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Design of an Electronic Medical Record (EMR) Information System for Vertigo Patients Using Python Algorithms

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Abstract
The increasing demand for digital transformation in healthcare services has encouraged healthcare facilities to adopt Electronic Medical Records (EMRs) that are more efficient, integrated, and capable of supporting patient safety. Vertigo patients require accurate documentation of clinical complaints, medication history, dosage information, pharmaceutical stock, and potential drug interactions because their treatment often involves multiple medications and comorbid conditions. This study aimed to design and develop a Python-based Electronic Medical Record and Pharmaceutical Service Information System for vertigo patients. This study employed a descriptive observational design combined with a prototype-based system development approach. Retrospective secondary data were obtained from 110 outpatient vertigo patient records, including demographic characteristics, comorbidities, medication use, and potential drug interactions. The system was developed using Python algorithms to support patient data input, medical record storage, medication inventory management, prescription tracking, dosage documentation, and binary-search-based data retrieval. The results showed that the developed system was able to integrate clinical documentation and pharmaceutical service functions into a structured digital workflow. The system facilitated patient history retrieval, medication stock monitoring, drug information searching, and pharmacy medical record management for vertigo cases. The findings indicate that the proposed EMR system can improve documentation accuracy, accelerate access to patient and medication information, reduce administrative inefficiencies, and support medication safety in vertigo care. The implication of this study is that Python-based EMR development can serve as a practical and scalable model for strengthening healthcare digitalization, particularly in integrating clinical records and pharmaceutical services in hospital or clinical settings.

Keywords: Digital Health; Electronic Medical Records; Pharmaceutical Information System; Python Algorithm; Vertigo Patient.

INTRODUCTION

Scientific Digital transformation has reshaped healthcare services by shifting clinical documentation, pharmaceutical administration, and patient data management from fragmented paper-based routines toward integrated, data-driven, and interoperable systems. In this context, Electronic Medical Records (EMRs) are no longer viewed merely as digital repositories, but as core infrastructure for improving continuity of care, clinical decision-making, patient safety, service efficiency, and health data governance (Ademola et al., 2024; Hossain et al., 2025; M. Lee et al., 2025). The strategic value of EMRs is particularly evident in health systems that require rapid access to patient history, medication records, diagnostic information, and treatment documentation, because the quality of clinical decisions depends heavily on the completeness, timeliness, and accuracy of recorded data (Cahyaningrum et al., 2025; Torab-Miandoab et al., 2025; Torkman et al., 2025). In Indonesia, the urgency of EMR implementation has been strengthened through Minister of Health Regulation No. 24 of 2022, which requires health service facilities to implement electronic medical records as part of improving service quality, legal certainty, data security, confidentiality, integrity, and availability (Asyfia et al., 2023; Larasati et al., 2024; Palojoki et al., 2024).

Despite its potential, EMR implementation requires more than technological conversion from paper to digital formats, because successful adoption depends on system usability, workflow suitability, data protection, human resource readiness, infrastructure reliability, and organizational acceptance. Previous studies have shown that EMRs can improve documentation quality, reduce administrative delays, support clinical coordination, and enhance the efficiency of healthcare services when the system is designed according to user needs and institutional workflows (Alharbi, 2025; Cahyaningrum et al., 2025; Torab-Miandoab et al., 2025). However, digital medical record systems may also create new risks when the interface is difficult to use, when data entry is incomplete, when interoperability is weak, or when alerts are not clinically relevant, indicating that EMR development must integrate technical, clinical, pharmaceutical, and user-centered considerations (Gurupur et al., 2025; Olakotan et al., 2025; Poulos et al., 2021). Therefore, the development of EMR systems for specific clinical conditions must be grounded in both healthcare service needs and information system principles, particularly when the system is expected to support medication management, drug availability monitoring, and clinical safety functions (Hossain et al., 2025; Kinlay et al., 2024; Tsai et al., 2020).

Vertigo is one of the clinical conditions that requires accurate documentation, timely assessment, and careful pharmaceutical management because it may arise from peripheral vestibular disorders, central neurological causes, medication-related conditions, or comorbid diseases. Vertigo and dizziness are frequently reported in clinical practice and may reduce mobility, increase fall risk, disrupt daily functioning, and create economic burdens for patients and healthcare facilities (Elbeltagy et al., 2026; Grill et al., 2026; Smit et al., 2025). Clinically, vertigo management requires precise recording of symptoms, onset, duration, triggers, accompanying complaints, diagnosis, therapeutic history, and medication response, because distinguishing peripheral from central vertigo is essential for appropriate treatment and patient safety (Koukoulithras et al., 2022; S.-U. Lee et al., 2025; Tarnutzer et al., 2025). In pharmaceutical services, vertigo patients may receive antihistamines, histaminergic agents, calcium-channel antagonists, antiemetics, benzodiazepines, analgesics, or medications for comorbid conditions, making structured medication records important for preventing duplication, dosage errors, contraindications, and potential drug–drug interactions (Di Mizio et al., 2021; Hain & Uddin, 2003; Hunter et al., 2022).

Medication safety is a central concern in EMR-based pharmaceutical services because preventable medication-related harm remains a major global patient safety issue. The WHO emphasizes that unsafe medication practices and medication errors contribute substantially to preventable harm, while computerized clinical decision support systems can help reduce medication errors through allergy alerts, dosage checks, drug–drug interaction warnings, and medication monitoring functions (Bell et al., 2025; Forni et al., 2010; Ye & Bronstein, 2025). Nevertheless, studies also indicate that alert fatigue, low specificity of warnings, and poor integration with clinical workflow may reduce the effectiveness of digital safety features, meaning that EMR-based systems must balance automation, clinical relevance, simplicity, and usability (Howarth et al., 2020; Newton et al., 2026; Yusof et al., 2024). Thus, an EMR system for vertigo patients should not only store patient identity and medical history, but also support pharmacy stock control, prescription tracking, dosage documentation, drug interaction checking, and rapid retrieval of patient treatment records (Amalia et al., 2021; Naamneh & Bodas, 2024; Torab-Miandoab et al., 2025).

Python provides a flexible technological foundation for developing healthcare information system prototypes because it supports object-oriented programming, database integration, graphical user interface development, data retrieval algorithms, and scalable clinical data processing. Prior research on open-source EHR systems and Python-based health informatics tools indicates that modular, transparent, and customizable programming environments can support the development of healthcare applications, particularly in settings that require adaptable systems and cost-effective digital solutions (Fahim et al., 2025; Shaikh et al., 2022; Syzdykova et al., 2017). Algorithmic functions such as searching, sorting, structured data storage, automated notification, and rule-based checking can strengthen the operational performance of EMR systems by enabling faster access to patient records, more systematic medication inventory management, and more consistent documentation of pharmaceutical services (Oliveira et al., 2023; Rani et al., 2025; Torab-Miandoab et al., 2025). Therefore, the integration of Python algorithms into an EMR and pharmaceutical service system is relevant for healthcare facilities that need practical, efficient, and user-friendly digital tools to support the management of vertigo patient data and medication services ("22nd ISoP Annual Meeting 'Putting Patients First in Pharmacovigilance: International Perspectives from Global South' 6–9 November 2023 Bali, Indonesia," 2023; Javeedullah, 2025; Rocha et al., 2016).

