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Bleeding Risk and Fall Response in Hospitalized Patients Receiving Warfarin: Roles of Pharmacists, Laboratory Professionals, Dietitians, Healthcare Assistants, Healthcare Security Personnel, Medical Coders, and Hospital Administrators

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Abstract

Background: Hospitalized patients receiving warfarin need protection from thromboembolism, bleeding, and fall-related injury. Fragmented medication, laboratory, nutritional, and operational processes can delay appropriate care.
Methods: A targeted synthesis examined guidelines, clinical studies, and safety standards available through 31 December 2024, addressing anticoagulation assessment, fall prevention, bleeding management, and multidisciplinary responsibilities.
Results: Priorities include verifying the anticoagulation indication and international normalized ratio (INR) target, reviewing interactions, ensuring reliable laboratory communication, supporting consistent vitamin K intake, and individualizing fall precautions. Head-injury findings determine imaging urgency; warfarin use does not make every fall an automatic indication for computed tomography. Major bleeding and an isolated elevated INR require different management. Pharmacist-directed services and tailored fall-prevention programs support selected outcomes, but evidence does not establish an independent bleeding-prevention effect for every profession.
Conclusion: A coordinated pathway connects clinical expertise with observation, environmental safety, accurate coding, and institutional accountability. Professional boundaries, prompt escalation, individualized treatment decisions, and reliable follow-up are central to implementation. The combined pathway requires prospective evaluation.

Keywords: Warfarin; Patient falls; Hemorrhage; Anticoagulation; Interprofessional collaboration; Patient safety.

INTRODUCTION

Warfarin remains an important anticoagulant, but its narrow therapeutic range makes safe prescribing dependent on the relationship between indication, dose, international normalized ratio (INR), and the patient's changing clinical condition. Hospital admission may introduce medication changes, interrupted intake, procedures, and communication failures that destabilize previously satisfactory treatment. An INR result becomes useful only when a responsible clinician interprets it and an appropriate action reaches the bedside.[1,2]

The objective is to prevent avoidable harm while preserving necessary antithrombotic protection. NICE guidance for atrial fibrillation advises against withholding anticoagulation solely because of age or fall risk. That principle does not remove the need to reassess a patient with active hemorrhage or recurrent injurious falls. Similarly, changing anticoagulants requires indication-specific judgment: the RE-ALIGN trial was stopped early because dabigatran caused excess thromboembolic and bleeding events in patients with mechanical valves. A fall is therefore not an instruction to substitute a direct oral anticoagulant automatically.[3,4]

The World Health Organization describes medication harm as an interaction among medicines, patient and provider characteristics, and healthcare systems. This framework is especially relevant when responsibility extends beyond prescribers. Pharmacists, laboratory professionals, dietitians, healthcare assistants, healthcare security personnel, medical coders, and administrators contribute at different points. Their participation should strengthen the clinical team's work without implying interchangeable competencies or a proven outcome benefit for each role.[5]

Review approach

This review uses a targeted, selective evidence synthesis restricted to material published or issued by 31 December 2024. Searches of bibliographic records and authoritative organizational publications addressed warfarin monitoring, interactions, vitamin K intake, reversal, inpatient falls, head injury, critical laboratory results, coding, and patient-safety governance. Publication details were checked against PubMed/Europe PMC records or the issuing organization. Guidelines and standards were interpreted alongside relevant trials and observational evidence.

The approach was not a systematic review: no exhaustive retrieval, duplicate independent screening, pooled analysis, or formal certainty assessment was undertaken. No original patient data were collected. Clinical recommendations are distinguished from proposed operational arrangements. Where evidence concerns ambulatory anticoagulation, general inpatient populations, or emergency-department head injury, its transfer to hospitalized warfarin recipients is identified as an application requiring clinical judgment.

