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# A Web-Based Electronic Health Record Framework for ASHA Workers Using Python Flask and MySQL

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## Abstract

Delivery of healthcare services in rural areas depends on frontline health workers who maintain, update and communicate patient records. Manual health record maintenance limit the efficient retrieval, updating and monitoring of patient related information from the healthcare perspective. This research work proposes a web based Electronic Health Record (EHR) framework that can aid Accredited Social Health Activist (ASHA) workers in managing community healthcare information. The framework utilizes Python Flask as the application layer and MySQL as the relational database. A patient centric approach is adopted in the framework wherein patient record is the primary record including the healthcare visit record, vaccine record, health status record and medical report are recorded as events. Role-based access control is used for patient, ASHA worker, supervisor, zonal officer, district officer and administrator. The implementation was evaluated using operational parameters such as record entry time, entry error rate, report generation time, data completeness, report-access time, data retrieval time, system availability, and record access accuracy. The reported outcomes reveal record entry time as 2 minutes per record, entry error rate at 0.5%, report generation time as up to 5 seconds, data completeness of 99%, and system availability of 99.8%.

**Keywords:** Electronic Health Record, ASHA Workers, Python Flask, MySQL, Healthcare Information Management, Role-Based Access Control, Digital Health.


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## 1. Introduction

Healthcare information management in rural communities involves continuous collection, updating, and exchange of patient information among frontline health workers, healthcare facilities, and administrative authorities. Accredited Social Health Activists (ASHAs) act as an important interface between the rural communities and the modern healthcare system. The role of ASHAs includes providing healthcare services in the community, maintaining records, and supporting preventive healthcare.

Despite the importance of these activities, health information collected manually or through fragmented systems is not easy to obtain and monitor. Patient information, healthcare visits, medical reports, vaccination details, and other healthcare activities may be maintained separately, limiting longitudinal access to an individual's healthcare history. The EHR system solves this problem by relating various health activities to the patient's record.

Existing EHR studies have focused on structured health-information management, interoperability, and information exchange. Still, what is missing is an approach to EHR design that is lightweight and tailored to the work flow of ASHA workers, especially one which integrates field patient registration and recording of healthcare events with information retrieval by supervisors and administrators.

To address this requirement, the current study has designed a web-based framework for EHR with the help of Python Flask and MySQL. The application processing is provided by Python Flask, whereas relational data storage will be provided by MySQL. The current framework follows a patient-centric approach where all health-related activities are linked with the patient's record.

The important contributions of this study include:

1. A patient-centered web-based EHR architecture for ASHA-driven healthcare information management.
2. A longitudinal healthcare record management system that can link healthcare operations to patient records.
3. A role-based access system that works at the level of fields, supervisors, and

administrators.

4. The suggested approach unifies patient records at the ASHA level, healthcare event logging, and role-based access in one Flask-MySQL EHR system.
5. Test performance of the developed system using record entry, retrieval, report generation, completeness, accuracy, and availability parameters.

## 2. Related Works

Accredited Social Health Activists (ASHAs) play an important role in India's community-based healthcare system, who serve to link rural communities with formal healthcare facilities. They are charged with tasks such as health awareness programs, assistance in maternal and child health, referral services, prevention of diseases, and community-based healthcare. Several studies have been conducted on the role, knowledge, and participation of ASHA workers in various aspects of healthcare.

Knowledge and awareness of ASHA workers are especially crucial since it plays a key role in the provision of proper information on health matters by such workers. Sreehari [3] conducted research on the awareness of ASHA workers on feeding practices of infants, thereby underlining the importance of ASHA workers in the promotion of proper healthcare practices for mothers and infants. Shashank [4] examined the knowledge of ASHA workers on antenatal and postnatal care, proving the importance of the knowledge possessed by ASHA workers for maternal healthcare at the community level.

In addition, the scope of activities conducted by ASHA workers has been extended to preventive healthcare measures as well as specialized healthcare interventions. Hariprasad et al. [7] conducted a study to assess the viewpoint of ASHA workers on self-sampling for HPV in Sikkim, India. This study reflects how ASHA workers are involved in screening as well as preventive healthcare measures in their community settings.

