

A Web-Based Hospital Management System For Iganga District Hospital, Uganda

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ABSTRACT

The emergence of Hospital Information Systems has enabled quick communication by the staff and the immediate dissemination of patient information. However, at Iganga district hospital, there are challenges of inappropriate data Keeping practices, inaccurate reports, time wastage in data processing, storing, and retrieval that are encountered by the hospital management. Therefore this paper describes the design of a web-based hospital information management system as a solution to curb these challenges. Design science methodology was adopted by the study. Both qualitative and quantitative methods were employed to obtain views on information system development and implementation in the hospital. Hypertext Preprocessor (PHP), Hypertext Markup Language (HTML), and Cascading Style Sheets (CSS) were used for front end design of the system user interfaces and My Structured Query Language(MySQL) was used for data management at the backend. Unit and Integration system tests were done and the system proved to provide efficient and effective patient services and healthcare administration.

Keyword: - Hospital, ICT, Electronic Healthcare and Hospital information system

1. INTRODUCTION

Hospitals are seen as the focal healthcare providers in developing economies. In this regard, hospitals should be the primary target organizations for advancing health information systems in such economies (Raja et al.,2015; Malik & Khan, 2009; Clifford, Blaya, et al,2008). The World Health Organization (WHO), disputed that hospitals are fundamental for medical and social organizations that provide comprehensive health care to people (Adebisi et al, 2015).

Jayawardena (2014) posited that to manage a health organization effectively and efficiently, a good Health Management Information System (HMIS) is crucial. HMIS can manage several system users, track all the user functions and rights assigned to them (Adebisi et al, 2015).

Just like any large business organization, a hospital requires a complete management system that is flexible, data-based, and innovative to function properly (Yuriy, 2020). This is because a hospital is one of the most complexes of administrative organizations and numerous operational works such as recording Patients information, recording diagnosis-related information administered to Patients, information storage about various diseases and available medications to cure them, generation of bills are done in a hospital (Adebisi et al,2015).

Currently, research reveals that in most hospitals, the majority of these operations are done on papers. Yuriy (2020), however, argued that this traditional approach of maintaining paper-based medical records is cumbersome and time-consuming when the need for a record retrieval arises. This further increases the risk of errors and inaccurate recording. This similar situation is consistently observed for the Iganga district hospital. According to Sultan et al (2014), computerized hospital management systems improve information management and quality of patient care by replacing the paper or manual way of doing things.

Due to the increasing population needs and aids to the practicing doctors, hospital service efficiency, there is a very high demand for Hospital Information systems in hospitals (Balaraman & Kosalram, 2013). Therefore, this study aimed at describing the design and implementation of a web-based hospital management system for Iganga district hospital in eastern Uganda.

II. LITERATURE REVIEW

2.1 Hospital information systems

A Hospital Information System (HIS) is defined as a comprehensive, integrated information system that manages the administrative, financial, and clinical aspects of a hospital. In several ways, such systems contribute to quality assurance activities. For example, they assess the quality of primary care, monitor quality indicators, and support clinical care evaluation studies, (Jayawardena, 2014; Duy Hai, 2011; LittleJohns et al, 2003; Ssekitooleko, 2017). Hospital information systems can be categorized into three types: i) Consumer informatics, ii) bioinformatics and iii) medical and clinical informatics (Igbajar & Acholonu, 2015).

2.2 Requirements for Adoption of Hospital Management Information Systems

The ease of adoption of electronic health information systems is dependent on existing infrastructure in a hospital or health care organization (Ward et al 2006; Ssekitooleko, 2017).

Developing economies such as Uganda need to therefore invest heavily in infrastructure to facilitate any attempt aimed at the adoption of hospital management information systems (Igbajar & Acholonu, 2015; Ouma & Herselman, 2008).

Effective application of hospital information systems requires a broadband Internet connection with high-speed capability for data retrieval and transfer (Igbajar & Acholonu, 2015; Ouma & Herselman, 2008).

An uninterrupted power supply is another prerequisite for the adoption of hospital information systems. This is because it ensures the avoidance of unintended shutdowns that could lead to data loss or permanent system damage.

