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Improving the Coordination of Care for Periprocedural Antithrombotic Medication Management in Patients Undergoing Elective Surgery

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Abstract

Background. The complexity of preoperative antithrombotic medication (ATM) management is a frequently encountered clinical challenge. For patients prescribed ATM, pre-admission clinic providers have limited time between the visit and the surgical date to coordinate ATM management and communicate the plan to the patient. This may result in an increased risk of perioperative adverse events, case delays and cancellations, and is a patient safety concern.

Available Knowledge. A review of the literature evaluated best practices for capturing patients taking ATM. A clinical decision support system (CDSS) alert emerged as strategy to improve the care coordination pathway for periprocedural ATM management.

Methods: The overarching objective of this project was to plan, design, and implement an intervention to improve ATM periprocedural care coordination. The intervention was a computer application for auto-identification and flagging of ATM to deploy a CDSS alert for referral to an online workflow organization tool (list manager) to manage the coordination of care for periprocedural ATM. Phase I involved the design and development of the intervention. Phase II was a pilot of the intervention in two clinical sites to test the alert generated list manager process.

Results. Qualitative and quantitative evidence demonstrated variation across surgical services in coordinating periprocedural ATM management. This data supported project approval by senior leadership. A project charter was created and requisitions for programming the intervention applications were submitted to information technology services. Implementation planning continues for piloting the intervention in two clinical areas where bleeding is of critical concern.

Conclusion. The project proved to be complex in both scope and design. The request for programming the CDSS alert was denied due to potentially unreliable medication reconciliation data in the electronic medical record. This required the project team to pivot to an alternative solution. A major limitation in implementation was the institution's response to two COVID pandemic surges. This extended the project timeline by several months.

Recommendations: ATMs continue to be identified as high-risk for adverse drug events. There is a gap in the literature to describe a best practice for managing the coordination of these medications in the perioperative setting. This quality improvement project demonstrates the need for further quality improvement initiatives and research on improving the coordination of periprocedural ATM management. Engaging patients to be involved in this care pathway is vital and can reduce the risk of perioperative adverse drug events.

Improving the Coordination of Care for Periprocedural Antithrombotic Medication Management in Patients Undergoing Elective Surgery

Introduction

Description of the Problem

The complexity of preoperative antithrombotic medication (ATM) management is a frequently encountered and well-documented clinical challenge (Barnes & Mouland, 2018; Filipescu et al., 2020; Flaker et al., 2016; Spencer et al., 2019). ATMs represent a class of medications which include: antiplatelet agents; vitamin K agonists; direct oral anticoagulants; and low molecular weight heparin. ATMs are widely prescribed in medical practice. They exert their mechanism of action upon clot formation primarily by direct inhibition of platelet activation or by targeting enzymatic events that occur along the clotting cascade to prevent thrombus formation (Becker, 2013; Eikelboom et al., 2012; Lowe, n.d.). Venous thromboembolism, mechanical heart valves, atrial arrythmias, and cardiac or cerebrovascular disease are common diagnoses for which antithrombotic medications are prescribed (*National Patient Safety Goal for Anticoagulant Therapy. (2018). The Joint Commission.*, n.d.). As a class of medications ATMs are frequently implicated in adverse drug events. For many surgical procedures, it is necessary to temporarily interrupt therapy to mitigate the risk of increased surgical bleeding.

Balancing interruption of therapy to minimize intraoperative blood loss, with risk of thrombotic events is a common clinical challenge for clinicians who perform preoperative screening. Frequently, ATMs are not managed in accordance with expert recommended guidelines although there is an abundance of clinical trial evidence to formulate best-practices for perioperative ATM management (Childers et al., 2018; Doherty et al., 2017; Moesker et al.,

2019; Niehoff et al., 2016; J. Shaw et al., 2017; J. R. Shaw et al., 2020). Poorly coordinated ATM care can lead to increased surgical morbidity and mortality, as well as extending hospital length of stay. Particularly important for patients undergoing neuraxial anesthesia is the risk of spinal hematoma which can have devastating consequences (Doherty et al., 2017; Horlocker et al., 2003; Jajosky et al., 2019). Cancellations and case delays on the day of surgery due to mismanaged ATM represent a significant cost for the organization. Another factor to be considered is patient distress relative to disruptions in arrangements undertaken in preparation for surgery (Barnes et al., 2020).

Consensus on an optimal approach to this clinical challenge remains a complex problem as ATM interruption decisions are often volleyed between the original prescriber, the primary care clinician, and the surgeon. The resulting lack of communication between clinician and patient regarding clear preoperative ATM instruction is a patient safety issue for all the aforementioned reasons, and a source of patient dissatisfaction (Barnes et al., 2020).

Local problem

At the project site hospital, a large tertiary academic medical center, patients present to the pre-admission testing clinic (PAT) for pre-operative evaluation on average 4-7 days prior to their scheduled surgical procedure. The majority of patients seen in pre-admission testing are classified as ASA (American Society of Anesthesiologists) III or IV, meaning they have severe systemic disease, substantive functional limitations, and one or more medically managed co-morbidities (*ASA Physical Status Classification System*, n.d.). Preoperative screening is required to determine fitness to undergo and optimization prior to surgery. Because many patients may be prescribed ATMs, the pre-admission screening appointment is the final opportunity to address clinical decisions regarding the perioperative management of ATM therapy.

It has been estimated that approximately a third of all patients on ATM presenting to PAT do not have a plan in place prior to their scheduled appointment (PAT staff, personal communication, April 2021). Timely management is critical because many of these medications need to be held several days in advance of surgery or bridging therapy with low molecular weight heparin needs to be arranged. When patients are scheduled for a pre-admission testing appointment less than a week in advance of surgery, there is insufficient time for providers tasked with addressing ATM management to develop a preoperative plan. Consultation with surgeons and prescribers, communication to the patient and/or family, and documenting the plan is impacted by this time-sensitive undertaking.

Over the past two years, the COVID pandemic has impacted the scheduling process for the PAT clinic. Patients are now seen 2-3 days prior to the surgical day to allow for preoperative COVID testing. Due to the lack of time for providers to complete the work required for ATM periprocedural management, this abbreviated timeframe presents a significant challenge. Ensuring ATMs are appropriately managed requires coordination of care among multiple providers and administrators across many medical specialties. These specialties typically include primary care, cardiology, surgery, and anesthesia providers. Where care is delivered can present additional challenges. It is not unusual for care to be fragmented across different out-of-network healthcare systems, each with unique medical record systems. This can significantly impact access to patient care information.

Coordinating care with multiple providers across multiple settings, many of whom may not be aware the patient is undergoing surgery, is a time intensive endeavor for pre-admission testing clinic providers and may result in case delay or cancellation. To address this problem, a workflow process was instituted for pre-admission nurse practitioners to manage ATMs

according to institutional guidelines via an electronic health record referral made during the scheduling process. However, this has proved insufficient for a variety of reasons. Most importantly, capture of all pre-operative patients on ATMs cannot be achieved if the patient is not identified as taking an ATM when the diagnosis of surgical need is made with the surgeon.

Ideally, ATMs should be identified during the medication reconciliation process at the initial encounter with the surgical provider. Consideration of a process to improve medication reconciliation rates has been addressed by hospital administration and is beyond the scope of this project. However, perioperative administration has targeted ATM mismanagement as an area for quality improvement. The overarching aim of the proposed project is to plan, develop, and implement an intervention to improve the care coordination workflow for periprocedural management of ATM in patients undergoing elective surgery at one large, tertiary care hospital.

Available Knowledge

A Preferred Reporting Items for Systemic Reviews and Meta-Analyses (PRISMA) guided review of the literature using the databases MEDLINE, CINAHL, OVID, and PubMed was undertaken to identify relevant research studies and evidence which address strategies for identification of ATM for the purpose of improving periprocedural coordination of ATM management. Keywords used were: medication reconciliation AND anticoagulation; medication safety; preoperative medication reconciliation; clinical decision support, and, perioperative anticoagulation management. Studies were included if they were in English, dated from 2005, and evaluated a best practice method for medication reconciliation, as well as a method for ATM preprocedure care management. The search was expanded after initial review of the literature to include quality improvement project evidence.

A total of 110 studies were considered and using PRISMA criteria 14 studies encompassing 8,746 adults were deemed eligible for inclusion in the systematic review. Of those, 7 were quality improvement projects. Three studies were randomized controlled trials (cluster, double-blind, 2-armed). The remainder were: a retrospective cohort design; a prospective comparison design; a quasi-experimental; and a mixed method study. Settings included a gastroenterology procedure unit (*n*=1), outpatient clinics (*n*=2), pre-operative screening clinics (*n*=3), emergency departments (*n*=2), and acute care hospital settings (*n*=6). Studies were conducted in the U.S., Australia, England, the Netherlands, Belgium, Canada, and Columbia. Mean age of participants was 64.5 and ranged from 53-74. Of the studies which reported gender data, fewer participants were males (*n*=2750, 31.46%). Strategies to improve perioperative ATM management included methods of medication reconciliation (n=7): use of pharmacists and/or pharmacy technicians (*n*=4); multidisciplinary team medication reconciliation (*n*= 2); and patient handheld lists for recall aid (*n*=1). Additional evidence included electronic health record best practice alerts for ATM use (*n*= 2) and clinical decision support systems (*n*=5). Studies, including non-research evidence were evaluated for strength and quality using the Johns Hopkins Nursing evidence-based practice research appraisal tool (Newhouse et al., 2007). Refer to the table in Appendix A for a synthesis of the most relevant literature organized by intervention.

The systematic review recognized viable strategies for identification of ATM. However, for the purpose of preoperative ATM management, utilizing an electronic health record (EHR) generated clinical decision support system (CDSS) alert was felt to be the most useful method. CDSS are computer applications embedded within the EHR that enhance medical decision making with targeted clinical knowledge and patient information. CDSS may provide prompts to

assist in implementing evidence-based care or reminders for specific patient care tasks (CDC, 2021; Sutton et al., 2020). ATMs are considered a high alert medication by many quality improvement agencies. Using the EHR to generate an alert to improve the coordination of care for patients on ATM should prompt a safe and seamless transition to the operating room (*National Patient Safety Goal for Anticoagulant Therapy. (2018). The Joint Commission.*, n.d.).

The literature provides compelling evidence to endorse the use of CDSS such as a best practice alert to assist clinical decision making (Barnes et al., 2020; Ibáñez-Garcia et al., 2019; Niehoff et al., 2016; Tamblyn et al., 2017). A best practice alert is a CDSS tool in the EHR which directs clinicians' attention to address a particular clinical task. Barnes et al (2020) demonstrated the use of CDSS to assist in the management of ATMs in a gastroenterology outpatient clinic. A best practice alert was designed and implemented at the time of scheduling to offer colonoscopy providers the choice of an option for referral to an anticoagulation management clinic or for self-management. This was supported by using institutional guidelines. The anticoagulation management clinic staff agreed to take on management of antiplatelet medications, a workflow with which they had not previously been involved. Their results showed the best practice alert improved the number of anticoagulation management referrals and demonstrated increased provider and patient satisfaction. The authors addressed limitations including a single center study and possible unmeasured confounding due to limited data collection. However, the intervention serves as a model for ATM management and could be applied in other settings using homegrown or commercial EHRs. Personal communication with the lead author of this implementation project confirmed the usefulness of CDSS deployed alerts as an appropriate strategy for improved coordination of periprocedural ATM care (G. Barnes M.D., personal communication, March 12, 2021).

