

Modernizing the US-DC Clinic's Patient Information System: A Design and Implementation Project

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Abstract—The modernization of the University of San Carlos (USC) Clinic's Patient Information System (PIS) aims to address significant inefficiencies and challenges in the clinic's current operations. The existing system, predominantly paper-based, struggles with incomplete student health records, limited reporting capabilities, ineffective health information dissemination, and inefficient patient feedback collection. This project adopts a user-centered design approach to develop a comprehensive, web-based PIS. The new system will capture complete medical and dental records, improve health information dissemination, facilitate robust patient feedback collection and analysis, generate detailed reports, issue notifications, and optimize medical certificate issuance. Key design principles include accessibility, scalability, and basic security measures. By implementing this modern PIS, the USC Clinic seeks to enhance operational efficiency and improve the quality of healthcare services provided to its students.

Index Terms—Patient Information System, Health Records, Clinic Management, University of San Carlos, System Modernization, User-Centered Design, Medical Records Management, Healthcare IT, Accessibility, Security, Privacy, Scalability.

I. INTRODUCTION

A. Problem Background

The University of San Carlos (USC) Clinic plays a crucial role in ensuring the health and well-being of its students, faculty, and staff. However, the clinic's current Health Information System (HIS) is predominantly paper-based and fragmented, creating several challenges that impede the delivery of efficient, comprehensive, and high-quality healthcare services.

Incomplete Student Health Records:

The clinic's existing system struggles to capture complete medical records, particularly for incoming first-year students. This gap in health histories can result in missed opportunities for preventive care, delays in diagnosis and treatment, and difficulties in tracking health trends across the student population. Comprehensive health records are essential for effective healthcare delivery, enabling the clinic to provide timely and appropriate interventions.

Inefficient Consultation Management:

Managing a high volume of consultations, especially for minor ailments such as coughs and colds, is a significant challenge under the current system. This inefficiency leads

to longer wait times, overcrowding, and frustration for both students and staff. Additionally, it delays the attention needed for more urgent medical issues, compromising the clinic's overall effectiveness.

Medication Inventory Control Issues:

The existing manual inventory management system, while adhering to the First-In, First-Out (FIFO) principle, is prone to errors. These errors can lead to stockouts and the expiration of unused medications, impacting the timely provision of care and resulting in unnecessary costs due to wasted resources. A robust inventory control system is vital for maintaining adequate medication supplies and ensuring patient safety.

Limited Reporting and Data Analysis:

The clinic relies on Google Sheets for daily treatment records, which, while convenient, limits data accuracy, reporting capabilities, and long-term data analysis. This limitation hampers the clinic's ability to generate comprehensive reports and gain valuable insights into clinic utilization and student health outcomes. Effective data analysis is crucial for informed decision-making and continuous improvement of healthcare services.

Cumbersome Administrative Processes:

The manual process for issuing medical certificates is time-consuming and inefficient, creating delays for both clinic staff and students. This inefficiency can hinder students' ability to promptly return to their academic and extracurricular activities. Streamlined administrative processes are necessary to reduce staff workload and improve the overall patient experience.

Inadequate Information Dissemination:

The clinic lacks a robust mechanism for disseminating health information and educational materials to the USC community across both the Downtown and Talamban campuses. This gap limits opportunities for preventive care, health promotion, and timely updates on relevant health issues. Effective communication channels are essential for fostering a well-informed and health-conscious university community.

Ineffective Patient Feedback Collection:

The current method of collecting student feedback is cumbersome and does not lend itself to systematic analysis. This inefficiency makes it difficult to gauge student satisfaction, identify areas for improvement, and make data-driven decisions to enhance the quality of care provided by the clinic. A streamlined feedback collection process is critical for ensuring continuous improvement and high standards of patient care.