Although previous studies have examined EMR implementation readiness, electronic prescribing, medication safety, drug interaction alerts, and vertigo management, most of them remain focused on general EMR adoption, broad hospital information systems, or clinical treatment strategies rather than on the integrated design of a disease-specific EMR system connected to pharmaceutical services for vertigo patients. Existing research has not sufficiently addressed how patient symptom records, prescription history, vertigo medication inventory, dosage alerts, and drug interaction checking can be combined within a Python-based information system prototype that is suitable for clinical and pharmacy workflows in Indonesian healthcare facilities (Madhavi et al., 2026; Perwirani & Puspitasari, 2023). This gap indicates the need for a more specific and operationally oriented study that links EMR design, pharmaceutical service management, vertigo case documentation, and algorithmic data processing in one integrated system. Therefore, this study aims to design and develop an Electronic Medical Record and Pharmaceutical Service Information System for vertigo patients using Python algorithms, with the specific purpose of improving the efficiency of patient data management, medication inventory control, prescription tracking, dosage documentation, and drug interaction monitoring in healthcare service settings.

METHODS

This study employed a descriptive observational design integrated with a case-study and prototype-based system development approach. The observational component was used to describe clinical and pharmaceutical patterns among outpatient vertigo patients, whereas the system-development component was directed toward designing an Electronic Medical Record (EMR) and Pharmaceutical Service Information System supported by Python-based algorithmic processing. This design was considered appropriate because retrospective medical record data can be used to describe patient characteristics, treatment patterns, and service documentation without manipulating clinical care, while prototype-based development enables iterative refinement of system functions based on user and service requirements (Hulley et al., 2022; Pressman & Maxim, 2020; Waluyo et al., 2025). The development of the EMR was also aligned with current digital health priorities and the Indonesian regulatory direction requiring healthcare facilities to implement electronic medical records (World Health Organization, 2021; Ministry of Health Republic of Indonesia, 2022).

The study was conducted at Mitra Sejati Hospital, Medan Johor. Clinical data were obtained retrospectively from secondary medical record data of outpatient patients diagnosed with or clinically suspected of vertigo. A purposive sampling technique was applied by selecting medical records that met the inclusion criteria, namely outpatient records containing vertigo-related diagnosis or complaints, medication history, dosage information, and pharmaceutical service documentation. Medical records that did not contain the minimum clinical and pharmaceutical information required for analysis were excluded. A total of 110 outpatient vertigo patient records were used as the empirical basis for describing patient demographics, clinical complaints, comorbid conditions, medication profiles, drug availability, and potential drug–drug interactions.

Data collection was conducted through three complementary techniques: retrospective review of outpatient medical records, field observation of pharmaceutical service activities, and literature review related to EMR development, vertigo management, pharmaceutical information systems, and Python-based data processing. The variables extracted from the medical records included patient demographic characteristics, comorbidities, chief complaints, symptom onset, episode duration, vertigo triggers, accompanying symptoms, prescribed medications, dosage information, drug availability, and potential drug–drug interactions. These variables were selected because structured symptom characterization, medication review, and pharmaceutical documentation are important components in clinical and service-based assessment of vertigo cases (Silva Gameiro et al., 2024; Tarnutzer et al., 2025).

The clinical and pharmaceutical data were analyzed descriptively using frequencies and percentages. This analysis was used to identify dominant patient characteristics, common vertigo-related complaints, patterns of medication use, drug availability, and the distribution of potential drug-interaction severity. Potential drug–drug interactions were identified by comparing prescribed medication combinations with relevant drug-interaction references and clinical decision support principles. This procedure was included because drug-interaction screening is an important component of medication safety, although the design of drug-interaction alerts must consider usability, clinical relevance, and the risk of alert fatigue (Stockley's Drug Interactions, 2025; Villa Zapata et al., 2022; Felisberto et al., 2024; Cahill et al., 2025).

The system was developed using a prototype model consisting of requirement identification, prototype design, prototype evaluation, system coding, system testing, system evaluation, and implementation. During the requirement-identification stage, information was collected from the needs of medical personnel, pharmacy staff, and prospective system users to determine the functional requirements of the EMR and pharmaceutical service system. This stage was supported by the principle that digital system development should begin with stakeholder consultation, user needs analysis, prototype development, iterative testing, and refinement based on empirical feedback (Waluyo et al., 2025). The prototype was designed to include patient data input, anamnesis records, prescription tracking, medication inventory management, dosage documentation, and drug-interaction checking. Python was selected as the main programming language because it supports structured data processing, modular programming, object-oriented development, graphical user interface construction, and algorithmic search functions (Matthes, 2023; Python Software Foundation, 2025).

System coding was carried out by translating the functional requirements into Python-based program modules. The main modules consisted of patient registration and identity management, clinical record entry, pharmaceutical service documentation, medication stock monitoring, prescription data retrieval, and drug-interaction identification. The drug-interaction checking feature was designed to compare medication combinations entered into the system with predefined interaction rules and to display interaction information based on severity category. This feature was intended to assist pharmacy staff in identifying potential medication risks during pharmaceutical service documentation, not to replace clinical judgment. The emphasis on integrated digital workflow is consistent with previous research showing that technology-based systems can improve transparency, documentation, work-process efficiency, and organizational responsiveness in digital service environments (Waluyo et al., 2025).

The developed prototype was tested using functional testing to ensure that each feature operated according to its intended purpose. The testing covered patient data storage, medical record retrieval, prescription documentation, stock monitoring, dosage recording, and drug-interaction identification. The final system evaluation focused on whether the prototype could support faster access to patient information, reduce manual recording errors, improve pharmaceutical documentation, and provide an integrated digital workflow for managing outpatient vertigo cases in healthcare service settings. The evaluation also considered usability and medication-safety aspects because EHR design can influence user performance, documentation quality, and the risk of medication-related errors (Cahill et al., 2025).