Other requirements include well-trained health care workers and information system administrators (Alquraini et al., 2007; Ouma & Herselman, 2008; Simon et al., 2008; Ward et al., 2006; Weimar, 2009).

2.3 Benefits of Hospital Management Information Systems

Hospital Information Systems improve workflow and bridge the gap in the availability of patient care between urban and rural communities by increasing patients' access to health care (Igbajar & Acholonu, 2015; Ouma & Herselman, 2008; Shekelle et al., 2006; Wallis 2007). Electronic health technologies enable effective networking by physicians, allows the online review of patients' treatment, and support accurate drug prescriptions.

These systems support the capability for multi-site review of patients' records and improved physicians' collaboration in inpatient care. They also enable decreased transmit time of test results by reducing the time taken to deliver paper versions (Raja et al., 2015; Keenan et al., 2006).

Similarly, clinical information systems capture clinical data to enhance prompt and efficient decision making (Ward et al., 2006; William & Boren 2008).

2.4 Challenges to Adoption of Hospital Management Information Systems

Several challenges hinder the effective adoption of hospital information technology. Electronic health systems adoption in the last decade has been constrained by inadequate knowledge of available technology, fear of workflow disruption causing clinicians' resistance, uncertainties about investment returns, difficult approval processes for high-capital spending more so for-profit organizations, database, and differences in information technology preferences between clinicians and administrators (Arash & Zarina, 2013; Alquraini, Alhashem, Shah, & Chowdhury, 2007; Ouma & Herselmen, 2008; Poon, Biumential, Jaggi, Honour, et al., 2004; Simon et al., 2008; Sobol et al., 1999; Ward et al., 2006; Weimar, 2009).

III. RESEARCH METHODOLOGY

The study adopted the design science methodology. According to Van Aken, (2015), design science research aims at developing knowledge that the IS/IT professionals can use to design solutions in form of artifacts for their field problems. Both qualitative and quantitative approaches were used in gathering the information system requirements. Questionnaires and interview guides supported this process. Purposive sampling was used to select the samples among the hospital staff that are directly involved with information management, patient care, and administration in the hospital. The researchers designed an innovative artifact in form of a web-based hospital management system.

IV. SYSTEM ANALYSIS, DESIGN, AND IMPLEMENTATION

A. *Analysis of the Existing Management System at Iganga district hospital, Uganda*

The system that is currently being used in the Iganga district hospital is entirely manual. Whereby the process of receiving a patient from the receptionist through treatment by a doctor, nurse, and or drug dispensing at the pharmacy is all recorded manually. Similarly, when the drugs are delivered by the National medical store or suppliers, all the information is recorded manually. This system of information storage is susceptible to problems such as illegal modification and update of records as well as consuming large storage space.

Additionally, with such a system, the hospital staffs find it cumbersome and time-consuming to capture, store and retrieve patient data, drug suppliers, and staff Payment receipts which also delays the generation of periodic medical reports. Therefore, paperwork reduces the overall efficiency of the healthcare system.

B. *System Design and development*

The researchers used both object-oriented and structured analysis and design approach. The object-oriented design supports the segregation of duties and modules in object-based program development. It further allows reuse and extension of objects to include new attributes and behaviors. Structured analysis and design help to better understand the logical movement of data throughout the system. An Entity-relationship diagram was the structured analysis and design tool that allow the researchers to comprehend the system and subsystems visually as a set of interrelated data flows among the database entities.

i. Entity Relationship Diagram

The entity-relationship diagram is presented in figure 1 below. The diagram illustrates the database system entities that were used, their corresponding attributes as well as the appropriate data types of the attributes.

