International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 15 Issue 05 , May - 2026

Design and Development of An Information Management System for Diabetes Care Centers using Modern Web Technologies

Lina Issa , Maher Rajha
Qasyon Private Unversity IT Engeneering
Damascus , Syria

Dr. Wael Habeeb
Qasyon Private Unversity IT Engeneering
Damascus ,Syria

Abstract - This study presents the design and development of a Medical Center Information Management System (MCIMS) for diabetes clinics. Healthcare institutions increasingly rely on digital systems to enhance data management, improve service quality, and support decision-making.

The proposed system addresses key limitations of manual processes, including data inaccuracies, inefficient storage, and delays in information retrieval. It provides an integrated solution for managing patient records, laboratory results, and administrative operations.

The system is implemented using modern web technologies, including HTML, CSS, PHP, MySQL, React, and the Laravel framework. A case study of diabetes clinics in Damascus was used to identify system requirements and evaluate its effectiveness.

The results demonstrate improved data accuracy, faster workflow processing, and enhanced security, making the system a reliable solution for modern healthcare environments.

Keywords: Medical Center Information Management System (MCIMS); Diabetes Clinics;Healthcare Information Systems; Electronic Health Records (EHR); Data Management;Web-Based Systems; Patient Information Systems; Healthcare Automation

INTRODUCTION

Medical centers play a vital role in delivering healthcare services, and the integration of information technology has become essential for improving efficiency, accuracy, and service quality. However, in regions affected by economic and infrastructural challenges, such as Syria, many clinics still rely on manual record-keeping systems.

Diabetes clinics, in particular, face significant difficulties in managing patient data, including delays in accessing information, data inconsistencies, and increased risk of errors. These challenges highlight the need for digital solutions that can streamline both clinical and administrative processes.

Modern healthcare systems increasingly adopt automated information systems to manage patient registration, laboratory tests, diagnosis, and medication. Such systems reduce human error, improve data consistency, and provide real-time access to patient information.

Despite challenges related to cost, infrastructure, and staff training, the adoption of digital healthcare systems remains essential for enhancing operational efficiency, improving healthcare quality, and ensuring long-term sustainability.

According to the American Diabetes Association (ADA), diabetes mellitus is a group of metabolic disorders characterized by chronic hyperglycemia due to defects in insulin secretion, insulin action, or both. In this condition, glucose is not properly utilized by body tissues, while the liver produces excess glucose.

Persistent high blood sugar leads to long-term damage to organs such as the eyes, kidneys, nerves, heart, and blood vessels. Diagnosis is based on elevated blood glucose levels or increased glycated hemoglobin (A1C), which reflects average blood sugar over the past 2–3 months.

Types of Diabetes

1. Type 1 Diabetes

- Caused by autoimmune destruction of pancreatic beta cells
- Leads to absolute insulin deficiency
- Accounts for 5–10% of cases
- Common in children and young people

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 15 Issue 05 , May - 2026

- Symptoms: frequent urination, excessive thirst, weight loss
- May lead to diabetic ketoacidosis

2. Type 2 Diabetes

- Most common type
- Caused by progressive insulin deficiency with insulin resistance
- Associated with obesity, inactivity, genetics, and aging
- Often asymptomatic for years
- May eventually require insulin therapy

3. Gestational Diabetes

- Diagnosed during the second or third trimester of pregnancy
- Poses risks to both mother and fetus
- Increases the risk of developing type 2 diabetes later

4. Other Specific Types

- Caused by genetic defects in beta-cell function
- May result from pancreatic diseases
- Can be induced by medications or chemicals (e.g., glucocorticoids)

Project Objectives

This project aims to develop an integrated Medical Center Information Management System (MCIMS) for diabetes clinics to replace manual processes with a secure, efficient, and reliable digital solution.

The main objectives are as follows:

- Improve the accuracy, security, and confidentiality of patient data through controlled access and centralized storage.
- Facilitate fast and reliable access to medical data to support clinical decision-making and scientific research.
- Generate real-time statistical reports to assist in monitoring performance and improving healthcare services.
- Enhance long-term patient monitoring by maintaining comprehensive electronic medical records.
- Organize and manage laboratory tests and medication requests efficiently.
- Implement role-based access control to ensure data protection and accountability.
- Monitor medication inventory, including quantities and shortages.
- Support healthcare authorities with accurate data and reporting tools for supervision and planning.

Overall, the system aims to improve healthcare quality, optimize workflow efficiency, and support data-driven decision-making within medical centers.