Table 1. Characteristics of Outpatient Vertigo Patients

Patient Characteristics	Total (N=110)	Persentage (%)
Gender Male Female	52	47
	58	53
Age		
10–18 years old	2	2
19–44 years old	17	15
45–59 years old	49	45
≥ 60 years old	42	38
Comorbidity		
Hypertension	55	50
Ischemic Stroke	14	12,72
Hemorrhagic Stroke	1	0,90
Congestive Heart Failure (CHF)	1	0,90
Hypertensive Heart Disease (HHD)	1	0,90
Angina	1	0,90
Cephalgia	8	7,27
Osteoartritis (OA)	1	0,90
Diabetic Neuropathy	2	1,81
Bells's Palsy	1	0,90
Maag	2	1,81
Dyspepsia	2	1,81

Table I shows that the study involved 110 outpatient vertigo patients, with a slightly higher proportion of female patients than male patients. Most patients were aged 45–59 years, followed by those aged 60 years and above, indicating that vertigo cases in this dataset were more common among middle-aged and older adults. Hypertension was the most dominant comorbidity, affecting half of the patients, followed by ischemic stroke and cephalgia. These findings justify the need for an EMR system that does not merely record vertigo complaints, but also captures comorbid conditions that may influence treatment decisions and potential medication risks.

Table 2. Overview of Vertigo Medication Use

Drug Class	Jumlah (N=110)	Persentase (%)
HistaminikBetahistin	87	79,09
Antihistamin Dimenhidrinat	41	37,27
Antagonis Kalsium Flunarizin	34	30,90
Antidopaminergik Domperidon	1	0,90
Vasodilator Citicolin	4	3,63
Benzodiazepin Alprazolam	2	1,81
Analgesik Paracetamol	16	14,54
Antiepileptik Amitriptilin	1	0,90
Antiepileptik	1	0,90
Karbamazepin Fenitoin	1	0,90
Suplemen Vitamin C	1	

Table 2 presents the medication profile of outpatient vertigo patients. Betahistine was the most frequently used medication, followed by dimenhydrinate and flunarizine. The presence of analgesics, supplements, benzodiazepines, antiepileptics, and drugs for comorbid conditions indicates that vertigo patients often receive multiple medications. Because one patient may receive more than one medication, the percentage distribution does not necessarily total 100%. This pattern strengthens the rationale for integrating medication history, stock control, and interaction-checking features into the proposed EMR and pharmaceutical service information system.

Table 3. List of Drug Interactions in Patients with Vertigo

Drug Interactions	Drug Interactions	Severity Level	Number of Incidents	%
Betahistin + Dimenhidrinat	Pharmacodynamics	Minor	40	38,83
Dimenhidrinat + Alprazolam	Pharmacodynamics	Moderate	1	0,97
Dimenhidrinat + Amlodipin	Pharmacodynamics	Moderate	5	4,85
Amitriptilin + Candesartan	Pharmacodynamics	Moderate	3	2,90
Amitriptilin + Amlodipin	Pharmacodynamics	Moderate	6	5,82
Amitriptilin + Pregabalin	Pharmacodynamics	Moderate	1	0,97
Amitriptilin + Alprazolam	Pharmacodynamics	Moderate	1	0,97
Amitriptilin + Ergotamin	Pharmacodynamics	Major	1	0,97
Erythromycin + Amlodipin	Pharmacodynamics	Moderate	1	0,97
Amlodipin + Kalk	Pharmacodynamics	Moderate	1	0,97
Amlodipin + Karbamazepin	Pharmacodynamics	Major	1	0,97
Amlodipin + Aspirin	Pharmacodynamics	Moderate	7	6,80
Amlodipin + Metformin	Pharmacodynamics	Moderate	1	0,97
Metformin + Glimepiride	Pharmacodynamics	Moderate	1	0,97
Aspirin + Spironolakton	Unknown	Moderate	3	2,90
Aspirin + Asam Folat	Pharmacodynamics	Minor	3	2,90
Aspirin + Glimepiride	Pharmacodynamics	Minor	1	0,97
Aspirin + Candesartan	Pharmacodynamics	Moderate	3	2,90
Ibuprofen + Ranitidin	Pharmacodynamics	Minor	1	0,97
Ibuprofen + Asam Valproat	Pharmacodynamics	Minor	1	0,97
PCT + Asam Valproat	Pharmacodynamics	Minor	1	0,97
Lansoprazol + Clopidogrel	Pharmacodynamics	Moderate	3	2,90
Clopidogrel + Meloxicam	Pharmacodynamics	Moderate	1	0,97
Clopidogrel + Karbamazepin	Pharmacodynamics	Mayor	1	0,97
Clopidogrel + Piracetam	Pharmacodynamics	Moderate	1	0,97
Clopidogrel + Atorvastatin	Pharmacodynamics	Moderate	3	2,90
Candesartan + Spironolakton	Pharmacodynamics	Moderate	5	4,85
Candesartan + Piroxicam	Pharmacodynamics	Moderate	1	0,97
Furosemid + Bisoprolol	Pharmacodynamics	Moderate	1	0,97
HCT + Spironolakton	Pharmacodynamics	Moderate	1	0,97
Bisoprolol + Candesartan	Pharmacodynamics	Moderate	3	2,90
	TOTAL		103	100

Table 3 identifies 103 potential drug interaction incidents among vertigo patients. The most frequent interaction was betahistine and dimenhydrinate, classified as minor, while several moderate interactions involved cardiovascular, antidiabetic, and analgesic drugs. Three combinations were classified as major, namely amitriptyline with ergotamine, amlodipine with carbamazepine, and clopidogrel with carbamazepine. These findings demonstrate that the EMR system must include drug-interaction alerts, especially because vertigo patients with comorbid conditions may receive complex medication regimens.

Table 4. Availability of Drug Brands at the Nearest Pharmacy Because Stock Can Vary

Drug Name & Class	Main Function	General Dosage	Indications for Use
Betahistine Mesilate / HCl *(Mertigo, Merislon, Betaserc)*	Promotes blood flow to the inner ear	6-24 mg, 2-3 times a day	Peripheral vertigo, Meniere's disease
Flunarizine *(Stugeron, Dizine, Tubloc)*	Prevents narrowing of blooc vessels in the brain (Calciun Antagonist)	5-10 mg per day (usually taken at night)	Prevention of migraines and vertigo
Dimenhydrinate *(Dramamine)*	Antihistamine to suppress th central nervous system (anti nausea & vomiting)	50 mg, 3-4 times a day	Acute vertigo accompanied by severe nausea/vomiting
Meclizine *(Dramamine Less Drowsy*	Relieves dizziness and motio sickness symptoms	25-100 mg per day (divided)	Vertigo, dizziness, motion sickness

Table 4 functions as a pharmaceutical reference for commonly available vertigo medications. It presents drug names, commercial brands, therapeutic functions, general dosage ranges, and clinical indications. In the system-development context, this table is useful for designing the medication database and pharmacy inventory module. However, dosage information should be treated as general reference data and must not replace physician prescription, pharmacist verification, or institutional clinical guidelines.

