

Design and Evaluation of a Pharmacy Medication Safety Platform for Reducing Prescription Errors in Ambulatory Multispecialty Care

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Abstract: *Multispecialty hospitals routinely expose patients to several independent prescribers, and this fragmentation makes it difficult for any single clinician to see the complete medication picture. Cardiology, nephrology, pulmonology and endocrinology teams frequently prescribe for the same ambulatory patient without a shared, real-time view of what has already been ordered elsewhere, and this gap is a well-recognised driver of drug duplication, drug–drug interactions, contraindicated combinations and dosing errors. This work describes the design and preliminary evaluation of a pharmacy medication safety platform intended to close that gap. A structured knowledge base was built from peer-reviewed literature and established drug-information resources covering five clinical specialties, and each eligible drug pair or medication-related problem was classified as a synergistic effect, an antagonistic effect, a therapeutic duplication, a contraindication, a drug–drug interaction, or a dose-related error. The platform links every prescription to a single, unique per-patient identifier so that medication histories generated in one department remain visible to prescribers in another. A rule-based screening engine, referred to here as the Cross-Interaction Decision Guard, compares each newly entered drug against the patient's existing medication record in real time and returns a severity-tiered alert together with the clinical reasoning behind it and, where appropriate, a safer alternative. Representative test scenarios drawn from the literature confirmed that the platform correctly identified synergistic and antagonistic combinations, cross-department duplication, established drug–drug interactions and dose-ceiling violations. The findings support the feasibility of a centralised, severity-tiered approach to ambulatory medication safety and indicate that such a system could meaningfully reduce preventable prescription errors once validated prospectively in a live clinical setting.*

Keywords: Clinical decision support system; medication safety; prescription errors; drug–drug interaction; adverse drug reaction; ambulatory care; polypharmacy

1. Introduction

A prescription error occurs whenever a decision about a patient's medicine, or the way that decision is written down, departs from what an experienced clinician would judge to be correct, and it remains the single most common category of medication error encountered in everyday practice [1]. Because a prescription is usually the first and most consequential step in the medication-use process, an error introduced at this stage tends to propagate through dispensing and administration largely unchecked. Prescribing mistakes have been implicated as a major contributor to preventable patient harm, with some estimates placing medical error among the leading causes of death in hospitalised populations [2], and the World Health Organization has made medication-related harm a global patient-safety priority through its "Medication Without Harm" initiative [3].

The scale of the problem is not confined to any single health system. Systematic reviews of prescribing performed by junior doctors in the United Kingdom report error rates that, while variable across studies, are consistently high enough to be considered a routine feature of hospital prescribing rather than a rare event [4], and community-based audits describe similar patterns in general practice [5,6]. In lower- and middle-income settings, including India, patients with chronic, multi-drug regimens appear to be at particularly elevated risk, since long-term therapy for conditions such as hypertension, diabetes and chronic kidney disease multiplies the number of possible drug combinations a prescriber must reason about at every visit [7].

Several distinct but overlapping problems sit under the umbrella term "prescription error." An adverse drug reaction (ADR) is a harmful and unintended response to a medicine given at a normal dose, and ADRs are estimated to account for a substantial share of hospital admissions while also ranking among the leading preventable causes of inpatient death [8,9]. A drug contraindication arises when a medicine is prescribed despite a condition, an organ impairment or a concurrent therapy that makes its use unsafe; these are frequently missed because most clinical checking tools are built around drug–drug logic rather than drug–disease matching [10]. Therapeutic duplication, in which a patient is unknowingly prescribed two products from the same pharmacological class, is common wherever prescribing is fragmented across specialties and has been linked to unnecessary toxicity and avoidable cost [11]. Drug synergism, where two agents acting through different mechanisms converge on the same physiological endpoint, can be clinically useful when intended but hazardous when accidental, and its antagonistic counterpart, in which one drug actively opposes the effect of another, carries an even more immediate risk profile. Classical drug–drug interactions (DDIs) remain widely under-detected: manual chart review has been shown to capture only a fraction of clinically important interactions, and detection accuracy falls further as the number of medicines a patient is taking increases [12,13]. Finally, dose-calculation errors, arising from simple arithmetic slips, unit confusion or reliance on paper-based prescribing, continue to occur even in settings with partial electronic support [14].

