

University of Wisconsin Hospital and Clinics

**Anticoagulation Management
Performance Improvement Team**

Consensus Document

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May, 2008

Executive Summary

Part I. Background on Anticoagulation

Anticoagulation (AC) management has moved to the forefront of many health care system performance improvement projects for three main reasons:

- Patient safety concerns
- Regulatory compliance (i.e. 2008 National Patient Safety Goal 3E, National Quality Forum (NQF) Safe Practice 28, 29)
- Financial implications

Part II. UWHC Anticoagulation Management Performance Improvement Team

In December, 2007, the UWHC quality council approved the creation of a multidisciplinary Anticoagulation Management Performance Improvement (AMPI) Team with the following objectives:

- Perform a gap analysis of current UWHC AC management versus NPSG 3E, and NQF Safe Practice recommendations
- Identify and prioritize areas for improvement
- Assess opportunities for standardizing AC use
- Develop specific recommendations and strategies to achieve improvements
- Identify measures that will track AC performance/regulatory compliance
- Determine resources required to implement improvements, maintain compliance and monitor performance

The tasks of the team were divided among three subgroups:

- Self-Assessment Subgroup
- Metrics Subgroup
- Best Practices Subgroup

Summary of AMPI Team findings:

- Multiple areas of regulatory noncompliance were identified through a gap analysis

Regulatory Standard	Total # of Criteria	Fully Compliant # (%)	Partially Compliant # (%)	Not Compliant # (%)
NPSG3E	11	3 (28%)	4 (36%)	4 (36%)
NQF Safe Practices	2	0	2 (100%)	0

- A list of recommended AC performance data to collect was developed
- 28 sources of AC management best practice literature were evaluated (see *Appendix II*)

Based on best practice literature, the AMPI Team recommends the creation of an AC management care team to implement recommended improvements, achieve regulatory compliance, and monitor ongoing AC performance. Pharmacist-led multidisciplinary teams described in the literature have been shown to decrease the rate of both VTE and bleeding complications and have been projected to provide significant savings in costs avoided.⁷⁻⁹

Part III. UWHC Anticoagulation Management Care Team Proposal

The UWHC Anticoagulation Management Care Team will be comprised of a pharmacist (1.0 FTE), a physician (0.2 FTE), and a nurse (0.2 FTE). Member roles/responsibilities are outlined in the proposal. A return on investment analysis is included.

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Part I.
Background on Anticoagulation

DRAFT

A. PATIENT SAFETY

Anticoagulants have the ability to prevent devastating medical complications. In fact, venous thromboembolism (VTE) is considered the most preventable cause of hospital death in the United States.¹ Without prophylaxis, the incidence of hospital-acquired deep vein thrombosis (DVT) in general medical and surgical patients ranges from 10 to 40%. The incidence increases to roughly 50% in patients with no prophylaxis prior to major orthopedic surgery.¹ Prophylactic anticoagulants have been shown to significantly reduce this risk. Therapeutic anticoagulation is the cornerstone of treatment for thromboembolic disease. However, titrating anticoagulants within narrow therapeutic indices at times proves difficult, even for the most experienced practitioners. Individual patient response to a standard dose is not always predictable. Variation in patient-specific factors such as rate of drug elimination further complicates the picture. Over-anticoagulation exposes patients to increased risk of hemorrhage, one of the most feared hospital complications. Under-anticoagulation leaves patients vulnerable to recurrent VTE.

Consequently, heparin, warfarin, and enoxaparin are ranked in the United States Pharmacopoeia (USP) Top 50 Drug Products Associated with Medication Errors as numbers 5, 7, and 12, respectively.² The Institute for Safe Medication Practices (ISMP) has designated all anticoagulants as *High-Alert Medications*, a category which includes those medications at increased risk of causing significant patient harm when used improperly.

Throughout Calendar Year 2007, a total of 62,934 doses of anticoagulant medications (warfarin, heparin, dalteparin, and enoxaparin) were administered to inpatients at the University of Wisconsin Hospital and Clinics (UWHC). UWHC received documented Patient Safety Net (PSN) reports of 83 events related to anticoagulant use within this time period. Thirty-one of these errors (37%) were Harm Score D or above, which implies that at minimum, the event reached the individual and required additional monitoring or treatment to prevent harm. The five most common type of events reported were: medication omitted, error in monitoring, extra dose given, wrong dose/overdose, and wrong administration rate. Related PSN data from the last 3 years is presented below. Given the episodic and volitional nature of PSN reporting, it is likely these numbers underestimate the true incidence of anticoagulation errors. It is important to note that number of errors has remained relatively consistent over the past three years, despite targeted efforts to improve the anticoagulation process.

Calendar Year 2007	Anticoagulation PSN Reports
Total # of PSNs related to anticoagulant use	83
# related to heparin use	47 (57%)
# related to warfarin use	21 (25%)
# related to dalteparin/enoxaparin use	15 (18%)
# of errors that were Harm Score D or above	31 (37%)

Calendar Year 2006	Anticoagulation PSN Reports
Total # of PSNs related to anticoagulant use	74
# related to heparin use	42 (57%)
# related to warfarin use	22 (30%)
# related to dalteparin/enoxaparin use	10 (13%)
# of errors that were Harm Score D or above	28 (38%)

Calendar Year 2005	Anticoagulation PSN Reports
Total # of PSNs related to anticoagulant use	76
# related to heparin use	40 (52%)
# related to warfarin use	21 (28%)
# related to dalteparin/enoxaparin use	15 (20%)
# of errors that were Harm Score D or above	35 (46%)

B. REGULATORY COMPLIANCE

Increased awareness of patient safety implications surrounding anticoagulant use has motivated hospital quality and regulatory organizations to develop various anticoagulation-specific requirements and recommendations. Specific examples include the following:

B1) National Patient Safety Goal 3E

As part of the 2008 National Patient Safety Goals, the Joint Commission™ (JC) mandated a requirement to reduce patient harm associated with anticoagulant use.³ The JC provided eleven specific implementation expectations and a timeline for implementation by January 1, 2009.

B1a) Implementation Timeline

Apr 1, 2008 Leadership Assigned	Jul 1, 2008 Implementation Plan	Oct 1, 2008 Pilot Testing Underway	Jan 1, 2009 Full Implementation
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B1b) Specific Implementation Expectations by January 1, 2009 (TJC NPSG 3E A1-A11)

1. The organization implements a defined anticoagulation management program to individualize the care provided to each patient receiving anticoagulant therapy
2. To reduce compounding and labeling errors, the organization uses ONLY oral unit dose products and pre-mixed infusions, when these products are available
3. When pharmacy services are provided by the organization, warfarin is dispensed for each patient in accordance with established monitoring procedures
4. The organization uses approved protocols for the initiation and maintenance of anticoagulation therapy appropriate to the medication used, to the condition being treated, and to the potential for drug interactions
5. For patients being started on warfarin, a baseline INR is available, and for all patients receiving warfarin therapy, a current INR is available and is used to monitor and adjust therapy
6. When dietary services are provided by the organization, the service is notified of all patients receiving warfarin and responds according to its established food/drug interaction program
7. When heparin is administered intravenously and continuously, the organization uses programmable infusion pumps
8. The organization has a policy that addresses baseline and ongoing laboratory tests that are required for heparin and low molecular weight heparin therapies
9. The organization provides education regarding anticoagulation therapy to prescribers, staff, patients, and families
10. Patient/family education includes the importance of follow-up monitoring, compliance issues, dietary restrictions, and potential for adverse drug reactions and interactions
11. The organization evaluates anticoagulation safety practices

B2) National Quality Forum Safe Practice Recommendations 28 and 29

The National Quality Forum (NQF) is an organization concerned with creating an avenue for national healthcare quality measurement and reporting. The safe practices are a set of 30 consensus standards that serve as a guide for healthcare consumers and providers to identify those practices that will reduce errors and improve care. Two of the safe practices are specifically related to anticoagulation.⁴

B2a) Safe Practice 28

Evaluate each patient upon admission, and regularly thereafter, for the risk of developing venous thromboembolism/deep vein thrombosis (VTE/DVT). Utilize clinically appropriate, evidence-based methods of thromboprophylaxis.