Mental healthcare is another emerging area of ASHA involvement. Bansal et al. [8] examine the perceptions of ASHA workers engaged in the HOPE collaborative care mental health intervention in rural South India. This article emphasizes the importance of involving frontline workers in community-based mental health care and the significance of analyzing their experiences and perceptions to integrate them into structured healthcare interventions.

There is an increasing complexity in the provision of healthcare services, necessitating systematic management of patient information from various healthcare providers. Electronic Health Records (EHRs) are tools used to store and manage the patient information digitally and can be used to maintain continuity of care in all healthcare settings. Nevertheless, EHRs need certain standards of implementation.

Pai et al. [9] presented a standardized EHR framework for the Indian healthcare system, stressing the importance of structured electronic health information management. The use of a standardized EHR framework helps ensure a common representation of patient data and better information flow among health care participants. This is especially significant in decentralized health care settings, where patients might be seen by community health workers, primary health care centers, hospitals, and specialists.

Although EHR systems offer a platform for managing healthcare information through digitization, interoperability and secure data exchange pose critical issues. The need to ensure secure and distributed healthcare information management has led to the exploration of blockchain technology as a solution. The use of standardized EHRs and blockchain technology allows for addressing complementary challenges in healthcare information management. In this regard, Pai et al. [9] considered developing standardized EHR systems in the Indian healthcare context

The web-based technology offers an infrastructure through which healthcare information systems can be created and accessed by various users. Python Flask has been used for the development of web-based applications. Aakash et al. [5] deployed a web-based application using Python Flask on Google Cloud Platform. This clearly shows that Python Flask is suitable for building cloud-based web applications. Ganesh [1] built a management system using Python Flask and MySQL. Similarly, Eppakayala et al. [6] have use Python Flask in their machine learning-based automated application. The Open Government Data (OGD) Platform of India contains information about the approved budget and spending for the remuneration of ASHA workers through the National Health Mission from the year 2018-19 to 2024-25.[10] This helps understand the budget allocated to the front-line health workers and gives context to the creation of digital healthcare management systems.

Although these studies are not specifically focused on ASHA-based healthcare systems,

they provide an implementation foundation for Flask-based web applications. In the context of healthcare information management, such technologies can provide the user interface through which authorized personnel can enter, retrieve, and manage structured health information. However, Flask should be considered an enabling implementation technology rather than the primary research contribution. The research contribution should instead be established through the healthcare workflow, information-management mechanism, security architecture, interoperability, and experimental validation.

## 3. Methodology

The proposed EHR framework is designed as a patient-centric, role-based information management system that helps with the conduct of ASHA level healthcare operations and further supervision and administration. The approach comprises five interrelated stages, including healthcare data collection, patient record formation, data verification, healthcare event management, and role-based storage and retrieval. The processing architecture isolates the user interface from the application processing and persistence layers.

The patient record is treated as the primary information entity. Healthcare visits, vaccination details, maternal and child healthcare information, status reports, and medical reports are depicted as healthcare events. This structure facilitates the connection of various interactions under one patient record, rather than generating a different record for each interaction.

