and coaching were delivered, along with patient experience and sharing experience from different hospitals and experts. Between learning sessions, hospital teams defined their project focus, measured appropriateness of prophylaxis, process mapped, engaged with staff and patients and identified, tested and implemented ideas for change using Plan-Do-Study-Act (PDSA) cycles.

“The opportunity to collaborate with other teams at the learning sessions was really worthwhile. It can be so difficult to get time to think about the best approach to take when you’re also keeping up with your day to day workload. Taking a day when you can focus on the issue, learning what has and hasn’t worked in other hospitals, can save so much wasted effort when you get back to base.”

Muriel Pate, Senior Pharmacist, Naas General Hospital

The Model for Improvement (© Associates for Process Improvement) is the quality improvement methodology used in this collaborative and in other HSE Quality Improvement Division projects.

This model is conceptually simple and ensures that only changes that have been demonstrated to lead to improvement on a smaller scale are scaled up for implementation, and that measurement is tracked over time to check if goals are being reached as improvements are made. Testing and implementation follow cycles with learning from each phase, while measurement tracks progress in real-time as changes take place.



What are we trying to accomplish?

The aim of the improvement collaborative was to achieve appropriate thromboprophylaxis (in line with the hospitals' guidelines) within 24 hours of the decision to admit for adult in-patients in the participating hospitals, by September 2017. Each hospital's aim was based on this, modified to indicate which patient group(s) and timelines they were focussing on.

Appropriate thromboprophylaxis is the best available measure that optimal blood clot prevention is in place and is a product of correct VTE risk assessment, choice of and dose of prophylaxis and correct action if prophylaxis is contra-indicated, e.g. due to bleeding risk.

How will we know that a change is an improvement?

Teams selected a random sample of 10 patients per fortnight from the total census or the census of their patient group (guidance in Appendix 4).

The hospital VTE protocol was followed to determine the patient's VTE risk, bleeding risk, appropriate choice and dose of prophylaxis depending on their patient group, weight, renal function and contra-indications to pharmacological or mechanical prophylaxis. A conclusion was reached as to what the appropriate prophylaxis for that patient was.

The patient's prophylaxis prescription and administration record was examined to determine what, if any, pharmacological prophylaxis was prescribed and given within 24 hours of the decision to admit. The patient was asked if they had mechanical compression in place and this was examined if relevant.

The pharmacological and mechanical prophylaxis were judged to be appropriate or inappropriate and the categories of inappropriateness recorded (e.g. indicated, not in place; inappropriate dose for patient weight).

Data was entered on a data collection form and into a standard Excel spreadsheet (both available on www.safermeds.ie).

The spreadsheets were loaded periodically using Sharefile® into a centralised database.

A QlikView® interface was developed by staff from the HSE Office of the Chief Information Officer. This presented the hospital's data and the all-hospital data back to each hospital so they could learn from and share their own data and learn from comparison with other hospitals' data. It also facilitated central analysis by the collaborative project lead.

What changes can we make that will result in improvement?

A key element of the success of the Model for Improvement is that ideas for change are collected, from reviewing previous work locally and reported from other sites, engaging with staff and patients involved in the processes and with experts. These ideas are then prioritised for testing.

At this point each idea for change is considered as a theory that it will have a positive impact. Even if it has been successful elsewhere, testing is needed to see if it is successful in the particular context and environment in question.

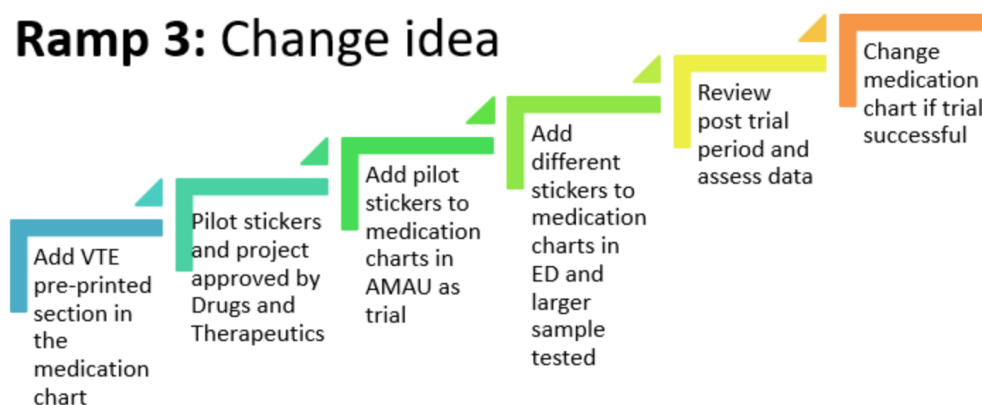
Plan-Do-Study-Act cycles

PDSA testing examines whether the prediction that a particular idea for change will lead to improvement is borne out in the particular setting where there is a wish to implement it. The first tests of any idea are very small, with some learning from each test. Each idea for change needs to be tested in a variety of circumstances to increase the degree of belief that it will have a positive impact if implemented fully. A PDSA testing form is available on www.safermeds.ie

“[It’s] beneficial to get objective feedback before “big-bang” implementation”
Collaborative participant

For example, pre-printed prescriptions for VTE prophylaxis in the drug chart was a popular idea for change. To implement this, the hospital would need to work with printers to redesign and print charts and educate and inform staff, particularly prescribers. To test this, many sites created stickers using pharmacy labels and got feedback from doctors, pharmacists and nurses. The revised stickers were applied to a small number of charts to see if they were filled in correctly and to get further feedback. Successful tests were piloted on a wider scale and, if successful, the changes were incorporated into the drug chart and implemented with education and information for staff. The PDSA ramp below illustrates a series of PDSA tests carried out by one hospital team to develop and test pre-printed prescription stickers.

Ramp 3: Change idea



Project coaching took place at each learning session, with hospitals grouped together to present their progress, challenges and receive coaching from faculty, including our patient representatives, and suggestions and comments from other hospitals. Interactive sessions also facilitated learning from each other, sharing of tools developed and answering queries.

Between learning sessions, a Yammer forum provided the opportunity to share documents, presentations, tools and to have conversations between participants and with faculty. Email and phone support was also provided to sites periodically and when requested.

What did we achieve?

86 people from the participating 27 hospitals attended learning sessions, along with 16 people from a further 6 hospitals. Data from 22 hospitals (n=2260) and from the post-collaborative survey (n=27) was analysed centrally.

Of the 22 hospitals submitting data discussed below, each took random samples of 10 patients every fortnight from a census of all patients in the patient group(s) in 15 hospitals, 6 hospitals focused on a more limited group (e.g. one or more wards) and in one hospital all patients in the patient group were reviewed, due to limited numbers. Improvement efforts focused on the same groups.

The data is presented using run charts. Run charts are a type of time order chart based on statistical process control methodology. They allow us to understand if the data is showing natural or common cause variation, or whether a change has occurred which is due to a special cause. Such charts are of great value to improvement teams as they provide more insight and real-time indications of what is happening, compared to traditional aggregate summary statistics which ignore time order or have a simple before and after measurement.

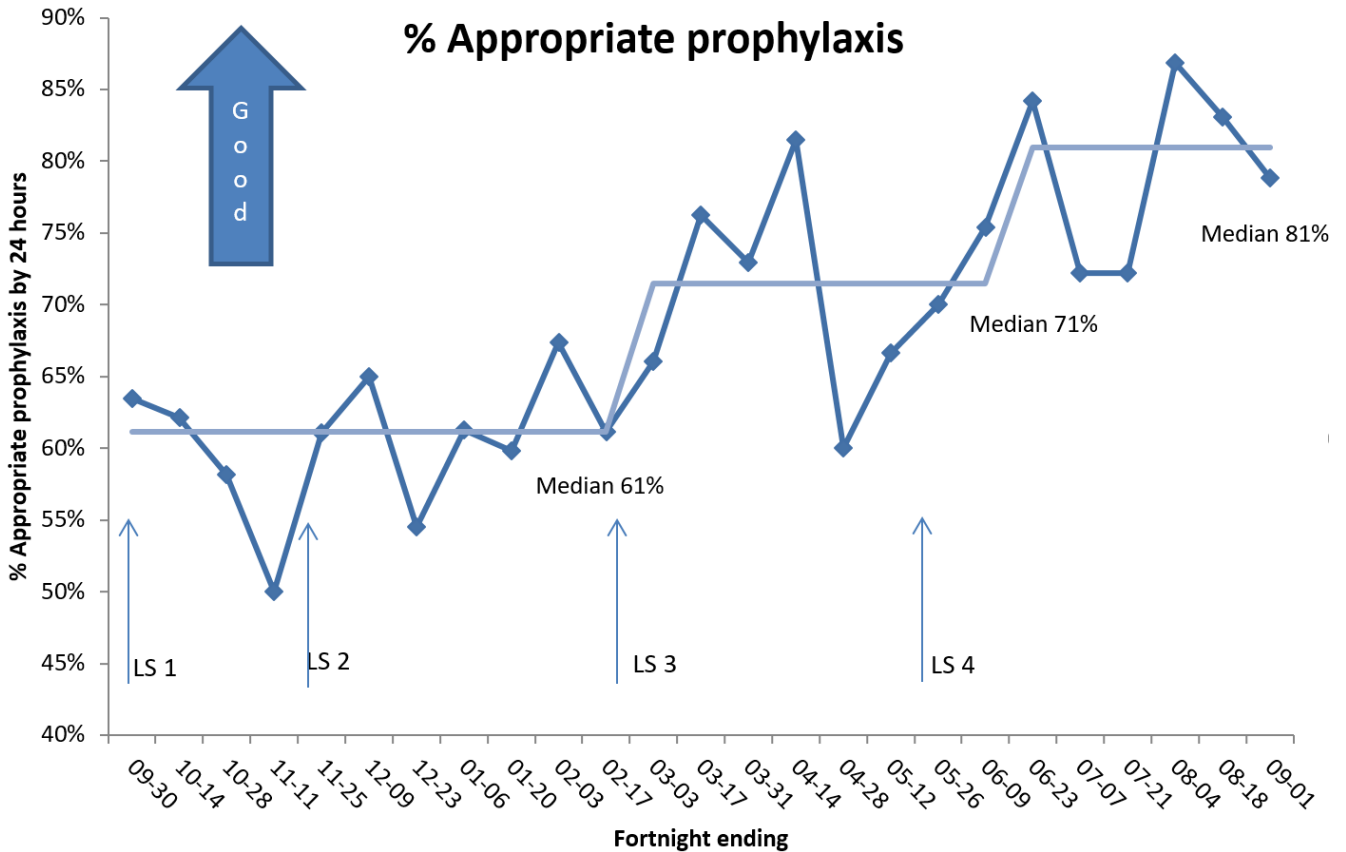
These run charts show the pooled mean % appropriateness from the 22 hospitals, plotted every fortnight. Normal variation around a median is expected, with less variation with increasing volumes of data. Interpreting the charts requires identification of one or more of four rules indicating that there is evidence of a non-random signal in the run chart. These equate to a probability of $p < 0.05$, or less than a 5% chance of occurring by chance when there is no real change²⁶. The rules are:

- 1: A shift: At least 6 data points are above or below the median line
- 2: A trend: At least 5 data points in a row going up or down
- 3: Too many or too few runs: Calculated from tables
- 4: An astronomical data point: A point clearly out of line with the normal variation of the data

In our project, we wanted % appropriate prophylaxis to increase, so we wanted to identify shifts or trends showing that we had non-random variation indicating an improvement.