Rationale

Conceptual model

The studies included in the systematic review were limited in terms of identifying theoretical frameworks. The majority were quality improvement studies or projects which followed the PDSA (plan, do, study, act) cycle as described in the *Model for Improvement* (Langley, G, Moen, R., Nolan, K., Clifford, N., & Provost, L., n.d.). Therefore, the literature was explored to identify a theoretical framework to best guide the project. The *Chronic Care Model* was selected as it provides a conceptual framework that encourages high quality chronic disease care by incorporating the essential elements of community, the health system, self-management, delivery system design, and clinical information systems (*The Chronic Care Model: Improving Chronic Illness Care*, n.d.).

The *Chronic Care Model* offers a foundational framework for organizing and providing care for older patients undergoing elective surgery with moderate to severe chronic diseases that may or may not be well controlled. The care of this patient population is often fragmented and involves several medical specialists. The *Chronic Care Model* elements of decision support, clinical information systems and integration of specialist expertise are the more relevant elements that guided improvement of preoperative ATM management (Appendix B, Figure B1.). The model also recognizes the patient's central role in managing their health. Patients undergoing elective surgery are queried on the indication and dosing of ATM, and for prescriber information. Self-managing ATM therapy interruption requires an active engaged patient who is relied upon to comply with preprocedure medication instructions (Turner, 2018).

Change theory

In accordance with concepts described by various healthcare quality improvement organizations, implementing change should be strategically guided by a theory that frames the change process (*Science of Improvement*, n.d.-b). *Kurt Lewin's Theory of Change* was selected for its simplicity and practicality in guiding the change process (Manchester et al., 2014). The underlying concepts in Lewin's change theory determine how and why change is needed and are described as force field analysis. Driving and restraining forces work to produce a state of equilibrium within an organization. Change is guided by three stages: Unfreezing, Moving or Transition, and Refreezing (Appendix B, Figure B2.). Briefly, Unfreezing, is characterized by creating awareness that a change is needed, communicating the logic and benefit of making the change, and engaging the staff in committing to the value added of the change. This necessitates involvement of key stakeholders including the end-users of the change as well as a variety of senior leadership whose support is necessary for successful implementation. The next stage involves implementing the change and providing continued education and communication surrounding the change. This stage is described as Transitioning or Moving and is "difficult because it has uncertainty and fear associated with change" (Shirey, 2013, p. 70). Leadership's continued active role in the change is crucial at this stage to support stakeholders and keep them engaged during the implementation process. Lastly, there is Refreezing whereby the change becomes the new norm and sustainability is reinforced to prevent reverting back to prior practices (Hussain et al., 2018; Shirey, 2013).

Specific Aims

The overall purpose of this improvement project was to improve the quality and safety of periprocedural ATM by optimizing care coordination for patients taking ATMs undergoing

elective surgery. The overarching aim was to design, develop, implement, and evaluate an intervention to improve the care coordination pathway for periprocedural management of ATM.

Phase 1 Specific Aims

- Identify and recruit members of a multidisciplinary team to collaborate on project aims and present the concept to perioperative administration for approval.
- Identify and engage key clinical stakeholders for in-depth analysis of current state of care delivery to gauge variation in practice.
- Deliver request to project site information technology service for design and development of computer applications for standardizing the coordination of ATM periprocedural management.

Phase 2 Specific Aims

- Recruit and work collaboratively with a high-volume surgical service to pilot the project.
- Collaborate with project site information technology service on computer application functionality and refinements.
- Satisfaction with the application process for management of periprocedural ATM is reported by 80% of pilot surgical service site staff.
- Improve rates of case cancellations and change in anesthetic plan pre and post implementation.
- Discrepancy between ATM identified on the surgical booking form and patient report on the day of surgery will be reduced post-implementation.

Methods

Context

The project site is a large urban tertiary academic medical center located in Boston, Massachusetts and is part of a newly formed multi-facility healthcare system in eastern Massachusetts. It is a large macrosystem of teaching, specialty, and community hospitals as well as physician groups and specialty practices. It is one of the state's largest employers. There are an estimated 26,000 elective surgeries performed annually by several different surgical services within the larger multi-facility network. At the project site hospital, the anesthesia department, a microsystem within the larger mesosystem of perioperative services, oversees the PAT clinic. All patients undergoing surgery receive some variation of preoperative evaluation (Table 1). In-person evaluations are performed in the PAT clinic and are reserved for the patients with the highest acuity who require determination for fitness to undergo surgery and anesthesia. Additionally, patients undergoing high risk surgeries require a PAT clinic visit. Approximately 30-35% of all patients undergoing elective surgery are seen in the PAT clinic.

As a small microsystem of the anesthesia department, the PAT clinic consists of a team of eight clinicians (one rotating anesthesia attending and seven nurse practitioners), two medical assistants, six administrative staff, a nurse case manager, the clinical manager, six telephonic screening nurses, and the medical director. Patients are scheduled for a PAT appointment when a surgery is booked via a central scheduling process.

Table 1.
PAT Visit Criteria

Telephonic	No PAT visit, low risk patient and low risk surgery; Patient will receive telephonic interview.
Waive	No PAT visit but patient is high risk with recent hospitalization or has a geographic hardship to come to the clinic. Record review by anesthesiologist for potential surgical risk. May be scheduled for clinic visit after this review.
PAT Clinic	Reserved for high-risk patients or patients having high risk procedure

The pathway of elective surgery necessitates the patient interact within the various layers of the medical center system as depicted in the clinical microsystems mapping tool

in Appendix C. Key players include members of the PAT provider group, surgical services, and the perioperative team members on the day of surgery. Central to this clinical microsystem is the patient who is prescribed ATM and presenting for elective surgery.

As mentioned previously, ATMs (Table 2) present a difficult and historically complex clinical issue relative to periprocedural management. It is often the case that a patient will need to hold any of these medications several days in advance of their scheduled procedure. Lack of an appropriate strategy to address the shared responsibility of management and coordination of care lies at the root of the problem. Many iterations of solutions have been proposed and trialed in the past but have been unsuccessful.

A cause-and-effect exercise (Appendix D) was undertaken to better understand the factors associated with inadequate coordination of perioperative antithrombotic management. Myriad causes were identified however, five significant areas were highlighted. Among these, communication and information systems were causes especially germane to the problem of mismanagement of ATM care coordination and were pertinent areas targeted for improvement by the intervention. Further barriers to this preprocedure care coordination pathway were: patient knowledge deficit; ownership of the ATM management process by providers with respect to whom should make the decision for holding or continuing the ATM; and scheduling of cases

Table 2.
Common Antithrombotic Medications

Anticoagulant	Antiplatelet
Apixaban	Aspirin
Fondaparinux	Clopidogrel
Enoxaparin	Cilostozal
Dabigatran	Dipyridamole
Dalteparin	NSAIDs (ibuprofen, naproxen, meloxicam)
Rivaroxaban	Prasugrel
Warfarin	Ticlopidine

several months out. ATM periprocedural management requires a shared decision-making process among clinicians involved in the patient's pre-surgical care and prescribing providers responsible for routine management of the patient's ATM, as well the patient. This step necessitates identifying the prescribing provider to facilitate discussion of the best method of management and communicating the plan to the patient. The indication for ATM prescription and risk of the surgical procedure are elements included in expert guidelines to be considered in formulating and finalizing a plan.

The driving and restraining forces which could impact the success of the project were identified and analyzed (Appendix E). Chief among these driving forces is patient safety which encompasses identification and management of ATM, documentation, and communication to all stakeholders of the periprocedural ATM plan. The hospital, its accreditors, and patients place a high premium on safe, high-quality care. Another important driving force is institutional cost concern relative to case delays, especially as it necessitates a change in the anesthetic plan, and cancellations due to poorly managed periprocedural ATM care. Impediments to implementation include limitations of the health information management system in our institution: siloed systems that do not have interoperability; a lengthy application process for requesting an IT change; and possible inability to program the CDSS alert application. Finally, considering the integration of a CDSS alert on the surgical booking form, alert fatigue is a concern especially relevant as clinicians are subject to numerous alerts during the clinical day. An additional interruptive alert integrated into clinical workflow may result in reluctance to recognize the beneficial outcomes of a proposed alert-generated workflow organization tool. Surgeons may be disinclined to embrace this strategy if it entails addressing another alert and clinic staff may find addressing an additional online form tedious and interruptive to clinical workflows. Although

restraining forces are considerable, they are not regarded as insurmountable and the potential driving forces are strong.

Intervention

The project intervention consisted of the design, development, implementation, and evaluation of a CDSS alert which provides a mechanism to reduce variation in practice and standardize periprocedural ATM care coordination across all surgical service lines. The function of the alert is to identify patients prescribed ATM and prompt referral to the institution's online workflow organizational tool termed a list manager which is described below.

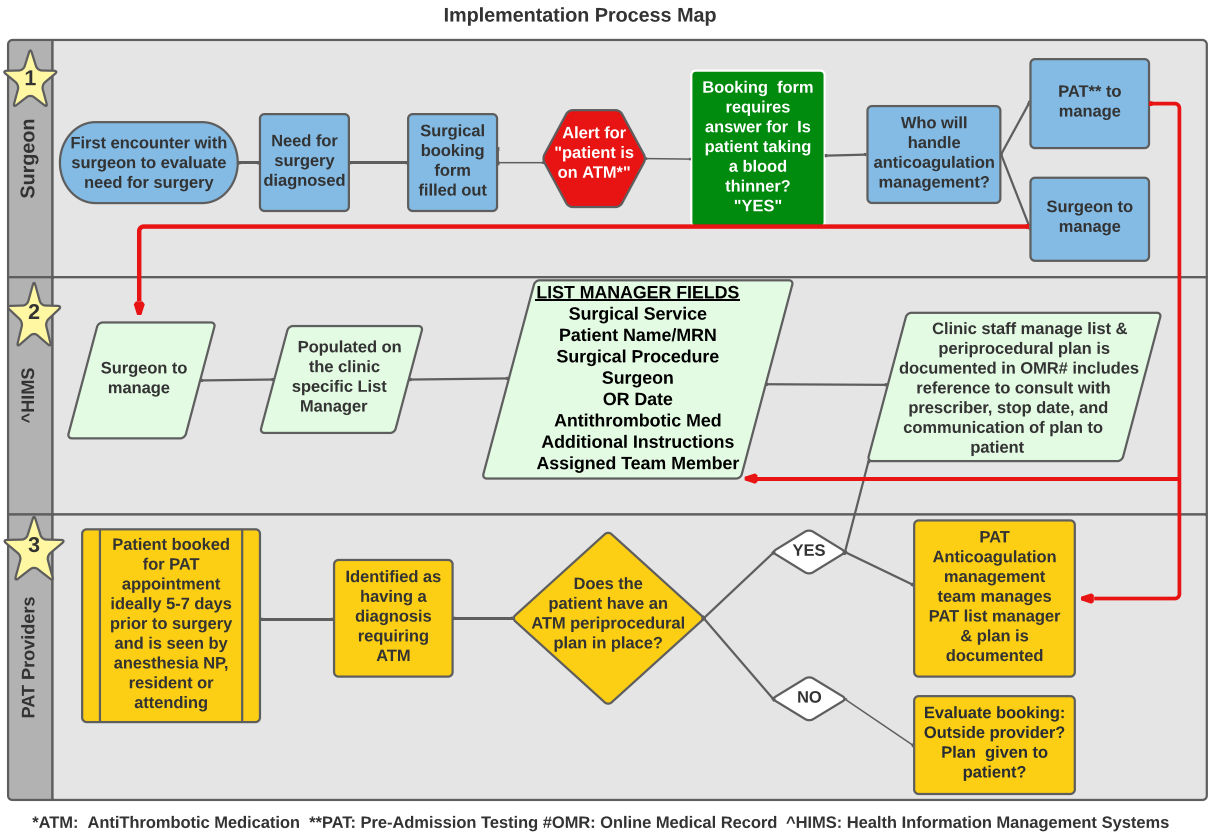
The computer alert application is dual functioning. Its primary function is identification and flagging of the most commonly prescribed ATMs (Table 2). This process continually monitors the EHR for ATM during all documentation activity. The second function involves a triggered CDSS alert to prompt recognition that the patient is prescribed an ATM. This occurs when a procedure is scheduled in the online surgical booking form. The alert function is predicated on medication reconciliation being done at the initial encounter with the surgeon when the patient's medications are reviewed and entered in the EHR. Based on this assumption, the application would automatically identify and flag the ATM and trigger the alert to deploy at the appropriate time.