B. Review of Related Literature

Effective patient information management systems (PIMS) are indispensable in modern healthcare settings, improving efficiency, accuracy, and patient care [1]. However, university clinics often face unique challenges due to their diverse patient populations, resource constraints, and specific operational needs [2]. Modernizing the Patient Information System (PIS) at the USC Clinic is crucial to address these challenges and leverage the latest technological advancements to enhance healthcare delivery.

Challenges in University Clinic PIMS

Research highlights several key challenges in university clinic PIMS that must be addressed during modernization:

Incomplete Patient Data:

- 1) Studies have shown that incomplete or inaccurate patient data can lead to medical errors, missed diagnoses, and delayed treatment [3].
- 2) In university settings, capturing comprehensive health information, especially for incoming students, can be particularly challenging due to various factors such as time constraints, limited resources, and varying levels of student engagement [4].
- 3) Effective strategies for addressing this issue include integrating student health records with enrollment systems and implementing proactive outreach programs to encourage students to provide their medical information [4, 5].

Inefficient Consultation Management:

- 1) Long wait times and inefficient scheduling are common issues in university clinics, leading to patient dissatisfaction and potential delays in care [6].
- 2) Implementing online self-scheduling tools and utilizing telemedicine for minor ailments can help improve patient flow and reduce wait times [7].

Medication Inventory Control:

- 1) Manual inventory management in clinics can be error-prone and lead to stockouts or expired medications [8].
- 2) Electronic inventory systems, especially those using the First-In, First-Out (FIFO) principle, have been shown to optimize medication usage, reduce waste, and improve cost-effectiveness [9].

Daily Treatment Records (DTR) and Reporting:

Paper-based or spreadsheet-based DTRs are inefficient and hinder data analysis. Electronic DTRs integrated within a PIMS can automate reporting, improve data accuracy, and provide valuable insights into clinic utilization and patient outcomes [10].

Medical Certificate Issuance:

Manual issuance of medical certificates can be time-consuming for both staff and students. Automating this process through the PIMS can streamline operations and improve student satisfaction [11].

Information Dissemination:

University clinics play a crucial role in health promotion and disease prevention. However, disseminating health information effectively across a large and dispersed campus can be challenging. Leveraging the PIMS to deliver targeted health campaigns, educational materials, and reminders can enhance the clinic's reach and impact [12].

Patient Feedback and Evaluation:

Collecting and analyzing patient feedback is essential for continuous improvement in healthcare settings. Electronic feedback systems integrated into the PIMS can streamline data collection, increase response rates, and enable the clinic to make data-driven decisions to improve service quality [13].

Latest Trends in HIS Technology

Modernizing the USC Clinic's PIS requires consideration of the latest technological advancements:

- 1) *Cloud-based Solutions:* Cloud-based HIS platforms offer scalability, cost-effectiveness, and remote accessibility, making them an attractive option for university clinics [14].
- 2) *Mobile Health (mHealth):* mHealth applications can empower patients to manage their health information, schedule appointments, and communicate with providers, enhancing patient engagement and convenience [15].
- 3) *Artificial Intelligence (AI):* AI and machine learning can be integrated into HIS to improve diagnostics, predict patient outcomes, and personalize treatment plans, ultimately enhancing the quality of care [16].

C. Statement of the Problem

The USC Clinic's reliance on a predominantly paper-based and fragmented patient information management system has resulted in several inefficiencies, including:

- 1) *Incomplete patient records*
- 2) *Limited reporting capabilities*
- 3) *Lack of streamlined communication channels for health information dissemination*
- 4) *Inefficient patient feedback collection*

These challenges hinder the clinic's ability to provide timely, efficient, and comprehensive healthcare services to the USC community. Addressing these issues is critical to improving clinic efficiency, enhancing patient satisfaction, and ensuring the highest quality of care for all USC students, faculty, and staff.

