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AI-Powered Insurance & Treatment Validation at the Point of Sale

HIPAA-Compliant, AI-Augmented Insurance Verification at Scale

We developed a high-performance backend system for a healthcare insurance company that enables pharmacies to instantly verify whether a customer is eligible for insurance compensation when purchasing medication. In addition to implementing the industry-standard NCPDP protocol, we introduced a dedicated AI layer that enhanced safety checks, optimized medication workflows, and automated critical decision-making processes.

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Business Challenge

A leading healthcare insurance provider set out to build an in-house platform for real-time insurance coverage validation at the pharmacy point of sale. The goal was to streamline operations, reduce dependency on legacy systems, and ensure safer, smarter decision-making.

- **Supporting complex policies:**
  including coverage for employees and their family members (spouses, children, dependents)
- **Reducing friction at pharmacies**
  through instant eligibility checks
- **Improving patient safety**
  by detecting treatment conflicts and automating rejections
- **Ensuring compliance**
  with HIPAA and NCPDP standards at scale

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Technical Challenge

To meet this goal, the solution had to:

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- Analyze currently prescribed medications in real time to detect combinations that may conflict or result in severe adverse effects
- Offer real-time safety net logic that could act on behalf of the insurance company with no human intervention
- Fully implement the NCPDP standard for pharmacy benefit verification and claims
- Ingest structured medical and insurance data to assess eligibility in <100ms
- Leverage AI to evaluate patient history and detect treatment contradictions

Large transformer models like GPT or BERT were ruled out early due to latency, cost, and lack of deterministic behavior.

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Choosing the AI

MODEL NAME	ARCHITECTURE	USAGE PURPOSE	LIMITATIONS IN THIS USE-CASE
PharmaExplain-GPT	GPT-4 (Generative Transformer)	Generate explanations for medical coverage	Too slow (>500ms latency), non-deterministic, high infra cost
FeedbackParse-BERT	BERT-style Transformer	Extract issues from patient complaints	Text-focused, unsuitable for structured, real-time pharmacy data
RxSequence-RNN	GRU-based RNN	Analyze treatment sequences for risk	Irrelevant sequential logic for point-based medication checks
CoveragePredict-LGBM	LightGBM	Predict insurance approval outcomes	Fast and interpretable — base for our chosen approach
RoutePharma-AI (Chosen)	XGBoost + Rule Engine	Real-time eligibility + treatment conflict detection	Ultra-fast, explainable, deterministic — selected solution

We chose XGBoost + Rules to ensure real-time decisioning, compliance-grade explainability, and deterministic output — all essential in the insurance-pharmacy workflow.

Tech Stack

Go

AWS
(ECS, Fargate, Lambda)

PostgreSQL

NCPDP Protocol

XGBoost

Rule Engine
(Drools)

ONNX Runtime
(planned for NLP extension)

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Our Solution

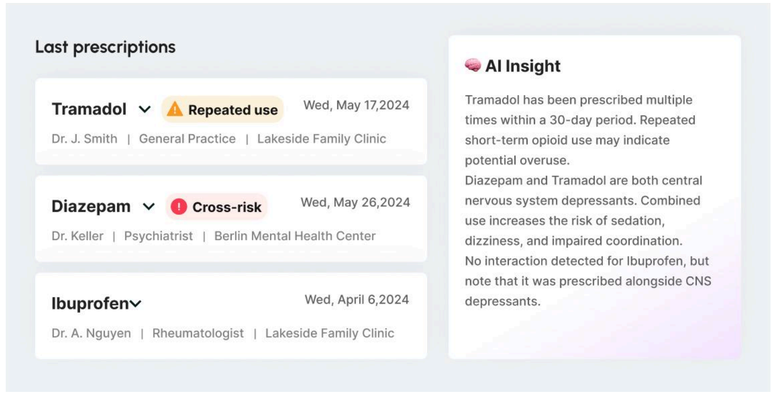
We built a system consisting of two tightly integrated layers:

AI Treatment Intelligence Layer

Built around a custom XGBoost model + rule engine, this layer provides:

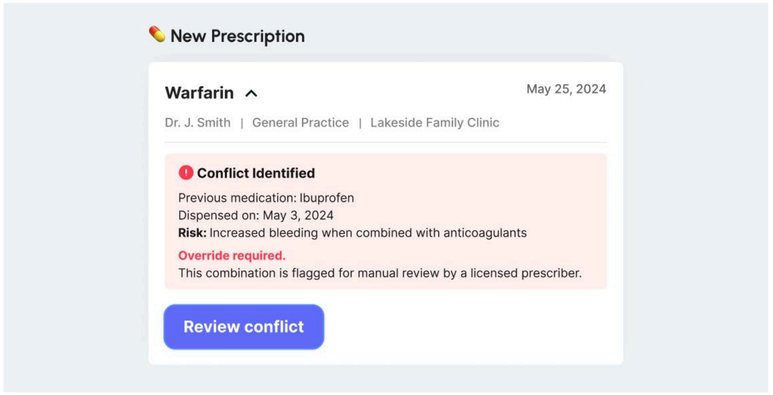
Historical Prescription Analysis:

AI examines past purchases to detect recurring risks or cross-medication dependencies



Interaction & Override Detection:

Identifies when current prescriptions cancel out or conflict with prior treatments



AI Treatment Intelligence Layer

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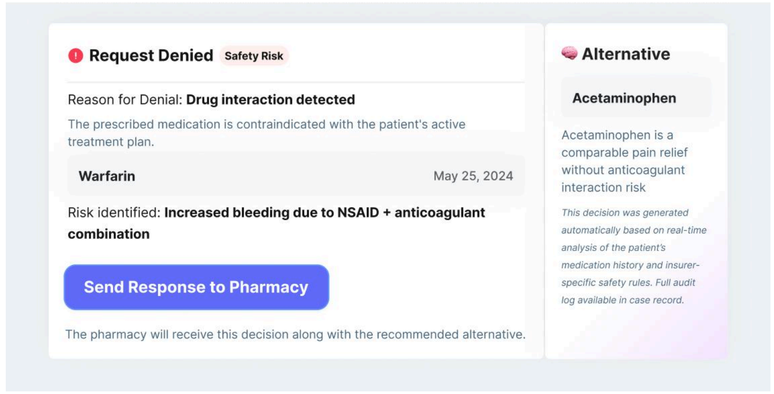
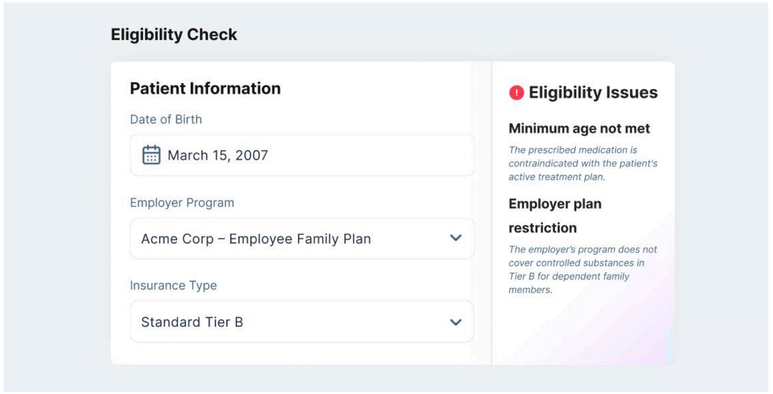
Smart Rejection Logic:

Issues an automated denial with suggested alternatives if the treatment poses risk or contradicts ongoing plans



Policy-Aware Automation:

Embeds insurer-specific rules, such as age-based eligibility or employer program nuances



Insurance Coverage Engine (NCPDP Protocol)

Parses input related to the patient, employer, and dependents

Validates eligibility using NCPDP message flows and real-time insurer queries

Returns precise approval/denial status for requested medications

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Why AI Was Introduced?

Originally, the platform operated on a deterministic rule-based engine that handled eligibility decisions: full approval, rejection, or partial coverage. These rules were based on policy parameters and clinical safety protocols.

However, over time, internal operations teams began to observe edge cases that rules alone couldn't address:

1. **Brand overlap**

   Patients purchasing medications with the same active substance but from different brands — triggering accidental overdose risks

2. **Conflicting prescriptions**

   Patients consulting different doctors and receiving treatments that canceled each other out or posed serious health risks

3. **Ineffective combinations**

   Cases where medications didn’t interact dangerously, but reduced each other's effectiveness, making treatment pointless

4. **Excessive strain**

   Multiple prescriptions in parallel creating unnecessary physiological load on the patient

Initially, these cases were flagged manually by care managers based on patient history and insurance claim patterns. This led to the realization that historical and contextual analysis could not be fully captured through static rules alone.