Identifying modifiable bleeding risk

Admission reconciliation should establish why warfarin is prescribed, the intended duration, the prescribed INR range, recent doses, the last dose actually taken, and recent INR results. A target range of 2.0–3.0 is common for atrial fibrillation and venous thromboembolism, but mechanical-valve targets depend on valve and patient characteristics. Relevant baseline information includes prior bleeding, anemia, kidney or liver dysfunction, alcohol exposure, previous falls, cognition, and the ability to follow a dosing schedule.[1,2]

Medication review must include nonprescription products and recent antimicrobial courses. In a veterans cohort, selected antibiotic co-prescriptions were associated with serious bleeding, while early INR testing after co-prescription was associated with lower risk. These observational findings support active surveillance rather than proving that a particular testing interval prevents every event.[6] Concomitant nonsteroidal anti-inflammatory drugs also increase bleeding risk: a meta-analysis reported nearly doubled odds of gastrointestinal bleeding with warfarin plus an NSAID. Gastrointestinal injury and platelet effects mean that a therapeutic INR cannot exclude clinically important medication-related bleeding.[7]

Bleeding vulnerability and fall propensity overlap but are not identical. Sedation, orthostatic symptoms, impaired transfers, urgency, and delirium require attention even when anticoagulation is within range. Conversely, excessive anticoagulation may be hazardous without a fall. Combining these assessments allows the team to address the mechanism of risk instead of treating the anticoagulant label as a substitute for examination.

Pharmacists, pharmacy technicians, and medication coordination

Pharmacists connect the treatment indication with the medication record, laboratory trend, interaction profile, and clinical condition. Within local prescribing arrangements, they can recommend dose changes, identify unnecessary concurrent antithrombotics, check reversal-product selection, and coordinate discharge follow-up. The medication record should distinguish an intentional temporary hold from an omitted dose and identify the clinician responsible for restarting treatment.

In a cluster randomized study involving 500 inpatients, a pharmacist-directed anticoagulation service improved compliance with transition-of-care measures. The reported reduction in a composite safety endpoint did not reach statistical significance; it should not be presented as conclusive proof of reduced major bleeding.[8] A systematic review of ambulatory services generally favored pharmacist-managed anticoagulation control, but outpatient findings cannot establish the effect of an inpatient multidisciplinary fall-response pathway.[9]

Pharmacy technicians and assistants support accurate medication histories, supply continuity, strength and formulation checks, and the practical availability of prescribed treatment under institutional policy. They can identify discrepancies and route them to the pharmacist or prescriber. Dose selection, interpretation of bleeding severity, and authorization of reversal remain with appropriately licensed clinicians. A useful safety measure is whether discrepancies are resolved before administration, rather than simply counting how many discrepancies staff identify.

Laboratory professionals: reliable INR testing and escalation

The laboratory contribution begins before analysis. Patient identification, correct citrate collection, adequate tube filling, mixing, and timely transport affect coagulation results. Underfilling can alter the blood-to-anticoagulant ratio; very high hematocrit may require citrate adjustment. Clotted, contaminated, or otherwise unsuitable specimens require action under laboratory acceptance criteria. When a result conflicts with the clinical picture, laboratory and clinical teams should investigate sampling or analytical error without delaying urgent treatment of an unstable patient.[10]

Testing frequency should reflect clinical circumstances. Initiation, significant medication changes, acute illness, abnormal results, bleeding, and reversal warrant closer monitoring than stable maintenance treatment. The institution should define how results become visible to the responsible team and how the next test is scheduled. INR measures vitamin K antagonist effect; it does not measure every contributor to hemorrhage or identify the bleeding site.[1,2]

Critical-result policies require an agreed notification threshold, an identified recipient, acknowledgment, and escalation when the recipient cannot be reached. CLSI GP47 emphasizes timely communication and organizational responsibility rather than a single universal threshold. Laboratory professionals should record the communication, including relevant timing and recipient, and participate in audits of delays. An automatically released result without confirmed clinical follow-up is an incomplete safety process.[11]

Dietitians: nutritional consistency without unnecessary restriction

Dietary counseling should promote a reasonably consistent vitamin K pattern, not prohibit vegetables. A systematic review found heterogeneous evidence and did not support routine restriction of dietary vitamin K as a way to improve anticoagulation. Dietitians can assess the patient's usual foods, recent poor intake, nutritional supplements, enteral products, and changes during admission, then communicate meaningful changes to the anticoagulation team.[12]