The project aims to tackle these specific problems by implementing a modern, web-based PIS that focuses on capturing comprehensive health and dental records, facilitating effective health information dissemination, and collecting and analyzing patient feedback. This initiative will lay the groundwork for future enhancements and broader deployment, ultimately transforming the USC Clinic's healthcare delivery.

D. Goals and Objectives

This project aims to design, develop, and implement a modern PIS for the USC Clinic to address the following specific objectives:

- 1) *Capture comprehensive medical and dental records for students.*

Streamline data collection to ensure complete and up-to-date medical and dental records for all students, including medical histories, treatment plans, and dental records.

- 2) *Increase the reach of health awareness campaigns.*

Use the PIS to promote health campaigns with dedicated pages featuring PubMats, banners, and other materials, encouraging proactive health management.

- 3) *Facilitate student feedback collection and analysis.*

Integrate digital evaluation forms to systematically collect and analyze patient feedback, enabling continuous improvement in healthcare services.

- 4) *Generate Detailed Reports for Data Analysis and Decision-Making*

Implement a module for generating customizable reports on patient visits, treatment outcomes, and feedback analysis to aid decision-making.

- 5) *Issue Notifications for Medication Reminders, Health Campaigns, and Clinic Updates*

Include a notification system for sending alerts on health campaigns, medication reminders, and important clinic updates via email and in-app notifications.

- 6) *Optimize the Issuance of Medical Certificates*

Streamline the process of issuing medical certificates by allowing quick access and input of relevant patient information, ensuring accuracy and efficiency.

By achieving these objectives, this project aims to transform the USC Clinic's patient information management, leading to improved healthcare delivery, enhanced patient satisfaction, and increased operational efficiency for the clinic staff.

E. Significance of the Study

The successful implementation of a modernized PIS at the USC Clinic has the potential to transform healthcare delivery for the USC community.

This project will directly benefit students by:

- 1) *Improving access to care:* Streamlined data collection and notifications will reduce wait times and make it easier for students to manage their health.
- 2) *Enhancing the student experience:* Faster service, personalized care, and access to their health information electronically will improve the overall student healthcare experience.
- 3) *Promoting student well-being:* Access to educational materials and targeted health campaigns through the PIS will empower students to take a more active role in their health, leading to better health outcomes.

The benefits extend to the clinic as well:

- 1) *Increasing efficiency:* By optimizing processes and centralizing data, the new PIS will free up staff time, allowing them to focus on direct patient care.
- 2) *Improving decision-making:* Accurate data and detailed reports will empower clinic leadership to make informed decisions regarding resource allocation and service improvement.
- 3) *Reducing costs:* Streamlining workflows, reducing paperwork, and optimizing medication inventory management will contribute to cost savings.

Beyond the immediate impact on the USC Clinic, this project can serve as a model for other university health centers seeking to modernize their systems and enhance student care. The lessons learned and best practices identified can be shared with the broader healthcare community, potentially contributing to improvements in patient care across diverse settings.

Additionally, the data collected through the new PIS can be used for research, potentially leading to new insights into student health trends and contributing to the development of more effective healthcare interventions in academic settings.

F. Scope and Limitations

Scope

The proposed PIS for the USC Clinic is designed to modernize and enhance the clinic's healthcare delivery through the following core functionalities:

- 1) *Comprehensive Health and Dental Records:*

- a) Centralized and secure storage of all student health information, including medical histories, treatment plans, medications, and dental records.
- b) Focus on capturing comprehensive records from the start of student enrollment, ensuring complete and up-to-date information.
- c) The system will focus on students but is not limited to students since faculty and university staff will be filling up the same forms.

- 2) *Health Information Dissemination:*

- a) Utilization of targeted communication tools to disseminate health information and promote preventive care.