Volume 15 Issue 9, September 2026

Fully Refereed | Open Access | Double Blind Peer Reviewed Journal

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These risks are magnified in multispecialty ambulatory care, where a single patient may be seen by cardiology, nephrology, pulmonology, endocrinology and neurology teams in the course of routine follow-up. Each department typically records its own prescriptions, and unless that information is actively shared, a second or third prescriber has no reliable way of knowing what has already been ordered. Electronic health record systems have been widely adopted as a partial remedy, but several evaluations of ambulatory electronic prescribing tools have found meaningful gaps in medication-related decision support and reconciliation, with some multiclinic assessments reporting that fewer than one in ten clinics could reliably reconcile a patient's medication list across encounters [15]. Clinical decision support systems (CDSS) that flag interactions automatically are one proposed solution, yet their real-world value is often undermined by alert fatigue: when a system raises large numbers of low-specificity warnings, override rates as high as 90 percent have been reported, meaning that clinically important alerts risk being dismissed along with trivial ones [16,17].

The present work responds to this gap by describing the design of a pharmacy medication safety platform built around a single, longitudinal, patient-centred medication record rather than department-specific records, paired with a severity-tiered alerting engine intended to preserve clinician trust while still catching the errors that matter. The specific aims were to (i) construct a literature-derived knowledge base of clinically significant drug pairs and medication-related problems across five major specialties, (ii) design a unique-identifier architecture capable of linking prescriptions generated in different departments into one shared record, and (iii) evaluate the resulting system's ability to detect representative synergistic, antagonistic, duplication, interaction and dose-related error scenarios drawn from the published literature.

2. Literature Review

A growing body of evidence supports the use of computerised decision support for medication safety, while also cautioning against its most common failure mode. A 2023 scoping review of CDSS interventions aimed at optimising drug prescribing found that the most successful implementations tended to involve active pharmacist participation and tight integration with existing clinical information systems, rather than a standalone alerting tool bolted onto the prescribing workflow [18]. A parallel rapid review conducted for the U.S. Agency for Healthcare Research and Quality concluded that computerised CDSS can reduce medication errors with moderate-strength evidence, but flagged alert fatigue, inappropriate overrides and other unintended consequences as persistent limitations that any new system must design around rather than ignore [19].

The alert-fatigue problem has been quantified in several recent analyses. A systematic review of DDI-alert behaviour reported override rates ranging from 55 to 98 percent across studied systems, and a more recent meta-analysis placed the overall physician override rate at approximately 90 percent, a figure that underlines how easily an undifferentiated warning system can be rendered clinically inert [16,17]. Economic evaluations of interaction-checking support have nonetheless

found a positive return on investment when alerts are well targeted, reinforcing the argument that the problem lies in alert specificity and design rather than in the underlying concept of automated checking [20].

Ambulatory settings present a distinct challenge from the inpatient CDSS literature that dominates much of this evidence base. Assessments of outpatient electronic health records have documented substantial variability in medication-safety functionality between systems, and one evaluation using a standardised ambulatory medication-safety tool found a mean safety score of only 57 percent across the clinics assessed, with electronic medication reconciliation functioning adequately in only a small minority of sites [15]. Systematic reviews focused specifically on ambulatory and outpatient prescribing echo this concern, identifying care transitions, cross-specialty prescribing and incomplete medication reconciliation as recurring contributors to preventable ambulatory medication errors [21,22].