The list manager is an existing institutional application for workflow organization modeled on a spreadsheet design and used to help manage specific clinical workflows. It is easily accessed via the institution's intranet (Appendix F). It is not a clinical documentation system and all documentation related to the clinical care of the patient is required to be recorded in the EHR. A list manager can be developed to the specifications of a user's request. A version of an

anticoagulation list manager is currently utilized in two clinical areas at the project site and served as an exemplar for the design of the intervention.

The pathway of the intervention is as follows. A surgical procedure is scheduled in the patient's EHR using an online booking form when the diagnosis for surgical need is made. Embedded in the form is a field to address ATM by asking the user if the patient is taking a blood thinner. The user must then answer yes or no, with answering in the affirmative initiating the pathway for ATM care coordination. As depicted below in Figure 1, three concurrent processes occur as the ATM care coordination pathway is activated. They are: 1. the surgeon encounter and surgical booking, 2. patient information populating the list manager, and 3. the pre-anesthesia visit.

Figure 1. Project Implementation Process Mapping



When the patient is flagged as having been prescribed an ATM by the system, a CDSS alert to address ATM management triggers on the booking form. The alert is an additional safeguard in the pathway for ATM. It draws the attention of the user to reinforce the requirement to answer the question in the blood thinner field during the booking procedure. The user is then offered an option for management if “yes” is selected: either the attending surgeon will manage, or the PAT anticoagulation management team will manage. Because the patient meets this clinical trigger their name and corresponding demographic and clinical information stream to the list manager tool. Cases booked months in advance will trigger the list manager to populate regardless of confirmation of the actual date.

The functionality of the list manager is designed to be clinic specific, so users are directed to a pre-select screen to choose their surgical service (Appendix G, Figure G1). After selection, the list manager brings the user to a main list screen (Appendix G, Figure G2). The main list screen organizes patients by name, medical record number, surgical procedure, surgeon, surgery date, and ATM medication with instructions. The main list screen also allows the user to self-assign. After selecting a patient, the user is brought to the details screen (Appendix G, Figure G3). The details screen has several fields which display information with action item and status drop-down menus and fields for free text notations. This allows users to easily follow the ATM management coordination process and maintains communication between staff.

Patients remain active on the list until inactivated by the user once the formulated plan is completed, communicated, and documented in the EHR. Patients referred to PAT would continue to be followed by the PAT anticoagulation management team. Either pathway generates a periprocedural plan within an appropriate time frame such that the transition to surgery is seamless for the patient whose plan is reinforced during their preoperative clinic visit or

telephone interview. Consideration was given to creating a templated EHR note to facilitate the documentation and would include all the requisite elements: reference to consult with the prescriber, stop date, bridge plan if needed, and when the plan was communicated to the patient and/or family.

The patient's PAT appointment is preceded by review of their electronic medical records by PAT clinic providers prior to their arrival. At this juncture, the periprocedural plan is documented either by the surgical service provider or the pre-admission anti-coagulation management nurse practitioner and is available to PAT clinician providers. Patients of external surgical providers with operating privileges at the project hospital who do not use the electronic health record online booking would not be captured by the list manager.

Implementation of the Intervention

Phase I

The intervention was designed to be implemented in two phases. A logic model was created to guide implementation (Appendix H). During the initial phase a collaborative team consisting of representatives from all stakeholder departments was convened. Key members included high level perioperative administration, information technology, representatives from the business innovation group, quality and safety managers, anesthesia, and a surgeon champion. With the support of the vice president of perioperative services, the project was given the go ahead to move forward into the inaugural stage. A business innovation (I^2) project manager was assigned to the project to assist the team leader with the implementation plan. A project charter was developed by the I^2 project manager in collaboration with the team leader. It outlined the objectives, roles and responsibilities, scope, and measures of the project (Appendix I).

The first step was for the project team leader and I² project manager to carry out a current state analysis. Key clinical stakeholder interviews were held with a sample of surgical clinics, the gastroenterology procedural unit, and PAT clinic. Two goals were set. The first was to observe and evaluate current practice to determine where variation in the ATM care coordination pathway existed. The second goal involved analysis of stakeholder interviews and observation data to ascertain best practices in coordinating ATM management. The list manager tool the PAT and gastroenterology clinic anticoagulation management teams utilized was identified as an approach which could be refined for individual surgical clinic use and scaled up across the myriad surgical specialties.

As outlined in the project charter, the project was overseen by a steering committee whose function was to provide oversight and direction. Once the project team agreed on the plan to implement the alert and list manager function, it was brought to the steering committee. Agreement was met on moving forward with a pilot in two surgical services where bleeding was of critical concern and therefore in need of timely, appropriate ATM management. The steering committee chair obtained approval from the surgical division chiefs to pilot the intervention.

The list manager functionality was reviewed and explained in-depth by information technology services (ITS) team members. The project team was able to design a list manager blueprint and visual mockup specific to ATM management as requested by the ITS team (Appendix J). In addition, the CDSS alert function was outlined. The documents were delivered to ITS for review and feasibility. The I² project manager submitted the requisition for consideration of programming the applications.

Phase II

The second phase of the project involved recruitment of two high-volume surgical services where bleeding and ATM management would be of critical concern as pilot sites to test the alert applications in a real time scenario. The project team set target dates to design, develop, and implement the role out of the CDSS alert and list manager tool. The pilot surgical services staff would be onboarded to the functionality of the list manager and utilize it for all surgical patients prescribed ATM presenting for surgical evaluation. The project plan was scheduled to run for 12 weeks with a series of rapid PDSA cycles allowing for measurement and analysis at the conclusion of each cycle and adjustments made prior to successive cycles. The project lead and team members would provide training during the onboarding phase. The staff would be asked to refrain from referrals to PAT during the trial period to acclimate to the functionality of the list manager and integrating its use into the clinical workflows.

This quality improvement project envisioned a proactive care coordination pathway by leveraging the capability of clinical information systems. Aligning with the framework of the *Chronic Care Model* it ensures productive interactions between providers and patients. Early identification of ATM driven by the computer applications, facilitates the shared decision-making process between providers to formulate a plan and to partner with patients for self-management (Lenert et al., 2014). Prompted by the alert, patients' ATM information is uploaded to the list manager in an appropriate time frame thus ensuring treatment decisions are evidence-based (*The Chronic Care Model: Improving Chronic Illness Care*, n.d.).

Evaluation of the Intervention

The project evaluation was guided by the quality improvement framework of the *Model for Improvement* (Langley et al., 2009). This framework guides change agents in evaluating whether a change has resulted in an improvement. The model is characterized by an iterative

learning approach of cyclic trial and error efforts. In this model, PDSA cycles are the mechanism by which quality improvement plans can be trialed, evaluated, revised, and re-cycled until a change is adopted or abandoned (*Science of Improvement*, n.d.-b; USAID ASSIST Project, 2020). Project objectives and measures are listed in Table 3.

Table 3. ***Project Measures***

Aim/Objective	How Operationalized
Obtain approval from senior leadership to convene a multidisciplinary team to collaborate on project aims	Project charter created Scheduled meetings with team members Document review of meeting minutes & notes
Project team will revisit RCA and gather data to support current state analysis	Document review of meeting minutes from clinic observations & stakeholder interviews
Deliver ITS requisitions for design of computer applications: CDSS alert, LMT	Document review of project team/ITS collaboration meeting notes Confirmation of request acceptance by ITS
Recruit high volume surgical service(s) to pilot plan	Track LMT utilization Comparison pre/post implementation of documented vs actual ATM
Pilot site staff satisfied with decision alert for management of ATM	Develop survey to measure domains
LMT: List manager tool; ITS: Information technology service; PAT: Pre-admission testing; EHR: Electronic record health; ATM: antithrombotic medication	

Measures and Analysis

Objective 1: *Obtain approval from senior leadership to convene a multidisciplinary team to collaborate on the project.* The project charter served as evidence that formal approval was given to start the project and a multidisciplinary team was convened to collaborate on the project aims. Qualitative evidence in the form of documented meeting minutes and recorded notes from team huddles served as measures of team collaboration.

Objective 2*: Project team will revisit root cause analysis and gather data to support current state analysis.* Measures to support root cause analysis included structured interviews

and observational data from a sample of five different clinic areas. Document review provided qualitative evidence that was used to construct a current state analysis.

Objective 3: *Requisition for consideration of programming the intervention computer applications submitted to information technology services.* The standard form to request programming was submitted to the ITS department for consideration of approval to program the computer applications.

Objective 4: *Recruit high-volume surgical service(s) to pilot the project plan.* For the second phase of the project two high-volume surgical services were approached to pilot the list manager application in real time. Measurement plans for this objective were to operationalize through EHR data set extraction measuring the number of documented ATM on the surgical booking form relative to the number of patients who report being prescribed ATM on the day of surgery. In addition, the IT service was engaged to survey structured data fields in the EHR system to track list manager user rates. As the pilot gets underway, quantitative analysis from both data streams using measures of frequency and proportion will be applied. Data will be displayed graphically with time series charts and reviewed bi-weekly over a period of 12 weeks. Analysis will consider factors associated with variation after each rapid cycle and adjustments will be made prior to the next iteration in keeping with the theory and framework of improvement science (*Science of Improvement*, n.d.-a). Human factors associated with technology usage, technological malfunctions, and workflow interruption are anticipated to account for variation.

Objective 5: *Pilot site staff are satisfied with the CDSS alert and utilization of the list manager for management of ATM*. Staff satisfaction with the project process for ATM management will be surveyed. Informal weekly email huddles with pilot surgical service staff

will assess attitudes and perceptions as well as apprehensions regarding usage. A post implementation survey will be administered. An online Qualtrics™ survey using a five-point linear rating Likert agree-disagree scale will be developed (*Qualtrics XM - Experience Management Software*, n.d.). This tool will capture staff feedback and perceptions related to the intervention's feasibility, ease of use, value added, workflow interruption, and sustainability (*Likert Scale,* n.d.) (Appendix K). Aggregated frequency and proportion data will be analyzed to gauge clinician perceptions of the intervention and intention to adopt with a goal of greater than 80% staff satisfaction. Qualitative analysis will be applied to assess huddle anecdotal evidence to identify and describe success as well as emerging issues. Survey and huddle data will provide the basis for the project lead and team members to continue support to users during the test period and to reinforce the change aligning with tenets of the refreezing stage of Lewin's model (Kaminski, 2011). Additionally, data analysis will allow team members to determine innovation sustainability with the long-term aim of becoming a standard practice for periprocedural ATM management. The table in Appendix L represents a more comprehensive measurement and analysis strategy.