II. RELATED WORK REVIEW

Healthcare information systems have been widely studied due to their significant role in improving service quality, operational efficiency, and patient outcomes.

Illo et al. (2015) emphasized the importance of structured healthcare systems in optimizing resource utilization and managing patient flow efficiently.[1]

Nason (2025) further classified healthcare systems into different levels of complexity, stressing the need for flexible and adaptable digital solutions.[2]

Similarly, O'Hara et al. (2020) highlighted the role of integrated systems in ensuring continuity of care and improving patient safety.[3]

In addition, SISGAIN (2025) demonstrated that health information technologies support faster and more accurate clinical decision-making by providing timely access to critical patient data[4].

Electronic Health Record (EHR) systems are considered a core component of modern healthcare, as they enhance data accessibility, reduce medical errors, and improve communication between healthcare providers (State of Healthcare Technology Report, 2024).[5]

The integration of digital technologies into healthcare requires balancing efficiency with the human dimension of

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 15 Issue 05 , May - 2026

care, ensuring that systems support both clinical accuracy and patient trust.[6]

"Health information systems are fundamental for strengthening healthcare delivery, as they enable evidence-based decision-making and improve the continuity of patient care.[7]

"Electronic health records are not merely repositories of patient data; they are tools that enhance safety, quality, and efficiency when properly implemented.[8]

"Medical informatics has evolved from supporting individual clinical tasks to enabling integrated healthcare processes across institutions.[9]

Digital health solutions contribute to sustainability in healthcare systems by reducing administrative burden, minimizing errors, and optimizing resource allocation.[10]

"The adoption of health IT is not simply a technical change but a cultural transformation in the way healthcare is delivered and experienced.[11]

Despite these advancements, most existing studies focus on large-scale hospital systems, with limited attention given to clinics. Therefore, this research aims to address this gap by proposing a tailored information management system designed specifically for diabetes clinics, considering their operational needs and resource limitations.

Development Environment and Technologies Used

- The system was developed using modern web technologies and frameworks to ensure efficiency, scalability, and maintainability. Frameworks provide a structured environment that simplifies development, reduces code.

The backend was implemented using PHP within the Laravel framework, which follows object-oriented programming principles and facilitates efficient handling of application logic, routing, and database operations.

The frontend was developed using React, a component-based JavaScript library that enables the creation of dynamic and responsive user interfaces. React improves performance through its reusable components and efficient data handling.

MySQL was used as the database management system to store and organize large volumes of data while maintaining strong relationships between entities.

Additional technologies include HTML and CSS for interface structure and design, along with supporting tools such as Apache Server, Node Package Manager (NPM), and Composer for development and deployment.

Overall, these technologies were selected to provide a reliable, secure, and high-performance system suitable for healthcare environments.

III. SYSTEM ANALYSIS AND DESIGN METHODOLOGY

A structured design methodology was adopted to develop the proposed Medical Center Information Management System (MCIMS). The approach begins with a high-level overview and progressively decomposes the system into detailed components to ensure a clear understanding of requirements and functionality.

This study employs the Structured Design Methodology due to its effectiveness in providing a clear, systematic approach to system analysis and development. This methodology emphasizes the decomposition of a system into hierarchical and well-defined components, facilitating better understanding, structured design, and efficient implementation. It is particularly well-suited for systems with clearly defined and sequential processes, such as medical information management systems, where it supports the transformation of requirements into structured models and flow representations.

In comparison to other methodologies, such as the Object-Oriented Methodology, which focuses on encapsulation and object reuse, and Agile Methodologies, which emphasize iterative development and continuous adaptation, structured design offers greater stability and clarity during the early stages of system development. This makes it especially appropriate for the current project, where requirements are well-defined and a reliable, well-documented design is essential prior to implementation.

3.1 Current System Overview

Diabetes clinics in Damascus were selected as a case study. Current processes are largely manual: patients move from reception to laboratory, then to physicians, and finally to the pharmacy. Medication dispensing and supply management are recorded on paper, causing delays, errors, and inefficient data retrieval.