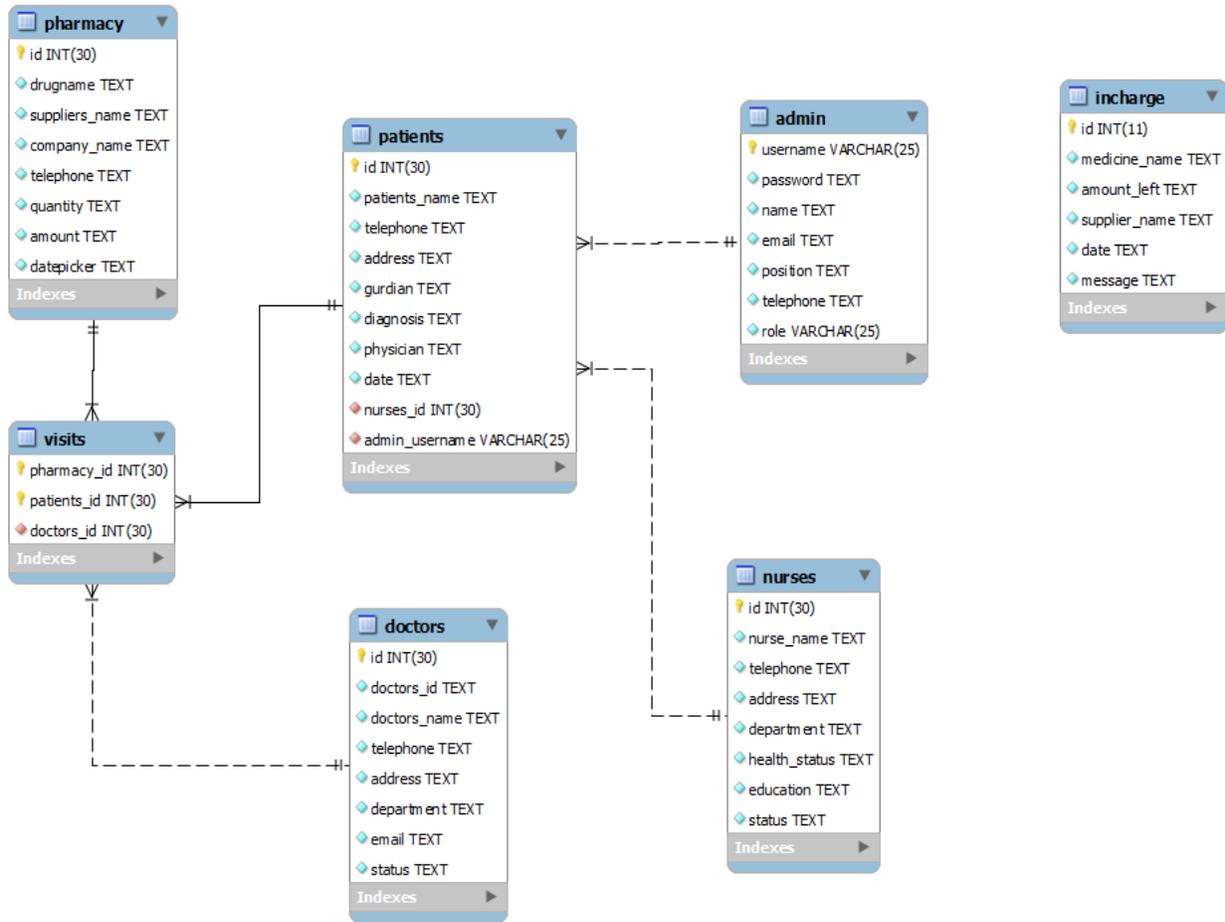


Fig -1: An Entity Relationship diagram for the web-based hospital management system

ii. Use Case Diagram

The architectural design of the proposed system is represented using a use case diagram below.

