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Design and Development of an Electronic Prescribing System

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ABSTRACT

The increasing adoption of digital healthcare solutions has accelerated the implementation of electronic prescribing (e-prescribing) systems to enhance patient safety, reduce prescription errors, and improve workflow efficiency. This study presents the design, development, and pilot implementation of an e-prescribing system in Chipata, Zambia, involving two healthcare facilities and two pharmacies. A baseline study identified persistent issues with handwritten prescriptions, including illegibility, delays in medication access, and low patient adherence. Using the Waterfall System Development Life Cycle (SDLC), the developed system integrated real-time drug interaction alerts, role-based access control, and compatibility with existing Electronic Health Records (EHRs). Pilot results demonstrated a 40% reduction in prescription errors, a 50% decrease in prescription fulfillment time, and a 20% improvement in medication adherence. Challenges such as limited technical infrastructure and user resistance were noted. Key recommendations include infrastructure enhancements, offline functionality, expanded training, and national scalability. This study highlights the transformative potential of e-prescribing systems in resource-limited healthcare settings.

Keywords: Digital health, E-prescribing, Healthcare efficiency, EHR integration, Patient safety.

1. INTRODUCTION

Electronic prescribing (e-prescribing) systems play a crucial role in modernizing healthcare by reducing medication errors and improving operational efficiency. However, challenges such as interoperability gaps, data security concerns, and resistance to change hinder widespread adoption, particularly in low-resource settings like Zambia. This study addresses these issues by developing a secure, user-friendly e-prescribing system tailored to local needs. The project scope includes system design, pilot testing in three facilities, and evaluation of key performance metrics over 12 months.

2. LITERATURE SURVEY

Global research underscores e-prescribing's benefits. Bates et al. (1999) found Computerized Physician Order Entry (CPOE) systems cut medication errors significantly [1], while Fischer et al. (2010) linked e-prescribing to higher adherence rates due to direct pharmacy transmission [2]. Grossman et al. (2011) identified integration with EHRs as a persistent challenge [3], and Jones & Lee (2020) stressed robust security measures like encryption [4]. In Zambia, Chanda & Ngulube (2019) noted EHR adoption struggles with infrastructure and training [5], yet e-prescribing-specific studies are scarce. This gap motivated this research to explore a tailored solution for Zambia's healthcare system.

3. RESEARCH OBJECTIVES

The primary objectives of this research are:

- To design an e-prescribing system with real-time alerts, EHR integration, and role-based access.

- To evaluate its impact on prescription accuracy, fulfillment time, and patient adherence.
- To identify implementation challenges and propose scalable solutions.

4. RESEARCH METHODOLOGY

A mixed-methods approach combined quantitative surveys and qualitative interviews with healthcare providers and pharmacists in Chipata, Zambia. The Waterfall SDLC structured the project:

Requirements Analysis: Gathered needs (e.g., real-time alerts, EHR integration) via stakeholder consultations.

System Design: Designed an Entity-Relationship (ER) diagram (Figure 1) and logical architecture (Figure 2). Development: Used React.js (frontend), Node.js (backend), and MySQL (database), ensuring modularity. Testing: Conducted unit, integration, and user acceptance tests for reliability and usability. Deployment: Piloted in Chipata Central Hospital, Mwami Mission Hospital, Med-Care Pharmacy, and Chipata Pharmacy for three months. Evaluation: Assessed error rates, fulfillment time, adherence, and user feedback. Experimental Work A baseline study assessed prescription management at the pilot sites. Paper-based systems showed 25-30% error rates (illegible handwriting, dosage errors), 15-20 minute fulfillment times, and 55% adherence due to lost prescriptions and delays. The e-prescribing system, deployed with features like drug alerts and secure logins, was tested over three months. Performance metrics were tracked, comparing pre- and post-implementation data to evaluate improvements.