Ethical Considerations

The project is considered quality improvement with the specific aim of improving the process of delivery of perioperative antithrombotic medication care. The project intervention follows existing and tested practices of utilization of clinical decision support applications for clinical care which are evidence-based. The project has been discussed and approved by the perioperative and anesthesia quality and safety team at the project institution. The team agree this is a quality improvement project which does not meet criteria that needs IRB approval of

research with human subjects. There is no associated funding from federal agencies or research organizations and involves only individuals employed and patients seen at the project site.

The project has also taken into consideration the UMass Boston Clinical Quality Improvement Checklist (Appendix M). It does not answer a research question, follow a research design or protocol, and does not generate new data to contribute to generalizability. The project or innovation proposed is quality improvement and does not meet the definition of human subject's research because it is not designed to generate generalizable findings but rather to provide immediate and continuous improvement feedback in the local setting in which the project is carried out. The University of Massachusetts Boston IRB has determined that quality improvement projects do not need to be reviewed by the IRB.

Results

The project implementation was initiated at an inaugural quality and safety kickoff meeting with representatives from senior perioperative leadership and the institution's business innovation group. The problem was presented, and the intervention was proposed. Approval was given to move forward on the first phase of the implementation plan and a project charter was created.

Phase I Pre-implementation

Phase I of the project implementation plan began with a series of touch-base meetings with key stakeholders in a sample of five different service clinics. The project team outlined a methodology to collect data on current practice in clinics with a definitive system versus those with no clearly defined process (Table 4). Touch-base meetings with representatives primarily responsible for ATM management workflow were set up and observational and interview data

were collected and analyzed. The qualitative data collected from the meetings were analyzed and used to support a current state analysis.

Observation and interview data showed a wide variation in practice with regard to the periprocedural management of ATM (Table 4). The vascular and gastroenterology clinics were deemed to have best practices including the use of a spreadsheet to organize patients and follow management progress.

Gastroenterology utilized the institution's homegrown online workflow organization tool (list manager). This unit had a dedicated team of nurses whose assigned role was to monitor the list daily and follow up on progress in coordinating preprocedure ATM management. The list provided consistency in communication between staff and patients on all coordination aspects of the preprocedure ATM management. During the phone scheduling process patients were asked by an administrative scheduler if they were taking a blood thinner. This information was communicated to clinic nurses who manually populated the main list when a patient was identified as taking a blood thinner. The team handled communication between providers for the ATM management and to the patient for instructions. A templated note was used to document the process and was available within the EHR once the plan was finalized.

The vascular clinic staff had a similar process utilizing an Excel spreadsheet which was manually populated by the nurse navigator. When a decision for surgery was made by the surgical provider and the patient was taking an ATM, this was verbally communicated to the nurse navigator. The nurse entered the requisite ATM information onto the spreadsheet. This document provided consistency in follow up, but the data fields required manual entry throughout the course of the management process. Patients on this list were followed by the

nurse navigator who handled all communications between providers and the patient. When the plan was finalized, the vascular clinic staff also utilized a templated note to document the plan.

Two of the five clinics reviewed did not have a standardized process in place to identify patients prescribed ATM, formulate a plan, and communicate the management plan to all stakeholders. The orthopedic clinic referred most patients to PAT to handle management and communication. Within the neurosurgery clinic, ATM management was handled by the team of nurse practitioners. About half of the population of neurosurgical patients prescribed ATM were referred to PAT and the remainder were handled in an ad hoc manner depending on who saw the patient in clinic when the decision for surgery was made.

Table 4: ***Current State Analysis***

Clinic Touchbase Meetings			
Clinic	**Method**	**Point Person**	**Findings**
PAT	Semi-Structured Interview	Clinician: PAT NP	• PAT ACM team process discussed • Process of how patient is referred to ACM team • Initial design explained: based on list manager by GI ACM team
Vascular Surgery	Observation; Semi-Structured Interview	Vascular RN Navigator	• Uses homegrown spreadsheet to follow patients on ATM • 2 RN navigators share workflow • Verbal communication from provider for ATM management & manually put on list
Orthopedic Surgery	Observation; Semi-Structured Interview	Clinician: Ortho-joint PA	• No structured process for ATM identification or management • Most often referred to PAT
Neurosurgery	Semi-Structured Interview	Clinician: 2 Neurosurgery NPs	• No structured process for ATM identification or management • About half of ATM patients are referred to PAT • NP clinicians arrange management
Gastroenterology	Observation; Semi-Structured Interview	GI ACM team lead: RN	• Dedicated RNs use list manager to follow patients • Use institutional guidelines to communicate instructions to prescribers and patient/family • All team members have access to the list to provide consistency in care

The data from these stakeholder touch-base meetings were used to support a current state analysis of periprocedural ATM management which was presented at subsequent steering

committee meetings. Navigating the many layers of administration within a large organization confounded the project team's ability to move the project intervention forward. The timeline for meeting project goals needed to be revised several times. After much deliberation and numerous meetings with senior leadership, the decision to utilize the functionality of the list manager and the booking form alert was agreed upon.

The project lead and I² project manager commenced work on developing the implementation plan. Interval meetings were set up on a biweekly basis between the team lead and the project manager to touch base on progress and adhere to target dates on the project timeline. To address the clinical information systems aspect of the project plan, meetings were arranged with representatives from ITS to discuss the redesign of the list manager to meet the purpose of the project objectives. These meetings also involved discussion around the CDSS alert design and functionality. Specifications for design of the list manager were described to ITS by the team. As requested by ITS, a mockup of the list manager tool in accordance with the list manager rules of engagement was delivered to ascertain feasibility of programming. The team was cautioned that technology demands due to the pandemic could result in delays in review for triage of all non-COVID related ITS requests. However, requisitions for approval of both computer applications were submitted to ITS to put the request into the queue for consideration of programming the alert and the list manager.

Phase II Pre-Implementation

For the second phase of the project two high-volume surgical services were approached to pilot the list manager application in real time. The project steering committee chair sought approval for the pilot from the division chiefs of the neurosurgery and orthopedic joint replacement surgery. Both services are areas where bleeding is of critical concern and timely,

appropriate ATM management is essential. Additionally, these areas were chosen as pilot sites based on the likelihood that a large percent of these patients are prescribed ATM. The project team connected with senior administrative personnel within each site to introduce the project intervention. The team collaborated on the role out strategy and set target dates for kick-off meetings in each of the pilot site areas. At the time of this writing the pilot is currently in the planning stage however, it is anticipated that pilot site surgical service staff will engage with the intervention and share feedback via interval surveys. Negotiations with surgical service senior leadership continue to be held to move the project forward in Phase II.

Discussion

Summary

The project intervention was developed and proposed in response to the ongoing need to improve the care coordination pathway of periprocedural ATM management. It proved to be complex in both scope and design and required multiple iterations in the planning and implementation process. Prior attempts to address the problem were not successful so it was important to be precise in the design of the project. Careful planning founded on existing evidence guided the conceptualization of the original intervention and project implementation plan. However, the project was unsuccessful in its first iteration to move past phase 1 for several reasons. The original specific aims are shown Appendix N.

Historically, at the project site, quality improvement of periprocedural ATM management was one of five perioperative initiatives targeted as an area for improvement. Previous solutions were unsuccessful in implementation and were suspended for reasons not well articulated. The first phase of this intervention in its original form involved garnering support from perioperative administration to begin work on the project by proposing the intervention at a series of high-level

meetings. The complex hierarchical decision-making structure within the organization proved to be challenging. This confounded the initial intention and caused the proposal process to be lengthy and onerous.

Once approval for the project to move forward was obtained, it was difficult to get consensus among stakeholders and to agree on a plan. There was pushback on several fronts from steering committee members. Because the intervention would affect several clinical areas, various leadership representatives expressed concerns. First, there was concern the project intervention was predicated on medication reconciliation which had the potential to interfere with clinical workflows. Second, there was continued debate on the best method to measure outcomes if and when the intervention transitioned to the implementation phase. Lastly, some members felt the current process worked well for their service and did not see a need to make a change. However, consistent with the unfreezing stage of Lewin's change model, continued support from high-level perioperative leadership was invaluable in moving the project forward from conceptualization to implementation (Manchester et al., 2014). After a period of several months a project charter was created.

Root cause and current state analysis contributed to the search for evidence to identify a best practice. Project team members studied qualitative meeting data and determined an alternative approach such as a list manager would be more conducive to improving ATM care coordination while not entirely abandoning the original intent of a CDSS alert. It was concluded this could be a first step towards standardizing the periprocedural ATM management pathway. Consequently, the development of the list manager took the team in a different direction and extended the timeline to account for the additional work involved. Additionally, target dates on the implementation timeline required several revisions due to long delays between the multiple

meetings required for establishing goals. This was due in part to difficulty arranging mutual meeting times because of conflicts with the schedules of key stakeholders. Furthermore, prompt communication between stakeholders was not always possible due to busy clinical and management obligations.

A CDSS best practice alert embedded in the EHR prompting attention for ATM management to be addressed is a valid method for improvement as described by Barnes et al. (2020). This premise is predicated on medication reconciliation being done at the initial encounter with the surgeon when the patient's medications were reviewed and entered in the EHR. The request to ITS for programming the CDSS alert intervention was denied. According to ITS, EHR medication lists may not be updated to reflect the most recent medication reconciliation and therefore an unreliable method to capture patients prescribed ATM. The project team felt an alert was still a viable part of the intervention but agreed to delay pursuing until data from the list manager implementation could demonstrate the need for the alert to improve identifying patients prescribed ATM to get them on the pathway. Appendix O illustrates the first iteration of the process as originally intended.

Further impediments in the implementation process pertained to the availability of the project manager from the I^2 group. To address projects associated with the institution's response to two COVID-19 surges this individual was pulled off the project several times. In addition, the original project manager left the institution as the project got underway. A new project manager was assigned and needed to be onboarded to the project and updated on progress. These delays set the project timeline back further.

The second phase of the original project intervention was engaging a high-volume surgical service to pilot the plan over a twelve-week period. This plan was not changed in

structure or function as the revised intervention was applicable to the second phase. The project team continues to engage with personnel from the pilot surgical services as described earlier.

Utilization of the list manager leverages a pre-existing application which can be refined to fit the needs of periprocedural ATM management. Workflow organization tools have been shown to improve patient outcomes by supporting coordination, collaboration, and teamwork in clinical settings. Although the literature did not demonstrate a specific organization tool such as a list manager, other tools included online dashboards, database capture systems, and electronic patient registries (Husain et al., 2021; Lee et al., 2017; Steitz et al., 2016; Tang et al., 2018).