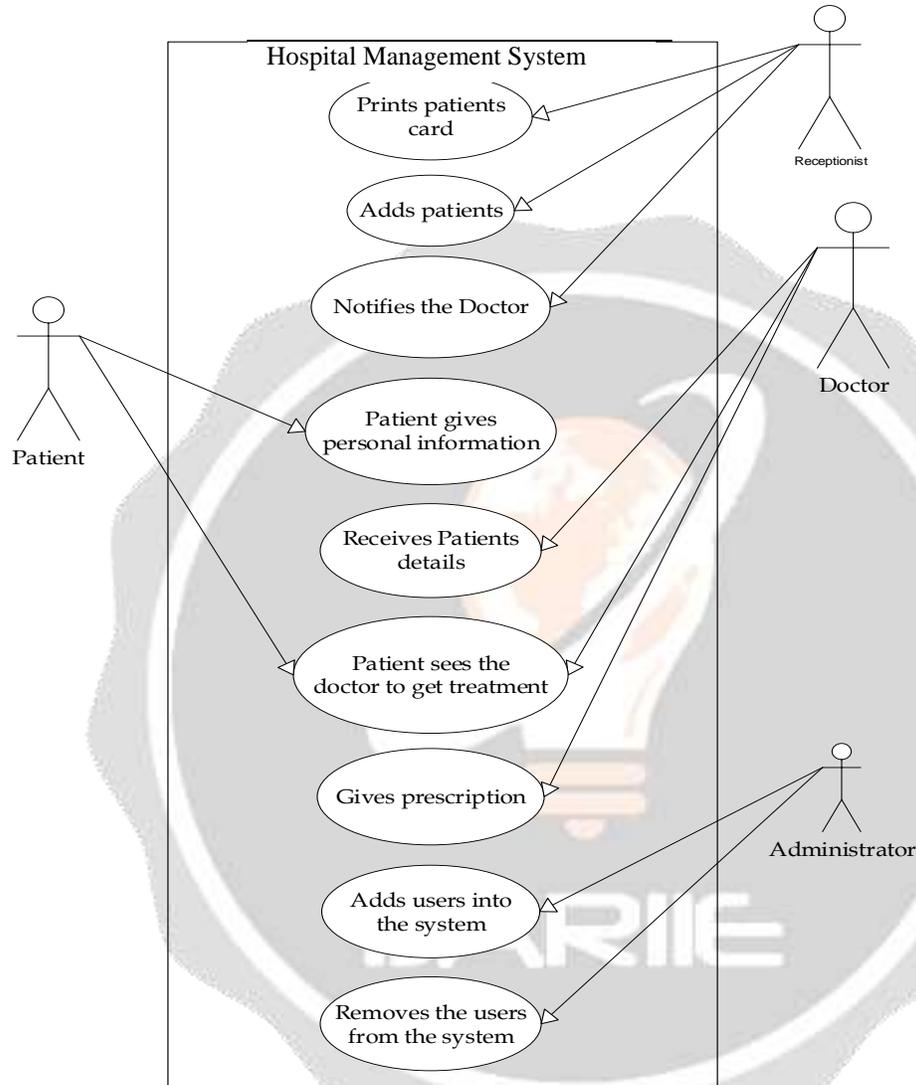


Fig -2: A Use Case diagram representing the web-based hospital management system

iii. Physical system Design

The database enables storage, adding, and retrieval of data. MYSQL, which is a relational database management system (RDBMS), was used to design the database. This is because relational database management systems organize large amounts of data and further define the dataset's relationships consistently and understandably. They additionally provide structures that are flexible enough to accommodate any kind of data.

Graphical user interfaces were developed using PHP, CSS, and HTML.

iv. System Requirements

Table 1 and Table 2 show the hardware and software requirements of the system respectively.

Table 1: Hardware requirements

Hardware components	Minimum requirements
Computer Processor	1.8GHz and above
Memory	256MBs and above.
Disk space	15GBs
Display resolution	1024*786
	16bit or 32 bit

The table above shows the hardware components required for the web-based hospital management system.

Table 2: Software requirements

Software components	Minimum requirement
Operating system	Windows XP
Database management	Wampserver, MYSQL
Graphical User Interface	Adobe Dreamweaver CS5

The above table shows the software components recommended for the system to attain effective performance.

C. The Proposed System

The proposed system is divided into Staff Scheduling Module, Patient Billing Module, Inpatient Management Module, and Pharmacy module. The system verifies and validates all user input. The user is notified in case of errors detected in the course of using the system.

1. Login Interface- This interface enables secure login to the system by prompting system users to provide correct system login details (username and password) before accessing other system modules and hence preventing unauthorized access.