B2b) Additional Specifications

Document the VTE risk assessment and prevention plan in the patient's record
Explicit organizational policies and procedures should be in place for the prevention of VTE

B2c) Safe Practice 29

Every patient on long-term oral anticoagulants should be monitored by a qualified health professional using a careful strategy to ensure the appropriate intensity of supervision

B2d) Additional Specifications

Explicit organizational policies and procedures should be in place regarding anti-thrombotic services that include, at a minimum, documentation of the following:

- Indication for long-term anticoagulation
- Target INR range
- Duration of long-term anticoagulation and/or a review date
- A longitudinal record of INR values and warfarin doses
- Timing of the next INR appointment

As part of the 2007 Leapfrog Hospital Quality and Safety Survey, UWHC scored itself against each of the 30 NQF Safe Practices. UWHC compliance with Safe Practice 28, was scored 23.4/35 (67%). Compliance with Safe Practice 29 was scored 11.76/25 (47%). These results indicate opportunities for improved compliance with the safe practices specified above.

B3) Hospital Quality Measure SCIP-VTE-1 and SCIP-VTE-2

The Surgical Care Improvement Project (SCIP) is a partnership of national organizations aimed at reducing the incidence of surgical complications in the United States by 25% by 2010. While some surgical complications are unavoidable, patient outcomes can be improved by adhering to standardized evidence-based care processes. Four SCIP hospital quality measures focus on collecting data regarding frequency of appropriate VTE prevention and outcomes.⁵

B3a) Hospital Quality Measure SCIP-VTE-1:

Surgery patients with recommended VTE prophylaxis ordered

B3b) Hospital Quality Measure SCIP-VTE-2:

Surgery patients who received appropriate VTE prophylaxis within 24 hours prior to surgery to 24 hours after surgery

B3c) Hospital Quality Measure SCIP-VTE-3:

Intra- or postoperative PE diagnosed during index hospitalization and within 30 days of surgery

B3d) Hospital Quality Measure SCIP-VTE-4:

Intra- or postoperative DVT diagnosed during index hospitalization and within 30 days of surgery

C. FINANCIAL IMPLICATIONS

C1) CMS Pay for Performance

Increased patient safety is only one of the reasons anticoagulation management is at the forefront of hospital quality improvement projects across the nation. The Centers for Medicare and Medicaid Services (CMS) has advocated for pay-for-performance legislation, which aims to increase healthcare quality and safety by providing financial incentives for adherence to practices known to decrease patient morbidity and mortality. As CMS is one of the main constituents in the SCIP initiative, it may potentially use SCIP measures, in addition to other above-mentioned nationally recognized goals and practices, as a way of evaluating and reimbursing hospital performance.

Similarly, it has been proposed that hospitals may not be reimbursed for re-admissions related to avoidable medical and surgical complications. Thus, it is increasingly important to avoid admissions due to bleeding and VTE caused by over- and under-anticoagulation, respectively.

C2) Capitated Reimbursement

In an era of capitated reimbursement, it is essential to explore avenues that allow for timely patient discharge while continuing to maximize optimal patient care. As an example, patients initiated on warfarin often require several days and multiple dose adjustments before attaining stable INR values within their goal range. It is not uncommon for a patient to remain hospitalized solely for the purpose of INR stabilization. It is financially wise to adopt practices that will lead to more rapid INR stabilization or that help identify appropriate candidates for outpatient “bridging” therapy with subcutaneous LMWH injections until the INR value is within goal.

Part II.
UWHC Anticoagulation Management
Performance Improvement Team

DRAFT

A. PERFORMANCE IMPROVEMENT TEAM DEVELOPMENT

The complexity and degree of overlap among the anticoagulation quality indicators and regulations described in Part I led to the decision in October, 2007, to submit a proposal to the UWHC quality council to charter an Anticoagulation Management Performance Improvement (AMPI) Team. The team was approved and held its first meeting in December, 2007.

B. MEMBERSHIP

The AMPI Team is comprised of medical, pharmacy, nursing, laboratory, nutrition, information technology services, and quality improvement personnel. Individual members are listed below.

B1) Executive Sponsor:

- Mark Kirschbaum, Ph.D., Vice President of Quality and Information

B2) Co-chairs:

- Ken Wood, D.O., Senior Director of Medical Affairs
- Steve Rough, M.S., R.Ph., Director of Pharmacy

B3) Members:

- Fred Brodsky, M.D.
- Sheryl Butts, Clinical Nurse Manager
- Teresa Darcy, M.D.
- Carol Diamond, M.D.
- Jennifer Drayton, Clinical Nurse Specialist
- Jane Dunn, Director of Clinical Nutrition Services
- David Dwyer, Clinical Nurse Manager
- Kerry Goldrosen, Clinical Pharmacist
- Jennifer Grice, Clinical Pharmacist
- Leanne Hammerschmitt, Clinical Nurse Specialist
- Vicki Hill, Director of EPIC Installation
- John Hoch, M.D.
- Rhonda Holden, Director of Ambulatory Nursing
- Anne Jaeger, Nurse Clinician
- Karen Palmer, Director of Specialty Clinics
- Leigh-Anne Lottridge, Nurse Care Team Leader
- Ann McBride, M.D.
- Barbara Nordin, Clinic Project Manager
- Virginia Robbeloth, Clinical Nurse Specialist
- Erin Robinson, Pharmacy Practice Resident
- Anne Rose, Clinical Pharmacist
- Susan Sanford-Ring, Director of Quality and Patient Safety
- Justin Sattin, M.D.
- Abby Tague, Clinical Pharmacist
- William Tanke, Pharmacy Manager
- Philip Trapskin, Pharmacy Manager
- Jose Valdez, Senior Data Analyst
- Linda Walton, Director of Medical Nursing
- Christine Whelley, Stroke Coordinator
- Eliot Williams, M.D.

C. CHARGE AND OBJECTIVES

The AMPI Team was charged with leading a coordinated effort to ensure UWHC’s ongoing compliance with anticoagulation-related quality indicators/regulations set forth by various external regulatory and advisory organizations (e.g. NPSG 3E; NQF DVT/VTE goals and safe practice recommendations).

The AMPI Team sought to attain this goal utilizing the following objectives:

- Perform a gap analysis to assess UWHC current level of compliance with NPSG 3E, and NQF anticoagulation safe practice recommendations
- Identify and prioritize areas for improvement
- Assess opportunities for standardizing anticoagulant use
- Develop specific recommendations and strategies to achieve improvements
- Identify measures to be monitored to ensure compliance and to determine effectiveness of anticoagulant use
- Determine resources required to implement improvements, maintain compliance and perform ongoing monitoring

D. SUBGROUPS

It was determined that the most effective way to achieve the specific objectives of the AMPI Team was the creation of three subgroups, each with its own scope and purpose. Each subgroup was asked to meet separately to accomplish its individual tasks and report back on activity and progress to the larger AMPI Team at large group meetings.