²⁶ Ott E. Process Quality Control, New York: McGraw-Hill, 1975, 39-44

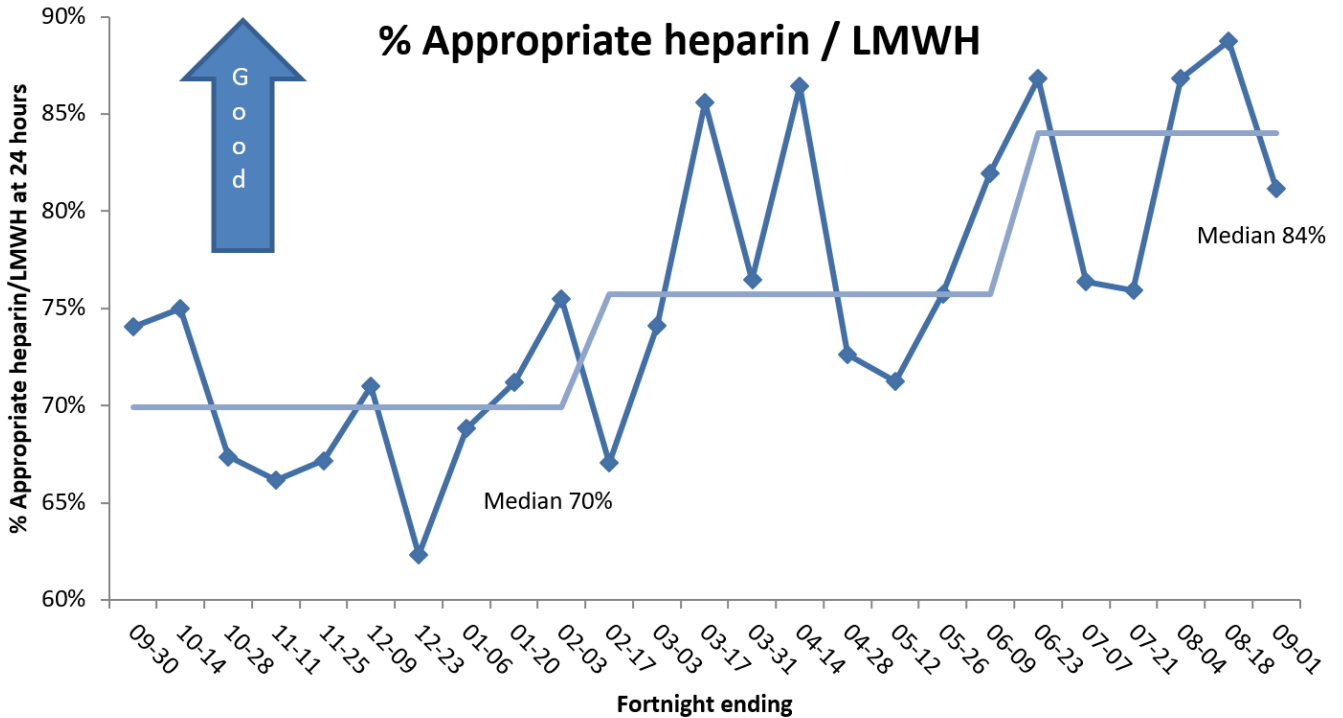
The primary outcome of the collaborative was to increase the percentage of patients with appropriate prophylaxis. This increased from a median of 61% to 81% ($p < 0.05$), a one-third increase. This equates to 34,000 more patients receiving the appropriate prevention annually in the hospitals in the collaborative and in the patient group (s) they were working with only.



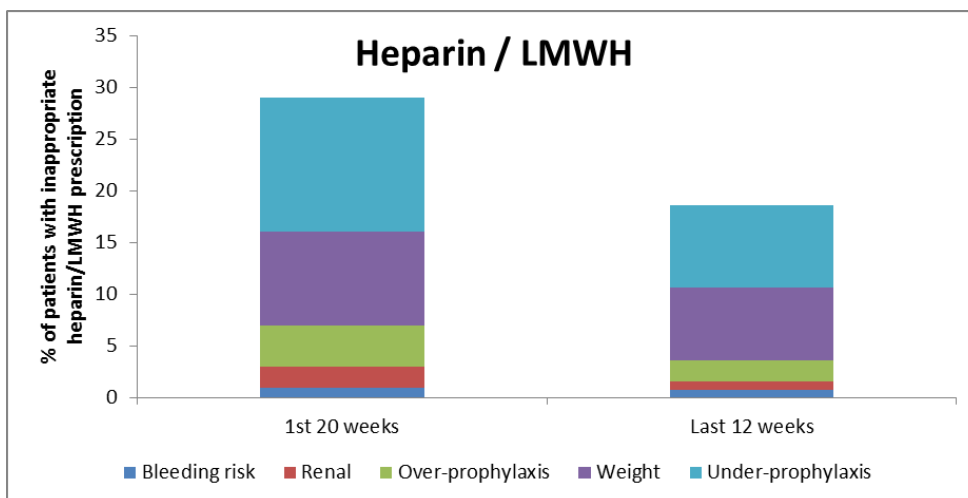
The graph above shows an initial median of 61%, then a shift where all data points from 05-12 onward were above that median, along with a trend from 04-28, and a further shift above the new median from 06-09 onward.

The overall measure of appropriate prophylaxis means that, for that patient’s VTE risk, bleeding risk, patient group, weight, renal function and presence or absence of contra-indications to mechanical compression, they received both the correct pharmacological prophylaxis (low molecular weight heparin, LMWH, or heparin, or none) and the correct mechanical compression prophylaxis (compression stockings, intermittent pneumatic compression device, both, or neither) for them, in line with the guidance in place in that hospital.

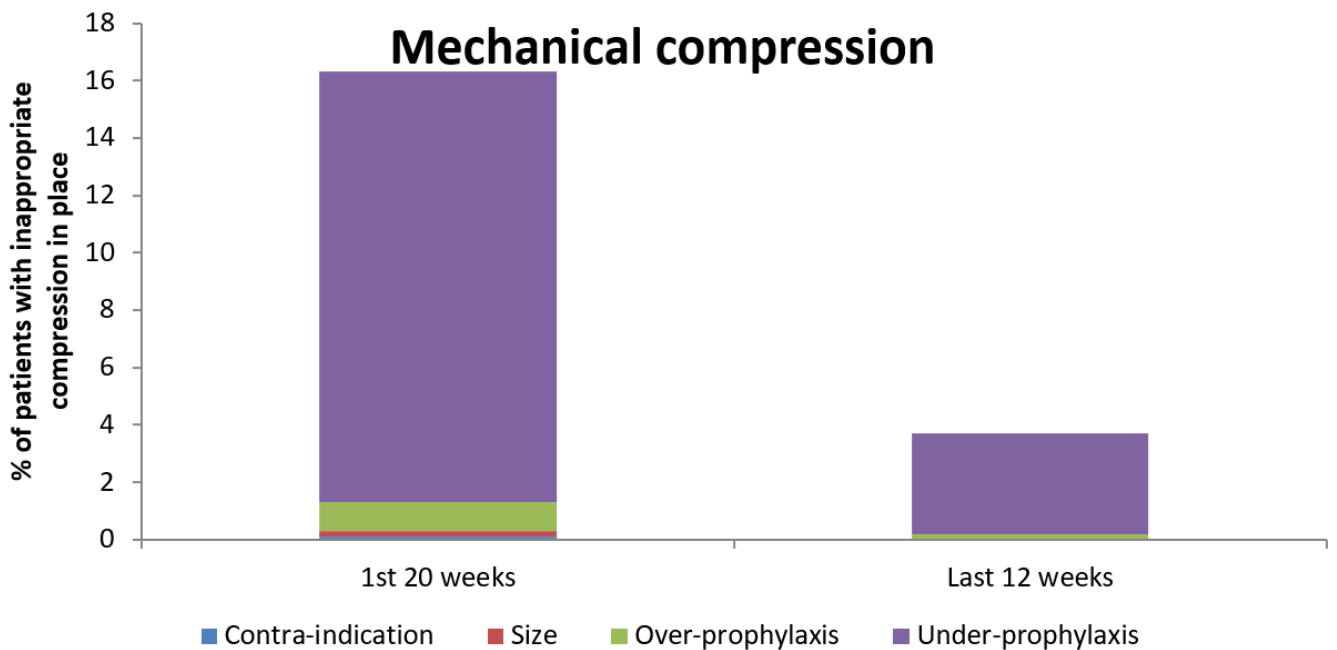
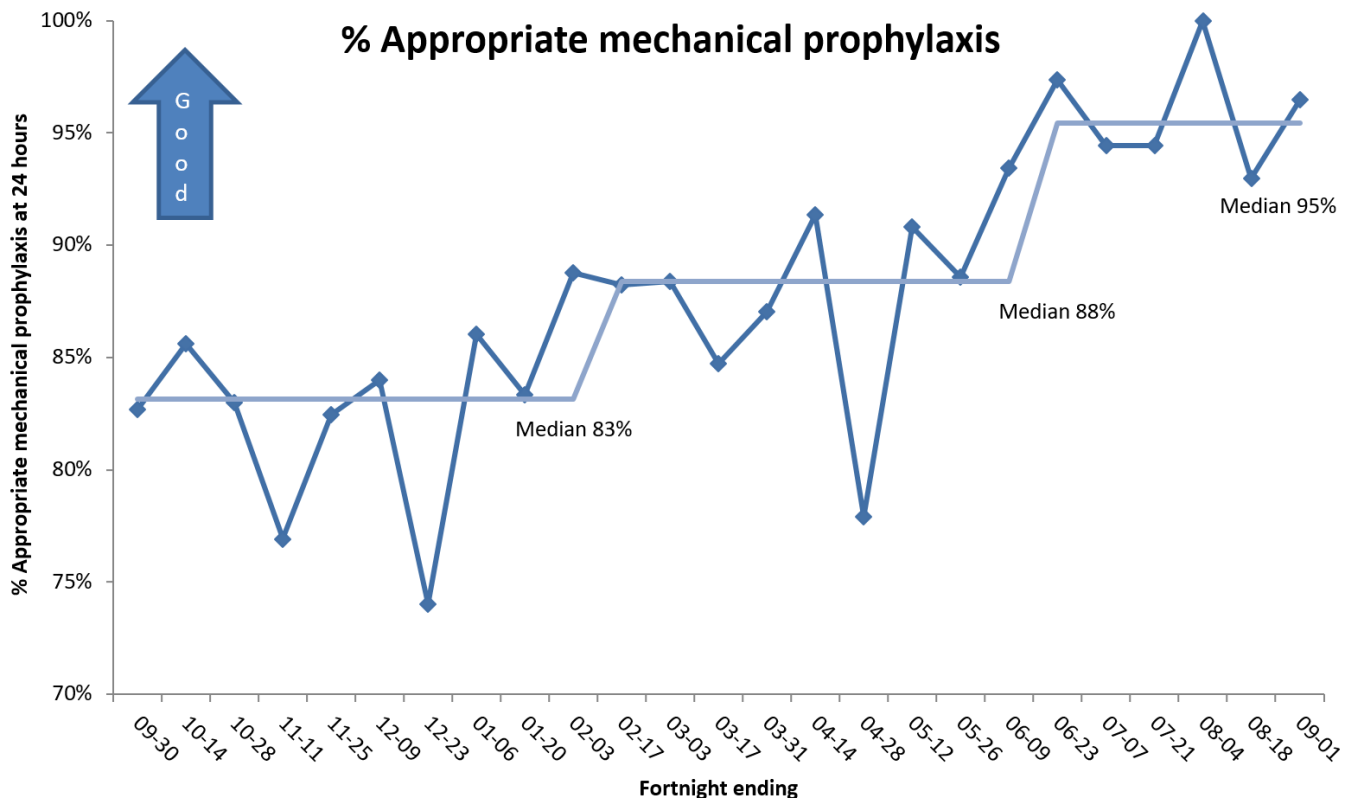
The percentage of patients with appropriate pharmacological (blood thinner) prophylaxis also increased substantially, from a median of 70% to 84% ($p < 0.05$). A shift was seen from 03-03 onward with a further shift above the new median from 06-09.