With the implementation of the intervention during this second phase, it is anticipated the team will collect data over a 12-week period. The data sets will be used to support scaling the intervention out in a stepwise manner to surgical services across the institution. Change is rife with skepticism and uncertainty relative to implementation which Lewin describes as the transition stage. Ongoing communication and education to the pilot surgical service clinicians strengthens driving forces to support the change (Kaminski, 2011). The team will need to address the concerns of pilot surgical service staff relative to the additive administrative layer the list manager may incur on an already over-burdened staff.

Limitations

There were two important issues which significantly impacted and limited the project's progress. First, the institution's homegrown information system did not allow for easy integration of clinical decision support as the systems are very siloed and have limited interoperability. Encoding for the applications to identify and flag ATM was predicated on up-to-date information which was troubling as three different systems were handling the same medication information. Second, the project was carried out during the COVID-19 pandemic and

the information technology service was inundated with requests that needed to be addressed in real time. As a result, requests for non-pandemic related items during this time were moved to the bottom of the triage list which caused long wait times for a response as to feasibility of programming the applications.

Conclusion

Optimizing the care coordination of perioperative ATM management is an important quality and safety metric for health care organizations that provide procedural and surgical services. Despite this being a critical need there is little consensus on a best practice for this care coordination pathway.

This quality improvement project was conceptualized to address the gap in operationalizing institutional guidelines for periprocedural ATM management in patients undergoing elective surgery. There was not a standardized pathway at the institution for managing this care coordination process which has been shown to be complex and involves multiple stakeholders (Flaker et al., 2016; Kurlander et al., 2018). The literature review demonstrated a gap in describing a best practice pathway and many authors called for additional research to address this gap (Flaker et al., 2016).

ATMs continue to be considered one of the highest-risk medications for adverse drug events and an institutional patient safety concern. Although the original intent for the intervention was predicated on a CDSS best practice alert to initiate the care coordination pathway, the project team was undeterred in the process when the request was denied. The team recognized medication reconciliation is a standard procedure required at all patient encounters and care transitions per institutional policy. Improving this institution-wide process represents a separate process improvement project. However, an unintentional benefit of implementing the

list manager is an improvement in medication reconciliation rates as a consequence. If that can be demonstrated, the team feels confident the CDSS alert function can be revisited.

Recommendations

An abundance of evidence exists which informs the management of perioperative ATM but there is a glaring gap in the literature to describe a best practice for the coordination of this care. There is clear consensus on the need to follow expert guidelines but little to inform the complex process of initiating the pathway to operationalize guideline directed care.

This quality improvement project demonstrates the need for more research and quality improvement initiatives to address this gap in knowledge and practice. As these high-risk medications continue to be a significant quality and safety concern for healthcare institutions and for national accrediting organizations, it would seem a reasonable aspiration (*2022 National Patient Safety Goals: The Joint Commission*, n.d.).

Additionally, the inclusion of patients in the process of coordinating care improves adherence and thus outcomes. According to the Joint Commission (2022) “patient education is a vital component” and “patient involvement can reduce the risk of adverse drug events” associated with periprocedural ATM management. Recognition of the essential role patients play in self-management assures perioperative ATM management is addressed and arranged well in advance of the day of surgery.

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Appendix A

Summary of the Synthesis of Evidence for Strategies to Identify ATM

Intervention	Number of Studies	Quality	Summary of Significant Findings
Clinical decision support (CDSS) tools to enhance medication safety	A. Barnes et al., (2020) B. Jajorsky et al., (2019) C. Rungvivatiarus et al., (2020) D. Tamblyn et al, (2019) E. Neioff et al, (2015) F. Ibanez-Garcia et al., (2019) G. Tamblyn et al., (2018)	III B II B V B II B V B V B V B	Application of a CDSS best practice alert (BPA) for management of antithrombotic medication (ATM) pre-procedure and for ordering ATM post op in patients with epidural catheters (A, B) Results indicate a CDSS generated BPA improves ATM management as compared to usual practice A: Patients pre-GI procedure: n = 2082 Clinicians: n = 144 B: post op patients w/ neuraxial analgesia catheters: n = 85 Use of BPA improves clinician compliance with med rec completion (C, D, E) C: Patients pre/post intervention 6,547/7,482 D: Patients on 4 inpatient units n = 3,491 E: Patient EHR n = 40 Validation that CDSS improve medication safety by integrating community-based med data with hospital data to reduce ADE and improve med rec completion (F, G)
Medication reconciliation done by pharmacist or pharmacy tech	H. Beccerra-Camargo et al., (2013) I. Bemt et al., (2009) J. Guisado-Gil et al., (2020) K. Hale et al., (2013) L. Murphy et al., (2009)	I B II B II B I B III B	Utilization of pharmacists and/or trained pharmacy techs for patient medication reconciliation at care transitions can reduce adverse drug events (ADE) (H, I, J, K) and improve medication safety (L) H: Patients from 3 different ED n = 270 I: Patients in pre-surgical screening clinic: n = 297 J: Pre-op colorectal patients: n = 308 K: Patients presenting to pre-admission clinic: n = 400 L: Randomly selected EHR review: n = 852
Using simple lists of common medication classes as a memory aid	M. DeWinter et al., (2011)	II B	Use of a limited question list of common medication classes as a memory aid in med rec processes resulted in a significant reduction of med omissions during clinician med rec ED Patients: n = 529
Patient hand-held lists of medications	N. Garfield et al., (2020)	III B Qualitative	Accurate patient handheld lists (electronic or paper) can help reduce medication errors Patient and clinician interviews: n = 32 Patients: n = 16 Clinicians: n = 16

Appendix B

Figure B1: *Chronic Care Model Elements*

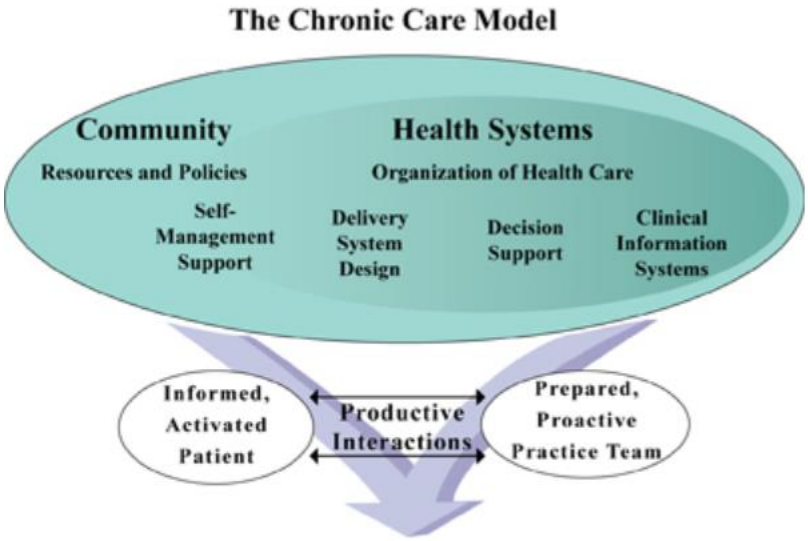

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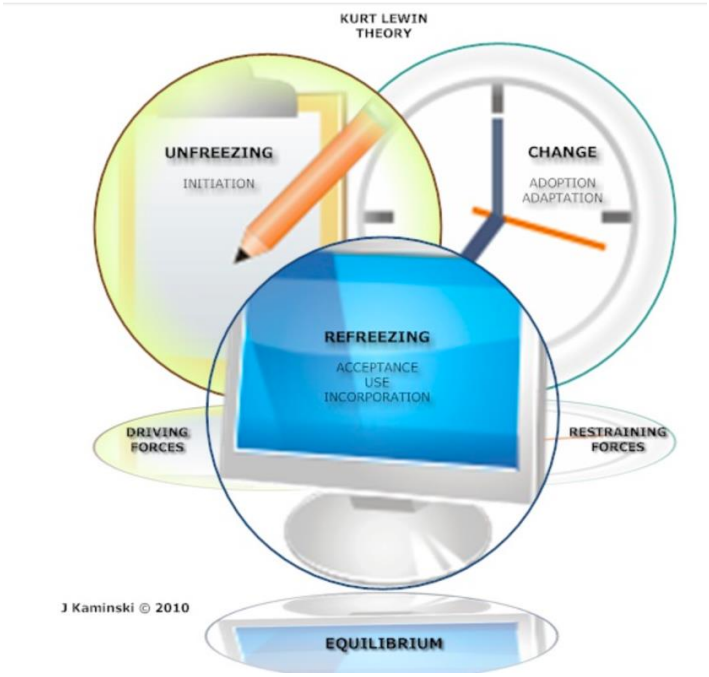
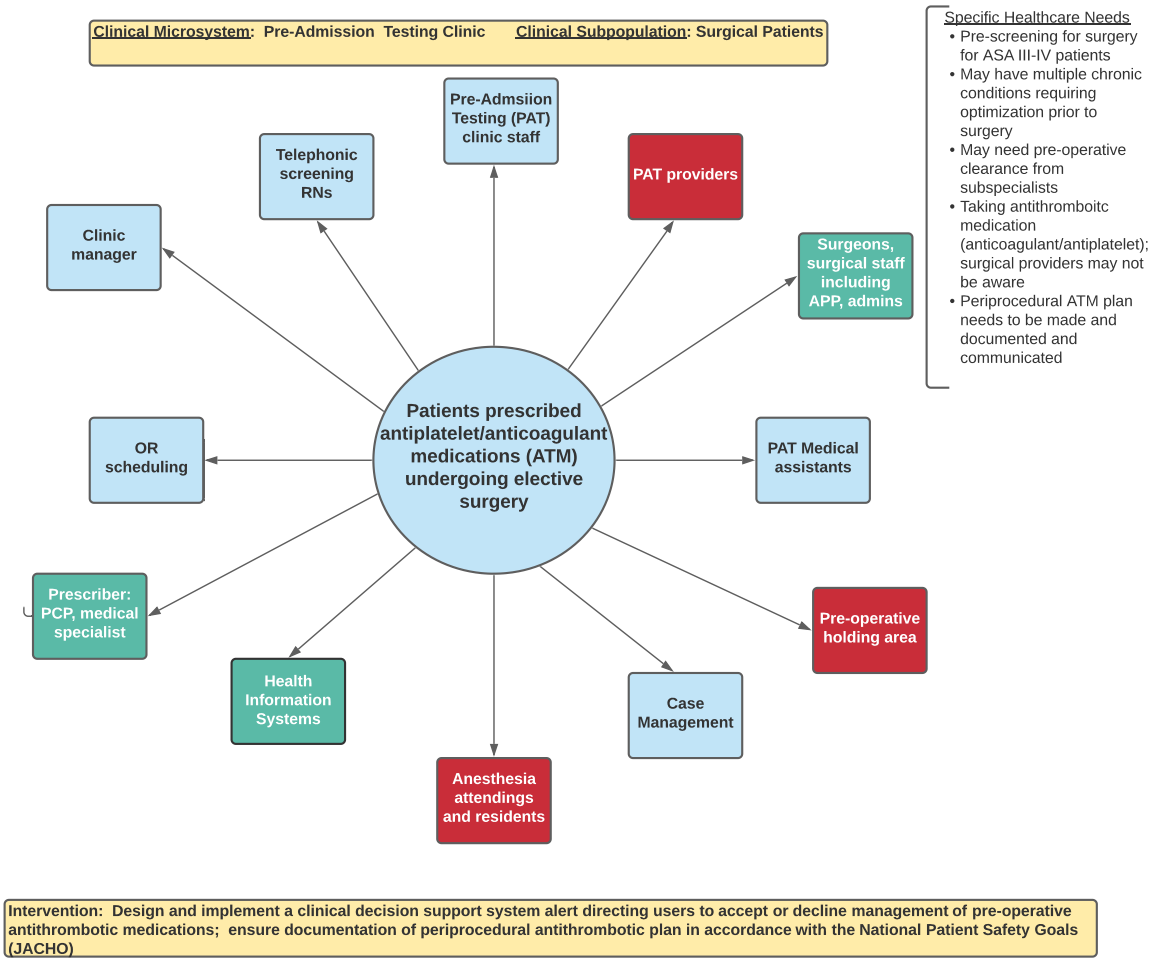
Figure B2: *Lewin's Theory of Change Model*