D1) Self-Assessment Subgroup

The objectives of the Self-Assessment Subgroup were two-fold. First, the subgroup performed a gap analysis of UWHC current systems of care versus the NPSG 3E and NQF safe practice recommendations. Secondly, the subgroup performed a more thorough gap analysis of UWHC current systems of care versus the 2005 ISMP *Medication Safety Self Assessment® for Antithrombotic Therapy in Hospitals*, an assessment tool that was chosen at the first AMPI Team meeting.

The Self-Assessment Subgroup met in January 2008. Members of the subgroup represented the pharmacy and nursing departments. The subgroup evaluated UWHC AC management within the eleven NPSG 3E specifications and the two NQF safe practice recommendations, based on knowledge and experience within the UWHC. The subgroup identified multiple points of compliance and several areas with room for improvement. (See *Appendix I* for details.)

The subgroup completed the ISMP self assessment. The assessment consisted of 125 elements which were scored on the degree of implementation (ranging from not implemented to fully implemented for all patients). The results of this assessment were communicated to the AMPI Team. It is anticipated that the assessment will be re-scored annually and the results used to track progress improving UWHC anticoagulation management.

D1a) Summary of Regulatory Compliance (See Appendix I for details)

Regulatory Standard	Total # of Criteria	Fully Compliant # (%)	Partially Compliant # (%)	Not Compliant # (%)
NPSG3E	11	3 (28%)	4 (36%)	4 (36%)
NQF Safe Practices	2	0	2 (100%)	0

D1b) Select Examples of UWHC Compliance with NPSG 3E/NQF Safe Practices

- UWHC uses programmable infusion pumps for the administration of heparin infusions
- The dietary service is notified of all patients receiving warfarin
- Documentation of VTE risk/prophylaxis within 24 hours of ICU transfer is audited quarterly
- UWHC uses only unit dose oral anticoagulants

D1c) Select Examples of UWHC Noncompliance with NPSG 3E/NQF Safe Practices

- Lack of written guidelines/policies (i.e. standardized warfarin dosing nomogram)
- Lack of standardized chart documentation (i.e. indication for anticoagulation; goal INR, expected duration of anticoagulation)
- Lack of defined monitoring standards (i.e. required baseline and ongoing laboratories)
- Lack of documented anticoagulant education (i.e. standardized patient counseling; physician/pharmacist/nurse competencies)

D1d) ISMP Self Assessment Results

RESULTS BY ISMP SECTION	Total # of Criteria	Fully Implemented # (%)	Partially Implemented # (%)	Not Implemented # (%)
Patient Information	32	13 (41%)	16 (50%)	3 (9%)
Drug Information	34	10 (30%)	11 (32%)	13 (38%)
Communication of Drug Orders and Other Drug Information	9	4 (44%)	1 (11%)	4 (44%)
Drug Storage, Stock, Standardization, and Distribution	12	8 (67%)	3 (25%)	1 (8%)
Medication Device Acquisition, Use, and Monitoring	4	3 (75%)	1 (25%)	0 (0%)
Competency and Staff Education	7	2 (29%)	3 (42%)	2 (29%)
Patient Education	16	6 (38%)	9 (56%)	1 (6%)
Quality Processes and Risk Management	11	1 (9%)	3 (27%)	7 (64%)
OVERALL ISMP RESULTS	125	47 (38%)	47 (38%)	31 (24%)

D2) Metrics Subgroup

The objectives of the Metrics Subgroup were threefold. First, this subgroup was asked to collect existing data from any recent UWHC AC-related performance improvement projects. Second, the subgroup was to develop a list of proposed data that should be collected as part of the self-assessment and/or related to overall UWHC AC management and safety. Third, this subgroup was asked to define metrics of system performance that UWHC may track before and after implementing new system changes recommended by the AMPI Team.

The Metrics Subgroup met in January, 2008. Members represented the quality improvement, pharmacy, and nursing departments. The subgroup identified measures to assess the

current/baseline and ongoing effectiveness of AC management at UWHC. This information was shared with the AMPI Team at its second meeting.

D2a) Existing UWHC Anticoagulation- Related Performance Data

D2a1) Quarterly DVT/Stress Ulcer Prophylaxis (SUP) ICU Audit

An audit of appropriate DVT prophylaxis is performed on all UWHC ICU patients on a quarterly basis. In 2006, the average rate of appropriate DVT prophylaxis in ICU patients across all four audits was 87%. In 2007, the average rate improved to 94% appropriate prophylaxis.

D2a2) Gynecology/Oncology VTE Prophylaxis Study

In 2006, an evidence-based DVT prophylaxis protocol was implemented for all UWHC Gynecology/Oncology surgical patients, unless they had a history of heparin-induced thrombocytopenia (HIT), an active VTE, or were on prior AC therapy. A retrospective chart review showed greater than 90% compliance with the protocol. In 2006, the rate of VTE in gynecology/oncology surgical patients decreased significantly when compared to 2005 (1.9% vs. 7%, $p=0.04$). No significant increase in bleeding complications was identified.

D2a3) SCIP Data

In the third quarter of 2007, 81% of UWHC surgical patients received all appropriate care per SCIP guidelines. Since 1st quarter 2006, this percentage has varied between 64.4 and 86.4%. The median percent of surgical patients receiving all appropriate care per SCIP guidelines in UHC hospitals is 65%.

D2a4) Heparin Protocol Medication Use Evaluation (MUE)

In 2005, an MUE was performed which analyzed the utilization, effectiveness and safety of the UWHC therapeutic heparin dosing guideline. A total of 95 charts were reviewed. Results indicated over 90% of patients were receiving heparin per guidelines with acceptable safety and efficacy. It was noted that approximately 17% of patients did not have a baseline activated partial thromboplastin time (aPTT) drawn. The mean time to therapeutic aPTT was approximately 22 hours. Auditors of the MUE identified this parameter as an opportunity for improvement. It was speculated that time to therapeutic aPTT may be prolonged due to nearly 30% of patients not having an aPTT value drawn 6 hours after the start of heparin infusion.

D2b) Recommended Anticoagulation Data to Collect

D2b1) Baseline/Current INR for patients on warfarin

- Once the time frame for both has been defined
- Audit every 6 months for all inpatients on warfarin

D2b2) Periodic chart reviews

- To assess the existence/location of information that requires documentation
 - Indication for AC
 - Expected duration of AC
 - INR Goal Range
- Audit 30 random charts on a quarterly basis

- Patients receiving warfarin, IV heparin, or therapeutic doses of LMWH

D2b3) Percent of time patients are within individual INR goal

- For ambulatory warfarin patients managed by UWHC AC Clinics
- Data is already being monitored
 - Last chart review in May, 2007
- Repeat audit on annual or semi-annual basis

D2b4) Length of stay (LOS) for patients initiated on warfarin during inpatient admission

- Collect baseline average LOS
- Monitor LOS data on an annual basis to assess impact of AC management changes

D2b5) Time from INR result to clinic contact

- For ambulatory warfarin patients managed in UWHC/UWMF clinics
 - Not AC Clinics
- Annual chart review of 50 random patients managed by primary provider

D2b6) Incidence of INR values greater than 6

- Institute for Healthcare Improvement (IHI) Trigger Tool
- Work with data analysts to pull values into a report
- Review report on a quarterly basis to monitor performance
- Possible addition to daily reports sent to unit pharmacists for review

D2b7) Incidence of aPTT values greater than 100 seconds

- IHI Trigger Tool
- Work with data analysts to pull values into a report
- Review report on a quarterly basis to monitor performance
- Possible addition to daily reports sent to unit pharmacists for review

D2b8) Incidence of vitamin K use

- IHI Trigger Tool
- Work with data analysts to pull values into a report
- Review report on a quarterly basis to monitor performance
- Possible addition to daily reports sent to unit pharmacists for review

D2b9) Auditing AC-related Health Facts for You (HFFY) content for minimum requirements

- As defined in NPSG3E implementation specifications, all education must contain
 - Importance of follow-up monitoring
 - Compliance issues
 - Dietary restrictions
 - Potential for adverse drug reactions
 - Potential for drug interactions
- One-time audit/revision of all current AC-related HFFY education
- Creation of a template for future AC-related HFFY to ensure minimum requirements

D3) Best Practices Subgroup

The Best Practices Subgroup had multiple objectives. Primarily, the subgroup was charged with summarizing the AC management best practices described in the literature exceeding NPSG 3E and NQF Safe Practice 28 and 29 and which UWHC may wish to consider implementing. Also, the subgroup evaluated the results of the 2007 University HealthSystem Consortium (UHC) Anticoagulation Survey, comparing AC management practices and team structures between 28 participating UHC hospitals. Additionally, the subgroup developed a concise summary of AC management team structures, resources, and roles described in the literature, and identified AC management existent best practices at UWHC that should be implemented system-wide.