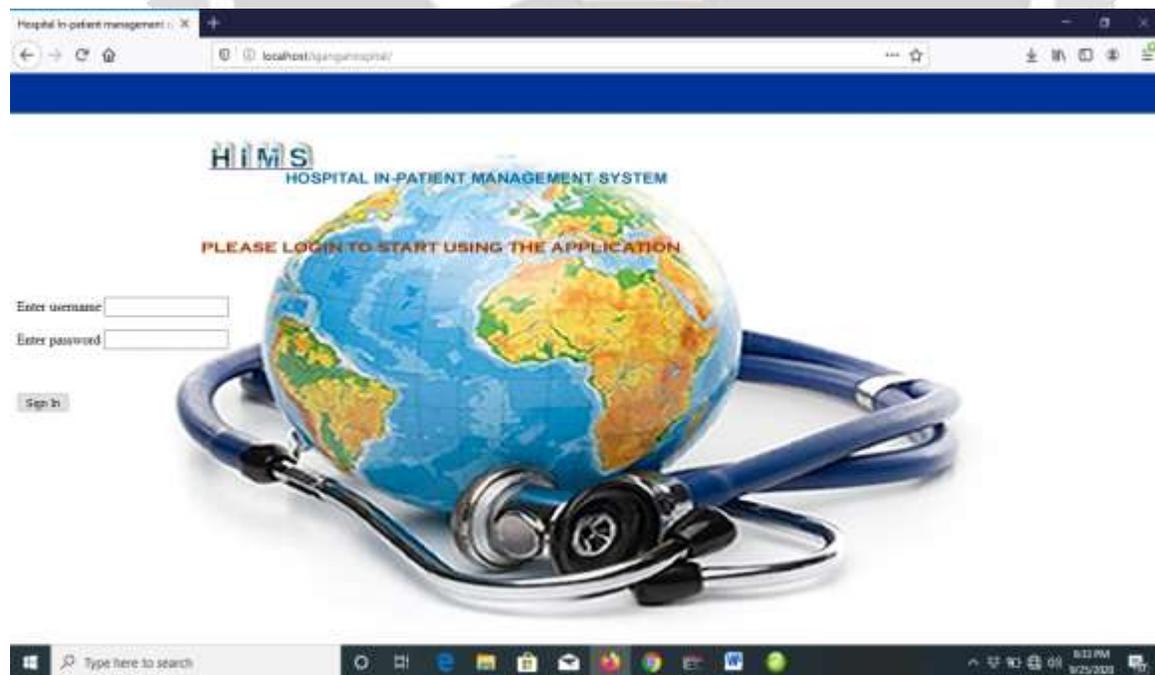


Fig -3: The login Interface for the web-based hospital management system

2. Staff Scheduling Module - This module supports the staff administrative functions like capturing complete information concerning the daily duties expected of the staff. In so doing, an efficient patient care process is assured.