Kaminski, J. (Winter, 2011). Theory applied to informatics – Lewin's Change Theory. *CJNI: Canadian Journal of Nursing Informatics, 6* (1), Editorial. http://cjni.net/journal/?p=1210

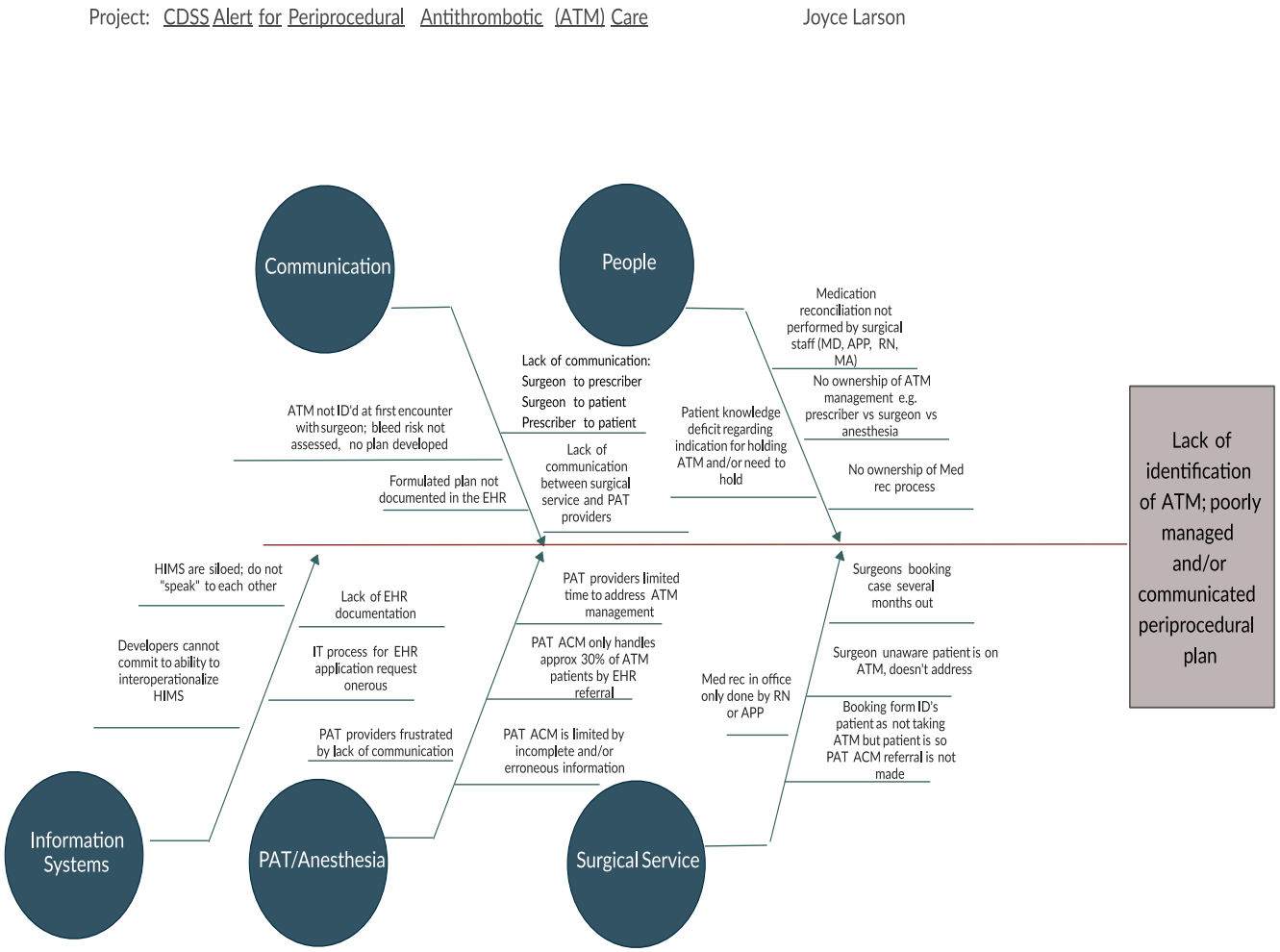
Appendix C

Clinical Microsystems Map



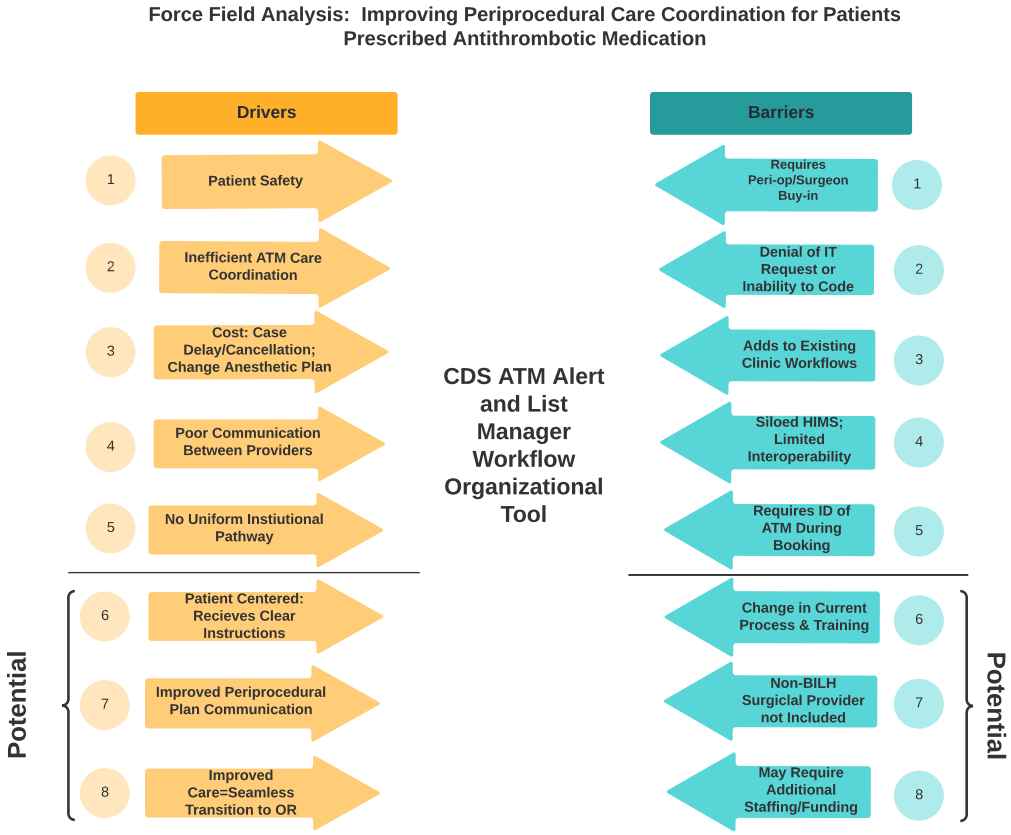
Appendix D

Fishbone Diagram



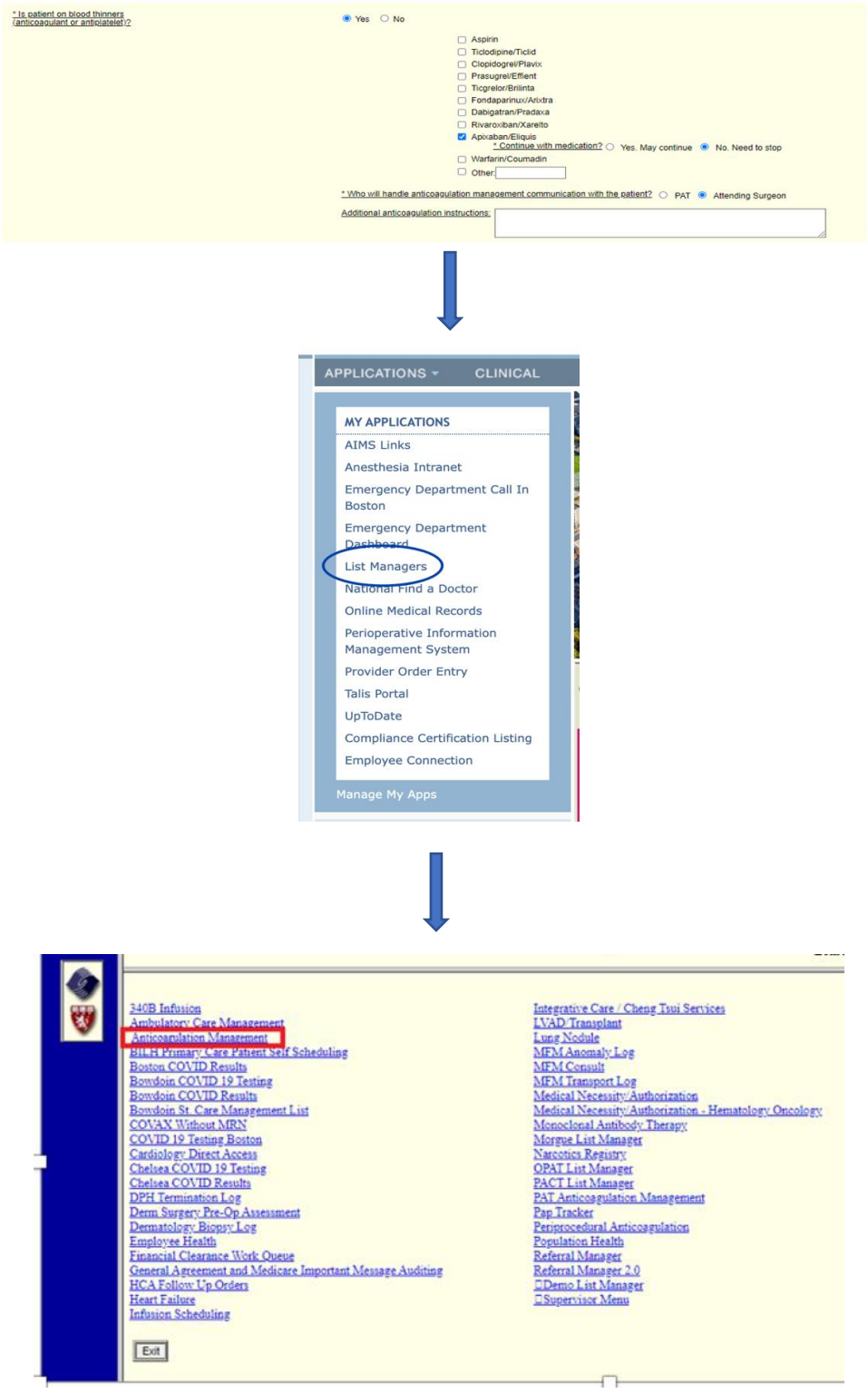
Appendix E

Force Field Analysis



Appendix F

List Manager Tool



Appendix G

List Manger Tool

Figure G1: Pre-Select Screen

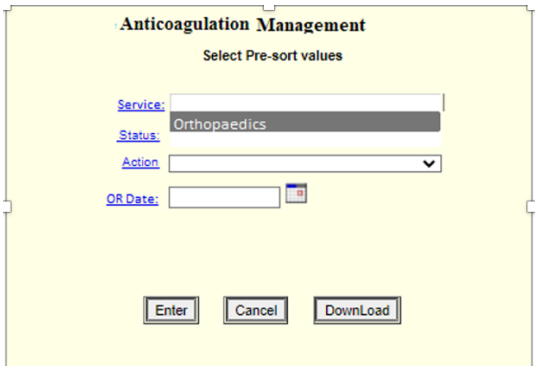


Figure C2: Main List Screen

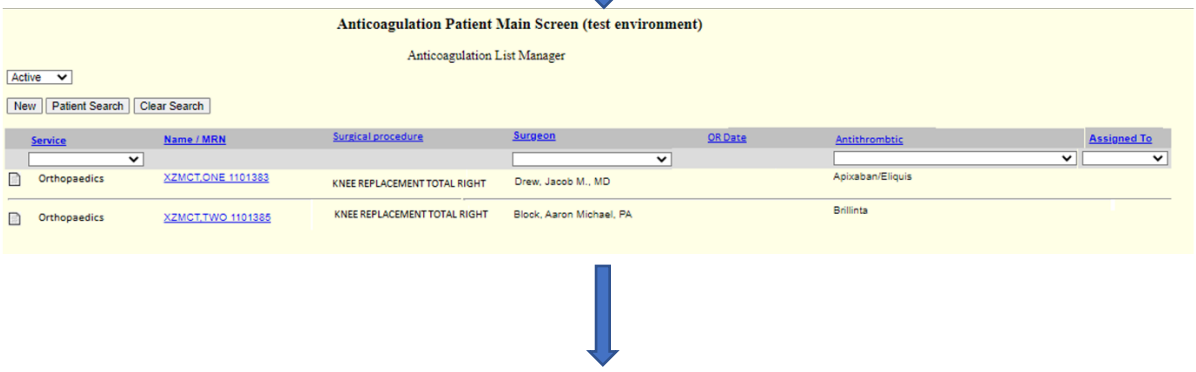
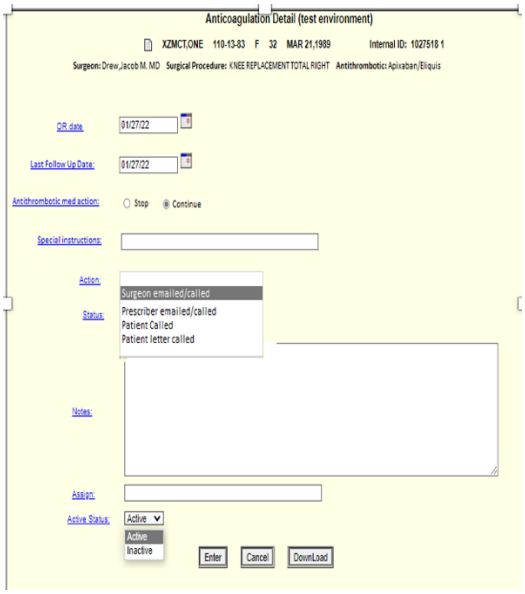
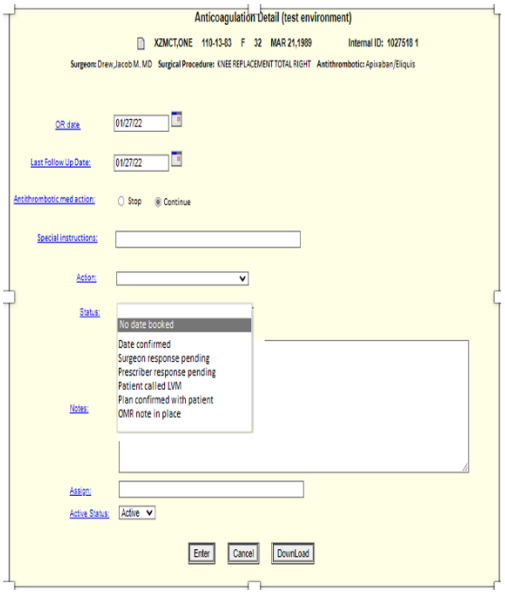