D3a) Anticoagulation Best Practice Literature Summary

Subgroup members collected and compiled AC management best practice literature, with a specific focus on AC management team structure. Twenty-eight sources were evaluated, summarized, and categorized in a table format. Categories of literature included the following: expert opinion on AC management, AC-management team structures, hospital-wide AC education, and use of technology in AC management. (See *Appendix II* for details.)

D3a1) Expert Opinion in Anticoagulation Management (*Selected Sources*)

- The American College of Chest Physicians (ACCP). The Seventh ACCP Conference on Antithrombotic and Thrombolytic Therapy: Evidence-Based Guidelines. *Chest*. 2004;126(Supplement 3)
 - New version anticipated in 2008

D3a2) Anticoagulation Management Team Structures

Based on the literature reviewed, the most evidence exists for a pharmacist-led anticoagulation management care team. In 2007 Philips et al published the results of an online survey of 33 institutions identified as having distinct inpatient AC services.⁶ Of the 25 responses, the vast majority described pharmacist-led teams that performed daily AC rounds. All teams managed patients on warfarin and the majority of these teams were involved in the management of other AC medications (i.e. LMWH, Factor Xa inhibitors).

Pharmacist-led inpatient AC services have been shown to decrease length of stay, lower Medicare charges, lower rates of bleeding complications, and lower inpatient mortality rates.^{7,8} Specifically, pharmacist-managed warfarin dosing services have been shown to out-perform usual physician-managed care and are estimated to provide significant savings in costs avoided.^{8,9}

D3b) Results of 2007 UHC Anticoagulation Survey

Data for the 2007 UHC Survey was collected from September to November, 2007. A total of 28 UHC hospitals responded to the survey, including UWHC. On average, there were 2 to 3 non-responders per question.

SURVEY QUESTION	UHC RESPONSES	UWHC RESPONSE
Number of patients managed by ambulatory AC clinic	75 – 2050	400
Type of clinician that manages patients in ambulatory AC clinic	Pharmacist: 15 Nurse Practitioner: 2 Team Approach: 4	Team Approach
Institutions with distinct inpatient AC services	9	No distinct inpatient service
Type of clinician that manages inpatient AC	Pharmacist: 6 Nurse Practitioner: 1 Team Approach: 9 Physician: 1	Team Approach
What tools are used to facilitate AC care for inpatients?	Guidelines: 15 Protocols: 18 Care sets: 7 All of these: 4 None of these: 6	Guidelines

D3c) Existing UWHC Anticoagulation Best Practices

D3c1) UWHC Ambulatory Anticoagulation Clinic

The UWHC anticoagulation clinics located at UStation and UW West Clinic collectively manage over 400 patients. The clinics are pharmacist-run through a collaborative practice agreement with a physician director. Pharmacists provide point-of-care INR testing for patients managed at the clinics, effectively eliminating the time delay between INR result and clinic contact. A subset of patients is managed via telephone.

Pharmacists at the AC clinic meet on a quarterly basis to review all thromboembolic and bleeding events in their patients, as well as all INR values greater than 6 (an IHI trigger tool). Potential causes and room for improvement are discussed. One measure of AC clinic performance status is the percent of time patients are within their therapeutic INR range (TTR). Most AC clinics have TTR percentages between 40-65%, compared with 35-60% for physician-managed usual care. In a chart review performed in May of 2007, the UWHC AC clinics demonstrated a TTR of 67.1%, which is on the high end of performance for ambulatory AC clinics.

E. AMPI TEAM RECOMMENDATIONS

Implementing the specific improvements to AC management outlined above is beyond the scope of the AMPI Team, due to the large size and broad representation of the team. Based on the results of the best practice literature review, the AMPI Team recommends the development and implementation of a pharmacist-led multidisciplinary UWHC Anticoagulation Management Care Team to carry out the specific changes that will improve the performance and standardization of AC management throughout UWHC. The roles, responsibilities and estimated benefits of this care team are described in Part III.

Part III.
UWHC Anticoagulation Management
Care Team Proposal

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A. PROPOSAL

This proposal requests the approval of an Anticoagulation Management Care Team in order to ensure optimal anticoagulation management across all patient care areas of UWHC and to coordinate improved transition from inpatient to ambulatory anticoagulation management.

B. BENEFITS

Potential benefits of the AC care team are as follows:

B1) Improved Patient Safety/Patient Care

- More seamless transition from inpatient to ambulatory AC management
- Reduced complications/ADRs from over- and under-anticoagulation
- Increased time within goal INR range

B2) Improved AC management consistency/standardization

- Standardized VTE screening and prophylaxis/treatment
- Standardized warfarin dosing via nomogram/protocol
- Standardized AC monitoring/laboratory draws
- Consistent AC discharge education

B3) Improved reporting/data collection

- SCIP-VTE-1, 2, 3, 4
- NQF Safe Practices

B4) Improved regulatory compliance

- NPSG3E
- NQF Safe Practices

B5) Reduced cost

- Decreased LOS
- Reduced thrombotic and bleeding complications
- Reduced drug cost for dalteparin used for “bridging”
- Potentially increased reimbursement through Pay for Performance

C. TEAM MEMBERSHIP

The UWHC Anticoagulation Management Care Team will be comprised of a pharmacist, a physician, and a nurse, as described below.

D. RESPONSIBILITIES

D1) Pharmacist: 1 FTE

D1a) Leadership/Practice Management

D1a1) Lead and coordinate meetings of the care team

D1a2) Serve as chairperson of the UW Health Anticoagulation P&T Subcommittee

D1a3) Work with the Health Link team and key stakeholders to develop workflows that

- Promote evidence-based VTE risk assessment, prophylaxis, and treatment
- Allow for AC-related data collection to track AC management effectiveness

D1a4) Work with members of the Center for Drug Policy (CDP) to create necessary AC guidelines and protocols for approval by P&T and the Joint Practice Committee

- UWHC Anticoagulation Management Program Definition
- Warfarin Dosing Nomogram
 - Initiation
 - Maintenance
- Standardized Warfarin Monitoring Procedures
 - Including definitions of “baseline” and “current” INR
- Standardized Heparin/LMWH Monitoring Procedures
 - Including appropriate circumstances to draw Factor Xa, heparin levels
- Maintaining/Updating Heparin Infusion Protocol
- VTE Risk Assessment Flowchart
- VTE Prophylaxis and Treatment Guidelines

D1b) Quality/Performance Improvement

D1b1) Maximize the implementation of NPSG3E requirements by January 1, 2009

- NPSG3E FAQ due early 2008
- Assess need to broaden focus of care team beyond warfarin, heparin, LMWH

D1b2) Coordinate medication use evaluations of AC medications

D1b3) Ensure the collection and reporting of AC-related quality improvement metrics

- SCIP-VTE-1, 2, 3, 4
- NQF Safe Practices 28, 29

D1b4) Ensure ongoing safe anticoagulation management systems are implemented and maintained in all practice settings

D1b5) Actively participate in the Medication Safety Committee

D1b6) Review all PSNs involving anticoagulants

D1c) Anticoagulation Clinical Expert/Resource

D1c1) Establish/maintain AC pharmacist certification

D1c2) Serve as a resource for AC management questions for special patient populations

- Provide dosing/monitoring recommendations for management of patients with HIT, LMWH dosing in obesity, patients with concurrent thrombosis and bleed, etc.