On the data-infrastructure side, curated drug-interaction knowledge bases such as DDInter and DrugBank have become standard reference sources for building CDSS logic, since they provide structured information on interacting drug pairs together with severity ratings, proposed mechanisms and suggested management strategies [23,24]. More recent work has also begun exploring machine-learning approaches to DDI and synergy prediction, suggesting that rule-based knowledge-driven systems of the kind described here may eventually be complemented by predictive models, although such approaches currently remain at an earlier stage of clinical validation than curated, literature-derived rule sets [25,26]. Taken together, the literature converges on three design principles that were carried into the present platform: prescribing decision support is more effective when it is integrated into existing clinical workflows rather than imposed alongside them; alerts must be prioritised by clinical severity to avoid the fatigue that erodes trust in the system; and ambulatory, cross-specialty medication reconciliation remains a comparatively under-served problem relative to single-department inpatient CDSS.

3. Materials and Methods

This project did not involve prospective patient recruitment. Instead, it followed a structured, literature-derived approach in which published evidence and validated drug-information resources were used to build and test the platform's clinical knowledge base, consistent with the proof-of-concept scope appropriate to a dissertation-stage software design.

1) Data Sources and Search Strategy

Bibliographic and drug-information databases were searched to identify clinically relevant medication-related problems applicable to both inpatient multispecialty and ambulatory outpatient care. The primary bibliographic sources searched were PubMed/MEDLINE, Scopus, Web of Science, SpringerLink, Google Scholar and Harvard Academic search platforms, supplemented by the curated pharmacological reference DrugBank. PubMed/MEDLINE was used chiefly to identify peer-reviewed clinical and pharmacological literature and CDSS-evaluation studies; Scopus and Web of Science supported citation tracking and identification of

multidisciplinary sources; and DrugBank was used to verify and cross-check individual drug-pair information, since curated interaction databases of this kind are widely regarded as reliable references for interaction mechanism, severity and recommended management [23,24]. Search terms combined concepts related to clinical decision support ("clinical decision support system," "CDSS"), medication-related problems ("drug-drug interaction," "medication error," "prescribing error," "therapeutic duplication," "contraindication," "synergism," "antagonism," "polypharmacy") and setting ("ambulatory care," "outpatient," "multispecialty hospital," "medication safety"). Recent publications were prioritised, while older landmark studies were retained where they remained directly relevant to CDSS methodology, reflecting the continuing evolution of both drug-interaction evidence and CDSS design practice.

2) Inclusion and Exclusion Criteria

A drug pair or medication-related problem was included in the knowledge base when both agents were in routine clinical use, the problem was documented in a recognised drug-information database or peer-reviewed source, the pharmacodynamic or pharmacokinetic consequence was clinically meaningful rather than purely theoretical, and the combination was relevant to the medication classes commonly prescribed in multispecialty hospital or ambulatory settings. Entries were excluded when supporting evidence was purely theoretical, when two entries represented different brand names of an identical active ingredient, or when the available information was insufficient to assign a clinically actionable recommendation. Where the same interaction was reported by more than one source, the information was consolidated into a single entry rather than counted twice, and particular attention was paid to medication combinations that arise during care transitions such as hospital admission, discharge and referral between specialties, since patients frequently continue medicines initiated by different prescribers across these transitions.

3) Data Extraction and Categorisation

For every eligible entry, the following variables were extracted: the generic and chemical names of each drug; the pharmacological or therapeutic class; the type of medication-related problem; the expected clinical consequence and its severity; the supporting evidence; the recommended clinical action; applicability to inpatient and/or ambulatory settings; and the proposed alert category and priority. Each entry was then assigned to one of six predefined categories- drug synergism, drug antagonism, therapeutic duplication, drug contraindication, drug-drug interaction, or dose-calculation error- so that the resulting alert could carry both a classification and an explanation rather than a bare notification. This distinction was considered important given the well-documented tendency of clinicians to override generic, non-specific interaction alerts [16,17]. The final knowledge base spanned five major clinical specialties- cardiology, nephrology, pulmonology, endocrinology and, to a lesser extent, neurology- chosen because they represent departments through which ambulatory multispecialty patients commonly rotate.