5. RESULTS AND DISCUSSION

Baseline Findings At Chipata Central Hospital, 30% of prescriptions had errors (e.g., illegible handwriting), with two adverse drug reactions linked to missing patient history. Mwami Mission Hospital reported 25% dosage inconsistencies, causing delays. Adherence was 55%, with 60% of patients facing delays due to lost prescriptions or transport issues. Pharmacies averaged 15-20 minute processing times, with 18% requiring verification calls.

a. Pilot Results

Post-implementation, errors dropped 40% (to 15-18%) due to automated checks, fulfillment time fell to 8-10 minutes (50% reduction), and adherence rose to 75% (20% increase) with digital reminders (Table 1). Users praised workflow efficiency, though older staff needed training, and internet reliability posed challenges.

Metric Baseline Post-Implementation Improvement Error Rate 25-30% 15-18% 40% reduction Fulfillment Time 15-20 min 8-10 min 50% reduction Adherence Rate 55% 75% 20% increase

Table 1: Baseline vs. Post-Implementation

Metric	Baseline	Post-Implementation	Improvement
Prescription Error Rate	25-30%	15-18%	40% reduction
Prescription Fulfillment Time	15-20 minutes	8-10 minutes	50% reduction
Medication Adherence Rate	55%	75%	20% increase
Verification Calls from Pharmacies	Frequent	Rare	Drastic reduction
User Satisfaction (Healthcare Providers)	Mixed	Positive	Improved workflow

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Figure 1: Database Structure

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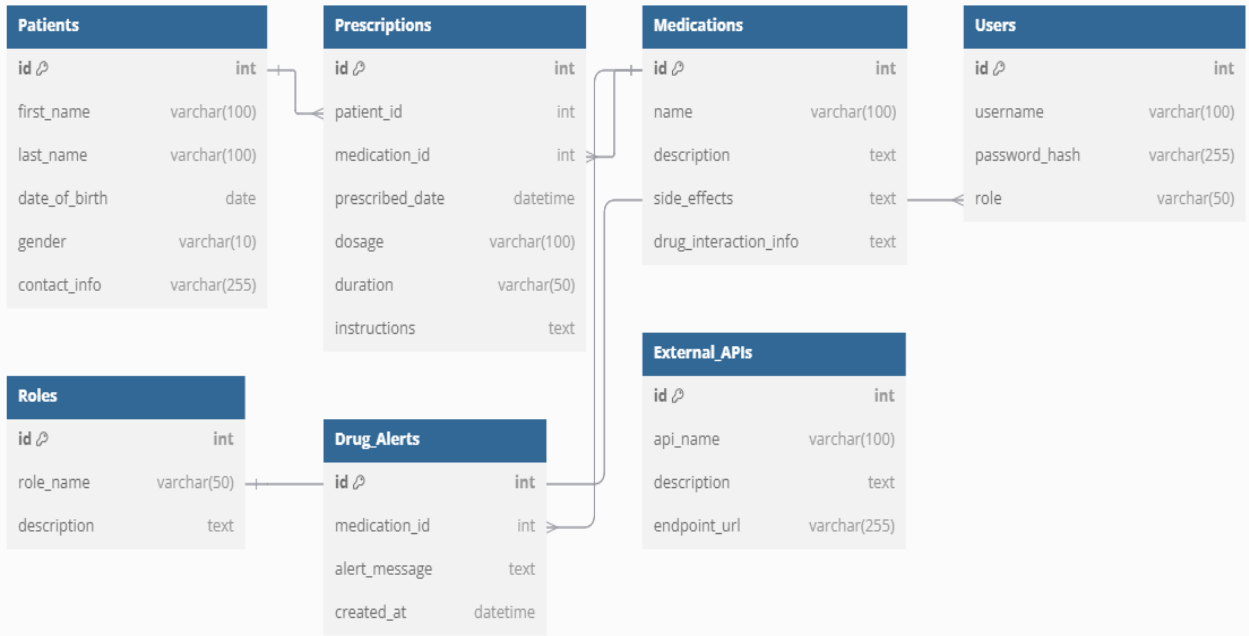

Figure 1: Database Structure

(ER diagram showing one-to-many relationships: healthcare provider to prescriptions, many-to-many: patients to medications)