D1c3) Assist with the identification of DVT patients that may be candidates for outpatient treatment with LMWH versus inpatient heparin infusion

D1c4) Maintain knowledge of current AC literature

- New *Chest Guidelines*, when available

D1c5) Publish the results of innovative AC management practices and/or research

D1d) Education/Training

D1d1) Inform prescribers and staff of the ongoing creation/approval of AC-related protocols/policies

D1d2) Work with Learning Center, pharmacists, and nursing staff to ensure standardized AC education provided to patients discharged on warfarin, subcutaneous heparin/LMWH

- Importance of follow-up monitoring
- Compliance issues
- Dietary restrictions
- Potential for adverse drug reactions (ADRs)
- Potential for drug interactions

D1d3) Educate pharmacists on patient care units regarding appropriate AC management

D1d4) Create/ensure standardized AC education for pharmacists, physicians, nurses

- Create competencies to assess knowledge/understanding

- D1d5) Hold monthly “Coagulation Rounds” for physicians/nurses/pharmacists that
 - Highlight AC management in unique patient cases
 - Provide updates on new AC-related treatment/prevention guidelines
- D1d6) Participate in the training of medical/pharmacy students/residents
 - AC rotation option

D2) Physician: 0.2 FTE

D2a) Leadership/Practice Management

- D2a1) Serve as a member of the UW Health P&T Committee and Anticoagulation Subcommittee
- D2a2) Serve as a liaison to UW Health medical staff regarding all AC guideline and surveillance issues
- D2a3) Assist in the development of AC management workflows
- D2a4) Assist in the development of AC guidelines and protocols for approval by P&T and the Joint Practice Committee
- D2a5) Coordinate the development and review of all order sets related to anticoagulation management

D2b) Quality/Performance Improvement

- D2b1) Participate in medication use evaluations of AC medications
- D2b2) Actively participate in the Medication Safety Committee
- D2b3) Coordinate peer review individual cases of patients with significant AC mismanagement
 - Major bleeding complications (i.e. intracranial hemorrhage)
 - Major thrombotic complications (i.e. massive PE)

D2c) Anticoagulation Clinical Expert/Resource

- D2c1) Review all inpatient orders for Factor Xa inhibitors on a weekday basis
- D2c2) Assist in the diagnosis of complex anticoagulation-related disease states (i.e. HIT) on a weekday consultation basis
- D2c3) Maintain knowledge of current AC literature
 - New *Chest Guidelines*, when available
- D2c4) Publish the results of innovative AC management practices

D2d) Education/Training

- D2d1) Assist in the development of physician education regarding appropriate AC use
 - Including appropriate house staff training
- D2d2) Attend and participate in monthly “Coagulation Rounds” that
 - Highlight AC management in unique patient cases
 - Provide updates on new AC-related treatment/prevention guidelines
- D2d3) Participate in the training of medical/pharmacy students/residents
 - AC rotation option

D3) Nurse: 0.2 FTE

D3a) Leadership

D3a1) Serve as a member of the UW Health P&T Committee and Anticoagulation Subcommittee

D3b) Education/Training

D3b1) Serve as a liaison to UW Health nursing staff regarding all AC guideline and surveillance issues

D3b2) Assist in the development of nurse education regarding the appropriate use of AC

D3b3) Assist in the promotion of and nurse training for all new and changing AC guidelines/protocols

E. REPORTING STRUCTURE

All members of the AC care team will report to their respective departments.

- Pharmacist will report to Philip Trapskin
- Physician will report to Ken Wood, D.O.
- Nurse will report to Zeena Engelke

F. RETURN ON INVESTMENT (ROI) ANALYSIS

F1) Summary

The implementation of the proposed Anticoagulation Management Team is conservatively estimated to provide nearly a 3:1 return on investment based on conservative annual cost savings estimates of \$550,000 and annual operating costs of \$200,000. A cumulative net savings of **\$1.65 million** is projected for UWHC over the first five years of this program.

F2) Background

Preventable medical/surgical complications from the inappropriate use of anticoagulants can be categorized into two primary categories; thromboembolic (e.g. pulmonary embolism (PE), deep vein thrombosis (DVT)) and hemorrhagic (e.g. retroperitoneal bleed). The sequelae of these complications include increased length of stay (LOS), avoidable treatment costs, and increased morbidity and mortality. Targeted interventions by pharmacist-led teams provide annual cost-savings of \$825,000 to \$9,500,000 in the literature depending on the scope of the team and intervention methods.^{7,8,9}

F3) ROI assumptions

F3a) Preventable medical/surgical complications currently occur at UWHC from the inappropriate use of anticoagulants. This is based on data reported via:

- Patient Safety Net (30 errors that caused harm are reported annually for warfarin, heparin, low molecular weight heparin);
- Patient Safety Indicators (PSI) from the Agency for Healthcare Research and Quality (AHRQ) that are collected by the UWHC quality department. Specific measures exist for postoperative DVT/PE and hemorrhagic events. Criteria for the development of these indicators include an assessment of preventability;
- Heparin protocol non-compliance found in a recent medication use evaluation;
- National reporting and monitoring on the incidence of adverse events related to anticoagulation. (e.g. 15% of medical inpatients develop VTE without appropriate prophylaxis)^{10,11}
- VTE prophylaxis assessment is not documented appropriately for UWHC inpatients today.

F3b) Includes conservative event rate estimates based on UWHC internal data

F3c) Uses conservative cost estimates¹²

F3d) Analysis does not include avoided payment reductions UWHC may achieve in the future via the avoidance of anticoagulation-related “never” events and due to the achievement of national quality agenda anticoagulation management outcomes measures.

Table 1. Cost savings analysis of postoperative anticoagulation complications

UWHC post-operative PSI data set	Mean excess LOS, days ¹⁰	Estimated excess cost per event (range) ¹²	Number of events for FY07	Potential cost savings if 50% of events prevented	Potential cost savings if 25% of events prevented
Thromboembolic	5.36	\$4700	154	\$361,900	\$180,950
Hemorrhagic	3.94	\$4700	48	\$112,800	\$56,400

Table 2. Cost savings analysis of medical inpatient anticoagulation complications

	Estimated excess cost per event (range) ¹²	Estimated number of annual events (10% of medical inpatients not appropriate prophylaxis; 15% of those predicted to develop PE/DVT) ¹¹	Potential cost savings if 50% of events prevented	Potential cost savings if 25% of events prevented
Medical inpatient VTE	\$4,700	187.5	\$440,625	\$220,313

Table 3. Cost savings analysis of avoided harmful anticoagulation medication errors

	Estimated excess cost per event (range) ¹²	Estimated number of annual events	Potential cost savings if 66% of events prevented
Avoidable medication errors that lead to patient harm	\$4700	30	\$93,060