Table 5. Basic Information and Anamnesis (Chief Complaint)

Category	Patient Data
Chief Complaint	Head spinning (vertigo), dizziness, and nausea.
Symptom Onset	Onset: (Date/Time).
Episode Duration	Constant / Intermittent (Specify in seconds/minutes/hours).
Vertigo Triggers	Rapid head movements / Changes in position / Stress / Fatigue.
Accompanying Symptoms	Nausea / Vomiting / Ringing in the ears (tinnitus) / Hearing loss

Table 5 standardizes the basic anamnesis items needed for the EMR interface. These fields are essential because vertigo assessment depends on the type of dizziness, onset, duration, trigger factors, and accompanying symptoms. By converting these clinical elements into structured digital fields, the system can support more consistent documentation, easier retrieval of patient history, and better clinical communication between medical and pharmacy staff.

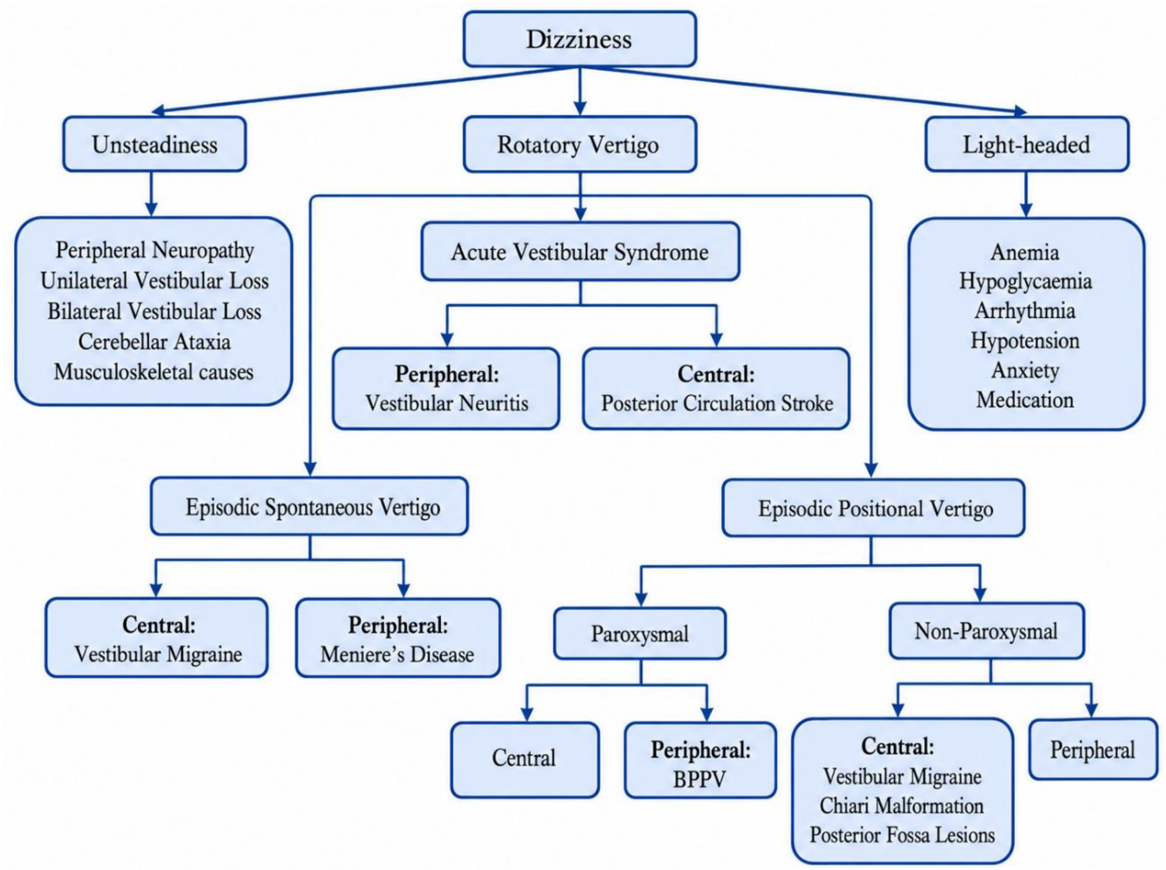

Figure 1. Drug Interactions in Patients with Vertigo

Figure 1 illustrates the clinical classification pathway used to support vertigo-related data recording in the EMR system. The figure begins with dizziness as the primary complaint and differentiates it into unsteadiness, rotatory vertigo, and light-headedness. Rotatory vertigo is further classified into acute vestibular syndrome, episodic spontaneous vertigo, and episodic positional vertigo, each of which may suggest peripheral or central causes. In the methodological context, this figure helps guide the structure of the anamnesis and diagnostic input fields, ensuring that symptom classification is systematically captured before medication data, dosage information, and potential drug interactions are processed in the pharmaceutical module.

RESULT AND DISCUSSION

System Workflow and Data Processing Structure

The developed Electronic Medical Record (EMR) and Pharmaceutical Service Information System was designed to support the digital management of vertigo patient data, pharmaceutical records, medication stock, and patient treatment history. The system workflow begins with the user accessing the application, entering patient-related information, and selecting whether the process involves patient management or data review. As illustrated in Figure 2, the system allows users to input data, access the patient data list, manage patient reports, process patient details, post data into the database, and review stored information before completing the workflow. This structure indicates that the proposed system does not function only as a static data-entry platform, but as an integrated workflow that connects patient registration, clinical documentation, pharmaceutical processing, and treatment review within one digital environment. The flowchart also demonstrates that the system logic supports two main operational pathways: direct completion when no further processing is required and extended processing when patient management or database recording is needed.