Under-prophylaxis, i.e. patients judged to be at risk of VTE who did not receive pharmacological prophylaxis and did not have a contra-indication to receiving it, was the largest category of inappropriate prophylaxis both at baseline and later in the collaborative. Inappropriate dose for the patient's weight was the next largest category. All categories decreased, with under-prophylaxis and choosing the inappropriate dose for the patient's weight remaining the largest category.

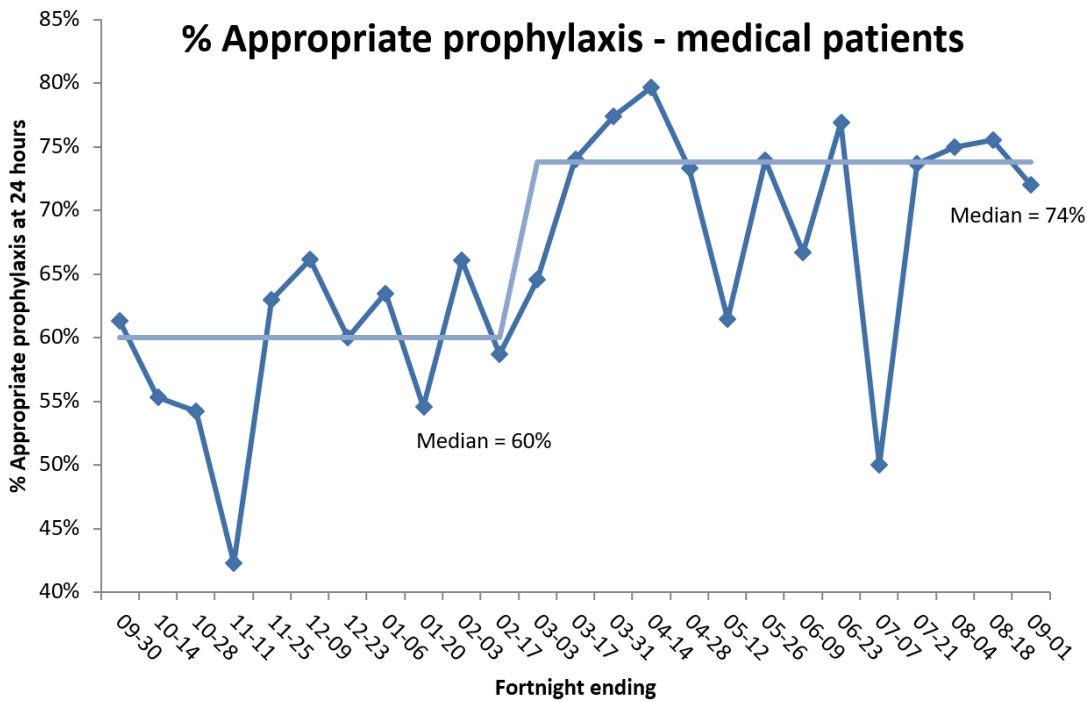


Mechanical compression appropriateness increased from a median of 83% initially to 95% ($p < 0.05$).

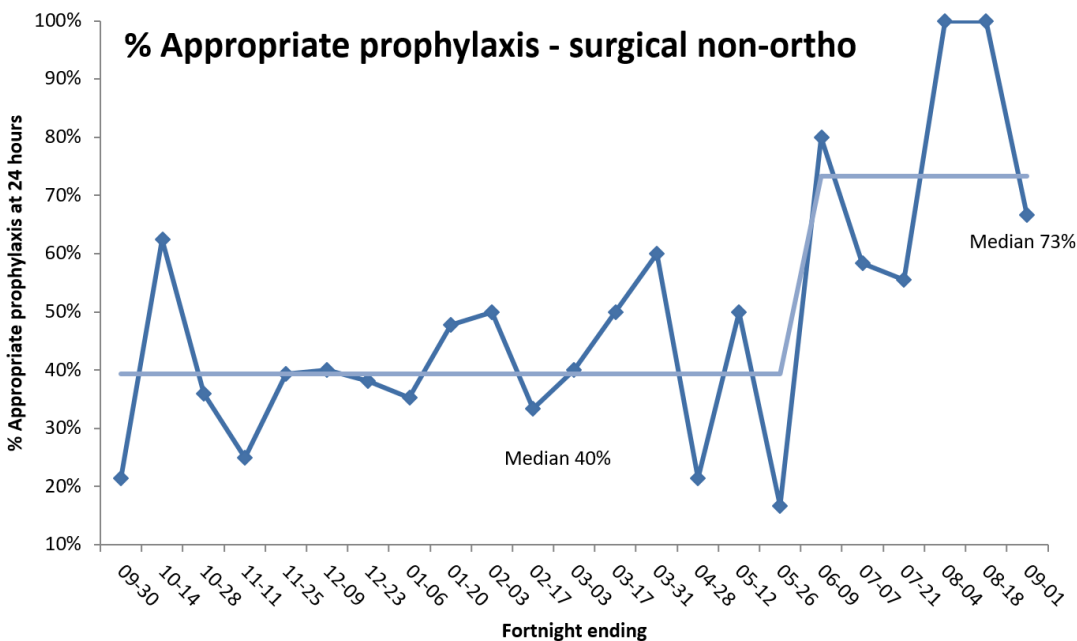


Again, under-prophylaxis was the major issue, but this was dramatically reduced during the collaborative.

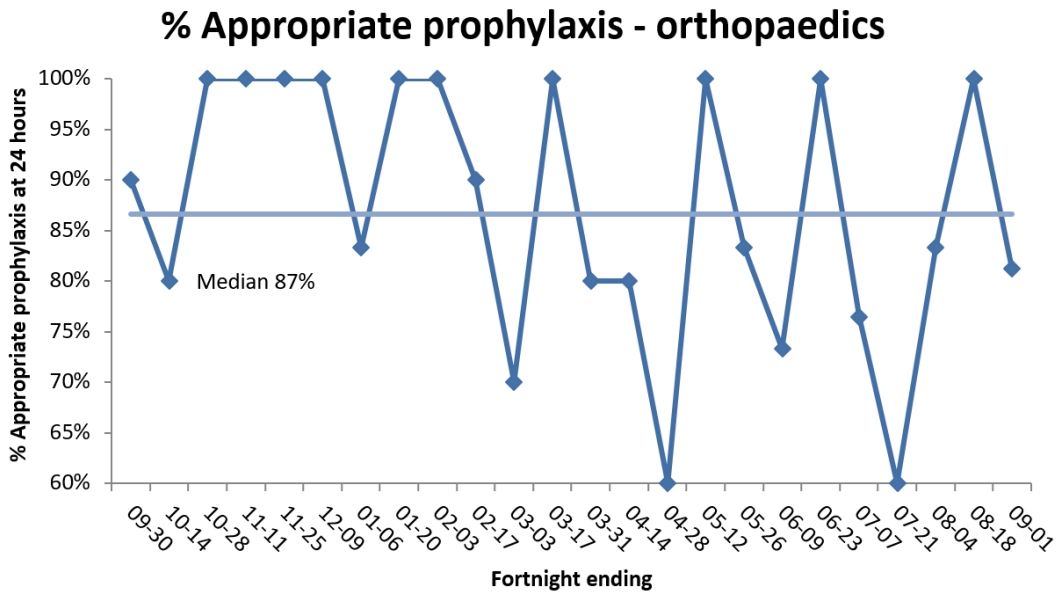
The median % appropriate prophylaxis for **medical** patients increased from 60% to 74% ($p < 0.05$). This was our largest patient group, $n = 1437$, from 15 hospitals.



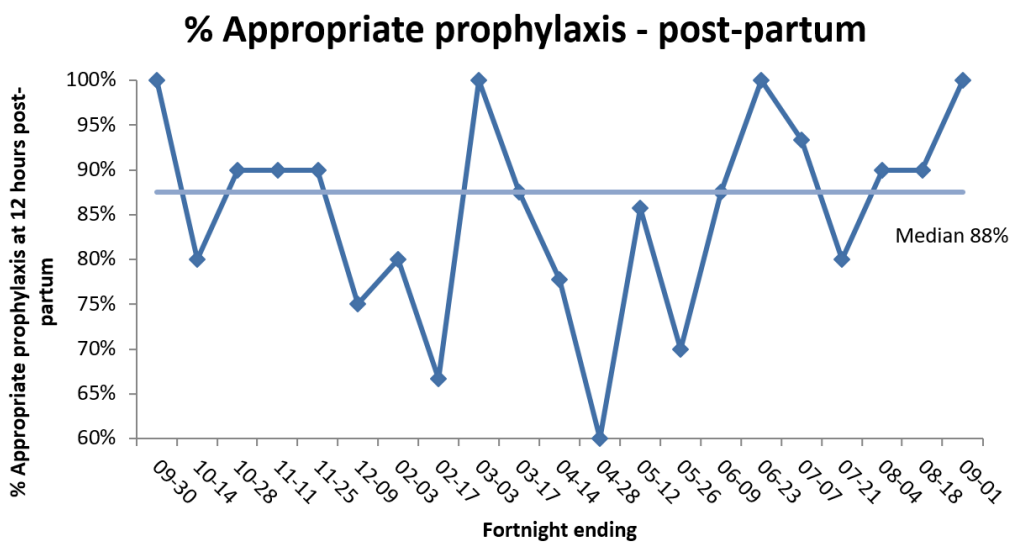
There was a consistently low rate of appropriateness of prophylaxis for **surgical non-orthopaedic** patients, $n=298$, across 7 hospitals. It took longer to see improvement in appropriateness, but the improvement overall was substantial, increasing from a median of 40% to 73% ($p < 0.05$).



For **orthopaedic** patients (n=222), processes and checks are well-established. Mechanical prophylaxis was appropriate in all cases. Pharmacological prophylaxis was only once omitted when indicated, and all of the other cases where prophylaxis was judged inappropriate were relating to dose adjustments for patient weight. In many cases, the guidance to adjust doses for weight was new and had not been fully implemented in these hospitals.



Three maternity hospitals participated, focusing on **post-partum women**, n=262. The median appropriateness was 88%, which did not change during the collaborative overall. Omission of thromboprophylaxis where indicated was the most common categories of inappropriate prophylaxis.



For these groups, where median appropriateness was high at baseline and many of the appropriate processes are in place, it may be more challenging to achieve further clear improvement. However, the hospitals working with these patient groups addressed various aspects of prophylaxis, e.g. improving education, awareness, patient education and refining protocols.

Hospital case study – Increased appropriateness from 37% to 70% with multiple improvements

This model 3 hospital focused on all medical in-patients for measurement and improvement efforts. Their improvement team spent 468 hours in total, with high engagement with doctors and pharmacists, moderate with nurses and a little with patients. They were true to QI methodology but had minimal governance oversight. At baseline, their median appropriateness was 37% and they had a partial policy in place. By the end of the collaborative, they had a policy and a prompt in doctors' documentation fully implemented. They had partially implemented education for doctors, nurses and patients. They had tested putting the VTE protocol in the drug chart, preprinted prescriptions and a prompt in nursing documentation. They achieved a median of 70% appropriateness by the end of the collaborative and were actively continuing improvement work.