Table 4. Return on investment projections for UWHC Anticoagulation Team

	Year 1	Year 2	Year 3	Year 4	Year 5
Operating Expenses					
Pharmacist (1.0 FTE)	\$137,000	\$143,850	\$151,043	\$158,595	\$166,524
Nurse (0.2 FTE)	\$20,550	\$21,578	\$22,656	\$23,789	\$24,979
Physician (0.2FTE)	\$41,400	\$43,470	\$45,644	\$47,926	\$50,322
Total annual operating expenses	\$198,950	\$208,898	\$219,342	\$230,309	\$241,825
Ongoing savings					
Thromboembolic postoperative events	\$180,950	\$180,950	\$180,950	\$180,950	\$180,950
Thromboembolic medical events	\$220,313	\$220,313	\$220,313	\$220,313	\$220,313
Hemorrhagic postoperative events	\$56,400	\$56,400	\$56,400	\$56,400	\$56,400
Prevention of adverse drug events that lead to patient harm, standardization of monitoring	\$93,060	\$93,060	\$93,060	\$93,060	\$93,060
Total annual savings potential	\$550,723	\$550,723	\$550,723	\$550,723	\$550,723
Total net savings (cost)	\$351,773	\$341,826	\$331,381	\$320,414	\$308,898
Cummulative net savings (cost)	\$351,773	\$693,599	\$1,024,979	\$1,345,393	\$1,654,291

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- 2) *United States Pharmacopeia* Top 50 Drug Products Associated with Medication Errors. Accessed at <www.usp.org/hqi/patientSafety/resources/top50DrugErrors.html> 17 Apr 2008.
- 3) The Joint Commission™. *2008 National patient safety goals*.
- 4) National Quality Forum. *National quality forum safe practices for better healthcare – 2006 update: a consensus report*.
- 5) *Surgical Care Improvement Project* Venous Thromboembolism Measures. Accessed online at <www.medqic.org> 17 Apr 2008.
- 6) Phillips KW and Wittkowsky AK. Survey of pharmacist-managed inpatient anticoagulation services. *Am J Health-Syst Pharm*. 2007;64:2275-78.
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APPENDIX I.
Anticoagulation Management Performance Improvement Team
Self-Assessment Subgroup Regulatory Compliance Analysis

Implementation Expectation	Interpretation	UWHC Inpatient	UWHC Ambulatory
1. The organization implements a defined anticoagulant management program to individualize the care provided to each patient receiving anticoagulant therapy.	<ul style="list-style-type: none"> Defined = written for TJC 	<ul style="list-style-type: none"> No known coordinated effort, pockets of efforts in various service lines (HVC, Ortho, Stroke) 	<ul style="list-style-type: none"> No known coordinated effort, pockets of efforts in various clinics (Internal Medicine A/B, ED)
	<ul style="list-style-type: none"> Similar expectation related to infection control programs 	<ul style="list-style-type: none"> No known coordinated effort, pockets of efforts in various service lines (HVC, Ortho, Stroke) 	<ul style="list-style-type: none"> No known coordinated effort, pockets of efforts in various clinics (Internal Medicine A/B, ED)
2. To reduce compounding and labeling errors, the organization uses ONLY oral unit dose products and pre-mixed infusions, when these products are available.	<ul style="list-style-type: none"> No tablet splitting allowed at the level of the nurse 	<ul style="list-style-type: none"> Compliant 	<ul style="list-style-type: none"> Not applicable
	<ul style="list-style-type: none"> Must use pre-mixed infusions if commercially available 	<ul style="list-style-type: none"> Non-compliant 	<ul style="list-style-type: none"> Unknown
3. When pharmacy services are provided by the organization, warfarin is dispensed for each patient in accordance with established monitoring procedures.	<ul style="list-style-type: none"> Policy must be written to establish these procedures 	<ul style="list-style-type: none"> Non-compliant 	<ul style="list-style-type: none"> Non-compliant
	<ul style="list-style-type: none"> Eliminate all floorstock and cabinet override of warfarin 	<ul style="list-style-type: none"> Compliant 	<ul style="list-style-type: none"> Compliant
4. The organization uses approved protocols for the initiation and maintenance of anticoagulation therapy appropriate to the medication used, to the condition being treated, and to the potential for drug interactions.	<ul style="list-style-type: none"> Protocols must be approved by Pharmacy and Therapeutics Committee and/or Joint Practice Committee 	<ul style="list-style-type: none"> Compliant (Known approved guidelines include the following: Deep Venous Thrombosis (DVT), Outpatient Management of DVT, Factor VII, Heparin Therapeutic Infusion, Argatroban, Lepirudin, Periprocedural Anticoagulation, Phytonadione, LMWH Interchange and Dosing Guideline) 	<ul style="list-style-type: none"> Compliant (Known approved guidelines include the following: Deep Venous Thrombosis (DVT), Outpatient Management of DVT, Factor VII, Heparin Therapeutic Infusion, Argatroban, Lepirudin, Periprocedural Anticoagulation, Phytonadione, LMWH Interchange and Dosing Guideline)

Implementation Expectation	Interpretation	UWHC Inpatient	UWHC Ambulatory
5. For patients being started on warfarin, a baseline International Normalized Ratio (INR) is available, and for all patients receiving warfarin therapy, a current INR is available and is used to monitor and adjust therapy.	<ul style="list-style-type: none"> Policy needs to be written, institution defines what is current 	<ul style="list-style-type: none"> Non-compliant 	<ul style="list-style-type: none"> Non-compliant
6. When dietary services are provided by the organization, the service is notified of all patients receiving warfarin and responds according to its established food/drug interaction program.		<ul style="list-style-type: none"> Compliant 	
7. When heparin is administered intravenously and continuously, the organization uses programmable infusion pumps.		<ul style="list-style-type: none"> Compliant 	<ul style="list-style-type: none"> Compliant
8. The organization has a policy that addresses baseline and ongoing laboratories tests that are required for heparin and low molecular weight heparin therapies.	<ul style="list-style-type: none"> Policy needs to be written 	<ul style="list-style-type: none"> Non-compliant 	<ul style="list-style-type: none"> Non-compliant
9. The organization provides education regarding anticoagulation therapy to prescribers, staff, patients, and families.	<ul style="list-style-type: none"> Policy needs to be written 	<ul style="list-style-type: none"> Education provided but expectations, content, and accountability are not defined 	<ul style="list-style-type: none"> Education provided but expectations, content, and accountability are not defined
10. Patient/family education includes the importance of follow-up monitoring, compliance issues, dietary restrictions, and potential for adverse drug reactions and interactions.	<ul style="list-style-type: none"> Content is developed but not standardized 	<ul style="list-style-type: none"> Education provided but expectations, content, and accountability are not defined 	<ul style="list-style-type: none"> Education provided but expectations, content, and accountability are not defined
11. The organization evaluates anticoagulation safety practices	<ul style="list-style-type: none"> Formal PI plan with defined metrics 	<ul style="list-style-type: none"> Non-compliant 	<ul style="list-style-type: none"> Non-compliant

Implementation Expectation	Interpretation	UWHC Inpatient	UWHC Ambulatory
NQF 28 Evaluate each patient upon admission and regularly thereafter for the risk of developing VTE/DVT. Utilize clinically appropriate, evidence-based methods of thromboprophylaxis	<ul style="list-style-type: none"> • Document the VTE risk assessment and prevention plan in the patient’s record 	<ul style="list-style-type: none"> • Non-compliant 	<ul style="list-style-type: none"> • Non-compliant
	<ul style="list-style-type: none"> • Explicit organizational policies and procedures should be in place for the prevention of VTE 	<ul style="list-style-type: none"> • Non-compliant 	<ul style="list-style-type: none"> • Non-compliant
NQF 29 Every patient on long-term oral anticoagulants should be monitored by a qualified health professional using a careful strategy to ensure the appropriate intensity of supervision	<ul style="list-style-type: none"> • Explicit organizational policies and procedures should be in place regarding anti-thrombotic services that include, at a minimum, documentation of the following: <ol style="list-style-type: none"> 1. Indication for long-term anticoagulation 2. Target INR range 3. Duration of long-term anticoagulation and/or a review date 4. A longitudinal record of INR values and warfarin doses 5. Timing of the next INR appointment 	<ul style="list-style-type: none"> • Non-compliant 	<ul style="list-style-type: none"> • Non-compliant