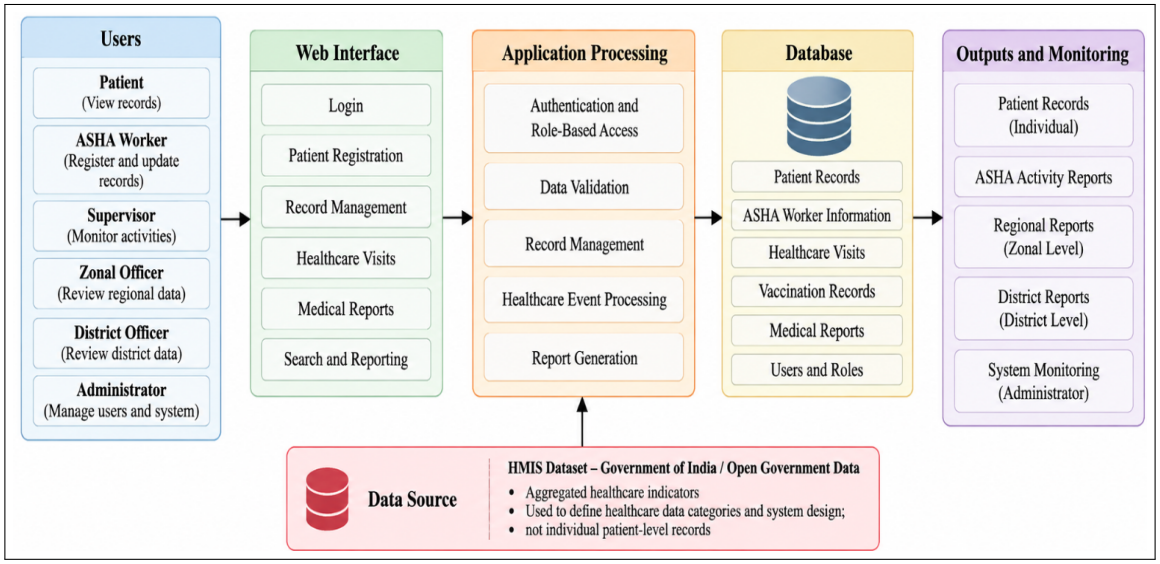



**Figure 1.** Working process of proposed EHR framework

### 3.1 Data Collection

The study uses the health care data are collected from the Open Government Data (OGD) platform of India, which provides State/UT-wise data on budget allocation and expenditure towards remuneration of ASHA workers under the NHM from 2018-19 to 2024-25[10]. The OGD dataset used in this research work is an aggregated health care indicator dataset, which does not have individual patient level demographic characteristics such as patient age, gender, name or any kind of patient identification code. However, the demographic characteristics have been included in the selected HMIS indicators using pre-defined age and sex specific categories. For instance, there are separate categories of live births of male and female, children diagnosed with diseases, deficiency and developmental delays of male and female children, and age-specific categories such as children aged 6 months to 6 years, 6-18 years, 6-10 years, and 10-19 years.

### 3.2 Patient-Centric Healthcare Information Model

One of the most important design considerations for the proposed EHR would be the use of the patient as the primary data object. The registration of the patient sets out the identity that would be used to relate all healthcare information to in future. This means that the information that does not change so often will be separated from information generated through healthcare events.

The patient record will have identification details and healthcare information. After the patient record is created, it can be used to relate other healthcare events, vaccinations, maternal healthcare information, and child healthcare information.

This organization provides longitudinal continuity. The system does not need to keep track of all the healthcare encounters through different patient records. Rather, the system builds on a patient's record through time by adding more healthcare encounters to the record that already exists. In this way, patient-based searches can reconstruct healthcare history.

Conceptually, the record can be represented as:

$$P_i = \{D_i, H_i, E_i, R_i\}$$

where $P_i$ represents the patient record, $D_i$ denotes patient identification and demographic information, $H_i$ represents health-related information, $E_i$ represents associated

healthcare events, and $R_i$ represents associated reports.

The formulation is used to describe the organization of information rather than to introduce a computational learning model.

### 3.3 Data Validation and Preprocessing

Raw information entered through healthcare interfaces is not directly treated as persistent EHR information. A validation stage is applied before database insertion or update.

The validation process considers:

- completeness of required patient information;
- consistency of entered field values;
- date and age formatting;
- contact-information formatting;
- duplicate patient identification; and
- consistency between related healthcare records.

Duplicate identification is critical because duplicate registration of the same patient would result in fragmented longitudinal medical record history. Therefore, the system checks the details of the patient against existing data before creating a new patient record.

### 3.4 Patient Record Creation and Longitudinal Updating

A verified patient record is transformed into a stable electronic patient record. This record serves as the basis for all the future health care transactions.

The framework distinguishes between: Identity information about the patient and healthcare information that depends on time. Identity information about the patient remains the primary information, while visits, vaccinations, reports, and healthcare news are included as related events. This way, healthcare encounters do not overwrite the information about the patient.

The resulting longitudinal structure can be represented as:

$$P_i \rightarrow \{V_{i1}, V_{i2}, \ldots, V_{in}\}$$

where $V_{ij}$ denotes the $j^{\text{th}}$ healthcare event associated with patient $i$.

This organization supports retrieval of both the current patient state and previously recorded healthcare activities.

### 3.5 Healthcare Event and Medical-Report Management

Healthcare-related activities are modeled as an event associated with the patient record. The key events implemented in the solution are the following: healthcare visits, vaccinations, maternal health monitoring, child health monitoring, and medical reports.