A small randomized trial in patients with unexplained unstable anticoagulation found improved INR stability with low-dose vitamin K supplementation. This selected population and surrogate outcome do not

justify routine supplementation for every hospitalized warfarin recipient. Guidance advises against routine supplementation solely to improve anticoagulation control.[13,2] The practical objective is adequate nutrition with foreseeable intake, followed by appropriate monitoring when intake changes. Counseling should use foods and meal patterns familiar to the patient and should align with the discharge medication instructions.

Fall prevention and the role of healthcare assistants

Fall prevention should translate assessment into an individualized plan. In a cluster randomized trial, a tailored fall-prevention toolkit reduced falls but did not demonstrate a significant reduction in fall-related injuries.[14] A later nonrandomized controlled study found associations with fewer falls and injurious falls. Its design limits causal attribution, and neither study tested a warfarin-specific program.[15]

Healthcare assistants can provide substantial practical support: keeping call devices and prescribed mobility aids accessible, assisting with toileting and transfers as trained, checking the immediate environment, and promptly reporting changes in alertness, gait, bruising, or visible bleeding. Delegation must specify tasks, supervision, and escalation. An assistant's observation should trigger assessment by the nurse or treating clinician; it should not be treated as a diagnosis or permission to alter anticoagulation.[16]

A care plan should state the assistance required for mobility and how staff respond when needs change. Patients and families need a consistent explanation of when to request help. Assistance should support safe activity rather than create avoidable immobility. The proposed pathway should also record whether planned help was available when needed, because a documented precaution has little value if staffing or workflow makes it inaccessible.

Responding to a fall and suspected head injury

After a fall, the initial priority is clinical assessment and stabilization. The response should establish the time and circumstances, witnessed or possible head impact, symptoms, baseline cognition, anticoagulant exposure, and other injuries. An unwitnessed event or unreliable history requires careful clinician assessment. Staff should preserve relevant observations and activate the appropriate emergency response when deterioration is apparent.

For a patient who has sustained a head injury, NICE NG232 distinguishes urgent imaging criteria from anticoagulant use alone. Where no other CT indication exists, it recommends considering CT within eight hours of injury for people taking anticoagulants, or within one hour if presentation is more than eight hours after injury. Neurological findings and other specified high-risk features can require earlier imaging. These recommendations concern head injury, not every fall in a patient taking warfarin.[17]

The 2023 ACEP policy advises against routine repeat CT or routine admission solely for observation after minor head injury when an anticoagulated patient has a normal baseline neurological examination, a negative initial CT, and no other indication for monitoring. This emergency-department recommendation does not replace the continuing care needs of an already hospitalized patient. New symptoms or deterioration require reassessment.[18]

Distinguishing excessive anticoagulation from major bleeding

An elevated INR and a major hemorrhage are different clinical states. The ACC pathway characterizes major bleeding as bleeding at a critical site, bleeding causing hemodynamic instability, or clinically overt bleeding associated with a hemoglobin decrease of at least 2 g/dL or transfusion of at least two units of red cells. Management includes stopping the anticoagulant, stabilizing circulation, identifying the source, and arranging appropriate procedural or specialist care. Reversal is considered for life-threatening bleeding or major bleeding that does not resolve with initial management.[19]

For patients treated with a vitamin K antagonist for venous thromboembolism who have INR greater than 4.5 but below 10 without clinically relevant bleeding, ASH suggests temporary cessation alone rather than routine vitamin K. In life-threatening bleeding with an elevated INR, it suggests four-factor prothrombin complex concentrate (4F-PCC) rather than plasma, together with warfarin cessation and intravenous vitamin K. These are conditional recommendations, and clinical context remains essential.[20]