APPENDIX II.
Anticoagulation Management Performance Improvement Team
Best Practices Subgroup Literature Review

Study	Key Results	Reference
Studies Focusing on Heparin and Warfarin Protocols/Nomograms		
1. Pooled comparison of anticoagulation clinics and routine medical care	<ul style="list-style-type: none"> Major bleeding events per patient-year: anticoagulation clinic, 0.028 (95% CI: 0-0.069) vs. routine care, 0.109 (95% CI: 0.043-0.268) Thromboembolic events per patient-year: anticoagulation clinic, 0.024 (95% CI: 0-0.08) vs. routine care, 0.162 (95% CI:0.062-0.486) 	Ansell JE, Hughes R. Evolving models of warfarin management: anticoagulation clinics,patient self-monitoring, and patient self-management. <i>Am Heart J.</i> 1996;132:1095-1100.
2. Twenty patients with acute DVT were treated with a heparin drip according to protocol, compared with 40 patients treated by physician preference	<ul style="list-style-type: none"> Time to therapeutic anticoagulant effect was significantly decreased in the group treated on protocol (p=0.025) 	Elliott CG, Hiltunen SJ, Suchyta M et al. <i>Archives of Internal Medicine.</i> 1994;154:999-1004.
Pharmacist-Managed vs. Physician-Managed Anticoagulation		
3. Analysis of 25 institutions' responses to a survey on the scope of existing pharmacist-managed inpatient anticoagulation services.	<ul style="list-style-type: none"> Majority of responders have a consultation-based service, and some provide automatic management of all patients on anticoagulants. The vast majority of services manage warfarin and heparin and some also manage LMWH, and Factor Xa inhibitors 	Phillips KW and Wittkowsky AK. <i>Am J Health-Syst Pharm.</i> 2007; 64:2275-78.
4. Analysis of adverse events related to outpatient warfarin therapy among 395 patients followed at a Veterans Affairs Hospital, with 306 enrolled in an anticoagulation clinic and 89 patients receiving usual care	<ul style="list-style-type: none"> Among the 12 patients with preventable adverse events related to anticoagulation, 8 were not enrolled in the anticoagulation clinic Patients receiving usual care had 20 times the relative risk (95% CI:6-62) of an adverse event compared with patients in the anticoagulation clinic. 	Hamby L, Weeks WB, Malikowski C. Complications of warfarin therapy: causes, costs, and the role of the anticoagulation clinic. <i>Eff Clin Pract.</i> 2000;3:179-184.
5. Two hospitals with pharmacist-managed inpatient anticoagulation services discuss important considerations for development and implementation	<ul style="list-style-type: none"> Activities of the pharmacists are discussed as well as challenges faced by both programs 	Dager WE, Gulseth MP. <i>Am J Health-Syst Pharm.</i> 2007;64:1071-79.

<p>6. An interdisciplinary team formally evaluated AC practices. A pharmacist-led AC service was implemented. Impact of this team was assessed.</p>	<ul style="list-style-type: none"> Following the implementation of a pharmacist-lead AC service, the hospital saw a decrease in VTE and bleeding rates, as well as projected an annual savings in over \$9 million in avoidable costs. 	<p>Jennings HR, Miller EC, Williams ES et al. Reducing anticoagulant medication adverse events and avoidable patient harm. <i>The Joint Commission Journal on Quality and Patient Safety</i>. 2008;34(4):196-200.</p>
<p>7. Comparison of pharmacist managed anticoagulation clinic with patient receiving usual care</p>	<ul style="list-style-type: none"> Patients in anticoagulation clinic had non-significant reductions in hospital admissions related to thromboembolic or bleeding events compared with control group. 	<p>Lee YP, Schommer JC. Effect of a pharmacist-managed anticoagulation clinic on warfarin-related hospital readmissions. <i>Am J Health Syst Pharm</i>. 1996;53:1580-1583.</p>
<p>8. Using the 1995 National Clinical Pharmacy Services database and the 1995 Medicare database for hospitals, data were retrieved for 717,396 Medicare patients treated in 955 hospitals for conditions requiring anticoagulant therapy.</p>	<ul style="list-style-type: none"> In hospitals without pharmacist-provided heparin management, death rates were 11.41% (p<0.0001), length of stay was 10.05% higher (p<0.0001), Medicare charges were 6.60% higher (p<0.0001), bleeding complications were 3.1% higher (p=0.0009) and the transfusion rate for bleeding complications was 5.47% (p=0.0008) than in hospitals with pharmacist-provided heparin management In hospitals without pharmacist-provided warfarin management, death rates were 6.20% (p<0.0001), length of stay was 5.86% higher (p<0.0001), Medicare charges were 2.16% higher (p<0.0001), bleeding complications were 8.09% (p<0.0001), and the transfusion rate for bleeding complications was 22.49% higher (p<0.0001) 	<p>Bond CA, Raehl CL. Pharmacist-provided anticoagulation management in United States hospitals: death rates, length of stay, Medicare charges, bleeding complications, and transfusions. <i>Pharmacotherapy</i>. 2004;24:953-63.</p>
<p>9. Inpatient pharmacist involved in collaborative process as part of discharge on low molecular weight heparin bridge therapy compared to historical control matched for injury severity in trauma</p>	<ul style="list-style-type: none"> Reduced length of stay (p<0.002) and inpatient days on warfarin (p<0.0001) 	<p>Bridges GC, Lee MD, Jenkins JK, et al. Expedited discharge in trauma patients requiring anticoagulation for deep venous thrombosis prophylaxis; the LEAP program. <i>J Trauma</i>. 2003;54:232-5</p>
<p>10. Pharmacist-assisted warfarin dosing protocol compared to physician direct dosing</p>	<ul style="list-style-type: none"> Decreased INR values >4 per patient (p=0.0059) Non-significant reduction in days to target INR or increase in INR values in target range favoring the pharmacist dose cohort 	<p>To EK, Pearson GJ. Implementation and evaluation of a pharmacist-assisted warfarin dosing program. <i>Can J Hosp Pharm</i>. 1997;50:169-75</p>