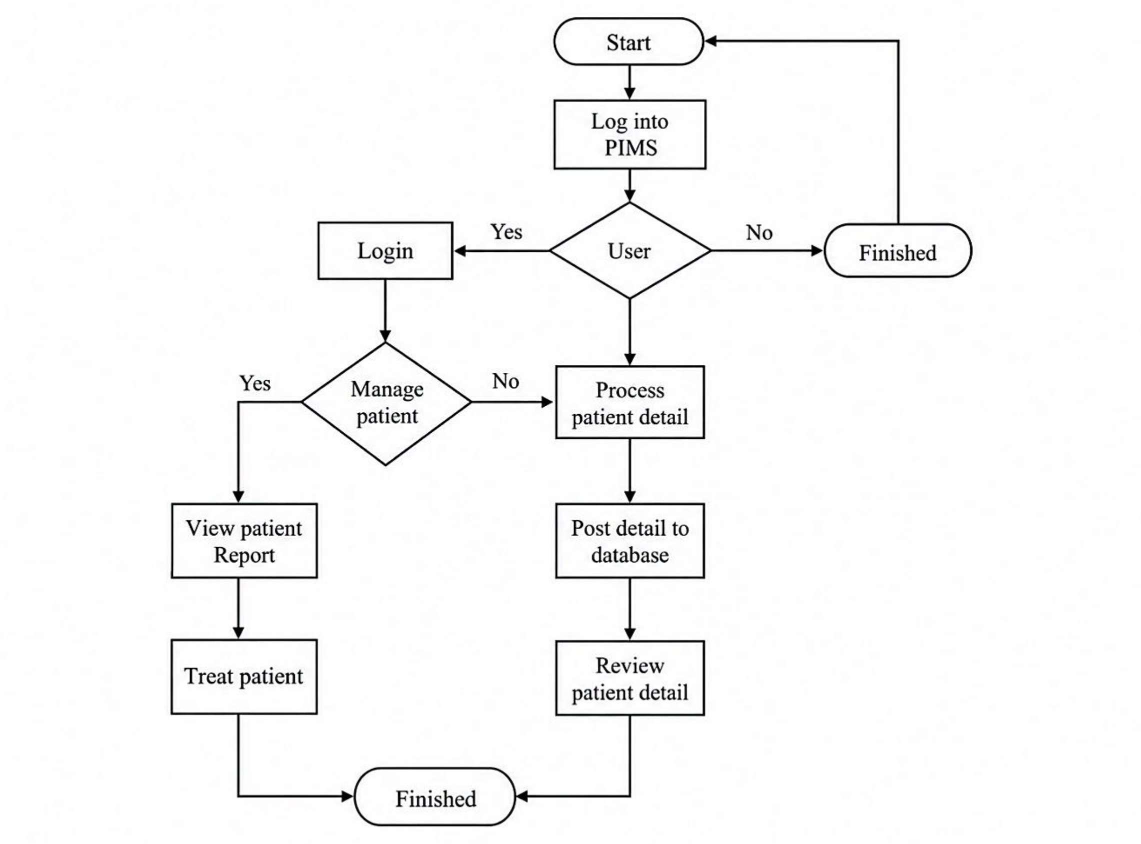

Figure 2. Flowchart of Data System

Figure 2 shows that the system workflow is structured around user-based decision-making. When the user enters data, the system verifies whether the user intends to access the data list or continue processing patient details. If patient management is selected, the system enables the user to view the patient report and proceed to treatment documentation. If patient management is not required, the system processes patient details, posts the information to the database, and allows review of patient data. This workflow is important because an EMR system for vertigo patients must accommodate both administrative and clinical-pharmaceutical tasks, particularly when patient complaints, medication prescriptions, and stock availability need to be handled in an integrated manner.

Medication File Storage and Prototype Interface

The medication file data storage component was developed to demonstrate how patient and pharmaceutical information can be stored, retrieved, and displayed through a simple Python-based interface. Figure 3 presents the initial prototype interface for medication file storage management. The interface shows the use of Python programming with a database connection, a graphical user interface window, and a function for saving medical and pharmacy-related data. The system is designed to create a patient table, store patient identity and symptom data, and provide an application window titled “Medical Record System – Vertigo.” This result shows that the prototype has established the basic technical foundation for managing vertigo medical records digitally.

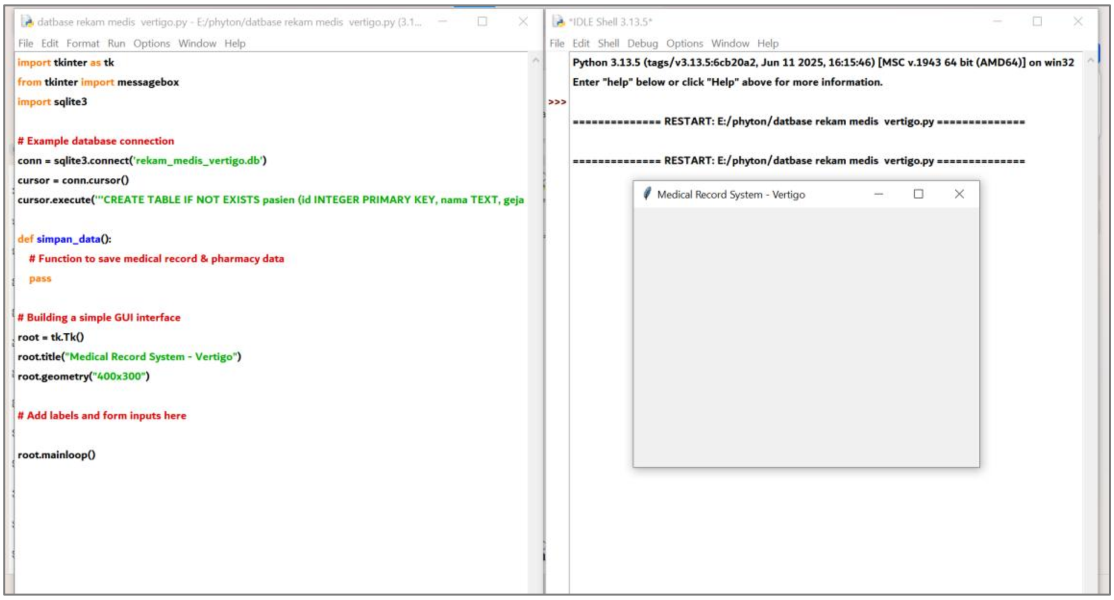

Figure 3. Diagram of Medication File Data Storage Management

Figure 3 indicates that the storage-management module integrates three essential components: a Python script, a database connection, and a graphical user interface. The Python script functions as the logic layer, the database functions as the storage layer, and the interface functions as the user-access layer. This design is relevant for healthcare facilities because medical staff and pharmacy personnel require a system that can store patient information securely while still providing an accessible interface for daily operational use. In practical terms, this module supports the transition from manual recording to digital storage, thereby reducing the risk of misplaced records and improving the speed of patient data retrieval.

Storage and Retrieval of Medication Data Using Binary Search

The system also incorporates a structured medication and patient-data storage model using the Binary Search algorithm. Figure 4 illustrates how medication data and associated symptoms are stored and retrieved based on patient identifiers. The displayed dataset includes patient ID, patient name, symptoms, and medication information, such as “VP-001” with dizziness and nausea treated with Betahistine 8 mg, “VP-002” with dizziness and ringing in the ears treated with Dimenhydrinate 50 mg, and “VP-003” with sudden vertigo and loss of balance treated with Flunarizine 10 mg. The use of Binary Search indicates that the system is designed to retrieve data more efficiently when the dataset is sorted according to the searchable field.