“Very hard working team which was determined by Chief Pharmacist. Heavy involvement from NCHDs who worked very hard on the project and contributed great ideas and motivated the team. Involvement of QI coach.” contributed to their success and challenges were “Lack of involvement by senior Management. Lack of access to governance structures within the hospital”.

Hospital case study – High appropriateness at baseline improved further with many improvements

Another large model 3 hospital tackled improving VTE prophylaxis in all patient groups. Their baseline median appropriateness of 80% reflected the presence of many measures introduced during previous improvement cycles. Their team spent 528 hours in total, were true to quality improvement methods and engaged doctors, pharmacists, nurses and patients. They introduced a VTE policy, education for doctors, nurses and pharmacists and for some patients, preprinted prescriptions, prompt in drug chart and in pharmacist documentation. They fully implemented a VTE protocol, risk assessment form and pharmacist check of VTE prophylaxis which had been partially in place. They achieved 90% median appropriateness of by the end of the collaborative.

“Teamwork Patient advocate speaking to NCHDs regular collaborative meet ups New contacts made through the collaborative Local QI guy” contributed to their success and “rotation of NCHDs” was a challenge.

The secondary outcome of the collaborative was to increase capacity and capability for quality improvement within the health service. Over 100 people have been trained in quality improvement and VTE prevention, 86 of these have applied this to a quality improvement project (action learning), and further people in each of the hospitals have been involved in each of those projects. Most of the teams have indicated that their improvement work is ongoing or plan to recommence in the near future. Most of the people involved were not in a VTE-specific role, and most were in roles that were not confined to one hospital area or ward. It is anticipated that they will thus have opportunities to apply their quality improvement skills to other areas in the future.

What did we learn?

Throughout the collaborative, we learned from hospitals sharing their progress in project coaching sessions, presentations, and sharing of tools and tips. We had measurement data from 22 of the 27 hospitals, some of which is presented in the previous section. We also surveyed the hospitals in early 2018. All 27 hospitals responded, giving an insight into the factors that helped and hindered improved VTE prevention, as well as what was already in place in high-performing hospitals at baseline. We carried out both quantitative and qualitative analysis of the responses and combined them with the measurement data to gain an insight into what contributed to success. These insights have contributed to the recommendations in this report.

The survey is available on www.safermeds.ie and included:

- which tools and processes were in place or tested before the collaborative started and by the end of the collaborative
- the extent to which elements of the recommended approach were implemented (use of the QI methodology, PDSA testing, support from a local QI coach, reported measures and progress to a governance committee) and the extent to which patients, doctors, nurses, pharmacists and healthcare assistants were involved and engaged with in the project. For both of these elements, answers were allocated the following scores; 0=not at all, 1=a little, 2=a moderate amount, 3=a lot, 4=all the time
- time spent by each member of the improvement team on measurement, attending collaborative sessions and the other aspects of quality improvement (time in hours for each member of the team in total for the collaborative)
- the extent to which the hospital environment supported innovation and improvement (for each element, 0= not at all, 1 = a little, 2= a lot) and whether roles and resources were in place which might influence quality (0= no, 1=partial (e.g. clinical pharmacy service reaching less than 2/3rds of patients, 2=full (e.g. full-time roles)

Baseline factors influencing high appropriateness of prophylaxis

Our participating hospitals varied considerably in the presence or absence of tools and processes to prevent VTE, in the patient groups they were focusing their improvement project on, in size and complexity of the hospital and casemix and in staffing levels and skillmix. These variables contributed to their initial % appropriate prophylaxis at baseline.

At baseline, 10 hospitals had 70% or greater appropriate prophylaxis. This group was more likely than the 12 hospitals with less than 70% appropriateness to:

- Focus on post-partum or orthopaedic patients. All six of these hospitals had over 70% appropriateness
- Have more processes, tools and education in place (allocated scoring of 4 points), partially in place (2 points) or tested (1 point) (mean points 19.4 vs 7.8, $p=0.006$). The mean number of tools or education partially or fully in place was 6.3 for those with high vs 2.6 for those with lower appropriateness, $p=0.0009$
- Have a VTE protocol, prompt or tickbox in nursing/midwifery documentation, a process for nurse/midwife check of VTE prophylaxis and/or patient education ($p<0.05$)
- Have a process for pharmacist check of VTE prophylaxis and nurse education ($p<0.10$)
- Other processes not different between groups at baseline were having a VTE policy, risk assessment form, education for doctors, nurses or pharmacists, preprinted prescription or other prompts.

The high-appropriateness hospitals had higher scores for hospital environment factors overall (score 12.6 vs 10.4, $p=0.039$) and support for innovation and improvement (score 6.4 vs 4.9, $p=0.014$), but not resources (having a medication safety pharmacist, clinical pharmacy, Nurse Practice Development or quality manager, alone or in combination).

Factors influencing high appropriateness of prophylaxis at the end of the collaborative

At the end of the improvement project, 15 hospitals had 70% or greater appropriate prophylaxis and 7 had less than 70%. Comparing those two groups, high-appropriateness hospitals were more likely to have:

- A higher total score for tools and education (mean 26.2 vs 17; one-tailed t-test, $p=0.048$)
- Routine process for pharmacist check (mean 2.77 vs 1.43; one-tailed t-test, $p=0.039$)
- Pharmacist education in place (mean 3 vs 1.1; one-tailed t-test, $p=0.012$)
- A more supportive hospital environment overall (mean 12.1 vs 10; one-tailed t-test, $p=0.035$), with more resources (mean 6.3 vs 4.9, one-tailed t-test, $p=0.035$), specifically clinical pharmacists (mean 1.7 vs 1, one-tailed t-test, $p=0.022$) and nurse(s) with responsibility for education, practice development or improvement (mean 1.9 vs 1.6; one-tailed t-test, $p=0.021$).

Factors influencing improvement

The hospitals were analysed as three groups, those who achieved no absolute difference, moderate improvement (range 5-13%) and substantial improvement (20% or greater) difference in the median % appropriateness from the baseline to the end of the collaborative.

The most popular changes which were tested, scaled up or introduced during the collaborative were education for doctors (increased in 14 hospitals), education for nurses (12), education for pharmacists (10), risk assessment form (9), education for patients (8), preprinted prescription (7), other prompt in the drug chart (6), routine pharmacist or nurse check (5 each) and prompt in doctors' documentation (5).

The involvement or engagement of patients, doctors, nurses or pharmacists and total score for engagement did not differ between groups, although many teams felt this was important.

The total score for tools and education, or any individual tool, did not differ between groups.

The figure below shows the time spent by all members of the team in hours over the improvement collaborative year, in total and on the particular strands of measurement, quality improvement and attending collaborative sessions. The collaborative required attendance at sessions and standard measurement, so there was less variation in these times. Those achieving substantial improvement spent more time on quality improvement activities (PDSAs, education and awareness activities, process improvement) than the other two groups ($p=0.011$).

	Total time per team (hours)	Measurement time per team (hours)	Quality improvement time per team (hours)	Collaborative sessions time per team (hours)
No improvement	300	121	133	46
Moderate improvement (less than 15%)	365	206	101	58
Substantial improvement (20% or greater)	500	162	280	58
Significant difference	No difference, $p=0.23$	No difference, $p=0.51$	Significant difference, $p=0.011$	No difference, $p=0.28$

A standard quality improvement methodology was taught and coached through the collaborative. The survey explored the extent to which teams were true to this methodology. Those with no improvement had a lower use of PDSA cycles and quality improvement methods than the other groups. There was no association between governance oversight and improvement.

	Quality improvement methods used	PDSA cycles used	Liaised with a local QI coach	Governance - reporting and oversight	Total score
No improvement	1.8	1.7	1	2.8	7
Moderate	3	2.85	1.3	3	10
Substantial	2.7	2.5	1.6	2.3	9
Difference	P=0.08 between no and moderate improvement	P=0.05 between no and moderate improvement	No significant difference	No significant difference	No significant difference

“It makes such a positive influencing difference to be able to talk about the work in the context of a national collaborative”

Caitriona Gowing, Chief Pharmacist, Midlands Regional Hospital, Portlaoise

Qualitative analysis

Responses to the open question, “Please describe any factors which helped your project progress, or which contributed to any successes you achieved” yielded recurrent themes, most commonly:

- Pharmacist and/or chief pharmacist leadership and involvement (8 responses)
- Support from the HSE Quality Improvement Division team and involvement in the collaborative (8)
- Teamwork (6)
- Hard work (4)

- Consultant involvement/support (4)
- Clinical director support (3)
- Learning from other hospitals (3)

“Team work. Patient advocate speaking to NCHDs. Regular collaborative meet ups. New contacts made through the collaborative. Local QI guy”

Responses to the question “Describe any factors which challenged or hindered your project progress or success” yielded a resoundingly consistent response. 15 respondents cited resources, time and/or staff availability as the biggest challenge to progress, with lack of doctor involvement (3 respondents), NCHD rotations (3), consultant involvement (2), nursing involvement (2) and management interest (2) also cited. The lack of national standard guidance (2) and limitations in the evidence base and/or lack of consensus about appropriate guidance (2) were also raised.

“Time, Time, Time!! There is a great will to be involved in QI however time a major issue with so many competing interests”

“No staff available to carry out work. Takes people away from regular duties/commitments. No Thrombosis Nurse. Person leading project too senior and therefore too many competing commitments”

In answer to “Please describe any additional factors which you think could have helped you or others improve VTE prophylaxis”, more allocated time (5), national guideline/protocol/consensus regarding dosing (4), a doctor on the team (3), access to a QI coach (2), a bigger/more multidisciplinary team (2) and electronic data collection (2) were most commonly suggested.

“A national guideline/stance would be helpful. If we had a project lead with more time to dedicate it would have kept the energy up. An electronic form, linked to the Excel database, would have facilitated faster data collection and eliminated the need for a separate data entry step and the subsequent need for data entry checks”

“Earlier focus on the ideas for change and PDSA cycles rather than the data collection”

“Greater involvement by senior management. Updates at governance level within hospital would be beneficial”

Our learning about pre-printed prescription(s)

Having a pre-printed prescription(s) in the drug chart was tested or introduced by 7 teams, all of whom felt by those testing it to be very successful. Many teams tested this by applying stickers initially and were incorporating it into future design of the drug chart, although this delayed roll out and full implementation. Ongoing measurement will be required to identify if significant improvements were realised on full implementation. This was very well received by doctors, nurses and pharmacists, was generally filled in with minimal need for education and was not time-consuming to develop, test, or fill in. A number of hospitals found the optimum place for this preprinted prescription to be on a dedicated anticoagulant page in the drug chart, to prevent duplication errors with anticoagulants.

Our learning about VTE forms

VTE risk assessment is essential to achieving appropriate prophylaxis. VTE forms or tools incorporating VTE risk assessment, bleeding risk assessment and guidance on prophylaxis choices, to be filled in and/or signed off, were in place in some or all areas of 8 of the 27 hospitals at the start of the collaborative, in paper (n=7) or electronic (n=1) format, and 9 other hospitals tested or introduced them during the collaborative.

A completion rate of 100% was achieved in one maternity hospital with an electronic tool completed by midwives in the delivery suite.

In our collaborative, we found no association between completion of the form and the appropriateness of prophylaxis in the hospitals where this could be assessed (see table below).