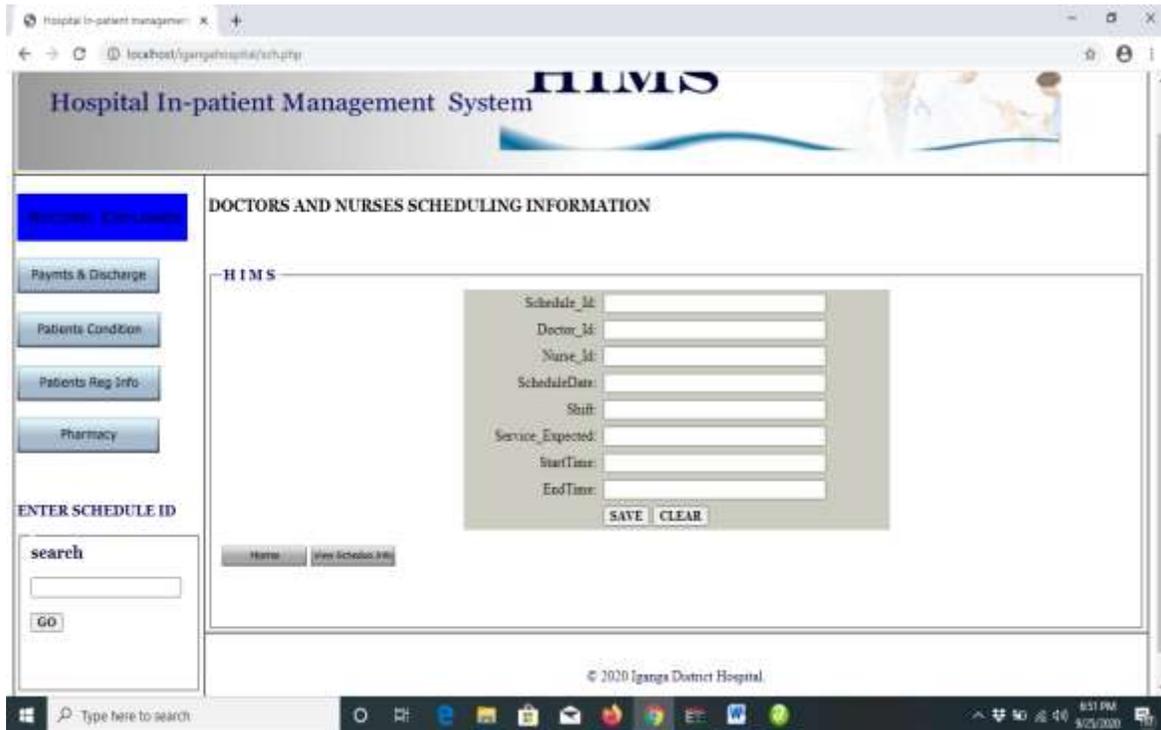


Fig -4: The staff management module interface for the web-based hospital management system

3. Pharmacy Module - This module deals with the tracking of drug stock levels and drug availability.

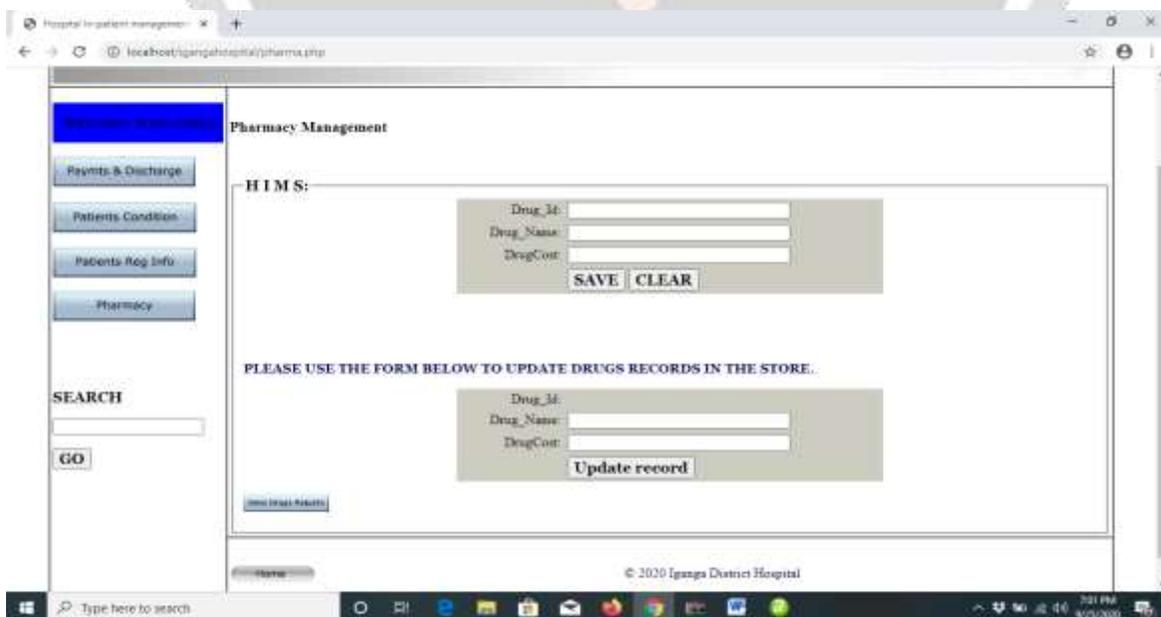


Fig -5: The Pharmacy module interface for the web-based hospital management system

4. Inpatient Management Module - This module manages the patient admission process through the discharge time. This module provides instant access to comprehensive patient information that enables health workers to schedule timely consultations and reviews with patients.



