

ABSTRAK

PERAMALAN PERMINTAAN FARMASI DENGAN PENDEKATAN ML/AI UNTUK OPTIMALISASI SUPPLY CHAIN RUMAH SAKIT (STUDI KASUS RUMAH SAKIT X)

Sistem kesehatan di Indonesia dihadapkan pada tantangan kompleks dalam peramalan permintaan farmasi, dipengaruhi oleh keragaman geografis dan ketergantungan signifikan pada impor. Secara spesifik, di Rumah Sakit X, terdapat inefisiensi rantai pasok internal yang ditandai tingginya frekuensi retur, pembelian langsung, dan peminjaman persediaan. Selain itu, volatilitas data transaksi farmasi harian semakin memperumit upaya peramalan akurat. Penelitian ini bertujuan untuk menyajikan pendekatan inovatif berbasis Pembelajaran Mesin (ML) dan Kecerdasan Buatan (AI) guna mengoptimalkan rantai pasok. Evaluasi komparatif dilakukan terhadap enam algoritma peramalan: *Simple Moving Average (SMA)*, *Weighted Moving Average (WMA)*, dan *Exponential Smoothing (ES)* sebagai metode deret waktu tradisional; serta *Linear Regression (LR)*, *Support Vector Regression (SVR)*, dan *Deep Learning Long Short-Term Memory (LSTM)* sebagai algoritma ML/AI. Analisis didasarkan pada data transaksi farmasi selama 650 hari, yang mencakup 374.171 kejadian penyerahan obat. Hasil penelitian menunjukkan bahwa model Deep Learning (LSTM) mencapai kinerja superior dengan Mean Absolute Percentage Error (MAPE) sebesar 2,35%, merepresentasikan peningkatan akurasi 34,4% dibandingkan metode tradisional SMA. Implementasi sistem peramalan berbasis ML ini berpotensi mereduksi kebutuhan stok pengaman sebesar 25-30% dengan tetap mempertahankan tingkat layanan 99,5%, yang berimplikasi pada penghematan biaya dan peningkatan ketersediaan obat di fasilitas Rumah Sakit X. Studi ini menegaskan bahwa adopsi ML/AI merupakan katalis transformatif untuk efisiensi manajemen rantai pasok farmasi di Rumah Sakit X.

Kata Kunci:

Kecerdasan Buatan, Optimalisasi Rantai Pasok, Pembelajaran Mesin, Peramalan Permintaan, Rantai Pasok Farmasi

ABSTRACT

PHARMACEUTICAL DEMAND FORECASTING USING ML/AI APPROACH FOR HOSPITAL SUPPLY CHAIN OPTIMIZATION (CASE STUDY: HOSPITAL X)

The Indonesian healthcare system faces complex challenges in pharmaceutical demand forecasting, influenced by geographical diversity and significant import dependency. Specifically, Hospital X experiences internal supply chain inefficiencies characterized by high frequencies of returns, direct purchases, and inter-hospital borrowing of supplies. Furthermore, the volatility of daily pharmaceutical transaction data exacerbates efforts for accurate forecasting. This study aims to present an innovative approach based on Machine Learning (ML) and Artificial Intelligence (AI) to optimize Hospital X's supply chain. A comparative evaluation was conducted on six forecasting algorithms: Simple Moving Average (SMA), Weighted Moving Average (WMA), and Exponential Smoothing (ES) as traditional time series methods; and Linear Regression (LR), Support Vector Regression (SVR), and Deep Learning Long Short-Term Memory (LSTM) as ML/AI algorithms. The analysis was based on 650 days of pharmaceutical transaction data from Hospital X, encompassing 374,171 dispensing events. Results demonstrate that the Deep Learning (LSTM) model achieved superior performance with a Mean Absolute Percentage Error (MAPE) of 2.35%, representing a 34.4% improvement in accuracy compared to the traditional SMA method. The implementation of this ML-based forecasting system has the potential to reduce safety stock requirements by 25-30% while maintaining a 99.5% service level, which translates into substantial cost savings and improved drug availability at Hospital X. This study confirms that the adoption of ML/AI is a transformative catalyst for pharmaceutical supply chain management efficiency at Hospital X.

Keywords:

Artificial Intelligence, Demand Forecasting, Machine Learning, Supply Chain Optimization, Pharmaceutical Supply Chain.