11. Protocol-driven dosing by pharmacist versus physician independent of protocol in orthopedic surgery patients	<ul style="list-style-type: none"> • Similar duration of inpatient therapy, no difference in complication rates 	Rivey MP, Wood RD, Allington DR, et al. Pharmacy-managed protocol for warfarin use in orthopedic surgery patients. <i>Am J Health-Syst Pharm.</i> 1995 Jun 15;52(12):1310-6
12. Pharmacist dosed warfarin after 4 days versus physician having the same protocol available	<ul style="list-style-type: none"> • Improved INR control ($p < 0.001$) with reduction in values > 6 or < 2 	Boddy C. Pharmacist involvement with warfarin dosing for inpatients. <i>Pharm World Sci.</i> 2001;23:31-5
13. Usual physician directed warfarin dosing to pharmacist consultation matched for anticoagulation indication	<ul style="list-style-type: none"> • Decreased critical INR values (> 3.5 or > 6.0; $p < 0.001$, length of hospital stay ($p = 0.009$) • Long-term outcomes on readmission for bleeding or recurrent thromboembolism at 3 months postdischarge showed a lower incidence of both in pharmacist cohort • For every \$1 spent on pharmacist staffing, \$8 in direct hospital cost savings were realized 	Dager WE, Branch JM, King JH, et al. Optimization of inpatient warfarin therapy; impact of daily consultation by a pharmacist-managed anticoagulation service. <i>Ann Pharmacother.</i> 2000;34:567-72.
14. Usual physician directed care to pharmacist management of heparin and warfarin under protocol using independent nomograms for each agent	<ul style="list-style-type: none"> • UFH: Increase aPTT values in ($p = 0.05$) or below ($p = 0.03$) the target range • Warfarin decreased time to initiate therapy ($p = 0.05$) and reduction in total hospital costs ($p = 0.05$) 	Mamdani MM, Racine E, McCreddie S, et al. Clinical and economic effectiveness of an inpatient anticoagulation service. <i>Pharmacotherapy.</i> 1999;19:1064-74.
15. Pharmacist-dosed heparin using new weight based protocol vs. physician	<ul style="list-style-type: none"> • Earlier aPTT in target range ($p < 0.001$) with fewer rate changes ($p < 0.001$) 	Pawloski SJ, Kersh PL. Therapeutic heparin monitoring service in a small community hospital. <i>Hosp Pharm.</i> 1992;27:703-6.
16. Pharmacy-managed inpatient anticoagulation service (using weight-based heparin protocol) for medicine inpatients compared with older fixed dose protocol without any active management by pharmacists	<ul style="list-style-type: none"> • Time to therapeutic PTT was less with nomogram protocol: 40 vs. 20 hours ($p < 0.05$) • Fewer supra-therapeutic PTTs with protocol: 1.7 vs. 5.5 ($p < 0.05$) • Bleeding rates: no difference but numbers were small 	Rivey MP, Peterson JP. Pharmacy managed, weight-based heparin protocol. <i>Am J Hosp Pharm.</i> 1993;50:279-284.
17. Performance of pharmacist run hospital-based outpatient anticoagulation clinic in England compared with historical control (management by rotating physician trainees)	<ul style="list-style-type: none"> • No significant difference for patients with stable INR in the baseline period, but patients with an INR result "out" of range were more likely to return to "in" range under anticoagulation clinic management compared with routine physician management 	Radley AS, Hall J, Farrow M, Carey PJ. Evaluation of anticoagulant control in a pharmacist operated anticoagulant clinic. <i>J Clin Pathol.</i> 1995;48:545-547.

<p>18. Pharmacy-managed inpatient anticoagulation service (flow sheet for monitoring, but no nomogram) for monitoring patients receiving warfarin for a variety of indications</p>	<ul style="list-style-type: none"> • Patients receiving the intervention were more likely to have PT “stability” at discharge: 61.5% vs. 42.3% (p=0.02) • Odds of having therapeutic PT at first outpatient clinic visit with intervention: OR 5.4 (95% CI: 1.87-15.86) 	<p>Ellis RF, Stephens MA, Sharp GB. Evaluation of a pharmacy-managed warfarin monitoring service to coordinate inpatient and outpatient therapy. <i>Am J Hosp Pharm.</i> 1992;49:387-394.</p>
<p>Multi-Disciplinary Anticoagulation Management Team Approach</p>		
<p>19. A multidisciplinary AC management team is described</p>	<ul style="list-style-type: none"> • Team consists of hematologist, pharmacist, and ARNP • ARNP role is described in detail and examples of nomograms and risk assessment tools are provided 	<p>Porter B. <i>AACN Clinical Issues.</i> 2002;13(2):221-33.</p>
<p>Nurse-Managed Anticoagulation</p>		
<p>20. Anticoagulation clinic for outpatients receiving warfarin for atrial fibrillation (managed by nurse practitioner using warfarin dosing nomogram)</p>	<ul style="list-style-type: none"> • Minor increase in percentage of patients with INR in desired range: 53.7% vs. 49.1% (p<0.05, but questionable clinical significance) 	<p>Gaughan GL, Dolan C, Wilk-Rivard E, Geary G, Libbey R, Gilman MA, et al. Improving management of atrial fibrillation and anticoagulation in a community hospital. <i>Jt Comm J Qual Improv.</i> 2000;26:18-28.</p>
<p>21. A discussion of nursing issues as they relate to the administration and monitoring of UFH</p>	<ul style="list-style-type: none"> • Emphasis is placed on the importance of education, information technology, and collaborative, multidisciplinary team approaches to anticoagulation management 	<p>Oertel LB. <i>Pharmacotherapy.</i> 2004;24(8 Pt 2):156S-160S.</p>
<p>Anticoagulation Hospital-Wide Education</p>		
<p>22. Evaluation of the effects of a hospital-wide VTE prophylaxis educational program</p>	<ul style="list-style-type: none"> • Education consisted of inservices, newsletters and quality assurance presentations on VTI prophylaxis. • A post-education chart review was performed and optimal VTE prophylaxis rates increased from 11% to 44% (p<0.001) 	<p>Dobesh PP, Stacy ZA. <i>Journal of Managed Care Pharmacy.</i> 2005;11(9):755-62.</p>
<p>Expert Opinion on Anticoagulation Management</p>		
<p>23. The Seventh ACCP Conference on Antithrombotic and Thrombolytic Therapy: Evidence-Based Guidelines</p>	<ul style="list-style-type: none"> • Evidence-based clinical practice guidelines on the use of anticoagulants • (New version expected in 2008) 	<p><i>Chest.</i> 2004;126(3 Suppl).</p>

24. Expert commentary on the management of anticoagulation in patients with atrial fibrillation	<ul style="list-style-type: none"> • Comments on the ACCP Chest Guidelines, the CHADs scoring criteria and ASHP Therapeutic Position Statement on anticoagulation management in patients with atrial fibrillation 	Dager WE. <i>Am J Health-Syst Pharm.</i> 2007;64:2279-80
25. ASHP Therapeutic Position Statement on Antithrombotic Therapy in Chronic Atrial Fibrillation	<ul style="list-style-type: none"> • American Society of Health-System Pharmacists (ASHP) statement of support of the ACCP recommendations for AC therapy in patients with chronic atrial fibrillation 	Nutescu EA. <i>Am J Health-Syst Pharm.</i> 2007;64:2281-91
Use of Technology in Anticoagulation Management		
26. Reported reductions in ADE related to anticoagulants by use of trigger tools	<ul style="list-style-type: none"> • Trigger tools increased the ability to provide real-time alert-based interventions • 45% reduction in inpatient AC adverse events • 53% reduction in outpatient AC adverse events 	Lederer J, Best D. <i>Journal on Quality and Patient Safety.</i> 2005;31(6):313-18
27. Pharmacy-based computer assisted heparin dosing compared to random historical cohort	<ul style="list-style-type: none"> • Earlier time to target aPTT value (p<0.001) 	Kershaw B, White RH, Muhgall D, et al. Computer-assisted dosing of heparin. Management with a pharmacy based anticoagulation service. <i>Arch Intern Med.</i> 1994;154:1005-11
Other		
28. Medline review of articles relating to the prevention and treatment of VTE in order to determine how to choose appropriate antithrombotic agents	<ul style="list-style-type: none"> • Data exists for the use of warfarin, heparin, LMWH, and fondaparinux for prevention and treatment of VTE • No one treatment is optimal for all patients. Many factors such as type of surgery, bleeding risk, and comorbid conditions need to be considered 	Nutescu EA, Wittkowsky AK, Dobesh PP et al. <i>Annals of Pharmacotherapy.</i> 2006; 40:1558-71.