- b) Dedicated web pages within the system for health awareness campaigns, featuring PubMats, banners, and other educational materials.
- 3) *Patient Feedback System:*
- a) Integration of user-friendly digital evaluation forms to collect and analyze patient feedback.
 - b) Automated reminders to encourage continuous patient input, enabling the clinic to identify areas for improvement.
- 4) *Report Generation:*
- a) The system will include a report generation module that allows clinic staff to create detailed, customizable reports on various metrics such as patient visits, treatment outcomes, and feedback analysis. These reports will be exportable to formats like PDF and Excel for further analysis and record-keeping.
- 5) *Notifications:*
- a) The system will feature a notification system that sends alerts and reminders for health campaigns, medication schedules, and important clinic updates via email and in-app notifications.
- 6) *Medical Certificate Issuance Optimization:*
- a) The PIS will optimize the process of issuing medical certificates by allowing clinic staff to quickly access and input relevant patient information, ensuring certificates are formatted correctly and include all necessary details. This will reduce administrative workload and speed up the issuance process.
- 7) *Initial Deployment Plan:*
- a) The initial deployment will focus on the USC DC Clinic.
- 8) *Platform:*
- a) The system will be web-based, ensuring accessibility through standard web browsers.
- 9) *Scalability:*
- a) The system will be designed to scale for future iterations and broader deployment across other clinics as needed.

Limitations

- 1) *Scope of Records:*
 - a) The initial focus will be on capturing comprehensive medical and dental records for students, aligning with the clinic's objective to gather extensive health information during enrollment phases.
- 2) *User Adoption:*
 - a) The success of the PIS implementation depends heavily on comprehensive training and ongoing support for clinic staff. Effective user adoption strategies are critical to ensure the system is used efficiently and effectively.

3) *Resource Constraints:*

- a) As a student-led project with limited resources, the development team may need to prioritize certain features over others. Some functionalities, such as medication tracking, inventory management, may be deferred to future iterations.

4) *Security Measures:*

- a) Initially, only basic security measures will be implemented to protect patient data, with plans to enhance security features in future updates. The system's user authentication will be basic and will not be able to verify whether a student is currently enrolled or has graduated.

5) *Standalone System:*

- a) The system will be operated independently and will not be integrated with existing systems.

Collaboration and Alignment:

The project team will collaborate closely with the USC Clinic to ensure the system aligns with the clinic's operational needs and objectives. This collaboration includes regular feedback sessions and iterative development to refine and enhance the system based on real-world use and requirements.

By addressing these scope and limitations, the project team aims to deliver a functional, user-friendly, and scalable PIS that significantly improves the USC Clinic's healthcare delivery, while also setting the stage for future enhancements and broader deployment.

II. METHODOLOGY

A. Conceptual Framework

The conceptual framework for developing the USC Clinic's PIS is centered on a user-centered design approach. This approach prioritizes the needs and workflows of both clinic staff and students, ensuring the system enhances healthcare delivery and patient satisfaction.

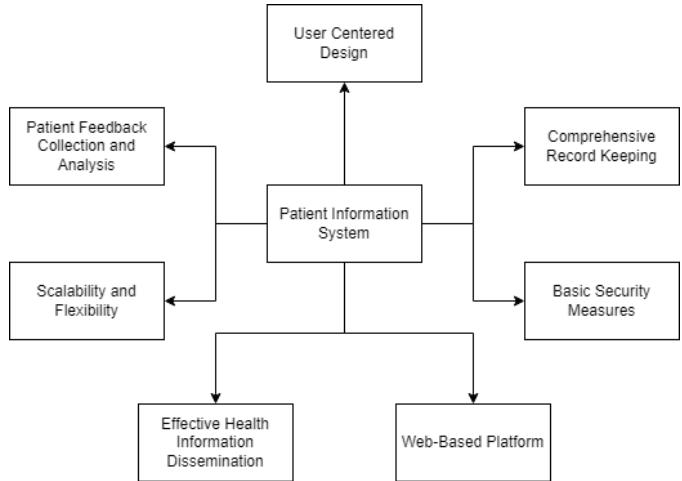


Fig. 1: Conceptual Framework

The framework encompasses the following key principles:

1) User-Centered Design (UCD):

- a) The development process will involve clinic staff and students from the outset, ensuring that the system is intuitive and meets their specific needs. Regular feedback sessions and iterative testing will be conducted to refine the system based on user input.