4) Platform Architecture and Workflow

The platform is organised around a unique per-patient identifier rather than a department-specific record. On first registration, each patient is assigned a code that links their demographic details, known allergies, current medications, prior medications (including those obtained outside the hospital) and diagnoses into a single longitudinal profile. When the patient is subsequently seen in any department, the prescriber accesses this shared record instead of starting from a blank department-specific chart, which is the architectural feature intended to close the cross-department visibility gap identified in the literature review [15].

Each drug record in the knowledge base is stored in a structured, machine-readable (JSON-based) format containing the fields described in Section III-C, which allows the screening logic to be queried programmatically rather than searched manually. When a prescriber selects a medicine, the platform displays the standard recommended dose and permissible maximum, accepts the prescriber's chosen dose, formulation, duration and instructions, and then passes the new entry to a rule-based screening engine- referred to here as the Cross-Interaction Decision Guard- which checks it against every medicine already present in the patient's unified record, irrespective of which department originally prescribed them.

Detected problems are returned as severity-tiered alerts rather than a single undifferentiated warning. A moderate clinical caution is generated for additive or synergistic combinations where both drugs individually appear acceptable but their combined pharmacodynamic effect may not be, while a critical clinical hazard is generated for antagonistic combinations, high-risk drug-drug interactions and dose-ceiling violations, where a drug's effect is directly opposed or the safety margin is exceeded. Each alert is accompanied by a short explanation of the underlying mechanism and, where applicable, a suggested substitute medication or dose adjustment, so that the prescriber can correct the order with an understanding of why it was flagged rather than simply overriding an opaque warning.

5) Evaluation Approach

In the absence of prospective patient recruitment, the platform's detection performance was assessed against a set of representative test scenarios constructed from the literature-derived knowledge base. Each scenario specified a set of patient characteristics, a complete medication list with doses and frequencies, the known interaction or medication-related problem drawn from the literature, and the CDSS response expected for that category (synergism, antagonism, duplication, drug-drug interaction, or dose-related error). This literature-anchored test-case approach mirrors the method used elsewhere to evaluate the ability of ambulatory electronic health record systems to detect unsafe medication orders [15], and was considered appropriate for a proof-of-concept evaluation preceding prospective clinical validation.