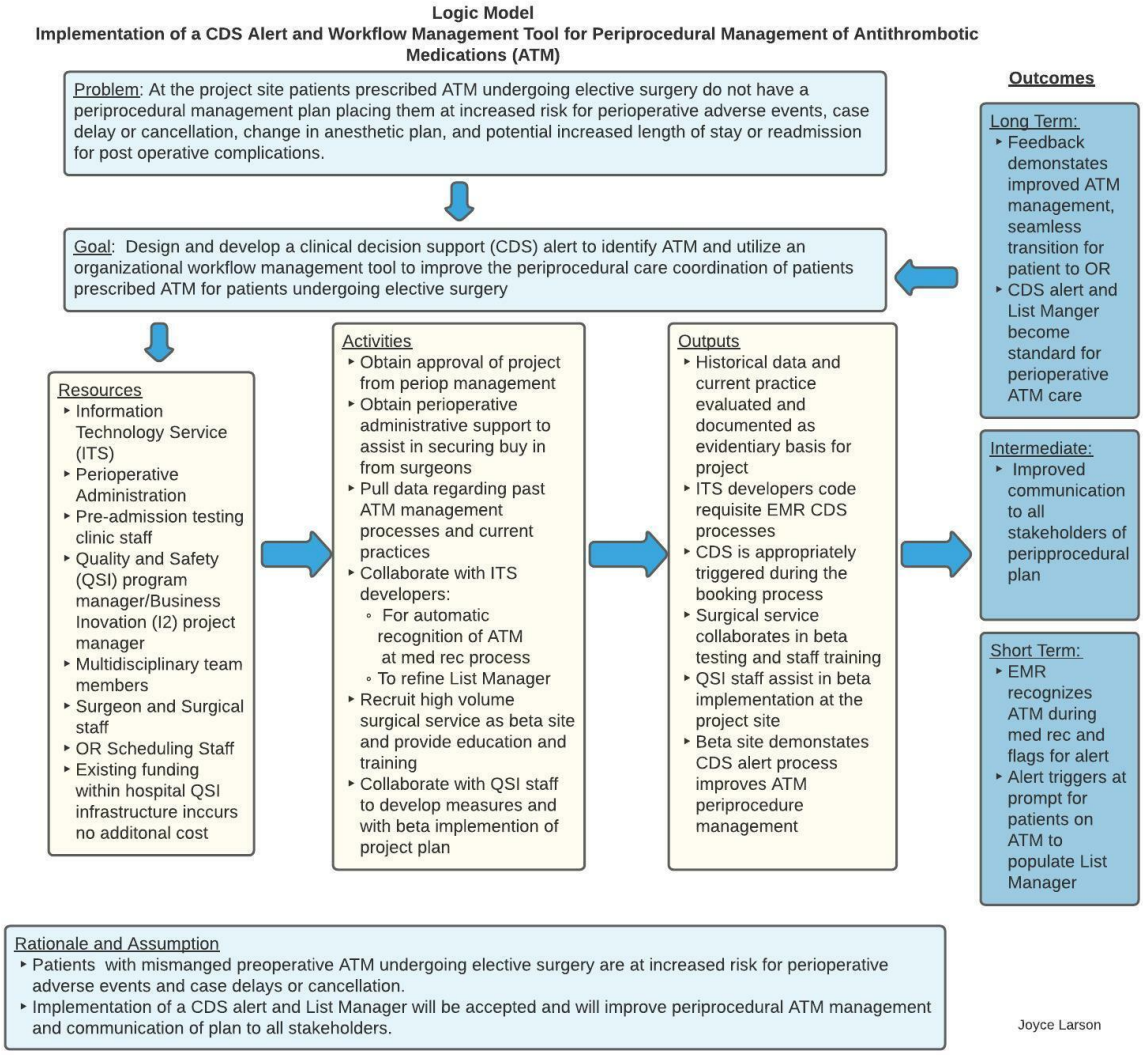
Figure G3: Details Screens





Appendix H

Logic Model



Appendix I

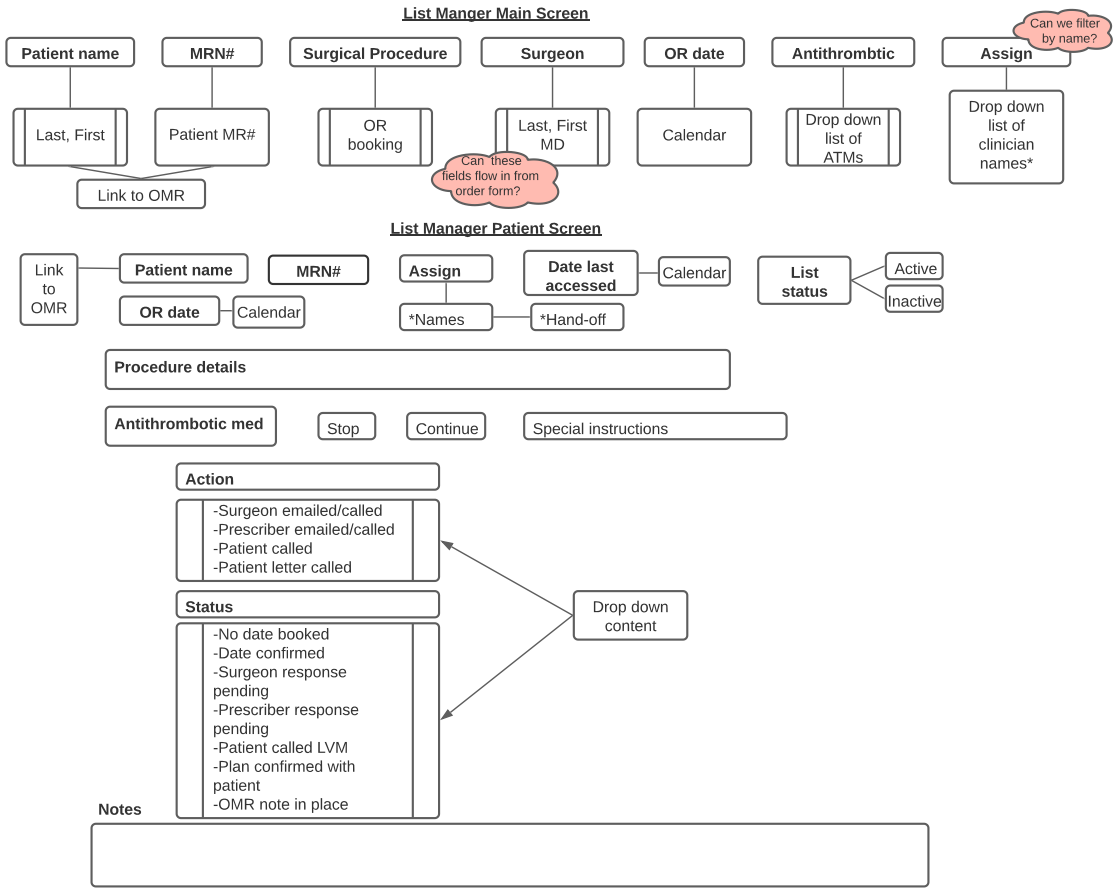
Project Charter

Project Charter — **Anticoagulation**

Role	Responsibilities
Project Sponsor	▪ Set project vision and purpose ▪ Define project scope, priorities and timeline ▪ Align the Core Team in project purpose, method and outcome ▪ Define project success criteria ▪ Act as the final approver and decision maker ▪ Communicate to the impacted stakeholders and to the greater enterprise as needed
Steering Committee	▪ Provide project oversight & direction ▪ Ensure the Core Team members are available to fully and consistently participate in the project ▪ Enable and empower the Core Team to make decisions ▪ Support the decisions made by the Core Team and confirm they align with the project goals and objectives ▪ Resolve issues escalated from the Core Team to ensure the project stays on track ▪ Review final project deliverables, assess operational readiness and make the go/no-go decision
Core Team	▪ Actively participate in meetings ▪ Propose, design and develop solutions in service of the project purpose and within the scope as defined within the project charter ▪ Establish the principles and clarify assumptions that guide design action ▪ Act as a steward of the objectives and assure alignment as decisions are made ▪ Acknowledge the constraints – physical and otherwise – in the operational design ▪ Create a design and a process that can be replicated effectively as opportunities arise
Team Leader	Core Team responsibilities, in addition to: ▪ Co-lead meetings with the Project Manager ▪ Elicit questions and concerns from colleagues and share with the Core Team ▪ Share messaging, on behalf of team, to all related stakeholders ▪ Ensure appropriate representatives participate in workshops ▪ Provide focus and keep the team working within the scope and ground rules agreed upon in the charter ▪ Keep the team disciplined to ensure the escalation process is followed for any issues that arise
Project Manager	▪ Promote a methodical and structured approach to problem solving ▪ Support development of project deliverables ▪ Develop and maintain a project plan ▪ Facilitate project kickoff, closure and hand-off ▪ Facilitate status meetings, document meeting minutes and track action items ▪ Track issues and escalate to Steering Committee as appropriate ▪ Prepare monthly status report ▪ Help with project documentation ▪ Assist with preparing and facilitating workshops

Appendix J

List Manager Mockup



Appendix K

Survey and Huddle Domains for Evaluating List Manager Adoption

Who is the intended recipient of your questionnaire?	The pilot site staff: Surgeon, APP, RN, and administrative staff
When will you administer the questionnaire? (e.g. pre, post, both, monthly, etc)	Weekly email huddles; Post implementation survey
What outcome are you measuring? (refer to your logic model)	Improved periprocedural care coordination for ATM management
What concepts/domains/attributes are you measuring? (Examples: Knowledge, beliefs, attitudes, perceptions, opinions, confidence, self-efficacy, behavior, attributes, feasibility, value added, etc.)	CDS alert function attitudes on: ▪ Feasibility (usefulness in addressing the problem of mismanaged ATM) ▪ Ease of use (opinions about interruption in clinical workflow) ▪ CDS associated alert fatigue (perceptions and attitudes about CDSS alerts) ▪ Value added ▪ Sustainability
What is your change theory?	Kurt Lewin Theory of Change Model
What dimensions from your change model are relevant to be included in your questionnaire?	Lewin Refreezing Survey results will attempt to analyze the project sustainability with long term goals of: ▪ Integration of the plan and upscaling to hospital wide use ▪ Becoming standard for periprocedural ATM management

Appendix L

Measures Table

Aim/Objective	Outcome/Outputs	Operationalize/Measure	Where to get Information	Comparison	Analysis
Form multidisciplinary team to collaborate on project aims; obtain approval from senior leadership	Scheduled Perioperative quarterly monthly QSI meeting agenda to include project proposal	Team members identified: Perioperative administration, ITS, QSI, Surgical representative, Business innovation team (I^2) Project charter created	Document review of meeting minutes	No	Qualitative
Revisit RCA & gather data to support current state analysis	Key stakeholders identified; in-depth analysis performed	Meeting minutes from clinic observations & stakeholder interviews	Document review of meeting notes	No	Qualitative
Deliver ITS requisitions to request design of list manager and consideration of CDSS alert	Requisition for list manager workflow tool approved and created for use by individual clinics and PAT; Approval for CDSS alert function given	ITS/project team collaboration on list manager and CDSS alert design and functionality	Document review of meeting minutes; Confirmation of request acceptance	No	Qualitative