The medical report is linked to the respective healthcare event rather than being considered an independent document. It allows for the tracing relationship between the report and the underlying patient event.

### 3.6 Relational Database Architecture

The EHR database utilizes a relational database format where the patient information is kept as the master file while all other healthcare information is linked to the specific patient. The database establishes connections between patients' records, ASHA staff members, visits to the healthcare facilities, and the relevant healthcare reports. This arrangement segregates the persistent data of the patient from the other healthcare information.

Patient records act as the entity used as a reference point in longitudinal information management. Patient encounters, vaccine administration, health status reviews, and health care records are all tied to the patient rather than being kept independently. In this way, there is no duplication of patient information, while healthcare information can be accessed in relation to both the patient and the healthcare activity involved.

The database also supports role-specific retrieval by allowing application queries to identify information relevant to ASHA workers, supervisors, zonal authorities, district authorities, and patients. Consequently, MySQL provides both persistent storage and the relationship mechanism required for patient-centric healthcare information management.

### 3.7 Flask-Based Application Processing

In Python Flask, the application-processing layer that lies between the user interfaces and the MySQL database has been designed. In response to the user requests created via the web interface, the application will process the user requests as per the health care operation requested. Processing of the request is done in order to create separation of presentation,

application logic and persistent storage. In the case where there is a request for data entry, then the information entered is received by Flask and processed as per the relevant healthcare record specifications. In the case where there is a request for retrieval of information, then Flask processes the request, retrieves the information from MySQL and then passes on the results to the relevant user interface. This approach ensures there is no direct interface of the user interface and database.

### 3.8 Authentication and Role-Based Authorization

The access to the EHR is managed depending on the user's designated role. The architecture provides the support for Patient, ASHA Worker, Supervisor, Zonal Officer, District Officer, and Administrator roles with each of these having their unique healthcare information management duties.

Once the user is authenticated, then the application determines the role of the particular user and the actions the user can perform. The ASHA workers are provided with functionalities which allow them to register new patients, record visits, update patient information, and manage medical reports. The supervisor and administrator roles have progressively wider monitoring and reporting functionalities while the patients have limited access to their own healthcare information and functionalities.

Thus, the authorization process takes place at the application level since it associates the user's role with his or her actions. It allows preventing the presentation of identical functionality to all the users.

The security of the suggested EHR framework can be assessed based on role-based access control test scenarios, which include unauthorized log in, access to other patients' records, privilege elevation, and unauthorized record modification. The system should prevent sensitive patient data from being accessed by unauthorized parties. But, for testing purposes, real-life test results of the security test will be needed.

### 3.9 ASHA-Level Healthcare Processing

ASHA level processing is the main interaction of the healthcare provider with the EHR. First of all, the ASHA level worker has to register the patient or get access to the existing patient record. All the next healthcare encounters will be related to the same patient record.

The processes include patient registration, patient record update, healthcare visit documentation, vaccinations information, mother-child healthcare information, and medical report management. Thus, the workflow facilitates both patient data capture and longitudinal patient data update.

A submitted healthcare activity passes through the application layer before persistence. The system validates the relevant information and associates the activity with the corresponding patient record. This association allows multiple healthcare interactions to be retrieved as part of the patient's longitudinal history and reduces fragmentation caused by maintaining separate records for individual activities.

### 3.10 Supervisory and Hierarchical Processing

The EHR extends beyond field-level input of data by providing hierarchical access to health care information. The information that is generated by ASHA workers can be accessed by supervisory and administrative users based on their roles.

In case of supervisory roles, health care information can be accessed to keep track of activities of ASHA and the patient records. Health care information and reports can also be accessed at higher administrative levels in the form of region and district-level reviews. This hierarchy results in a sequence of field-level record creation and supervisory and administrative record access.

In this way, the same health care records can be used to fulfil various information needs without requiring different sets of records at different administrative levels. As such, the field-level records created by ASHA can help in monitoring and reporting activities of higher levels as well.

### 3.11 Reporting and Information Retrieval

The reporting component allows for retrieval of healthcare data from the persistent database in a structured manner. In terms of patient level, authorized users are able to retrieve specific healthcare data and the related activities. For supervision and administration purposes, healthcare data and activities can be retrieved to monitor activities, review healthcare data and create reports.