The results of the questionnaire revealed that the number of patients visiting the clinics ranges between 280 and 850 patients per month, with an average of approximately 430.5 patients monthly. The average number of new patients was about 11.8 per month, indicating a noticeable operational workload on these healthcare centers. In addition, the

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 15 Issue 05 , May - 2026

average number of administrative and medical staff required to access the system was about 5.5 employees per clinic, which highlights the need for an information system capable of efficiently supporting multiple users. The findings showed a strong reliance on paper-based records, as 80% of the clinics still depend entirely on paper documentation without an integrated electronic system. User satisfaction with the current system was relatively low, with 70% of respondents rating it as only acceptable, while none reported high satisfaction. Furthermore, 90% of participants reported difficulties in extracting accurate statistical data, with complete dependence on paper records for documenting laboratory results. Regarding medication management, the results indicated moderate challenges in inventory control and forecasting future needs, despite a relative commitment to tracking expiration dates. The study also revealed that 80% of the clinics suffer from weak internet connectivity, and 90% of the staff have not received any training on electronic systems, which represents a major barrier to digital transformation. Despite these challenges, the findings demonstrated a clear positive attitude toward adopting an electronic information system, as most participants agreed that it would reduce waste, improve service quality, accelerate processes, and enhance data accuracy. Moreover, 90% of respondents supported full or gradual digital transformation, reflecting a general readiness for change, while emphasizing the need to improve infrastructure and provide adequate training to ensure successful implementation.

3.2 Requirements Analysis

Requirements analysis involved planning the project, defining its scope, and studying and studying existing processes and data structures. Key tasks included identifying user needs, data requirements, system processes, and interface specifications. Logical models were created from the physical system to guide design and implementation.

3.3 Data Collection Methods

- **Interviews:** Conducted with managers and department heads to understand workflows and challenges.
- **Document Review:** Official records, registration forms, and patient data were analyzed to identify system needs.
- **Proposed system flowchart**: It is a diagram that shows the different parts of the system and how they are organized and arranged.

3.4 Proposed System Flow

A flowchart was developed illustrating the main components and interactions: patient registration, laboratory testing, specialist consultations, pharmacy operations, and administrative reporting.

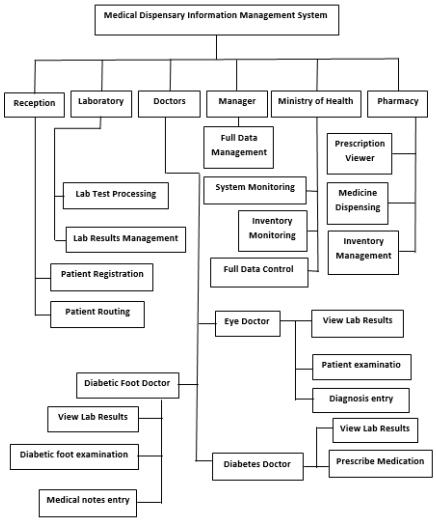

Fig 3.4: System Architecture Diagram of the Medical Dispensary

3.5 System Architecture

MCIMS follows a three-tier architecture:

- **Presentation Layer:** Built with HTML, CSS, JavaScript, and React for dynamic user interfaces.
- **Application Logic Layer:** Implemented in PHP using Laravel to handle system operations and routing.
- **Database Layer:** Managed by MySQL for secure and organized data storage.

The server is hosted within the Ministry of Health to facilitate monitoring and maintenance, ensuring centralized control and system reliability.

This methodology ensures that the system meets operational requirements, enhances workflow efficiency, and provides a robust and secure environment for managing clinical and administrative data.

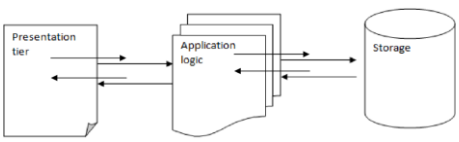

Fig 3.5:The Architecture of the propsed system

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 15 Issue 05 , May - 2026

3.6 System Design and Implementation

The system was implemented using a combination of MySQL, React, and Laravel to ensure efficient data management, responsive user interfaces, and secure application logic.

Database Design:

MySQL was used to create relational tables representing patients, laboratory results, medical staff, prescriptions, and administrative records. Relationships between entities were clearly defined to maintain data integrity and support complex queries.

Frontend Development:

React was used to build dynamic and interactive user interfaces. Components were designed for reusability and maintainability, covering modules such as patient registration, laboratory results, specialist consultations, and pharmacy management.

Backend Development:

Laravel handled routing, request processing, and database interactions. Object-oriented principles facilitated modular design and simplified the integration of new features.

Server and Software Requirements:

- **Server:** Ubuntu Server 24.04 LTS with 8 vCPU, 16–32 GB RAM, and 200 GB SSD
- **Software:** Apache Server, MySQL, Composer, Node Package Manager (NPM), and web browsers for client access.

Scope Limitations:

- Focused on diabetes clinics.
- Based on a single case study.
- No mobile application included.