Fig -6: The Inpatient management module interface for the web-based hospital management system

5. Patient Billing Module- This module handles all types of billing in the hospital by facilitating the billing operations for patients and service providers. It enables automatic posting of charges associated with services like bed charges and treatment given.

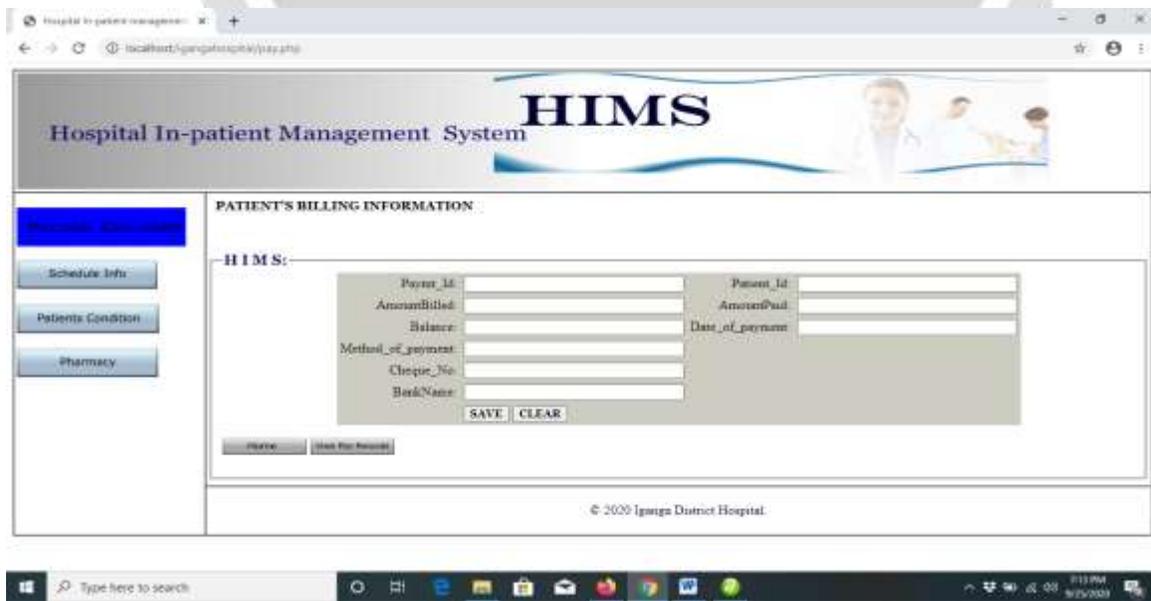


Fig -7: The Patient Billing module interface for the web-based hospital management system

V. SYSTEM TESTING

The software testing is vital for the IT industry. This is because system testing provides quality products both for the system based or web-based applications (Narula et al, 2013).

For this study, unit and integration testing were carried out by the research team in establishing if the system conforms to the intended purpose as well as check for bugs. Unit testing falls under the class of white box testing and this involved the testing of the independent units and groups of related units of the system. Integration testing involved testing the compatibility of the web-based hospital management system on various computer software and hardware platforms.

VI. CONCLUSION AND FUTURE RESEARCH

The developed web-based hospital management system solves the challenges of data redundancy, time wastage in records retrieval, billing management, and drug management at Iganga district hospital in eastern Uganda.

Additionally, there is enhanced security as access to the system entails authentication with a valid system username and password. The system does not keep track and alert of the expired drugs. Therefore future studies may focus on developing a web-based hospital management system that can track the expiry dates and expired drugs and alert the system users. The pharmacy module needs some more coding to accommodate the functionality of a barcoding facility to make the delivery simplified.

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