In a randomized trial of major bleeding, 4F-PCC was noninferior to plasma for hemostatic efficacy and superior for rapid INR correction. This supports prompt factor replacement when indicated but does not establish a mortality advantage.[21] The smaller INCH trial similarly favored PCC for rapid INR normalization in vitamin K antagonist-associated intracranial hemorrhage; it was stopped early, and definitive clinical-outcome conclusions were limited.[22]

Intracranial hemorrhage requires urgent specialist management. The 2022 AHA/ASA spontaneous intracerebral hemorrhage guideline supports rapid reversal of vitamin K antagonist anticoagulation, but its scope excludes traumatic hemorrhage; trauma-specific evaluation remains necessary after a fall.[23] Product dosing and repeat testing should follow the relevant protocol. INR correction alone is not proof that bleeding has stopped. Table 1 summarizes distinct response states without replacing bedside assessment.

Table 1. Distinguishing common post-fall and anticoagulation response states

Clinical state	Principal response	Essential safeguard
Fall without established head injury or major bleeding	Assess injuries, symptoms, circumstances, and anticoagulation status; update prevention plan	Do not order reversal or stop long-term treatment solely because a fall occurred
Head injury during warfarin treatment	Apply urgent clinical criteria; consider CT under the NICE anticoagulant pathway	Timing follows head-injury findings and presentation time, not the fall label alone[17]
Elevated INR without clinically relevant bleeding	Review cause and clinician-directed dose interruption or adjustment; arrange repeat INR	Do not equate an abnormal result with major hemorrhage[20]
Life-threatening or persistent major bleeding	Stabilization, source control, urgent clinical escalation, and indicated reversal	For warfarin, 4F-PCC is accompanied by vitamin K; monitor clinical response[19,20]
Recovery after bleeding	Reassess indication, bleeding source, thrombotic risk, and readiness to restart	Establish a documented individualized plan rather than indefinite unreviewed interruption

Healthcare security personnel and a safe response environment

Healthcare security personnel can help keep access routes clear, manage bystanders, protect privacy, identify environmental hazards, and facilitate the arrival of emergency responders. When a fall occurs in a corridor or public area, prompt notification and control of the surrounding space can support clinical assessment. Their incident account should record observed circumstances rather than speculate about injury or medication causality.

These are proposed operational contributions, not independently proven interventions against warfarin-related bleeding. Security staff should not determine CT eligibility, interpret INR results, or direct anticoagulant reversal. Restraint is not a default response to fall risk or confusion; clinical assessment, de-escalation, and applicable institutional safeguards govern any restrictive intervention. Roles should be rehearsed with the clinical team so that assistance does not obstruct care or expose confidential information.

Medical coders and trustworthy safety information

Medical coders translate documented diagnoses and circumstances into the classification required by their jurisdiction. Their contribution depends on clear clinical documentation of injury, bleeding site,

medication exposure, treatment, and any clinician-established relationship between a drug and harm. An elevated INR, a fall, and warfarin use appearing in the same record do not themselves authorize the coder to diagnose warfarin-induced bleeding.

The United States FY2024 ICD-10-CM guidelines illustrate why accurate documentation matters: adverse effects of correctly used medicines differ from poisoning involving improper use. These categories and sequencing rules should not be assumed to govern Saudi practice; the locally adopted classification and standards apply. When documentation is incomplete or inconsistent, coders should obtain clarification through the approved query process rather than independently adjudicating causality.[24] For quality improvement, coded events should be compared with clinical records and incident reports, because coding changes can alter apparent event rates without a corresponding change in patient harm.

Hospital administrators, governance, and care transitions

Administrators make the pathway workable by assigning accountable leadership, defining escalation arrangements, supporting staff training, and ensuring access to laboratory testing, imaging, reversal agents, and appropriate emergency care. They should involve clinical departments and support services when designing the pathway and investigate barriers reported by frontline personnel. The WHO patient-safety action plan supports institutional leadership, patient participation, workforce capability, and learning from harm.[25]

Evaluation should include clinically adjudicated major bleeding and injurious falls alongside process measures such as reconciliation completion and response to critical results. Balancing measures include thromboembolic events, excessive anticoagulant interruption, loss of mobility, and unnecessary testing. Rates need suitable denominators and case-mix interpretation; time in therapeutic range over a short, unstable admission should not be treated as equivalent to long-term outpatient control.