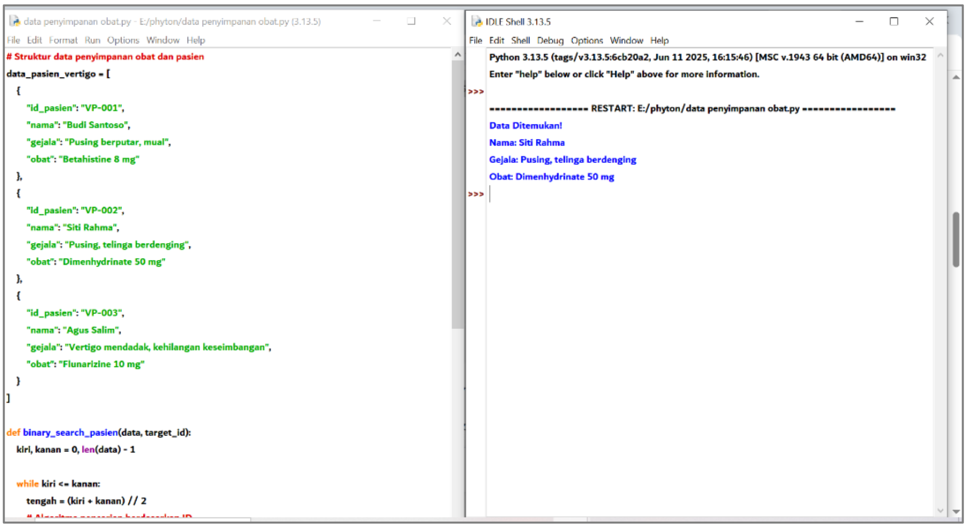

Figure 4. The Storage and Management of Medication Data and Associated Symptoms Using the Binary Search Algorithm

Figure 4 demonstrates the logic of structured data retrieval in the EMR prototype. By organizing patient data in a searchable format, the system can locate patient records based on patient ID and display related clinical and pharmaceutical information. This feature is especially important in vertigo management because patient history, symptom patterns, and previous medication use may influence current clinical decisions. Although the dataset used in the prototype is still limited, the binary search structure illustrates the system's potential to support rapid retrieval of patient records when applied to a larger database.

Output of Pharmacy Medical Records for Vertigo Patients

The output of the developed system is shown in Figure 5, which displays a pharmacy medical record for a vertigo patient. The system successfully saves the patient's medical record, displays the patient's treatment history, records the complaint, stores the prescribed medication and dosage, and shows remaining pharmaceutical stock. In the example shown, the system records a patient with dizziness and nausea, documents the prescribed therapy of Betahistine 8 mg with a dosage of three times daily, and includes a clinical note advising the patient to avoid sudden changes in head position. The system also displays the remaining stock of Betahistine, Dimenhydrinate, and Flunarizine.

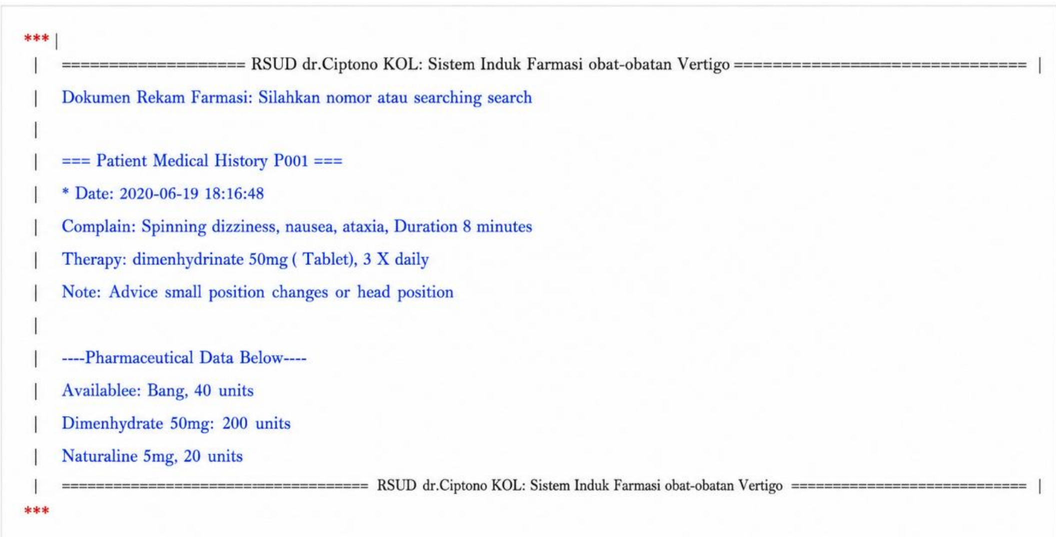

Figure 5. Pharmacy Medical Record for Vertigo Disease

Figure 5 confirms that the system can integrate clinical complaints, prescription information, dosage documentation, treatment notes, and stock monitoring into a single output. This is a significant result because pharmaceutical services for vertigo patients often require synchronization between clinical documentation and drug availability. By displaying the patient's complaint, medication, dosage, and pharmacy stock, the system supports more accurate prescription tracking and helps pharmacy staff monitor medication availability. This feature may reduce manual documentation errors and improve the continuity of medication services for patients with recurrent vertigo complaints.

Binary Search Function for Medication Retrieval

Figure 6 presents the function used to perform binary search on medication data. The algorithm begins by defining the lowest and highest positions in the medication list, calculates the midpoint, and compares the target medication with the medication name stored at the midpoint. If the target matches the midpoint value, the medication data are returned; if the target is greater or smaller, the search continues in the appropriate half of the dataset. The displayed output shows that the system can retrieve medication information such as Ibuprofen, including its associated symptoms and standard dosage.