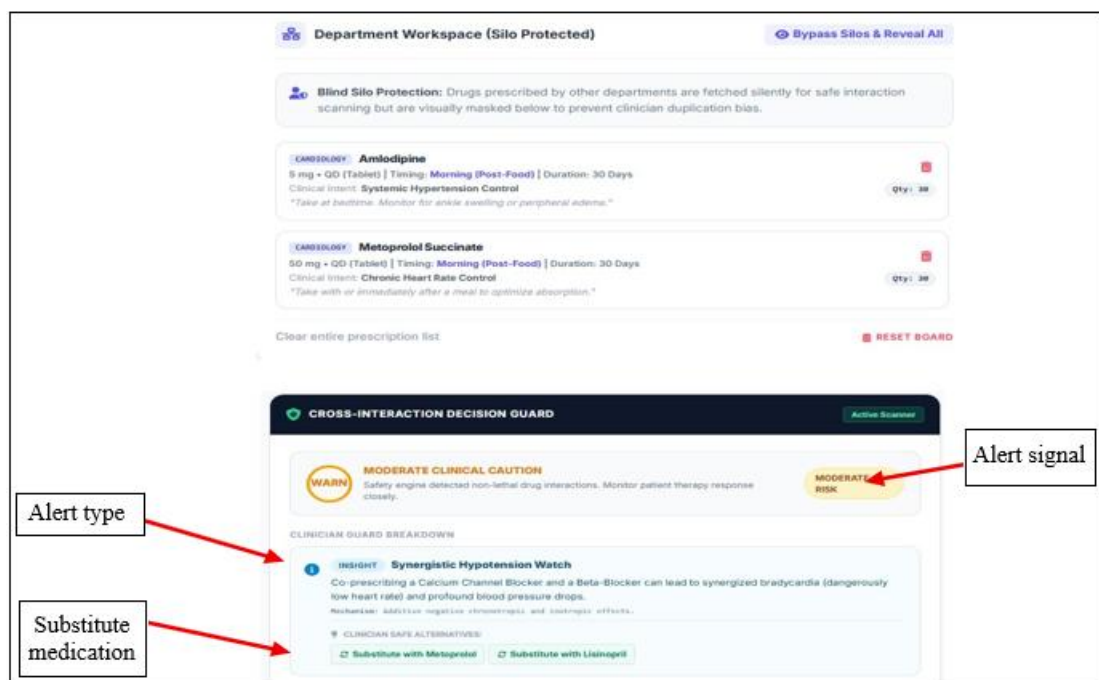
4. Results

Before describing individual test scenarios, it is useful to summarise the burden associated with each error category, since this burden motivated the platform's category-specific

design. Adverse drug reactions are estimated to account for 10 to 20 percent of hospital admissions and remain among the leading causes of death in hospitalised patients [8,9]. Drug contraindications are frequently missed in routine practice because most clinical checking tools emphasise drug-drug interaction screening over drug-disease matching [10]. Therapeutic duplication has been reported to account for as much as 31 percent of medication errors in emergency-department settings, contributing to unnecessary toxicity and cost [11]. Manual prescription review captures roughly 70 percent of clinically significant drug-drug interactions, with detection accuracy declining as the number of concurrent medicines rises [12,13]. Dose-calculation errors, for their part, are driven primarily by arithmetic mistakes, ten-fold dosing errors, unit misinterpretation and paper-based prescribing workflows [14]. Five representative test scenarios, one for each principal alert category, are described below to illustrate how the platform's Cross-Interaction Decision Guard responded.

1) Synergistic Effect Alert

A cardiology prescriber selected amlodipine, a calcium-channel blocker, and entered a dose of 5 mg once daily for 30 days within the recommended ceiling of 10 mg per day. The same prescriber then added metoprolol succinate, a beta-blocker, at 50 mg once daily against a maximum of 200 mg per day. On entry of the second drug, the Cross-Interaction Decision Guard compared it against the patient's existing record and identified the amlodipine-metoprolol combination as carrying a moderate clinical caution, since concurrent use of a calcium-channel blocker and a beta-blocker can produce additive cardiovascular effects, including bradycardia and an exaggerated fall in blood pressure. The system's explanatory alert advised closer monitoring of heart rate and blood pressure rather than blocking the prescription outright, consistent with the additive-risk rather than absolute-contraindication nature of this pairing.



2) Antagonistic Effect Alert

In a second scenario, a pulmonology prescriber ordered an albuterol inhaler for a patient already receiving metoprolol from cardiology. Because both prescriptions were linked to the same unique patient record, the platform detected the pairing at the point the second drug was entered and generated a critical clinical hazard alert: non-selective or insufficiently

cardioselective beta-blockade can blunt the bronchodilator response to albuterol, while albuterol's beta-agonist activity can, in turn, work against the intended heart-rate control from metoprolol. The alert flagged this mutual opposition of effect before the prescription was finalised, giving the prescriber the opportunity to reconsider the combination or select a more cardioselective alternative.

Department Workspace (Silo Protected) Engage Silo Masking

Blind Silo Protection: Drugs prescribed by other departments are fetched silently for safe interaction scanning but are visually masked below to prevent clinician duplication bias.