The process of data retrieval starts with a request from the authorized user through

the web interface. Flask retrieves the request and converts it into a corresponding database query. The necessary data is retrieved from MySQL and sent back to the appropriate interface or reporting process.

It is clear that the reporting component converts the stored healthcare data into information in role-specific format. The patient level data retrieval is concerned with individual healthcare data, while supervision and administration data retrieval can be done for multiple records to facilitate healthcare monitoring.

## 4. Implementation of the Proposed EHR Framework

The implementation is done by user authentication, patient registration, longitudinal record management, healthcare activity recording, supervisory processing, administrative management, and report generation.

### 4.1 System User Roles

The proposed platform consists of various types of users like Patient, ASHA Worker, Supervisor, Zonal Officer, District Officer, and Administrator. Each user type has certain responsibilities within the system. While the patient can view his/her healthcare information, the ASHA worker registers patients and updates visit records and report files. Supervisors and other high-ranking officials have been allotted tasks related to monitoring and reporting. The administrator takes care of users and database management. The task allocation among users is presented in Table 1.

**Table 1.** User roles and responsibilities

| User Role | Primary Responsibilities |
|---|---|
| Patient | View personal health records and manage appointment-related activities |
| ASHA Worker | Register patients, record healthcare visits, update patient information, and upload medical reports |
| Supervisor | Monitor ASHA worker activities and review patient healthcare data |
| Zonal Officer | Monitor healthcare performance and activities at the regional/zonal level |

| | |
|---|---|
| District Officer | Oversee district-level healthcare operations and review aggregated healthcare information |
| Administrator | Manage system users, access permissions, and database-related operations |

### 4.2 System Entry and User Access

This web application offers a unified access point where users get to access the various healthcare services provided. This is done from the home page, which serves as the first navigation interface that leads users to the system functionalities.




**Figure 2.** Home page of the proposed EHR application

The initial system interface that allows users to log into the EHR environment is shown in Figure 2. The program checks the login credentials of the user and assigns him/her the role on the basis of which the user gets access to relevant functions.

### 4.3 ASHA Worker Dashboard

ASHA Worker Interface is the main field-level data entry part of the system. The dashboard gives access to patient registration, patient record management, health care visits, medical reports, and other health care activities.