Hospital and patient group(s)	Completed		Not completed		% completed	Association between completion and appropriateness*
	Appropriate	Not appropriate	Appropriate	Not appropriate		
A Medical, surgical, orthopaedic	31 (48%)	34	31 (54%)	26	53%	No association, $p=0.4744$
B Medical	42 (79%)	11	54 (66%)	28	39%	No association, $p=0.1202$
C Medical, surgical	17 (65%)	9	55 (61%)	35	22%	No association, $p=0.8196$
D Medical, surgical, orthopaedic	32 (89%)	4	129 (83%)	27	19%	No association $p=0.4574$
E Post-partum	81 (82%)	18	0	0	100%	Not assessable
F Medical	0	0	99 (75%)	33	0%	Not assessable
G Medical	2 (100%)	0	53 (40%)	79	1%	No association, $p=0.166$
H Medical	3 (75%)	1	26 (63%)	15	9%	No association, $p=1$

* Two-tailed Fisher's Exact test

Nine additional hospitals stated in the survey that they tested or introduced risk assessment forms. Each of these hospitals reported difficulty in getting forms completed or increasing the completion rate.

The VTE risk assessment and prophylaxis form, in paper or electronic format, has been widely used internationally to improve hospital VTE prophylaxis. The Department of Health in England introduced an incentivised target for NHS hospitals to risk assess in-patients for VTE in 2010, with a target of VTE forms being completed for at least 90% of in-patients. Analysis determined that this was effective, with reductions in VTE as the primary cause of death (relative risk 0.85 (95% CI

0.75-0.96; $p=0.011$) and reduced post-discharge fatal VTE (RR 0.61 (0.48-0.79; $p=0.0002$) in hospitals achieving the risk assessment target for at least 90% of patients²⁷.

We have had input from a number of specialist haematologists who favour a structured form or electronic tool that is signed. We recommend that any change or measure being considered, including a form, is tested to ensure it can be applied in the clinical context and to evaluate its impact on the rate of appropriate prophylaxis.

Achieving and sustaining high appropriateness of VTE prophylaxis requires the presence of multiple measures to support VTE prophylaxis. Based on this collaborative and results from the 22 hospitals, a combination of the following measures is likely to result in a high degree of prophylaxis appropriateness and is recommended:

- a. VTE prevention protocol in an accessible location fitting into process flow, e.g. in the drug chart or electronic patient record**
- b. Prompt(s) or alerts, e.g. pre-printed prescriptions**
- c. Systematic process of independent check(s) of prophylaxis, e.g. by pharmacists, nurses, consultants, early in admission (e.g. before or at the post-take ward round) and**
- d. Education and information for staff and patients**

These recommendations are in line with international findings. We recommend any change or measure being considered is tested thoroughly and only implemented if tests confirm that they are associated with improved appropriateness of prophylaxis and are acceptable to staff, in line with good quality improvement practice.

Use of and trueness to the Model for Improvement method and the use of PDSA cycles to test changes was associated with greater improvement in the collaborative and is the recommended approach for hospitals aiming to improve VTE prevention.

²⁷ Lester W et al. Heart. 2013 doi:10.1136/heartjnl-2013-304479

Engaging patients

Patients have an opportunity to reduce their risk of developing blood clots, and to minimise the damage caused by a blood clot should one occur. Patient awareness of the risk of blood clots associated with hospitalisation and the high-risk 90 days after discharge is generally low, with most people not aware of the signs and symptoms of blood clots and what to do if they occur. Current interactions between healthcare professionals and patients may not sufficiently empower patients to understand their risk and the role they can play in protecting themselves.

We worked with a patient charity who developed patient alert cards and these have been piloted in seven hospitals. Feedback from both patients and staff was very positive and we have supported an initial print run to distribute to hospitals (Appendix 3 and www.safermeds.ie).

Ensuring all in-patients receive information, facilitated by the alert card, is a substantial logistic and educational challenge. Each hospital will need to ensure funding for further printing and distribution and drive an improvement process to ensure each patient receives them. How and by whom this will be done will vary with local context. Discharge and/or admission were identified as points where they could be discussed, with nurses best placed to discuss the cards with patients, in the pilot hospitals. In some hospitals, cards could be incorporated into admission or discharge packs or the information incorporated into an existing patient information booklet.

While patients are in hospital, they also have an opportunity to contribute to reducing their blood clot risk, through mobilisation, hydration and using/receiving blood clot prevention. Engagement between healthcare professionals and patients can help improve patient understanding of the purpose for and benefits of injections and stockings, along with minimising patient discomfort by ensuring stockings are only used where indicated, both legs are measured and the correct size used, and the stockings are fitted correctly and ensuring good injection technique. If a patient is fully informed of their risks and the risks and benefits of prevention strategies, they may make an informed choice to refuse prevention, which should be documented. The patient alert card may be helpful in facilitating these discussions and informing patients during hospitalisation as well as at discharge.

Recommendations to reduce the incidence of hospital-acquired VTE

Essential requirements to effectively reduce hospital-acquired VTE

Each patient admitted to hospital for an in-patient stay requires:

- The VTE prevention protocol to be followed when the decision to admit is made and repeated if clinical situation changes. The protocol comprises standardised:
 - VTE risk assessment
 - Bleeding risk assessment
 - Clinical decision support to guide the appropriate choice of prophylaxis, in line with the patient's VTE risk, bleeding risk, contra-indications to mechanical prophylaxis and any dose adjustment required due to renal impairment or weight
 - The appropriate prophylaxis prescribed, administered and/or applied.
- All of these steps should be completed as soon as possible after admission and appropriate prophylaxis received within 24 hours after the decision to admit.
- Patient information about any prophylaxis they are receiving, their continued risk for 90 days after hospitalization, the signs and symptoms of VTE and what to do if they occur.

Hospitals must ensure that:

1. Oversight for monitoring and improving VTE prevention is assigned to the appropriate governance committee and is an agenda item at meetings at least twice a year. The Drugs & Therapeutics Committee or Quality & Safety Committee may be assigned governance oversight of VTE prevention. As improving VTE prevention is a large undertaking, establishing a dedicated hospital Thrombosis Committee or Thrombosis Prevention Committee may be required, with reporting structures to higher levels of governance. This should be chaired by the VTE champion clinician, with membership which may include a specialist nurse, pharmacist, data manager, member of hospital risk management and member of hospital quality team.
2. There is a standardised hospital VTE prevention protocol, comprising VTE risk assessment, bleeding risk assessment and clinical decision support for choice and dose of prophylaxis according to the patient's risk, weight, renal function and contra-indications to prophylaxis.

The HSE template in Appendix 1 may be used to guide local decision-making when developing a hospital VTE prevention protocol.

3. Standardised VTE risk assessment following the VTE protocol is carried out for each in-patient as soon as possible after the decision to admit is made, and appropriate prophylaxis received asap and within 24 hours.
4. Tools and processes that have been tested and shown to effectively improve the provision of appropriate prophylaxis are in place. The combination of:
 - a. VTE prevention protocol in an accessible location fitting into process flow, e.g. in the drug chart or electronic patient record
 - b. Prompt(s) or alerts, e.g. pre-printed prescriptions (e.g. Appendix 2)
 - c. Systematic process of independent check(s) of prophylaxis, e.g. by pharmacists, nurses or consultants, early in admission (e.g. at the post-take ward round) and
 - d. Education and information for staff and patients

is likely to result in high appropriateness of prophylaxis. We recommend any change or measure being considered is tested thoroughly and only implemented if tests confirm that it can be applied in the clinical context and its impact on the rate of appropriate prophylaxis has been evaluated, in line with good quality improvement practice.

5. Each in-patient receives information about any VTE prophylaxis they are receiving, their risk of VTE for 90 days after hospitalisation, the signs and symptoms of VTE and what to do if they occur, facilitated by providing the Patient Alert Card (Appendix 3). Where this is a new change, a dedicated improvement effort with at least one coordinator will be required to test, implement and support this change.
6. Responsibilities for prescribing according to the VTE prevention protocol, independently checking prophylaxis and providing patient information prior to discharge is assigned and these healthcare professionals are clearly aware of their responsibility.

7. All staff involved in the processes of risk assessment, prescribing, administering, monitoring and checking VTE prophylaxis have access to the VTE prevention protocol and information about preventing VTE.

8. Monitoring of key metrics takes place at least quarterly and is reviewed at the appropriate governance committee at least twice a year. This includes:
 - a. Rate of Hospital-Acquired VTE (national KPI, reported to hospitals by the HSE).

 - b. Percentage of sampled patients with appropriate prophylaxis (i.e. in line with the hospital's VTE prevention protocol) within 24 hours of the decision to admit. Standardised sampling, data collection and measurement instructions are available in Appendix 4 and www.safermeds.ie . If the hospital wishes to use the established HSE system, the Excel spreadsheet on www.safermeds.ie must be used as is with no changes (other than data entry using the drop-down menus), in the established fortnightly intervals and auditing no more than 10 patients per fortnight. This can then be loaded up to Sharefile® and pulled into QlikView®. Hospitals may choose to measure at less frequent intervals using the same system. If the HSE system is not being used, the percentage of patients with appropriate prophylaxis should still be measured at least quarterly and for a random sample of 10 patients at the very least. Where the hospital is focusing on improving VTE prevention for a particular patient group, the sample may be taken from that patient group only to track progress while the improvement project is underway.

 - c. Percentage of sampled discharged patients who received information about VTE risk and signs and symptoms, for a random sample of 10 patients per quarter or greater.

 - d. Hospitals may supplement the above with additional more detailed quantitative and/or qualitative research, audit and measurement for improvement.

9. Hospital-acquired VTE is reported and managed in accordance with the HSE Incident Management Framework, including open disclosure (www.hse.ie/opendisclosure). Where the VTE occurred following treatment in another hospital, that hospital is also informed.

10. Hospital-acquired VTE is listed as a risk on the hospital's risk register.

11. An adequately resourced multi-disciplinary VTE prevention improvement team is supported to carry out quality improvement to reduce hospital-acquired VTE, ideally continuously. This team can coordinate the testing and implementation of the recommendations, as well as measure % appropriate prophylaxis. Appendix 4 includes a quality improvement and measurement guide, with additional material available on www.safermeds.ie . During VTE prevention quality improvement phases, the following is in place:
 - a. a senior clinical management team sponsor
 - b. an improvement team of a doctor, nurse and pharmacist, with additional members if available, e.g. a data manager. Experience in the collaborative has shown that a multidisciplinary team is crucial to success. This team is supported by the hospital to dedicate a minimum of a half day a week for 3 team members, applied to improvement activities and measurement, for the duration of the improvement work. Where teams were able to dedicate this time, improvement was achieved in 12 months. Teams dedicating less time are unlikely to achieve improvement in less than 18 months and should prioritise improvement activities over measurement, if a compromise is needed.
 - c. a wider project team including a lead clinician with interest and knowledge in the area and a quality improvement coach are available to the improvement team to advise, make decisions, support the team through challenges and to engage with their peer group where necessary
 - d. governance arrangements for the project and reporting

This VTE prevention team would ideally be coordinated by a full- or part-time thrombovigilance nurse or pharmacist coordinating improvement, staff education, information, auditing and incident management.

Toolkit

Appendix 1: VTE Prophylaxis Protocol Template

VTE Prophylaxis Protocol Template for In-Patients aged 16 or Over <Modify for local use>Assess all patients as soon as possible (within 14 hours¹) after the decision to admit. Reassess at consultant review and if their condition changes¹.