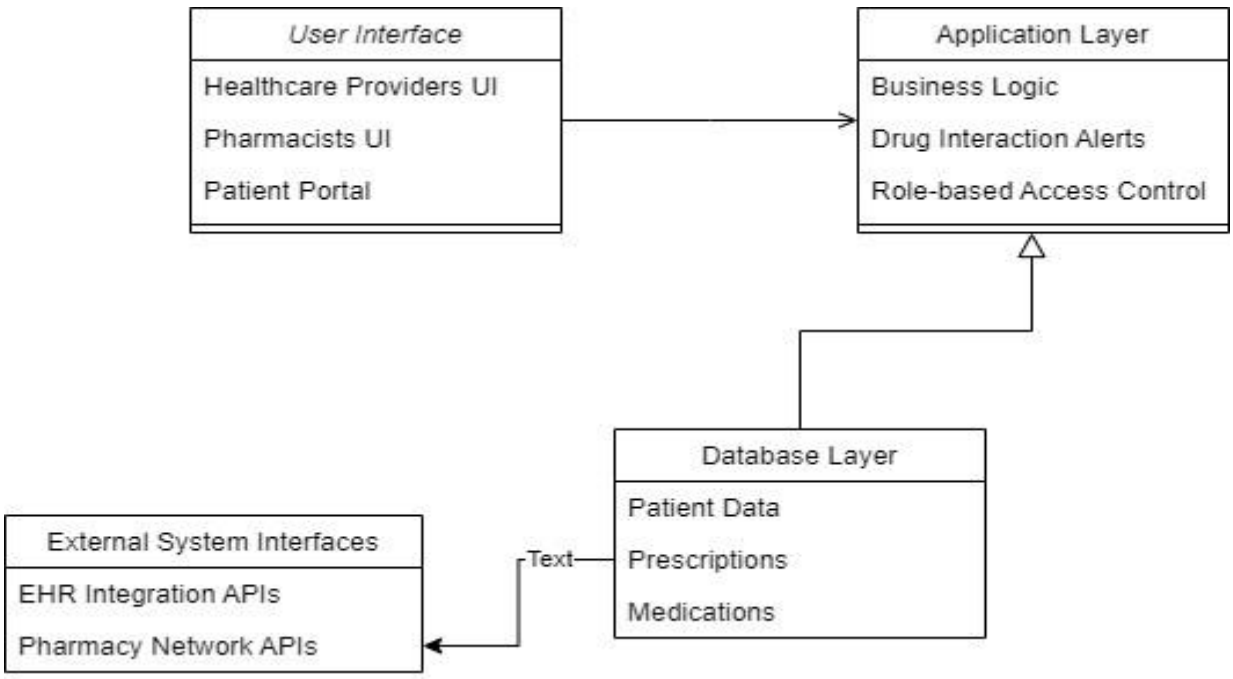

Figure 2: Logical Diagram

(Architecture with UI, application layer, database, and integration layer)

b. Discussion

The 40% error reduction aligns with Bates et al. (1999) [1], while improved adherence supports Fischer et al. (2010) [2]. Integration challenges echo Grossman et al. (2011) [3], and infrastructure issues reflect Chanda & Ngulube (2019) [5]. Security features like encryption, per Jones & Lee (2020) [4], ensured data protection. The system's success hinges on addressing training and connectivity barriers.

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6. CONCLUSION

The e-prescribing system demonstrated significant improvements in prescription accuracy, efficiency, and patient outcomes. Key recommendations include infrastructure enhancements, expanded training programs, and policy support for broader implementation. Future work should focus on system scalability and accessibility in rural areas.

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Mr. Aaron Katongo is a healthcare worker with over a decade of experience in the field of healthcare informatics currently working at Chipata Central Hospital in Eastern Province as an ICT Officer. His research focuses on the development and evaluation of electronic health record systems, telemedicine platforms, and other healthcare technologies. Mr. Katongo has participated in the implementation and deployment of SmartCare, ELMIS, DISALab and DHIS2 as his contributions to the field of healthcare informatics in the Ministry of Health Zambia.

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