Recruit high volume surgical service(s) to pilot plan	Utilization of CDS alert generated List Manager results in ATM periprocedural plan being addressed prior to scheduled PAT appointment; Decrease in % of misidentified ATM on surgical booking form	Track List Manger utilization rates; Track rate of documented ATM at booking vs DOS (#booking ATMs documented/#patients on ATMs)	ITS EHR	Yes Pre/post implementation	Frequency, % Change, Proportion;
Pilot site(s) staff satisfied with decision tool for management of periprocedural ATM	Staff express List Manager results in improved ATM management	Short survey to query feasibility, ease of use, value add, sustainability, workflow improvement	Likert survey via online survey platform	Yes Ongoing an interval time scale	Frequency, % Change

Appendix M

Clinical Quality Checklist

CLINICAL QUALITY IMPROVEMENT CHECKLIST		
Date: 03/30/2021	**Project Leader: Joyce Larson ANP-c**	
Project Title: Implementation of a Clinical Decision Support Alert to Improve Periprocedural Management of Antithrombotic Medications		
Institution where the project will be conducted: Beth Israel Medical Center Pre-Admission Testing Clinic		
Instructions: Answer YES or NO to each of the following statements about QI projects.	**YES**	**NO**
The specific aim is to improve the process or deliver of care with established/ accepted practice standards, or to implement change according to mandates of the health facilities' Quality Improvement programs. There is no intention of using the data for research purposes.	**X**	
The project is **NOT** designed to answer a research question or test a hypothesis and is **NOT** intended to develop or contribute to generalizable knowledge.	**X**	
The project does **NOT** follow a research design (e.g. hypothesis testing or group comparison [randomization, control groups, prospective comparison groups, cross-sectional, case control]). The project does **NOT** follow a protocol that over-rides clinical decision-making.	**X**	
The project involves implementation of established and tested practice standards (evidence based practice) and/or systematic monitoring, assessment or evaluation of the organization to ensure that existing quality standards are being met. The project does **NOT** develop paradigms or untested methods or new untested standards.	**X**	
The project involves implementation or care practices and interventions that are consensus-based or evidence-based. The project does **NOT** seek to test an intervention that is beyond current science and experience.	**X**	
The project has been discussed with the QA/QI department where the project will be conducted and involves staff who are working at, or patients/clients/individuals who are seen at the facility where the project will be carried out.	**X**	
The project has **NO** funding from federal agencies or research-focused organizations, and is not receiving funding for implementation research**.**	**X**	
The clinical practice unit (hospital, clinic, division, or care group) agrees that this is a QI project that will be implemented to improve the process or delivery of care.	**X**	
The project leader/DNP student has discussed and reviewed the checklist with the project Course Faculty. The project leader/DNP student will **NOT** refer to the project as research in any written or oral presentations or publications.	**X**	

Appendix N

Initially Conceptualized Project Specific Aims

Phase 1 Specific Aims

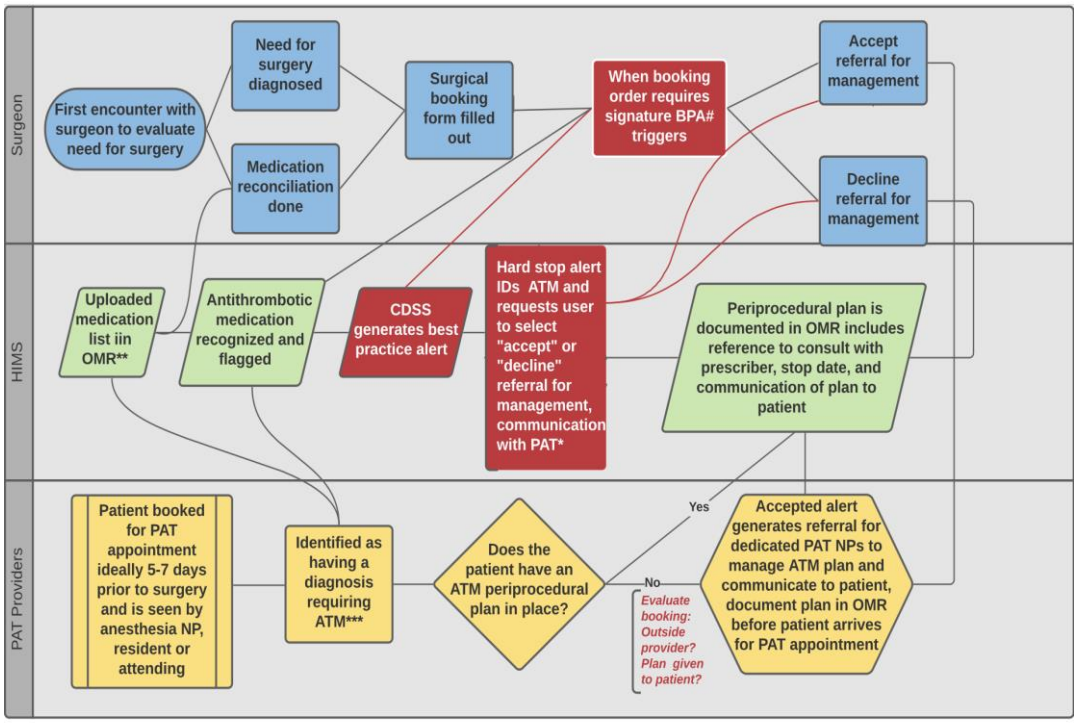
- Form a multidisciplinary team to collaborate on project aims.
- Medication reconciliation will be completed by surgical service licensed personal for 85% of first preoperative encounters.
- Collaborate with the project site information technology service to design an application for machine identification and flagging of ATM during medication reconciliation at initial patient encounter with goal of a 95% recognition rate.
- Design a clinical decision support alert application which utilizes the recognition and flagging of ATMs to deploy during procedure scheduling at final signature.

Phase 2 Specific Aims

- Recruit and work collaboratively with a high-volume surgical service to pilot the project and track staff satisfaction via informal huddles over a period of 12 weeks and administer an online survey post implementation.
- Satisfaction with the application process for management of periprocedural ATM is reported by 80% of pilot surgical service site staff.

Appendix O

Original Periprocedural ATM CDSS Alert Implementation Process Map



#BPA: Best Practice alert; *PAT: Pre-Admission Testing; **OMR: Online medical record; ***ATM: Antithrombotic medication

Alert will state: *"This patient is taking a blood thinner. Prior to completing this order please review and select an option for management and communication of periprocedural plan to the patient".* Option of referral to PAT for management and communication requires user to accept or decline.

- Accept: PAT will handle communication with prescriber and communicate plan to the patient.
- Decline: Periprocedural plan for blood thinners must be documented in OMR and include reference to prescriber consult, communication with patient and stop date.