2) Comprehensive Record Keeping:

- a) The PIS will provide centralized and secure storage of all student health information, including medical histories, treatment plans, medications, and dental records. The system will focus on capturing comprehensive records from the start of student enrollment, ensuring complete and up-to-date information.

3) Effective Health Information Dissemination:

- a) The system will include targeted communication tools for sharing health information and promoting preventive care. This will be achieved through dedicated web pages for health campaigns featuring PubMats, banners, and other educational materials.

4) Patient Feedback Collection and Analysis:

- a) The PIS will integrate user-friendly digital evaluation forms and automated reminders to collect and analyze patient feedback. This continuous feedback loop will help the clinic identify areas for improvement and enhance the quality of care provided.

5) Scalability and Flexibility:

- a) The system will be designed to scale for future iterations and broader deployment across other clinics. The modular architecture will allow for the addition of new features and functionalities as the clinic's needs evolve.

6) Basic Security Measures:

- a) Initial implementation will include basic security measures to protect patient data, with plans to enhance security features in future updates. This ensures compliance with privacy regulations and safeguards sensitive information.

7) Web-Based Platform:

- a) The PIS will be a web-based application accessible through standard web browsers, ensuring ease of access for users. Hosting on Heroku will provide a robust and scalable environment for the application, simplifying deployment and management.

B. Systems Analysis and Design

1) Systems Analysis:

The initial phase of the project will focus on understanding the current state of the USC Clinic's patient information management through direct interaction with clinic staff and a review of existing forms.

Ongoing Needs Assessment

A continuous needs assessment approach will be employed throughout the project life cycle, with regular meetings and feedback sessions with clinic staff. This iterative process will ensure that the PIS is closely tailored to the evolving needs and workflows of the clinic.

The needs assessment will focus on:

- 1) *Interviews:* Structured interviews will be conducted with clinic staff, including doctors, nurses, and administrators. The interview guide will focus on understanding their daily tasks, challenges they face with the current system, and desired features in a new PIS.
- 2) *Observations:* Direct observation of daily clinic operations will be carried out to identify bottlenecks, inefficiencies, and opportunities for improvement in the existing system. Observations will be documented in field notes, which will be analyzed to identify recurring patterns and themes.
- 3) *Form Analysis:* Existing forms for medical and dental health records will be thoroughly analyzed to understand the types of data being collected, their structure, and how they are used in the current workflow.

Current Processes of the USC Clinic:

1) Paper-Based Records:

The USC Clinic predominantly relies on paper-based systems for managing patient information. This includes storing medical histories, treatment plans, medications, and dental records in physical files. This approach leads to several inefficiencies, including difficulties in maintaining complete and accurate records, delays in retrieving patient information, and increased risk of data loss or damage.

2) Patient Feedback Collection:

The clinic currently uses Google Forms to collect patient feedback. While this provides a basic mechanism for gathering input from students, it lacks integration with other clinic systems, making it challenging to systematically analyze the feedback and implement improvements based on student responses.

3) Health Information Dissemination:

The clinic does not have a robust system in place for disseminating health information and educational materials to students. There are limited channels for reaching out to the student population with health campaigns, updates, and preventive care information. This gap limits the clinic's ability to promote health awareness and timely interventions.

Challenges Identified:

- 1) Incomplete and fragmented patient records due to reliance on paper-based systems.
- 2) Inefficiencies in data retrieval and record maintenance.

- 3) Limited ability to systematically analyze and act on patient feedback.
- 4) Ineffective communication channels for health information dissemination.

By understanding these current processes and their limitations, the project aims to develop a comprehensive, web-based PIS that addresses these challenges and enhances the overall efficiency and effectiveness of the USC Clinic's healthcare delivery.