Step 1: VTE risk assessment VTE Risk Factors	Medical score	Surgical/trauma risk factor	Local decision where guidelines recommendations differ. Medical scores in brackets are based on relative risk, but are not in the original Padua Prediction Score.	Medical score	Surgical/trauma risk factor
Surgery/anaesthesia 90 mins or greater, or to pelvis or lower limb 60 mins or greater, hip or knee replacement or hip fracture ²		At risk	Significant heart, metabolic, endocrine, respiratory disease ²⁻⁴	1	At risk
Acute surgical admission with inflammatory condition or intra-abdominal condition ²		At risk	Ischaemic stroke ³⁻⁴ (discuss with stroke team) or Acute MI ²⁻⁴	1	At risk
Immobility expected for at least 3 days ²⁻⁴ (confined to bed +/- bathroom ^{2,3} or reduced relative to normal state ²)	3	At risk	Acute infection ²⁻⁴ or Acute or chronic inflammatory disorder ²⁻⁴	1	At risk
Active cancer or treatment (chemo-or radiotherapy within 6 months or metastases) ²⁻⁴	3	At risk	Local decision: Aged 70 or over ^{3,4} or over 60 ²	1	At risk
Previous DVT/PE ²⁻⁴	3	At risk	Local decision: Surgery in previous 30 days ^{3,4}	2	At risk
Thrombophilia ²⁻⁴	3	At risk	Local decision: Pregnant or up to 6 weeks post-partum ²	(3)	At risk
Taking oestrogen-containing contraceptive or HRT ²⁻⁴	1	At risk	Local decision: Varicose veins with phlebitis ²	(1)	At risk
BMI 30 or greater (obese) ²⁻⁴	1	At risk			

Medical: At risk if Padua score 4 or greater^{3,4} or Reduced mobility and at least one other risk factor^{1,2} **Surgical/Trauma:** At risk if any one or more risk factor(s)^{1,2}

Step 2: Bleeding risk assessment (any risk factor below = contra-indication to LMWH / heparin)

Active bleeding ^{2,4}	On anticoagulant at therapeutic levels/dose, e.g. warfarin, dabigatran, rivaroxaban, edoxaban, apixaban, heparin, enoxaparin: No additional prophylaxis except while anticoagulant held ²
Platelets less than 50 x 10 ⁹ /L ⁴ (or local decision: 75 x 10 ⁹ /L ²)	Undergoing procedure with high bleeding risk, e.g. neurosurgery, spinal or eye surgery ^{2,4}
Bleeding disorder, e.g. haemophilia, Von Willebrand's ^{2,4}	
Acquired bleeding disorder e.g. liver failure with PT over 15 ^{2,4}	History of Heparin-Induced Thrombocytopenia (HIT): Contact haematology or pharmacy
Acute stroke (discuss with stroke team) ^{2,4}	Epidural or spinal or lumbar puncture in last 4 hours or expected in next 12 hours ^{2,4}
Blood pressure 230 systolic or 120 diastolic ^{2,4} or greater	Other bleeding risk: if risk of VTE outweighs bleeding risk, consider pharmacological prophylaxis. If risk of bleeding outweighs risk of VTE, consider mechanical VTE prophylaxis ¹

Step 3: Recommended prophylaxis (local decision re duration; e.g. until low-risk for VTE on risk assessment, until discharged or for minimum 7 days¹. Prolonged prophylaxis is recommended post-total hip replacement, total knee replacement, major abdominal surgery for cancer and considered for people with myeloma receiving thalidomide, pomalidomide or lenalidomide with steroids, and for people with pancreatic cancer who are receiving chemotherapy¹).

All patients	Adequate hydration, early mobilisation			
All surgical patients (or at-risk surgical patients)	Mechanical compression: Anti-embolism stockings* +/- intermittent pneumatic compression devices / foot pumps			
High-risk medical (score 4 or greater) with C/I to heparins	* Do not use in suspected or proven peripheral arterial disease, severe dermatitis, massive leg oedema, leg deformity preventing correct fit, peripheral neuropathy, recent skin graft, allergy to fabric or acute stroke (use IPCD ¹). Use caution and clinical judgement if applying stockings over venous ulcers or wounds ¹ .			
	Weight 50-100 kg and GFR over 30 mL/min	Weight 101-150 kg	Weight less than 50 kg	GFR less than 30 mL/min
High-risk medical (score 4 or greater), no C/I	Tinzaparin 4500 units ⁵ or enoxaparin 40 mg once daily ⁵	Consider tinzaparin 4500 units bd ⁶ or enoxaparin 40 mg bd ⁶	Consider tinzaparin 3500 units ⁶ or enoxaparin 20mg once daily ⁶	Heparin 5000 units twice daily or Tinzaparin 3500 units daily (caution ⁵) or enoxaparin 20 mg daily ⁵ (contra-indicated in GFR less than 15 mL/min ⁵)
High-risk surgical (any risk factor), no C/I				
Moderate-risk surgical (local decision: delete if no moderate-risk category)	Tinzaparin 3500 units ⁵ or enoxaparin 20 mg once daily ⁵	Consider tinzaparin 4500 units once daily ⁶ or enoxaparin 40 mg ⁶ once daily		
Low-risk medical (score 3 or lower) or Low-risk surgical (no risk factor)	No heparin or low molecular weight heparin Medical patients: no mechanical compression unless patient is high-risk with contra-indication to heparins Surgical patients: local decision: mechanical compression in at-risk or all surgical patients			

Step 4: Give the patient (and family members/carers if appropriate) verbal information and the patient alert card¹. Prescribe appropriate prophylaxis**Step 5: As part of the discharge plan, give patients (and family members/carers if appropriate) verbal information and the patient alert card¹. Give those discharged with prophylaxis information about its importance and how to use it effectively and safely¹ and notify their GP¹.**

1. Venous thromboembolism in over 16s: reducing the risk of hospital-acquired deep vein thrombosis or pulmonary embolism (NICE Guideline 89); March 2018

2. Department of Health (UK) Risk Assessment for VTE. March 2010

3. Barbar S et al. The Padua Prediction Score. J Thromb Haemost 2010; 8:2450-7

4. Kahn SR et al. Chest 2012; 141, 2 Suppl. (ACCP 9th Edition)

5. Summaries of Product Characteristics, www.hpra.ie

6. UKCPA HAT Committee QA326_2. Doses of thromboprophylaxis in extremes of body weight Feb 2017

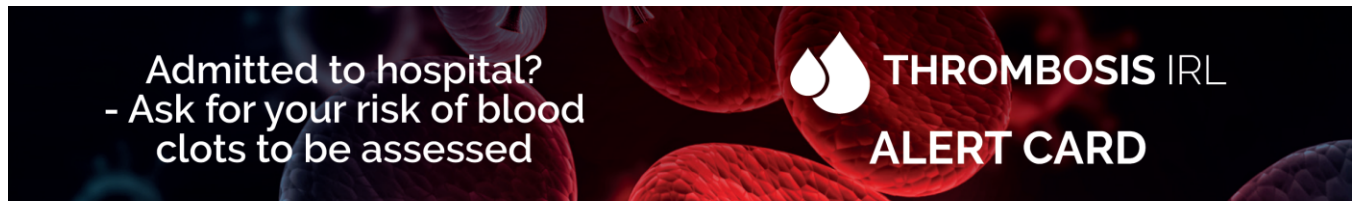
Appendix 2: Sample pre-printed prescription

Regular Prescriptions

(Prescribe antimicrobials in antimicrobials section)

			Year	Day & Month DD/MM					
Pharmacological Thromboprophylaxis (name) Prescribe only if indicated and patient has no contraindications			6						
			8						
Route	Dose	Frequency & Prescriber circle time	10						
Special Instructions		Reviewed By	12						
		Date	14						
Prescriber Sig	Reg No	Date	18						
Stop Date	Reason	Signature	22						
Mechanical Thromboprophylaxis (name) Prescribe only if indicated and patient has no contraindications			6						
			8						
Special Instructions Measure to select appropriate size Assess fit, compliance and skin integrity daily and sign		Reviewed By	10						
		Date	12						
Prescriber Sig	Reg No	Date	14						
Stop Date	Reason	Signature	18						
			22						
Drug (Generic Name)			6						
			8						
Route	Dose	Frequency & Prescriber circle time	10						
Special Instructions		Reviewed By	12						
		Date	14						
Prescriber Sig	Reg No	Date	18						
Stop Date	Reason	Signature	22						
Drug (Generic Name)			6						
			8						
Route	Dose	Frequency & Prescriber circle time	10						
Special Instructions		Reviewed By	12						
		Date	14						
Prescriber Sig	Reg No	Date	18						
Stop Date	Reason	Signature	22						

Appendix 3: Patient alert card



WHAT IS A BLOOD CLOT?

This is the formation of a clot inside a blood vessel, usually in the leg, which may break off and go to the lungs. This can be fatal.

60% of clots happen in **HOSPITAL** or in the **90 DAYS** following admission. 



Blood clots can be very serious - but there are effective treatments to deal with them and help prevent them

SIGNS AND SYMPTOMS OF A BLOOD CLOT

- Swelling or pain in one leg or calf
- Warmth or redness in the leg
- Short of breath or rapid breathing
- Chest pain (particularly when breathing deeply)
- Coughing or coughing up blood

If you have one or more of these, you may have a clot and need urgent treatment

Charitable Status Number: 20154240

www.thrombosisireland.ie



WHAT CAN I DO TO HELP MYSELF?

- Ask for your risk of blood clots to be assessed if you are admitted to hospital
- Walk and move as much as possible
- Drink plenty of fluids
- If directed to use stockings or medication, follow instructions exactly
- Remember, a clot can form up to 90 days after being in hospital
- If you have any signs or symptoms of a clot, take **immediate action** to seek medical help

You have a **HIGHER CHANCE** of getting a clot in **HOSPITAL** Than on a **AEROPLANE!** 



Seirbhís Sláinte
Níos Fearr
á Forbairt | Building a
Better Health
Service

YOU MAY BE AT INCREASED RISK IF:

- In hospital and for the 90 days after discharge
- Immobility (More than 3 days in bed or long haul travel more than 6hrs) or in a leg cast
- Surgery
- Active cancer or receiving cancer treatment
- You or a close relative had a blood clot in the leg or lung
- Thrombophilia (tendency to clot)
- Pregnancy or up to 6 weeks after birth
- Oral contraceptive pill or HRT
- Heart, lung or inflammatory disease
- Age over 60 years or being overweight
- Varicose veins with phlebitis

Appendix 4: How to carry out a quality improvement project to reduce hospital-acquired VTE