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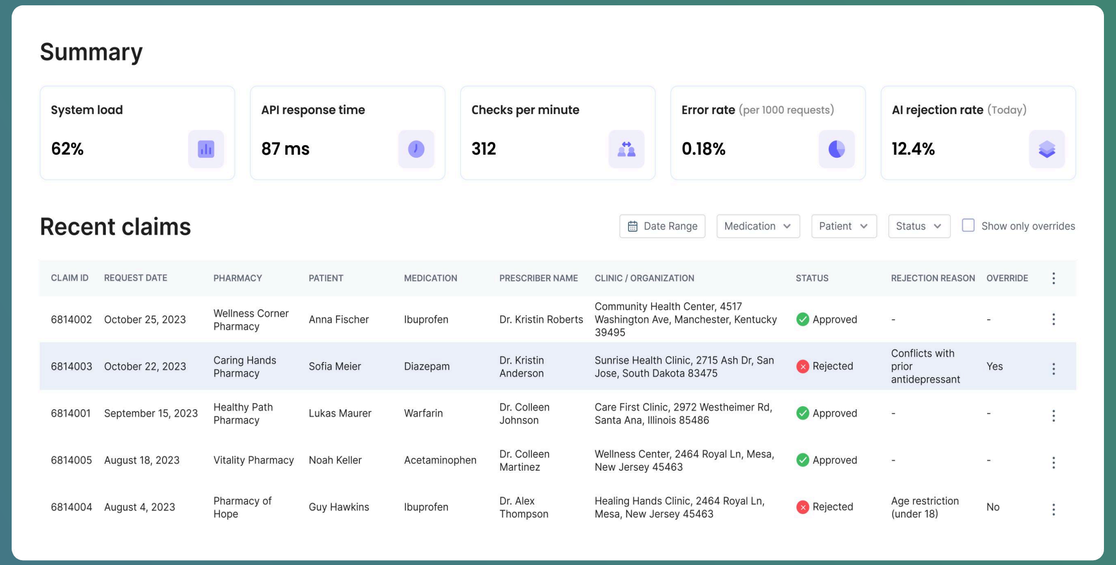
To address this:

AI was first introduced as an assistive tool — flagging potential conflicts for human review based on patterns found in historical prescription data.

As confidence in AI accuracy grew, and it consistently aligned with expert reviews, the model was gradually integrated into the live decision-making pipeline.

Today, it functions as a core part of the response logic — complementing the rule engine by adding contextual awareness, risk detection, and dynamic validation of new prescriptions

The result: smarter automation that can detect real-world clinical risks, not just policy violations — all while maintaining real-time performance.



Summary

System load	API response time	Checks per minute	Error rate (per 1000 requests)	AI rejection rate (Today)
62%	87 ms	312	0.18%	12.4%

Recent claims

Date Range | Medication | Patient | Status | Show only overrides

CLAIM ID	REQUEST DATE	PHARMACY	PATIENT	MEDICATION	PRESCRIBER NAME	CLINIC / ORGANIZATION	STATUS	REJECTION REASON	OVERRIDE
6814002	October 25, 2023	Wellness Corner Pharmacy	Anna Fischer	Ibuprofen	Dr. Kristin Roberts	Community Health Center, 4517 Washington Ave, Manchester, Kentucky 39495	Approved	-	-
6814003	October 22, 2023	Caring Hands Pharmacy	Sofia Meier	Diazepam	Dr. Kristin Anderson	Sunrise Health Clinic, 2715 Ash Dr, San Jose, South Dakota 83475	Rejected	Conflicts with prior antidepressant	Yes
6814001	September 15, 2023	Healthy Path Pharmacy	Lukas Maurer	Warfarin	Dr. Colleen Johnson	Care First Clinic, 2972 Westheimer Rd, Santa Ana, Illinois 85486	Approved	-	-
6814005	August 18, 2023	Vitality Pharmacy	Noah Keller	Acetaminophen	Dr. Colleen Martinez	Wellness Center, 2464 Royal Ln, Mesa, New Jersey 45463	Approved	-	-
6814004	August 4, 2023	Pharmacy of Hope	Guy Hawkins	Ibuprofen	Dr. Alex Thompson	Healing Hands Clinic, 2464 Royal Ln, Mesa, New Jersey 45463	Rejected	Age restriction (under 18)	No

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Impact

<100ms response time
for insurance + safety validation

80% fewer treatment conflicts flagged
due to AI-driven prescription intelligence

Expanded eligibility support
for employee family members via structured policy rules

100% explainable outcomes
fully auditable for compliance and regulatory review

Millions of prescription events processed
with zero downtime or manual approval fallback