2) Systems Design:

Informed by the findings of the systems analysis and ongoing needs assessment, the system design phase will focus on creating a detailed blueprint for the new PIS.

Design Principles

The following design principles will guide the development of the PIS:

- 1) *User-Centered Design (UCD):*
 - a) Prioritizing the needs and workflows of clinic staff and students.
 - b) Engaging users throughout all stages of development to ensure the system is intuitive and efficient.
- 2) *Comprehensive Record Keeping:*
 - a) Providing centralized and secure storage for all student health information.
 - b) Facilitating effective and timely healthcare delivery with complete and up-to-date records.
- 3) *Effective Health Information Dissemination:*
 - a) Including tools for sharing health information and promoting preventive care.
 - b) Utilizing dedicated web pages for health campaigns.
- 4) *Patient Feedback Collection and Analysis:*
 - a) Integrating user-friendly digital evaluation forms and automated reminders.
 - b) Systematically gathering input from students and implementing changes based on feedback.
- 5) *Scalability and Flexibility:*
 - a) Designing a scalable architecture for future enhancements and broader deployment.
 - b) Ensuring modular components can be easily updated or expanded.
- 6) *Basic Security Measures:*
 - a) Implementing basic security measures to protect patient data.
 - b) Including encryption and secure user authentication, with plans for future security enhancements.
- 7) *Web-Based Platform:*
 - a) Ensuring the PIS is accessible through standard web browsers.
 - b) Providing flexibility and ease of use for both clinic staff and students.

System Features

- 1) *Comprehensive Health Records:* Capture and store complete medical and dental records of students.

The system provides centralized and secure storage for all student health information, including:

- a) Medical histories
- b) Treatment plans
- c) Medications
- d) Dental records

Users can:

- a) Enter detailed records during student enrollment
- b) Update records with each visit
- c) Upload documents such as medical lab results and X-rays

Access is restricted to authorized personnel to ensure data privacy and security. The system integrates with other modules to maintain comprehensive and current health records.

- 2) *Health Information Dissemination:* Utilize the system for targeted health campaigns and educational materials.

This feature uses targeted communication tools to share health information and promote preventive care, including:

- a) Dedicated web pages for health awareness campaigns
- b) PubMats, banners, and other educational materials

Automated notifications are sent via Email and In-app messages. These notifications inform users about health campaigns, preventive measures, and educational updates. The system also provides links to external health resources.

- 3) *Patient Feedback System:* Integrate digital evaluation forms to gather and analyze patient feedback.

The system integrates user-friendly digital evaluation forms to collect and analyze patient feedback. Features include:

- a) Digital forms for feedback after consultations or treatments
- b) Automated reminders to encourage continuous feedback

The system includes tools for:

- a) Analyzing feedback trends
- b) Generating reports to facilitate quality improvement initiatives

- 4) *Report Generation:* Generate detailed, customizable reports for clinic operations and patient care analysis.

This module generates customizable reports on various metrics such as patient visits, treatment outcomes, and feedback analysis. Users can:

- a) Create detailed reports based on specific criteria (e.g., date range, type of visit, treatment outcomes)

- b) Export reports in PDF and Excel formats
- Additionally, visual tools are provided for:
- a) Generating graphs and charts
 - b) Visualizing data trends and insights
- 5) *Notifications:* Issue timely notifications and reminders for health campaigns, medication schedules, and important clinic updates.
- Features include:
- a) Automated alerts for upcoming events, medication reminders, and health campaign updates
 - b) Custom notifications for specific events or announcements
 - c) A log of all sent notifications for auditing and follow-up purposes

- 6) *Medical Certificate Issuance Optimization:* Streamline and optimize the issuance of medical certificates, ensuring accuracy and efficiency.