Step One: Establish the team, governance and support structures

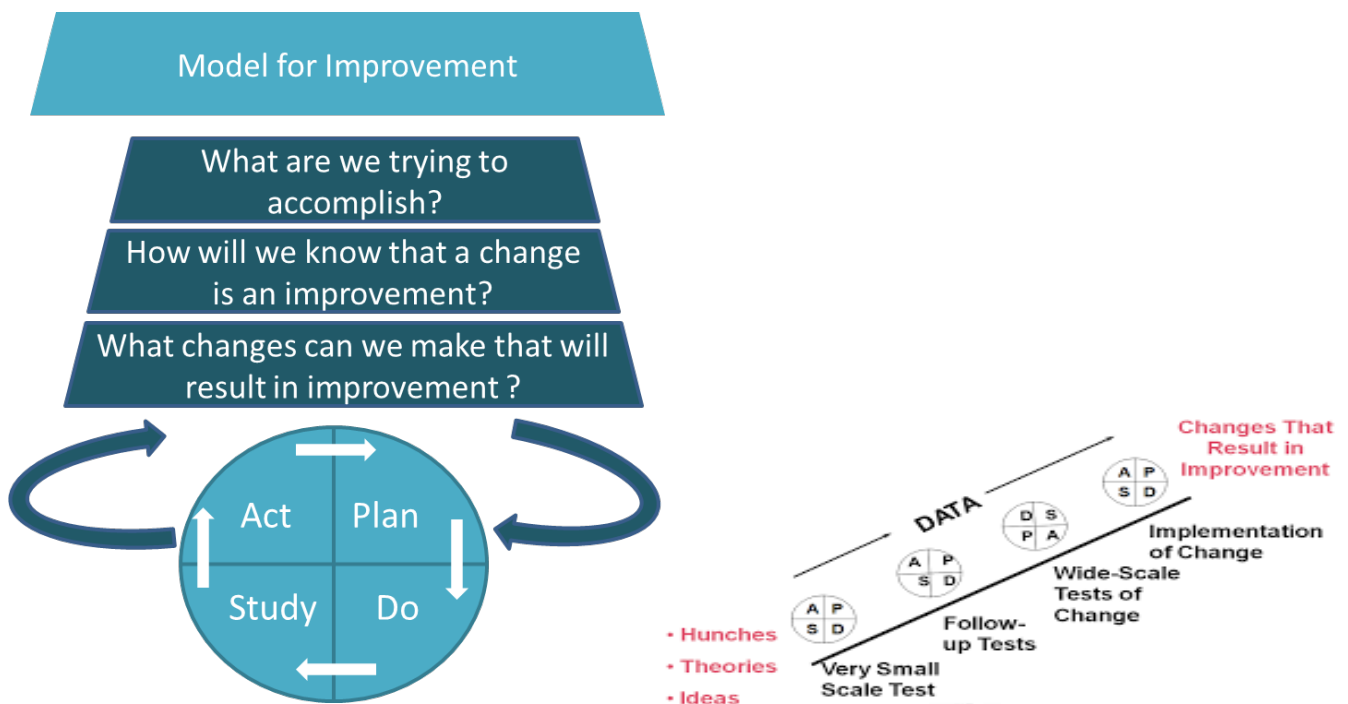
Once the need for a quality improvement project has been identified, the following are required:

- **Sponsor:** A senior management team member with clinical responsibilities must be identified to support and champion the project and to keep the senior management team updated with progress.
- **Governance:** Local governance and reporting arrangements for the project should be defined, e.g. Thrombosis Committee, Drugs & Therapeutics Committee or other Quality and Safety Committee.
- **Improvement team:** a **multidisciplinary team of three** healthcare professionals (e.g. a doctor, nurse and pharmacist) to carry out improvement and measurement work, with additional people if required. Teams must consist of more than one discipline and having one or more non-consultant hospital doctors involved, on the team or pulled in at particular stages, is recommended. The hospital must put in place arrangements so that each of the team members can dedicate a minimum of a half day per week each for 12-18 months. During an improvement phase, teams achieving substantial improvement spent 500 hours in total (equivalent to 3.5 hours per week for 3 team members for 46 working weeks of the year) and, where a compromise was necessary, prioritised time on improvement activities as opposed to measurement.
- **Wider project support:** The improvement team will need access to subject-matter, process and quality improvement expertise. This may be a formal committee or group, or the individuals may be identified and consulted as required during the project. Involvement of a haematologist or consultant with expertise in VTE prevention is recommended, in particular to inform decisions about the local hospital protocol. Identifying a quality improvement coach, i.e. somebody who has carried out quality improvement projects previously, e.g. somebody who has completed the Diploma in Leadership and Quality in Healthcare with the RCPI/HSE or a quality manager, is recommended. This person may provide structured or

informal support, e.g. meeting the project team for coffee every month or being available for queries about the methodology and help with challenges.

The structure of the improvement team and hospital support is devised with reference to factors known to improve the likelihood of success in quality improvement, the Model for Understanding Success in Quality²⁸.

The Model for Improvement (© Associates for Process Improvement) is the quality improvement methodology used in this collaborative and in other HSE Quality Improvement Division projects.



This model is conceptually simple and ensures that only changes that have been demonstrated to lead to improvement on a smaller scale are scaled up for implementation, and that measurement is tracked over time to check if goals are being reached as improvements are made.

Step Two: What are we trying to accomplish?

Construct a clear aim statement. The aim should be Specific, Measurable, Actionable, Realistic and Time-bound (SMART aim), i.e. what, how much, for which patients, by when. Appropriate thromboprophylaxis is recommended, as it is the best available measure that the optimal blood clot prevention is in place.

²⁸ Kaplan H et al. The Model for Understanding Success in Quality (MUSIQ): building a theory of context in healthcare quality improvement. *BMJ Qual Saf* 2012 Jan;21(1):13-20

The team, with consultation with staff and patients, should decide:

- the target for appropriateness (which should be a stretch goal, equating to good or very good performance),
- the patient group (e.g. all in-patients, or one or a combination of medical, surgical non-orthopaedic, orthopaedic, post-partum, maternity in-patients, or a more specific group, e.g. in-patients with cancer),
- the time at which appropriate prophylaxis will be measured. In the collaborative this was 24 hours after the decision to admit. A recent update of NICE guidance states that prophylaxis needs to be first administered within 14 hours of admission, if this is appropriate for the patient
- the end-date of the project or date when the team aims to have achieved the aim

An example of a SMART aim is:

Achieve appropriate prophylaxis (against hospital guidelines) for a median of at least 90% of medical patients by 14 hours after the decision to admit, by end September 2019

Step Three: How will we know that a change is an improvement?

3.a. Defining appropriate thromboprophylaxis

The hospital VTE protocol must be defined in order to measure the appropriateness of thromboprophylaxis. If a protocol is in place in the hospital, appropriateness is measured against this. If there is no defined hospital protocol, the improvement team together with one or more haematologists and other experts, must decide which guidance is being followed and make choices about the detail of the protocol. Measurement can begin once the protocol is agreed for measurement purposes, i.e. the protocol does not need to have been introduced, circulated, staff educated on it etc. The implementation of and education about the protocol can come later, with adjustments made depending on results of testing.

Appendix 1 contains a VTE protocol template which can be referred to in this process. The protocol should include:

VTE risk assessment

There are many VTE risk assessment tools and these are regularly changed and revised in line with the evolving evidence base. Tools differ in their complexity and in the extent to which they

have been clinically validated. As many tools were in use in Irish hospitals before the collaborative, a template was developed referencing risk factors in commonly used tools. Each hospital must decide whether to use one or more specific tools, and whether to use them as is or modify them and may revise the template to meet their needs.

For medical in-patients, the template references a scoring tool, the Padua Prediction Tool, for medical patients. Scoring tools are recommended by the American College of Chest Physicians (ACCP). Padua, Geneva, IMPROVE and other tools are available. The template also references the Department of Health (UK) tool for both surgical and medical patients. This was recommended in older National Institute of Clinical Excellence (NICE) guidance. On updating their guidance in 2018, NICE has recommended the use of a risk assessment tool developed by a professional body in the UK, published in peer reviewed journals, and state the Department of Health tool is the most widely used tool.

For surgical in-patients, the Department of Health (UK) tool is referenced in the template. Risk scoring tools, particularly Caprini, are recommended by ACCP. Caprini is a clinically validated tool and stratifies risk in surgical patients very effectively. It is more complex than the Department of Health tool and may require a separate protocol for medical and surgical patients if Caprini is to be used, as both are unlikely to fit on one protocol.

For post-partum women, the Irish guideline and the Royal College of Obstetrics and Gynaecology guideline, as well as local adaptations are in use in Irish hospitals.

For women who are pregnant and admitted to hospital, the Irish guideline may be used. The Department of Health (UK) guidance includes pregnancy or up to 6 weeks post-partum as a risk factor, with women otherwise assessed as medical patients. Significantly, Padua does not include pregnancy

In orthopaedics, VTE risk assessment may not be formalised as most or all patients are considered at risk. Where a tool is used, the Department of Health (UK) tool or ACCP guidance are in use.

3.b. Measuring appropriate thromboprophylaxis

Once the hospital VTE protocol is agreed for measurement purposes, measurement can begin. If the protocol is subsequently modified, measurement can be against the updated protocol, noting when the change occurred.

Measurement for improvement is different from types of measurement that healthcare professionals and managers are more familiar with, measurement for research and measurement for accountability²⁹.

	Improvement	Accountability	Research
Aim	Improving care	Comparison, regulation	New knowledge
Observability	Observable	No test	Blinded or controlled
Bias	Consistent	Adjust to reduce	Design to eliminate
Sample size	Just enough, small sequential	100% of relevant data	Just in case data
Hypothesis	Flexible, changes	None	Fixed
Testing	Sequential	None	One large test
Is change improvement?	Run or control charts	None	Statistical tests against hypothesis

[Solberg table]

With measurement for improvement, small random samples of patients from the chosen patient group are identified and appropriate prophylaxis measured at the time point agreed in the aim. Small samples mean that a degree of natural variation is expected and no judgement is made on any one or few points. Instead, measurements are plotted as a time series, as run charts or statistical process control (SPC) charts, known also as control charts. Interpretation of the charts is based on a series of rules which determine whether variation is due to common or special causes, i.e. whether the process is in control or not. Interpreting measurement is described further below.

The step-by-step guide to measurement is described below:

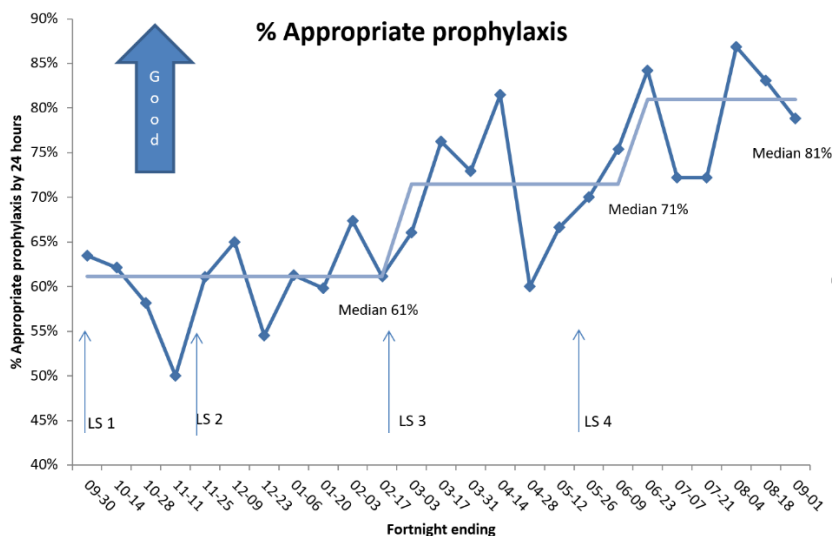
1. Select a random sample of 10 patients per fortnight from the census of the patient group(s).
2. Follow the hospital VTE protocol to determine the patient's VTE risk, bleeding risk, appropriate choice and dose of prophylaxis depending on their patient group, weight, renal function and contra-indications to pharmacological or mechanical prophylaxis. Conclude what the appropriate prophylaxis for that patient should be.