PULMONOLOGY: Albuterol Inhaler
2 Puffs • Puffs (Inhaler) | Timing: Morning (Post-Food) | Duration: 14 Days
Clinical Intent: Acute Bronchospasm Rescue
Inhale 2 puffs every 4 to 6 hours as needed for sudden shortness of breath. Qty: 56

CARDIOLOGY: Metoprolol Succinate
50 mg • QD (Tablet) | Timing: Morning (Post-Food) | Duration: 30 Days
Clinical Intent: Chronic Heart Rate Control
Take with or immediately after a meal to optimize absorption. Qty: 30

Clear entire prescription list RESET BOARD

CROSS-INTERACTION DECISION GUARD Active Scanner

CRITICAL CLINICAL HAZARD
One or more therapeutic parameters clash with active drug records. Proceeding without correction is highly contraindicated. **HIGH DANGER**

CLINICIAN GUARD BREAKDOWN

CRITICAL Pharmacological Antagonism
Metoprolol blocks beta receptors (primarily Beta-1, but some Beta-2 spillover), while Albuterol relies on stimulating Beta-2 receptors to open airways. They actively neutralize each other, triggering severe bronchospasms.
Mechanism: Mutual Beta Receptor Blockade.

CLINICIAN SAFE ALTERNATIVES:
Substitute with Amlodipine Substitute with Carvedilol

Alert type

Substitute medication

Alert signal

3) Drug Duplication Alert

A patient was first prescribed naproxen in the cardiology department. When a neurology prescriber subsequently attempted to prescribe naproxen again for the same patient, unaware of the earlier order, the platform's cross-department check against the unified medication record identified the

second order as a duplicate of an existing active prescription and displayed a duplication alert, allowing the neurology prescriber to review and either withdraw or modify the order before it was finalised- the specific failure mode that department-siloed record-keeping is unable to prevent.

Department Workspace (Silo Protected) Engage Silo Masking

Blind Silo Protection: Drugs prescribed by other departments are fetched silently for safe interaction scanning but are visually masked below to prevent clinician duplication bias.

CARDIOLOGY: Naproxen
250 mg • BID (Capsule) | Timing: Morning (Post-Food) | Duration: 7 Days
Clinical Intent: Chronic Inflammation Relief
Take with food or a glass of milk to protect stomach lining. Qty: 14

Clear entire prescription list RESET BOARD

CROSS-INTERACTION DECISION GUARD Active Scanner

100% Prescription Verified
No active dangerous contraindications, duplicate risks, or dosage threats flagged. **LOW RISK**

CLINICIAN GUARD BREAKDOWN

✓ Clinician protocol evaluation passed. This workspace therapy combination is safe.

Duplication Alert
Naproxen is already prescribed for this patient in another department.

Alert signal

4) Drug–Drug Interaction Alert

In the cardiology department, a prescriber entered aspirin 75 mg together with warfarin 5 mg for the same patient. On entry of the second agent, the Cross-Interaction Decision Guard recognised this as an established, clinically significant drug–

drug interaction and returned a high-danger alert, since concurrent antiplatelet and anticoagulant therapy substantially increases the risk of bleeding and haemorrhage. This scenario illustrates the platform's ability to intercept a well-documented, high-severity interaction of the kind that

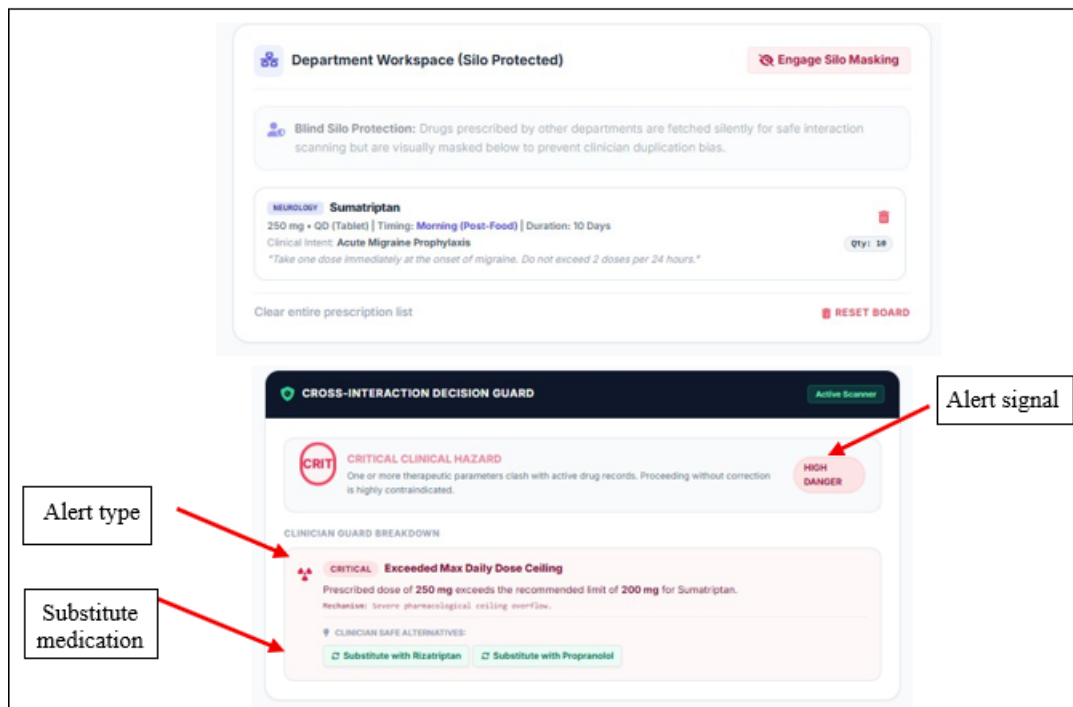
manual review is known to miss in a meaningful proportion of cases as medication counts rise.