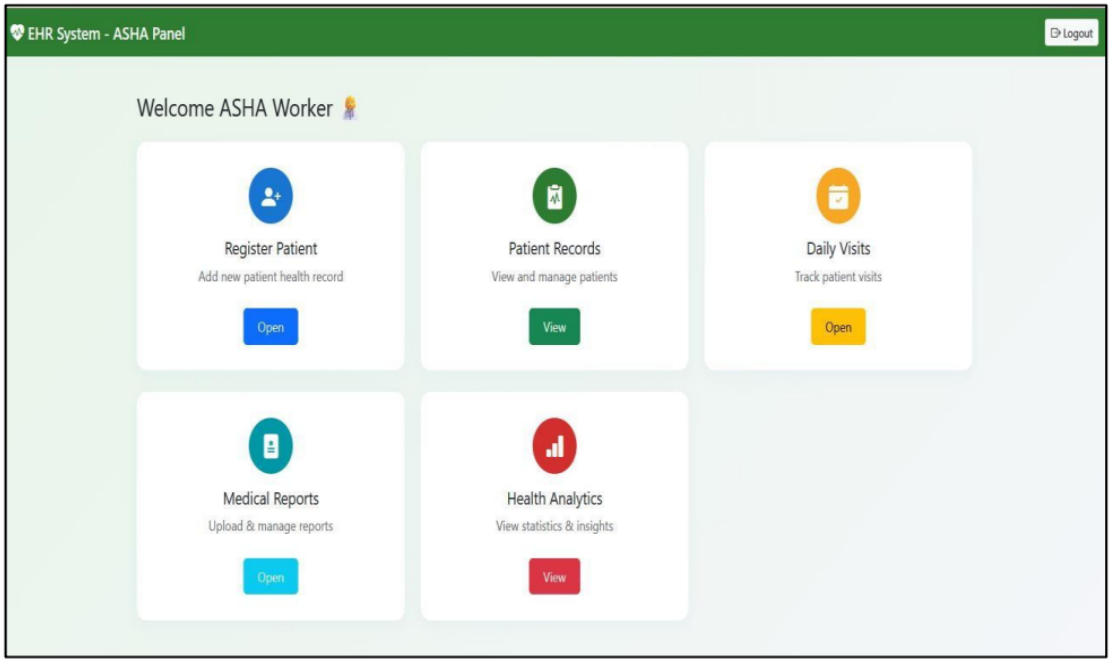



**Figure 3.** ASHA worker dashboard for field-level healthcare information management

As shown in Figure 3, the dashboard integrates the major operations required during community-level healthcare activities. Instead of maintaining separate interfaces for unrelated data-entry tasks, the dashboard provides a unified access point from which the ASHA worker can create and update patient-related information. This design connects field-level data collection with the centralized EHR repository.

### 4.4 Patient Registration and Record Creation

Patient registration is the initial record-creation operation. The registration interface captures patient identification and demographic information together with relevant healthcare information.

Figure 4 illustrates the structured registration mechanism used to establish the patient record. The submitted information is subjected to the validation procedures described in the methodology before being persisted in MySQL. After registration, the patient is created as an object to which further healthcare processes may be attached. In this way, the visits or the reports are not allowed to stand alone but rather the patient is taken as the entity against whom the healthcare information will be recorded.

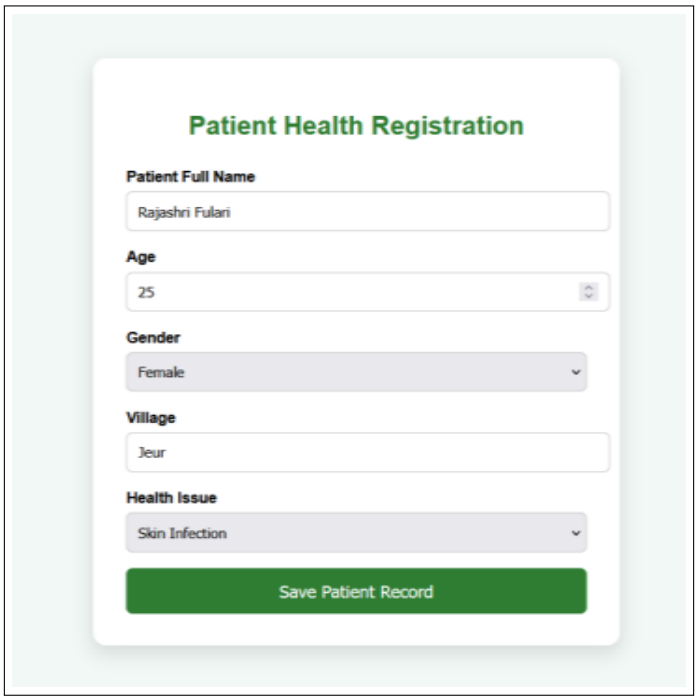



**Figure 4.** Patient registration interface for creating a digital healthcare record

## 4.5 Patient Record Management

The patient-record interface provides access to information stored for an individual patient and supports subsequent record management.