This feature streamlines the process of issuing medical certificates by:

- a) Allowing clinic staff to quickly access and input relevant patient information
- b) Using predefined templates to ensure consistency and accuracy

The system provides:

- a) Fast retrieval and input of patient data
- b) Reduced administrative workload
- c) Speedier certificate issuance

Verification and approval steps by authorized medical personnel are included to maintain the integrity of the certificates.

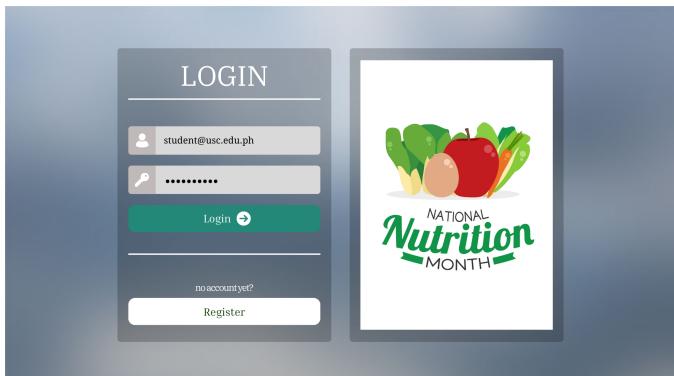


Fig. 3: Application Registration



Fig. 4: Context Diagram

Context Diagram

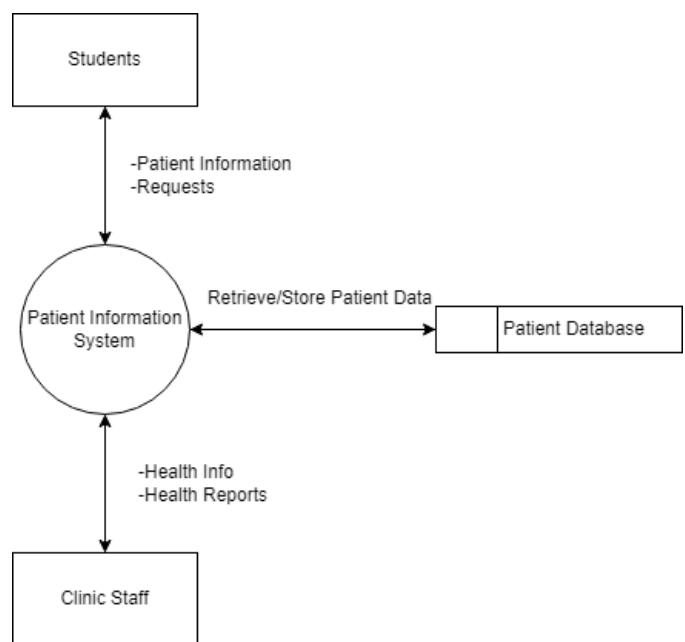


Fig. 5: System Architecture

The context diagram illustrates the high-level interactions between the PIS and its external entities. Clinic staff and students are the primary users who interact with the PIS for tasks such as managing patient records, and accessing health information.

System Architecture

The proposed PIS will follow a three-tier architecture, a well-established and scalable approach for web applications:

- 1) *Front-End (Presentation Layer):* The front-end will be developed using HTML, CSS, and JavaScript, with the React framework for its component-based structure, virtual DOM for efficient rendering, and large developer community, ensuring long-term support and maintainability. This will provide a modern, responsive,

- and interactive user interface for both clinic staff and students.
- 2) *Back-End (Application Layer):* The back-end will be built using Python with the Django framework. Django's "batteries-included" philosophy provides built-in tools for handling common web development tasks like routing, authentication, and security, reducing development time and complexity. Django's robustness and security features make it suitable for handling sensitive health data.
 - 3) *Database (Data Layer):* PostgreSQL will be used as the database management system due to its robust security features, scalability, and strong support for complex data relationships, which are essential for managing healthcare information.