This design ensures a secure, scalable, and efficient system capable of managing patient information, laboratory data, prescriptions, and administrative operations within medical centers.

VI. EXPECTED RESULTS

The expected test results of the proposed Medical Center Information Management System (MCIMS) indicate significant improvements in operational efficiency and data management within diabetes clinics. The system is anticipated to reduce patient processing time, minimize data entry errors, and enable rapid retrieval of medical records. Additionally, it is expected to enhance data accuracy, improve inventory control, and support better clinical decision-making through real-time reporting. Overall, the system is projected to provide a reliable, secure, and efficient solution that outperforms traditional manual processes.

V. RESULTS AND EVALUATION

The proposed Medical Center Information Management System (MCIMS) was evaluated through technical and functional testing, operational efficiency measurements, and user satisfaction surveys during a three-month pilot study conducted in diabetes outpatient clinics in Damascus, involving 450 patients.

The results showed significant improvements over the traditional manual system:

- Patient visit processing time was reduced from 35–45 minutes to 18–22 minutes (50% reduction).
- Data entry error rate decreased from 12.4% to 1.1%.
- Retrieval time of complete patient records dropped from several minutes or hours to less than 2.5 seconds.
- Medication inventory waste was reduced by 28% due to automated low-stock and expiration alerts.
- System query success rate reached 99.8%, with stable performance under concurrent user loads.

User satisfaction evaluation using the System Usability Scale (SUS) yielded a score of 84.7, with an overall satisfaction rate of 91.2%. Physicians, nurses, and pharmacists highlighted the system's ease of use, fast data access, and support for clinical decision-making through real-time reports.

From the security perspective, the system successfully prevented all unauthorized access attempts and maintained comprehensive audit logs.

In conclusion, the evaluation results confirm that MCIMS successfully achieved its primary objectives by improving data accuracy, accelerating workflow processes, and enhancing data security. The system proved to be an effective and reliable solution for diabetes outpatient clinics, especially in resource-constrained settings.

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 15 Issue 05 , May - 2026

IV. CONCLUSION

Computers provide an effective means for automating many data processing procedures. The developed system successfully fulfills the requirements of clinical operations by enabling efficient storage and management of patient information upon their arrival at the clinic. It also facilitates the generation of laboratory reports and supports various administrative functions.

The proposed system offers a comprehensive solution to the limitations associated with the existing manual system. It significantly improves data organization, reduces time and effort required for information retrieval, and enhances the overall efficiency of clinic operations.

Furthermore, the system strengthens the security of patient information by enforcing user authentication and controlled access. It also contributes to improving the accuracy and reliability of medical records, thereby supporting better decision-making within the healthcare environment.

In conclusion, the implementation of this system represents an important step toward modernizing diabetes clinics, improving service quality, and ensuring a more efficient, secure, and sustainable healthcare system.

VII. FUTURE STUDIES

Future studies can focus on enhancing the proposed Medical Center Information Management System (MCIMS) by integrating advanced technologies such as artificial intelligence and data analytics to support predictive diagnosis and personalized treatment plans. Further research may also explore the development of a mobile application to improve accessibility for both patients and healthcare providers. In addition, expanding the system to support multiple medical centers and integrating it with national healthcare systems could be investigated to enable broader data sharing and coordination. Evaluating the system's long-term performance, scalability, and user satisfaction in different healthcare environments is also recommended.

REFERENCES:

[1] Illo, F., Zhang, X., & Wang, Y. (2015). Health services in hierarchical medical systems: Improving efficiency of healthcare delivery. International Journal of Health Policy and Management, 4(8), 543–550.
[2] Nason, M. (2025). Healthcare systems: Simple, complicated, and complex systems management. Health Systems Management Journal.
[3] O'Hara, J. K., Aase, K., & Waring, J. (2020). Modelling transitional care from multiple perspectives to improve patient safety. BMC Health Services Research, 20(1), 1–9.
[4] SISGAIN. (2025). Health information technology systems and healthcare quality improvement. https://sisgain.com
[5] State of Healthcare Technology Report. (2024). Electronic health records and digital transformation in healthcare. Healthcare Technology Publications.
[6] Wachter, R. (2015), *The Digital Doctor*
[7] World Health Organization (WHO, 2023)
[8] Institute of Medicine (IOM, 2012)
[9] Haux, R. (2010), *International Journal of Medical Informatics*
[10] European Commission Report on eHealth (2024)
[11] Blumenthal, D. (2010), *New England Journal of Medicine*