Discharge creates another vulnerable transition. A named clinician or service should receive the indication, INR target, dose plan, most recent result, next testing arrangement, interaction changes, and any unresolved bleeding or fall concerns. Patients should receive understandable instructions, including what symptoms require urgent help. WHO transition-of-care guidance emphasizes structured processes, information continuity, workforce capacity, and patient involvement.[26] Table 2 brings the professional roles together as a proposed implementation framework.

Table 2. Proposed professional responsibilities and auditable implementation measures

Professional group	Contribution within authorized scope	Example process measure
Pharmacists and pharmacy support staff	Clinical medication review by pharmacists; supervised reconciliation, supply, and discrepancy escalation by technicians or assistants	Unresolved medication discrepancies before the next planned dose
Laboratory professionals	Specimen quality, validated INR analysis, critical-result communication, and escalation	Time to acknowledgment of a critical result
Dietitians	Assess intake and supplements; support nutritional adequacy and consistent vitamin K intake	Documented communication of substantial intake changes
Healthcare assistants	Delegated mobility assistance, environmental checks, observation, and escalation	Availability of the assistance specified in the care plan

Professional group	Contribution within authorized scope	Example process measure
Healthcare security personnel	Clear access, manage the immediate environment, notify clinicians, and support response logistics	Identified access or environmental hazards resolved
Medical coders	Apply local coding rules to supported documentation; seek appropriate clarification	Clinically reviewed agreement between coded events and records
Hospital administrators	Resource allocation, clear responsibilities, staff preparation, and multidisciplinary learning	Completion of agreed corrective actions after event review

Limitations and research priorities

Evidence supporting this topic is uneven. Pharmacist services and tailored fall-prevention programs have been evaluated, but their designs, populations, and outcomes differ. Nutritional studies often measure INR stability rather than major bleeding. Reversal trials provide stronger evidence for rapid correction than for mortality, and selected guideline recommendations remain conditional. Head-injury guidance must be applied to the clinical presentation and setting.

The combined seven-profession pathway proposed here has not been tested as a single intervention. Security and coding contributions are principally organizational, and causal claims about their independent effects would be premature. Local evaluation should prospectively define bleeding severity, fall injury, treatment delays, and thrombotic balancing outcomes. Future studies should examine implementation fidelity, patient experience, staffing requirements, and the reliability of information exchanged between services.

Conclusion

Protecting hospitalized patients who receive warfarin requires coordinated attention to anticoagulation, mobility, injury assessment, and the systems connecting them. Safety depends on recognizing the difference between a medication discrepancy, an elevated INR, a fall, a head injury, and a major hemorrhage. Each may require a different response. An institutionally agreed pathway should help staff recognize these distinctions, reach the appropriate clinician promptly, and document what happened and what action followed.

The professions represented in this review offer complementary contributions. Pharmacists support medication decisions and transitions, while pharmacy technicians and assistants strengthen the reliability of delegated medication processes. Laboratory professionals make monitoring dependable through specimen quality and communication. Dietitians help reconcile anticoagulation requirements with adequate nutrition. Healthcare assistants contribute repeated bedside observation and practical support for safe movement. Security personnel facilitate a safe environment and unobstructed emergency response. Medical coders preserve the accuracy of documented information, and administrators provide the resources and accountability necessary for the pathway to function.

Implementation should preserve professional boundaries and avoid attributing benefits that have not been demonstrated. The aim is neither unrestricted continuation of anticoagulation despite significant bleeding nor reflex withdrawal after any fall. Decisions should reflect the treatment indication, current injury and bleeding findings, reversible hazards, thrombotic risk, and the patient's preferences. Durable improvement requires reviewing clinically meaningful outcomes together with process reliability and balancing harms. A well-coordinated service is therefore defined by timely, appropriate decisions and continuity of responsibility, rather than by the number of disciplines listed in its policy.

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