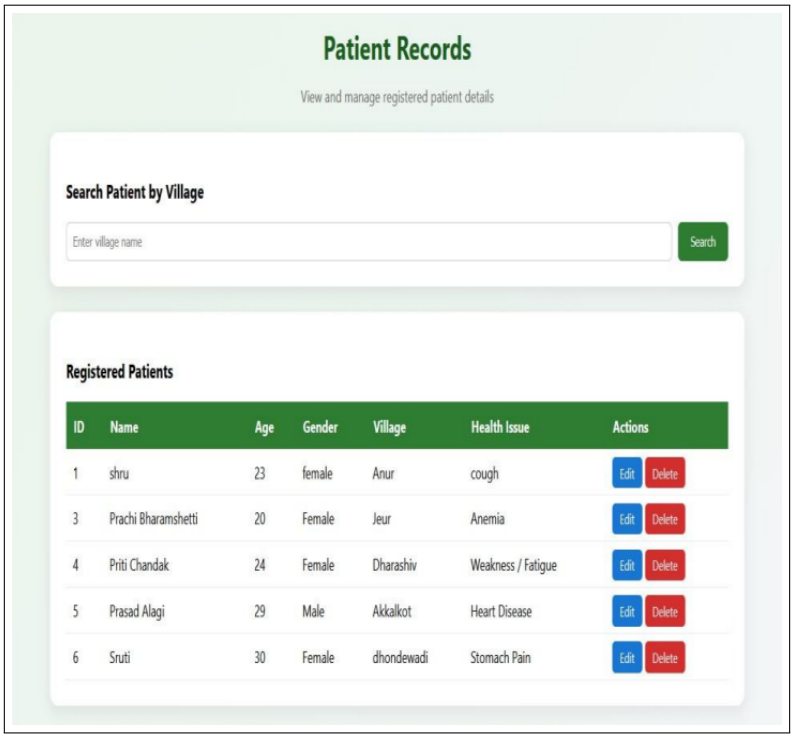



**Figure 5.** Patient record interface for longitudinal healthcare information management

Figure 5 illustrates the process of moving from the first registration phase to continuous management of the records. New information about the healthcare services can be included in the current record whenever any further activity is performed. The system allows longitudinal updating instead of using the EHR only for a one-time registration process. The patient's record serves as a connection between patient information and healthcare activities.

### 4.6 Database and Application Processing

The healthcare information system uses MySQL to store the persistent information, and the application processing layer uses Flask. The design architecture separates the interface and database layer such that all requests made through the interface are processed through the application layer and then persisted in the database or fetched from there.

The relational database creates relationships between patient information, ASHA, healthcare visit, and health report information. Thus, any information created through an interface is related to the appropriate patient or healthcare activity. Therefore, the database does more than just persist information; it provides the persistence and relationship layer for EHRs.

## 5. Results and Discussion

The implemented EHR system was evaluated across the major user roles using operational performance indicators associated with their respective system activities. The evaluation considers record-entry time, error rate, report-generation time, data completeness, report-access time, trend-identification accuracy, data-retrieval time, system availability, and patient-record access accuracy. The consolidated results are presented in Table 2.

**Table 2.** Performance evaluation of the proposed EHR system

| Performance metric | Result |
|---|---|
| Record-entry time | 120 seconds per record |
| Entry-error rate | 0.5% |
| Report-generation time | ≤ 5 seconds |
| Data completeness | 99% |

| | |
|---|---|
| Report-access time | 3 seconds per report |
| Trend-identification accuracy | 98% |
| Data-retrieval time | 4 seconds per report |
| System availability | 99.8% |
| Patient-record access time | ≤ 2 seconds |
| Patient-record data accuracy | 100% |

The results demonstrate that the implemented system is able to generate response time with varied features based on the type of task carried out by the individual user roles. While the ASHA worker's process takes about 120 seconds or 2 minutes per record because it entails direct entry of patient data as well as its processing, the other processes of the supervisor, zonal, district, and patient are those of retrieving or accessing data/report and, as such, their response times are much shorter at 5, 3, 4, and 2 seconds, respectively. The system has 99% data completeness, 0.5% entry error rate, 98% trend detection accuracy, and 99.8% system availability.

Overall, the results indicate that the implemented platform provides measurable operational support for healthcare-record entry, retrieval, reporting, and monitoring. However, the presented study lacks information about the number of test cases used, number of replications, hardware settings of the tests, data set size, standard deviation, and confidence intervals. For this reason, the findings can only be considered as operational performance measures of the system and not as its statistically validated performance.

## 6. Conclusion

This work presented a web-based Electronic Health Record (EHR) framework for supporting healthcare information management by ASHA workers. The system includes functions like patient registration, digital health records management, visit management, medical reports management, access control based on user role and supervisor monitoring. The proposed design is implemented through the use of Python Flask and MySQL database. The interfaces provided in the design allow for structured input, updates, access and management of the patient's information while DFDs, flowchart and sequence diagrams describe the flow of

information between the users. The results provided from the implementation of the framework show the system performance measures in terms of operational performance with respect to ASHA workers, supervisors, zonal authority, district authority and patients. The performance results include average record entry time of 2 minutes per record, entry error rate of 0.5%, report generation time of 5 seconds, and patient record access time of 2 seconds. The results also include data completeness rate of 99%, trend detection rate of 98%, and availability of the system at 99.8%.

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