The screenshot displays a clinical decision support system interface. At the top, it shows a 'Department Workspace (Silo Protected)' with an 'Engage Silo Masking' button. Below this, there's a section for 'Blind Silo Protection' explaining that drugs prescribed by other departments are fetched silently for safe interaction scanning but are visually masked. The main area lists two medications: Aspirin (75 mg • QD (Tablet) | Timing: Morning (Post-Food) | Duration: 30 Days) and Warfarin (Coumadin) (5 mg • QD (Tablet) | Timing: Morning (Post-Food) | Duration: 30 Days). Both have a 'Qty: 30' indicator. A 'Clear entire prescription list' button and a 'RESET BOARD' button are at the bottom of this section. Below the medication list is a 'CROSS-INTERACTION DECISION GUARD' section with an 'Active Scanner' button. This section displays a 'CRITICAL CLINICAL HAZARD' (CRIT) alert: 'One or more therapeutic parameters clash with active drug records. Proceeding without correction is highly contraindicated.' The alert is labeled 'HIGH DANGER'. Below the alert is a 'CLINICIAN GUARD BREAKDOWN' section showing 'CRITICAL: Synergism / Bleeding Hazard' with a detailed explanation: 'Aspirin prevents platelet aggregation while Warfarin blocks coagulation factors. Taking both exponentially elevates internal bleeding, gastrointestinal hemorrhage, or hemorrhagic stroke risk. Mechanism: dual pathway anti-hemostasis.' It also provides 'CLINICIAN SAFE ALTERNATIVES': 'Substitute with Clopidogrel' and 'Substitute with Prasugrel'. Red arrows point from labels 'Alert type', 'Substitute medication', and 'Alert signal' to the 'CRIT' icon, the 'Substitute with Prasugrel' button, and the 'HIGH DANGER' label, respectively.

5) Dose Adjustment Alert

In a fifth scenario, a prescribed dose exceeded the level considered appropriate for the patient's documented renal function. Rather than returning a generic "dose error" message, the platform generated an explanatory alert- "dose adjustment required due to reduced renal function"- together with the relevant patient parameter, reflecting the design principle that a prescriber is more likely to act correctly on an alert whose clinical rationale is visible than on an unexplained warning.

Across all five scenarios, the platform's severity-tiering behaved as intended: additive or synergistic combinations were returned as moderate cautions, while antagonistic pairings, high-risk drug-drug interactions and dose-ceiling violations were returned as critical hazards. In every case, the alert was generated only because the two relevant prescriptions were linked through the shared, unique patient identifier rather than recorded separately by department, which was the central architectural hypothesis under evaluation.