²⁹ Solberg LI, Mosser G, McDonald S. The three faces of performance measurement: improvement, accountability and research. *Jt Comm J Qual Improvement*. 1997 Mar;23 (3):135-47

3. Examine the patient's prophylaxis prescription and administration record to determine what, if any, pharmacological prophylaxis was prescribed and given within the time after the decision to admit that you have picked (e.g. 14 or 24 hours). Ask the patient if they have mechanical compression in place and examine if it is the right size etc.
4. Conclude whether the pharmacological and mechanical prophylaxis are appropriate (as indicated in the hospital guideline). If not appropriate, record the category/ies of inappropriateness (e.g. indicated but not in place; inappropriate dose for patient weight).
5. Enter data onto data collection form, spreadsheet or electronic tool. The collaborative data collection form and spreadsheet are hyperlinked on www.safermeds.ie
6. If using the system developed by the collaborative, load the spreadsheet periodically to Sharefile® and review using QlikView®. Contact safermeds@hse.ie to receive further information and to obtain a QlikView® licence if you wish to use this system.

3.c. Plotting and interpreting measurement

A run chart is a type of time series line chart used to track measurements over time. For more information on run charts and their interpretation, see Perla et al³⁰.



Step Four: What changes can we make that will result in improvement?

A key element of the success of the Model for Improvement is that ideas for change are collected, from reviewing previous work locally and nationally (including learning described in this report), the

³⁰ Perla RJ, Provost LP, Murray SK. The run chart: a simple analytical tool for learning from variation in healthcare processes. *BMJ Quality & Safety* 2011;20:46-51 <http://qualitysafety.bmj.com/content/20/1/46>

literature and engaging with staff and patients involved in the processes and with experts. These are ideas that are thought likely to help achieve the aim. These ideas are then prioritised for testing.

Step Five: Plan-Do-Study-Act Testing

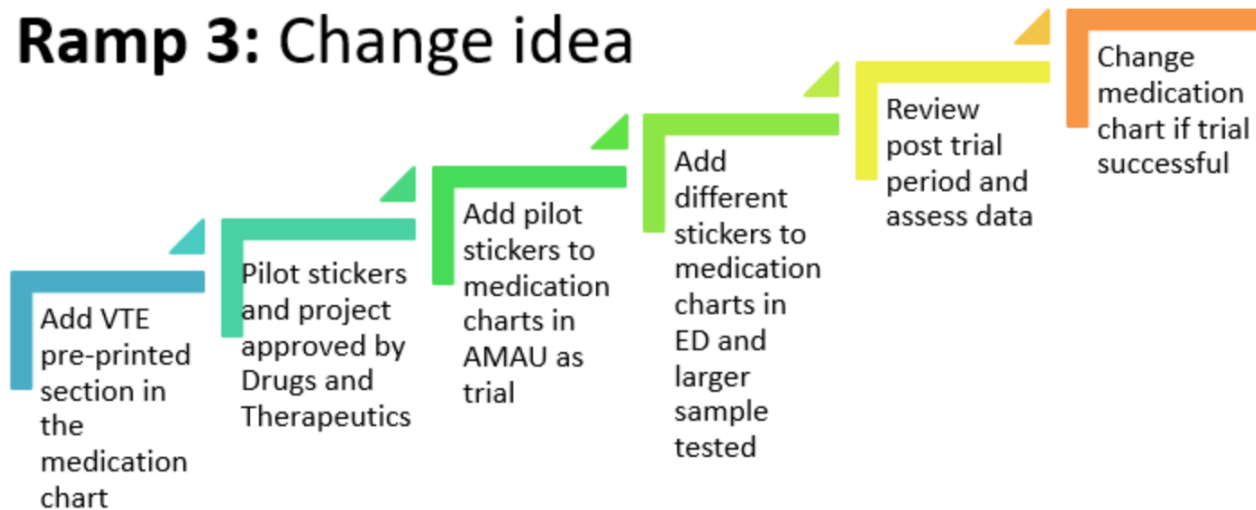
PDSA testing examines whether the prediction that a particular idea for change will lead to improvement is borne out in the context in which it needs to work. The first tests of any idea are very small, with some learning from each test. Successful or promising tests are tested in different circumstances and/or scaled up for further testing. Where multiple tests are carried out on one idea, this is known as a PDSA ramp.

A sample PDSA form is included at the end of this section.

The initial PDSAs should be small enough to be carried out in a short time period, often less than 30 minutes, and may be tested with one patient, one nurse, one doctor etc. As testing scales up, a tool or method may be tested for a week or longer if needed to obtain information. Measurement and/or feedback should inform whether the tool is effective, what needs to be changed etc.

For example, an idea many hospitals tested was having pre-printed prescriptions for VTE prophylaxis in the drug chart. To implement this, the hospital would need to make big changes including working with printers to redesign and print charts and educate and inform staff, particularly prescribers. To test this, many sites created a sticker using pharmacy labels, showed it to doctors, pharmacists and nurses, got feedback and made changes. In further tests, the revised stickers were applied to a small number of charts to see if they were filled in correctly and to get further feedback. Successful tests were piloted on a wider scale. If the tests were still successful, the changes were incorporated into the redesign of the drug chart and implemented, along with education and information for staff. The PDSA ramp below illustrates a series of PDSA tests carried out by one hospital team to develop and test pre-printed prescription stickers.

Ramp 3: Change idea



Step Six: Implementation Plan-Do-Study-Act Cycles

When testing has established that a particular change should be implemented and how that should best be done, the PDSA approach should be continued. This means that the team plan implementation, predict what will happen, look for information and feedback to see whether the implementation is going according to plan or what adjustments need to be made, study this information and act on it. In this way, implementation is a stepwise process too and any unforeseen consequences are picked up early in the process, making room for adjustments.

Step Seven: Control Phase

If the project has achieved its goal, or if this phase of improvement has completed, measurement should continue to monitor whether improvement is sustained and to facilitate early action should this be required. As measuring the % of patients with appropriate prophylaxis can be time-consuming, the frequency of measurements may drop, e.g. to 10 patients every month or every quarter. Reporting to the governance committee should also continue.

The team or a different team may now commence a new project with a further patient group, or focus on a new aspect of preventing harm from VTE, e.g. ensuring patients are informed about the risk by working on the logistics and staff engagement/education aspects of ensuring they get the patient alert cards (appendix 3).

Appendix 5: Advisory Group membership

Dr Philip Crowley, National Director, HSE Quality Improvement Division (Chair)

Ciara Kirke, Clinical Lead, National Medication Safety Improvement Programme, HSE Quality Improvement Division (project lead)

Maeve Raeside, General Manager, HSE Quality Improvement Division

Dr David Vaughan, Director of Quality and Patient Safety, Children's Hospital Group

Olivia Sinclair, Nurse Consultant

Catriona O'Leary, Anticoagulation Clinical Nurse Specialist, Cork University Hospital

Dr Susan O'Shea, Consultant Haematologist, Cork University Hospital

Dr Jeremy Sargent, Consultant Haematologist, Our Lady of Lourdes Hospital, Drogheda, and Beaumont Hospital

Professor Sean Tierney, Consultant Vascular Surgeon, Tallaght University Hospital

Professor Sean Gaine, Consultant Respiratory Physician, Mater Misericordiae University Hospital

Dr Brian Cleary, Chief Pharmacist, Rotunda Hospital

Oran Quinn, Chief Pharmacist, Our Lady's Hospital, Navan

Melissa Redmond, Chair, Patients for Patient Safety Ireland

Olive O'Connor, Patient representative

Dr John Fitzsimons, Clinical Director, HSE Quality Improvement Division and Consultant Paediatrician, Our Lady of Lourdes Hospital, Drogheda

Appendix 6: Participating hospitals

Beaumont Hospital, Dublin
Cappagh National Orthopaedic Hospital
The Coombe Women and Infants University Hospital, Dublin
Cork University Hospital
Letterkenny University Hospital
Mallow General Hospital
Mater Misericordiae University Hospital, Dublin
Mayo University Hospital
Mercy University Hospital
Midlands Regional Hospital, Mullingar
Midlands Regional Hospital, Portlaoise
Midlands Regional Hospital, Tullamore
Naas General Hospital
National Rehabilitation Hospital
National Maternity Hospital Dublin, Holles Street
Our Lady of Lourdes Hospital, Drogheda
Roscommon University Hospital
Rotunda Hospital, Dublin
South Infirmary Victoria University Hospital
South Tipperary General Hospital
St Colmcille's Hospital, Loughlinstown
St James's Hospital, Dublin
St John's Hospital, Limerick
St Luke's General Hospital, Kilkenny
St Vincent's University Hospital, Dublin
Tallaght University Hospital
Wexford General Hospital

Appendix 7: Acknowledgements

We would like to acknowledge the contributions of the many individuals who gave generously of their time, energy and enthusiasm to achieve success in the collaborative and to continue to drive towards further improvement to reduce the incidence of hospital-acquired VTE. In particular, we would like to thank:

- The participants from each of the hospitals listed in Appendix 6, who dedicated themselves to this project with energy and enthusiasm.
- The HSE Quality Improvement Division team who participated in all aspects of coordinating the collaborative and learning sessions, including Ciara Kirke, Philip Crowley, Maeve Raeside, Alison Cronin, Deirdre Coyne and Lorraine Gilligan.
- Contributors to and faculty for our learning sessions, including David Vaughan, Olivia Sinclair, Maeve Raeside, Philip Crowley, Melissa Redmond, Johnny McHugh, Brian Cleary, Teresa Donnelly, Oran Quinn, Audrey Purcell, Paull Rafferty, John Fitzsimons, Mary Browne and Ciara Kirke.
- Eoin Darcy, Jennifer Veale and Malcolm Cooke from the HSE Office of the Chief Information Officer, for their work to ensure measurement could be supported and analysed.
- Gemma Moore and Emma Hogan, HSE Quality Improvement Division for advice on constructing and analysing surveys and for statistical advice.
- The collaborative Advisory Group (Appendix 5) and those who reviewed drafts of this report.

Appendix 8: Glossary

Venous thromboembolism, VTE: Blood clots

Deep venous thrombosis, DVT: Blood clot in the deep veins, usually of the legs

Pulmonary embolism, PE: Blood clot in the blood vessels of the lungs

Thromboprophylaxis, VTE prophylaxis, VTE prevention: Use of pharmacological and/or mechanical thromboprophylaxis to reduce a patient's risk of developing VTE.

Pharmacological (thrombo)prophylaxis: Use of an anticoagulant (blood thinner) injection, infusion or tablet to reduce a patient's risk of developing VTE.

Mechanical (thrombo)prophylaxis, mechanical compression: Compression stockings and/or intermittent pneumatic compression devices which may be used to reduce the risk of VTE.

VTE prevention protocol, VTE protocol: Standardised VTE risk assessment, bleeding risk assessment and clinical decision support on VTE prophylaxis choice and dose based on the patient's risk, contra-indications, weight and renal function.

VTE risk assessment: A systematic process of considering a patient's risk of developing a VTE during or after hospitalisation. This is usually achieved with reference to a risk assessment tool, which may be a risk scoring tool (e.g. Padua, Caprini, IMPROVE), a risk identification tool (e.g. Department of Health UK, ACCP guidance for orthopaedic patients), or a modification of one or more tools (e.g. VTE prevention protocol template in Appendix 1, which combines Padua scoring for medical patient, Department of Health UK risk assessment for surgical patients and additional items for consideration).

Appropriate thromboprophylaxis: The choice of pharmacological and or mechanical prophylaxis agent (one, both or neither) and dose which is appropriate (correct) for that patient's VTE risk, bleeding risk, contra-indications, weight and renal function, according to the hospital's VTE prevention protocol.