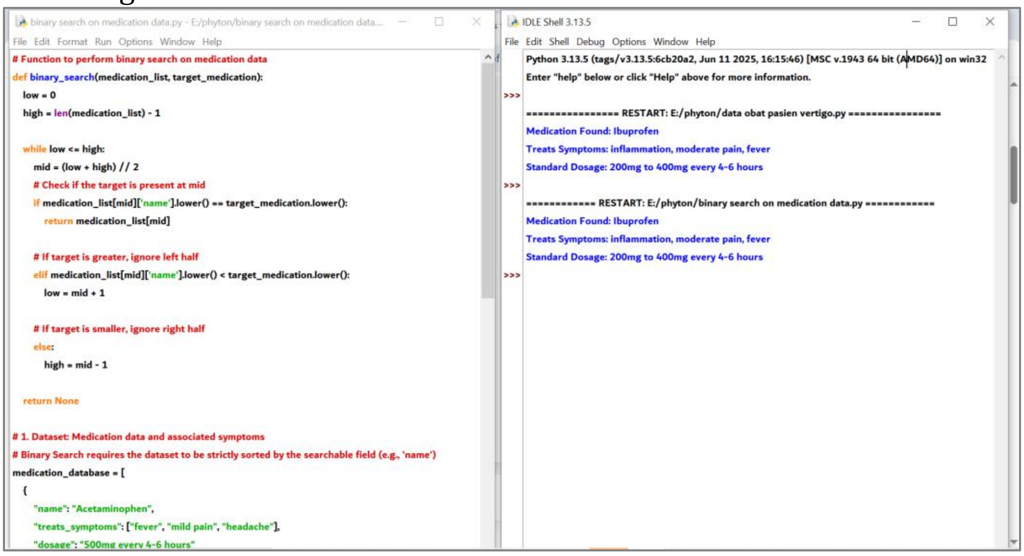

Figure 6. Function to Perform Binary Search on Medication Data

Figure 6 illustrates the algorithmic foundation of the medication retrieval feature. The use of binary search is appropriate when medication data are sorted because it reduces the search space at each step and enables faster retrieval than sequential searching. In the context of pharmaceutical services, this feature can help users locate drug information, symptom associations, and dosage references more efficiently. The integration of this algorithm into the EMR prototype shows that the system is not only designed for data storage, but also for computational support in retrieving clinically relevant medication information.

System Database Structure

The system database structure is displayed in Figure 7. The database uses a nested structure that separates patient data from medication data. In the example, patient "P101" is linked to two prescriptions, "M201" and "M202," while the medication data store the name, dosage, and frequency of each medication. The example lookup retrieves the medications prescribed to the patient by matching prescription identifiers with the medication database. This structure demonstrates a relational logic in which patient records and medication records are connected through prescription identifiers.

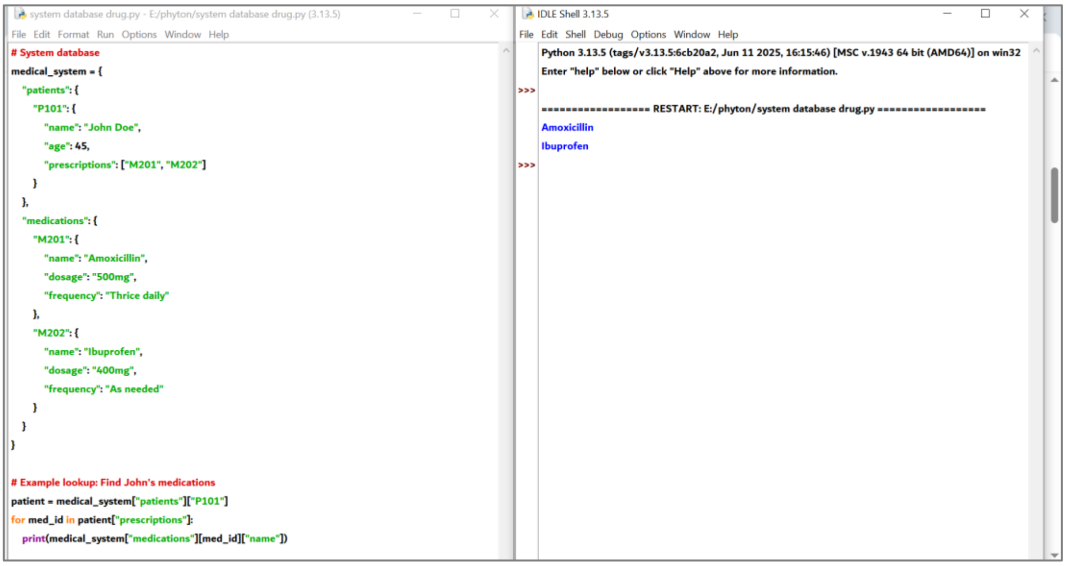

Figure 7. System Database

Figure 7 shows that the prototype database is designed to connect patient information and medication information systematically. This database structure is important because EMR systems require clear relationships between patient identity, clinical history, prescription records, and pharmaceutical data. By separating patients and medications while linking them through prescription identifiers, the system becomes more scalable and easier to maintain. This design can also support future expansion, such as adding drug interaction alerts, medication history tracking, comorbidity data, and prescription validation features.

Discussion

The findings of this study demonstrate that the Python-based Electronic Medical Record (EMR) and Pharmaceutical Service Information System can support the digital management of vertigo patient data, medication inventory, prescription tracking, dosage documentation, and potential drug-interaction monitoring. The system output indicates that clinical complaints, patient identity, medication history, prescribed dosage, pharmaceutical stock, and patient-treatment notes can be integrated into a single workflow, while the use of binary search enables faster retrieval of medication and patient-related information. These findings are consistent with the general evidence that EMR systems can improve healthcare quality by increasing time efficiency, supporting guideline adherence, and reducing medication errors when they are properly implemented (Campanella et al., 2016). However, the present study extends this general finding by positioning EMR not only as a documentation tool, but also as a disease-specific and pharmacy-connected system for vertigo cases, which is more operationally focused than many broad EMR implementation studies. The manuscript also reports that the system supports stock management, automatic notifications, transaction recording, report generation, and user acceptance testing among pharmacy staff, indicating that the prototype has practical relevance for pharmaceutical workflow improvement.

These findings also correspond with Tsai et al. (2020), who reported that EHR implementation can generate benefits for healthcare delivery but that adoption challenges often prevent health institutions from fully realizing its potential. In line with this, the present system addresses one practical implementation challenge by translating clinical and pharmaceutical needs into a simple digital workflow that can be accessed by users for patient management, medication recording, and database review. Nevertheless, unlike large-scale EHR studies that tend to focus on institutional adoption, interoperability, and organizational barriers, this study contributes a more applied prototype for a specific clinical condition. This difference is important because vertigo management requires repeated documentation of symptom onset, episode duration, triggers, accompanying symptoms, medication response, and comorbid risks. Therefore, the value of the proposed system lies in its ability to structure vertigo-related clinical data into searchable and retrievable digital records rather than simply replacing paper documentation with electronic forms.

The results further strengthen findings from Upadhyay & Hu (2022), who emphasized that EHR systems may improve quality and safety, but their effectiveness depends on how clinicians experience and use the system in practice. The current study supports this perspective by showing that the system was designed around user needs, including pharmacy staff requirements for recording incoming and outgoing drugs, monitoring stock, generating reports, and retrieving medication information. The positive user acceptance indicators reported in the manuscript suggest that usability and workflow alignment are essential for EMR adoption. However, the present study differs from Upadhyay et al. because it does not primarily investigate clinicians' lived experiences; rather, it develops and tests a functional prototype. This distinction indicates that future studies should move beyond technical feasibility and include deeper qualitative evaluation of user satisfaction, workload, perceived usefulness, and barriers to long-term system use.