5. Discussion

The results support the feasibility of using a single, patient-centred medication record, rather than a set of department-specific records, as the basis for cross-specialty medication-error detection in ambulatory multispecialty care. Synergistic pharmacodynamic effects, where two agents acting through different mechanisms converge on a shared physiological endpoint, were correctly flagged as a moderate caution even though each individual drug would have appeared safe in isolation, and the severity tier escalated appropriately to a critical hazard for antagonistic combinations, where one agent actively opposes the effect of the other and the immediate clinical risk is higher. Duplicate prescribing across departments, a documented contributor to unnecessary toxicity and cost [11], was reliably caught because the platform checks a single unified record rather than a department-specific one, and this same cross-department visibility is what allowed a classical, well-established drug-drug interaction to be detected with confidence rather than depending on manual review, which is known to miss a growing share of interactions as a patient's medication count increases [12,13].

Dose-related errors were addressed by enforcing pharmacological ceiling doses and by presenting the reasoning behind each alert rather than a bare error message, an approach chosen specifically to counter the alert-fatigue and override behaviour repeatedly documented in the CDSS literature [16,17]. Drug contraindications and adverse drug reactions proved harder to intercept through drug-drug logic alone, since most existing systems, including the present one in its current form, are oriented toward interaction screening rather than drug-disease matching; given how strongly ADRs contribute to hospital admissions and mortality [8,9], extending the platform toward systematic drug-disease checking is an important next step rather than a peripheral one.

Taken together, the underlying design choice- a shared, patient-centred medication record combined with severity-tiered, explained alerts and suggested alternatives rather than a single undifferentiated warning- appears to be what allows the platform to fit into existing prescribing workflows while limiting the alert fatigue that undermines many conventional CDSS deployments [16,17,19]. The principal limitation of the present evaluation is that it rests on simulated, literature-derived scenarios rather than a live, patient-recruited clinical trial. Real-world detection accuracy, prescriber override behaviour, and the reliability of individualised dosing recommendations, which depend on up-to-date laboratory parameters such as renal function, will need to be measured prospectively. Any implementation involving genuine cross-department data sharing would also need to satisfy institutional data-governance and patient-consent requirements before deployment in an actual multispecialty hospital setting.

6. Conclusion

This work set out to design and evaluate a pharmacy medication safety platform for reducing prescription errors and adverse effects in ambulatory, multispecialty care, and the findings support the feasibility of that objective. Built around a unique per-patient medication record shared across departments, the platform's Cross-Interaction Decision Guard correctly identified and severity-tiered the clinically important categories of prescribing error examined here- synergistic and antagonistic pharmacodynamic effects, cross-department drug duplication, established drug-drug interactions, and dose-ceiling violations- while explaining its underlying reasoning and, where applicable, suggesting safer alternatives. This moves the platform beyond passive warning generation toward active, workflow-integrated decision support.

The findings reinforce the concerns raised in the background literature: adverse drug reactions, contraindications,

duplication and interaction errors are common and often clinically significant, and manual review alone, particularly across a fragmented departmental structure, captures only a fraction of them. By centring medication history on the patient rather than the department, and by tiering alerts according to clinical severity instead of treating every mismatch as an equally weighted warning, the platform is positioned to reduce both missed errors and the alert fatigue that limits the effectiveness of many existing decision-support systems.

As a proof-of-concept software design validated against representative, literature-derived scenarios rather than live patient data, this work establishes that the core detection logic, severity tiering and cross-departmental architecture function as intended. The logical next steps are prospective validation in a real ambulatory multispecialty setting, expansion of the underlying drug-interaction and drug-disease knowledge base, formal measurement of prescriber override and alert-fatigue rates, and incorporation of individualised renal and hepatic dosing parameters drawn from live laboratory data. Subject to these extensions, the platform offers a practical, clinically grounded approach to helping prescribers identify and correct medication errors at the point of care.

Acknowledgment

The authors thank the Department of Pharmacology, K.M. College of Pharmacy, Madurai, for institutional support during the course of this work.

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