The medication-safety component of this study is also supported by Syrowatka et al. (2023), who found that computerized provider order entry combined with medication-related clinical decision support systems is associated with reduced medication errors and adverse drug events, although unintended consequences such as alert fatigue, inappropriate overrides, and overdependence on alerts may occur. The present study is aligned with that evidence because the developed system incorporates dosage alerts and drug-interaction checking as part of the EMR-pharmacy workflow. However, this study also needs to be interpreted carefully because the prototype has not yet measured whether these alert features significantly reduce real medication errors or adverse drug events in clinical practice. Therefore, while the system provides a promising basis for medication safety, its clinical effectiveness must still be validated through controlled implementation studies, pre-post comparisons, or prospective monitoring of medication error rates.

The drug-interaction findings in this study are particularly relevant when compared with Felisberto et al. (2024), who reported that drug–drug interaction alert systems often face high override rates, with many alerts ignored by physicians even after system adjustments. This comparison implies that the presence of drug-interaction alerts alone is not sufficient to guarantee safer prescribing. The alert system in the proposed EMR should therefore be developed with severity prioritization, clear clinical explanations, user-friendly design, and pharmacist verification so that users are not overwhelmed by excessive or low-relevance alerts. In the present study, the identification of minor, moderate, and major interaction patterns among vertigo patients provides an important foundation for building more targeted alerts. This is a meaningful contribution because the system can be designed to prioritize major and clinically significant interactions rather than generating undifferentiated warnings that may contribute to alert fatigue.

The clinical relevance of this study is also supported by Di Mizio et al. (2021), who discussed drug–drug interactions in vestibular diseases and noted that antihistamines, including dimenhydrinate and related vestibular suppressants, are commonly used in peripheral vestibular vertigo. This is consistent with the medication pattern in the present study, where betahistine, dimenhydrinate, and flunarizine appeared as frequently used antivertigo medications. The comparison shows that vertigo pharmacotherapy is not merely a matter of recording prescribed drugs, but also requires systematic monitoring of drug combinations, comorbid medications, and interaction severity. The present study therefore adds practical value by connecting vertigo medication profiles to an EMR-based pharmaceutical record and inventory system. This integration is important because vertigo patients may have comorbidities such as hypertension, stroke history, diabetes-related complications, or cardiovascular problems, which can increase the complexity of medication management.

The findings also relate to Chen et al. (2023), who showed that vestibular rehabilitation combined with antivertigo drugs can improve vertigo-related outcomes, balance function, and daily activity ability in patients with vestibular neuronitis. Although the present study does not evaluate therapeutic efficacy, it supports the clinical-management side of vertigo care by ensuring that medication history, patient complaints, dosage, and treatment notes are recorded systematically.

This comparison highlights a complementary relationship: while Chen et al. focused on clinical intervention outcomes, the present study focuses on the digital infrastructure needed to document and support such treatment processes. In other words, accurate EMR and pharmaceutical documentation can become an enabling condition for better longitudinal monitoring of vertigo treatment, medication response, recurrence patterns, and follow-up care.

The novelty of this study lies in the integration of a disease-specific EMR for vertigo patients with pharmaceutical service functions using Python algorithms. Unlike many EMR studies that focus broadly on hospital documentation, this study combines vertigo patient records, anamnesis data, medication inventory, prescription history, dosage information, drug availability, drug-interaction identification, and binary-search-based retrieval within one prototype. This integrated design provides a distinctive contribution because it responds to the practical intersection between clinical documentation and pharmacy management. The use of Python also gives the system flexibility for further development, including database expansion, interface refinement, automated reporting, medication alert prioritization, and future integration with more advanced clinical decision support. The novelty is therefore not merely the use of EMR technology, but the development of a condition-specific, pharmacy-oriented, and algorithm-supported prototype for managing vertigo patient care.

The implications of this study are theoretical, practical, and managerial. Theoretically, the study contributes to health informatics literature by showing that EMR development can be strengthened through disease-specific design and pharmaceutical-service integration. Practically, the system can help medical and pharmacy personnel retrieve patient information more quickly, reduce manual documentation errors, monitor drug availability, and improve the continuity of vertigo patient care. Managerially, the system supports the digital transformation agenda in Indonesian healthcare facilities, especially in relation to the implementation of electronic medical records and the need for secure, efficient, and integrated health data management. This is relevant to (Fita Rusdian Ikawati & M. Syauqi Haris, 2024), who reported that digital medical record implementation in Indonesian hospitals continues to face challenges related to technological readiness, regulation, data security, interoperability, infrastructure limitations, implementation cost, and staff adoption. Therefore, the proposed system can serve as an initial model, but its future implementation must be accompanied by institutional readiness assessment, data protection mechanisms, user training, and interoperability planning.

Despite its contributions, this study has several limitations. First, the system remains at the prototype stage, so its effectiveness in real clinical environments has not yet been tested through long-term implementation. Second, the study uses retrospective and limited clinical data, which may not fully represent broader vertigo patient populations across different hospitals or healthcare settings. Third, the algorithmic demonstration uses a relatively small dataset, meaning that system performance, scalability, and retrieval efficiency still need to be evaluated using larger and more complex databases. Fourth, although the system includes drug-interaction and dosage-alert functions, the study has not measured alert accuracy, clinical relevance, override behavior, or impact on actual medication-error reduction. Fifth, data security, privacy protection, role-based access, audit trails, interoperability with hospital information systems, and compliance with broader health information standards require further technical validation. Future research should therefore conduct usability testing with larger user groups, integrate real-time hospital data, validate drug-interaction rules with pharmacists and clinicians, compare system performance with manual workflows, and assess whether the system significantly improves documentation quality, service efficiency, medication safety, and patient outcomes.

CONCLUSION

This study concludes that the development of a Python-based Electronic Medical Record (EMR) and Pharmaceutical Service Information System provides a practical and integrated digital solution for managing vertigo patient data, pharmaceutical records, medication inventory, prescription history, dosage documentation, and potential drug-interaction monitoring. The system demonstrates its capacity to transform manual medical and pharmacy recording into a more structured, searchable, and efficient digital workflow through patient data input, database storage, stock monitoring, treatment-history retrieval, and binary-search-based medication access. The integration of clinical documentation and pharmaceutical service functions represents the main contribution of this study, particularly because vertigo patients often require repeated symptom monitoring, accurate medication records, and careful attention to comorbidities and drug combinations. The findings indicate that the proposed system can support healthcare personnel in improving documentation accuracy, accelerating access to patient information, reducing administrative inefficiencies, and strengthening medication safety in vertigo care. Nevertheless, the system remains at the prototype stage and requires further validation through larger datasets, real-time hospital implementation, usability testing, data-security assessment, interoperability evaluation, and clinical effectiveness measurement. Future studies should refine the system by incorporating more advanced clinical decision support, role-based access control, automated alert prioritization, and integration with hospital information systems to ensure that the EMR can be implemented safely, sustainably, and effectively in broader healthcare settings.

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