Technology Choices and Rationale:

- 1) *React (Front-End):* Chosen for its component reusability, efficient rendering, and large community support, ensuring a modern and maintainable user interface.
- 2) *Django (Back-End):* Selected for its built-in security features, rapid development capabilities, and suitability for handling sensitive health data.
- 3) *PostgreSQL (Database):* Chosen for its strong security, scalability, and ability to handle complex data relationships in a healthcare setting.
- 4) *Heroku (Cloud Platform):* Selected for its low cost, which provides enough resources for development and testing of small to medium-sized applications. It also offers easy deployment and integration with popular development tools.

Implementation of Features:

- 1) *Comprehensive Health and Dental Records*

Implementation Steps

 - a) *Data Entry Forms:* Developed with React.js components for an interactive user interface.
 - b) *Document Upload:* Handled using Django's file upload capabilities, storing documents securely in PostgreSQL.
 - c) *Access Control:* Managed through Django's authentication and authorization systems.
 - d) *Integration:* API endpoints created with Django Rest Framework (DRF) to ensure seamless module integration.
- 2) *Health Information Dissemination*

Implementation Steps

 - a) *Web Pages:* Designed with React.js for dynamic health campaign pages.
 - b) *Content Management:* Managed through Django's admin interface for uploading educational materials.
 - c) *Notification System:* Automated using Django's email functionality and WebSockets for real-time notifications.

- 3) *Patient Feedback System*

Implementation Steps

 - a) *Evaluation Forms:* Created with React.js for user input, processed with Django on the backend.
 - b) *Automated Reminders:* Managed using Django Celery.
 - c) *Feedback Analysis:* Visualized using Chart.js integrated into the Django framework.
- 4) *Report Generation*

Implementation Steps

 - a) *Report Builder:* Customizable reports generated with Django and React.js.
 - b) *Export Options:* Implemented using ReportLab for PDF and Pandas for Excel.
 - c) *Visualization Tools:* Utilized Chart.js for data visualizations.
- 5) *Notifications*

Implementation Steps

 - a) *Automated Alerts:* Scheduled using Django Celery.
 - b) *Custom Notifications:* Developed in React.js for user-generated alerts.
 - c) *Notification Log:* Maintained in PostgreSQL for auditing.
- 6) *Medical Certificate Issuance Optimization*

Implementation Steps

 - a) *Template-Based Certificates:* Designed using Django templates.
 - b) *Data Access:* Efficiently managed through optimized database queries.
 - c) *Verification Process:* Implemented with Django's tools for authorized approval.

Basic Security Measures:

- 1) *Encryption:* All sensitive patient data stored in the database will be encrypted using PostgreSQL's built-in encryption features.
The pgcrypto extension in PostgreSQL will be used for column-level encryption. Sensitive columns, such as patient names, medical records, and treatment plans, will be encrypted using pgcrypto functions.
- 2) *Role-Based Access Controls (RBAC):* Restrict access to sensitive data based on user roles and permissions.

Common Features for All Users: Access personal health information, submit feedback, receive health information, update personal details, and upload files.

User Roles and Exclusive Permissions:

- a) *Student:* No additional permissions.
- b) *Nurse:* View and update patient medical and dental records, enter and update treatment plans, access and update treatment histories, record patient vitals and symptoms, supervisor role.
- c) *Medical Doctor:* View and update comprehensive patient medical records, diagnose and prescribe

- treatments, access and update treatment histories, approve medical certificates, manage critical health alerts.
- d) *Dentist*: View and update dental records, enter and update dental treatment plans, perform dental diagnoses and treatments.
 - e) *Staff*: Manage patient intake and registration, handle administrative tasks such as issuing medical certificates, generate reports and data analysis.

Authentication: Users will be authenticated using a secure login system with unique usernames and passwords. Django's built-in authentication system will be utilized to manage user authentication.

Authorization: The system will leverage Django's built-in authorization framework to implement RBAC. User roles and permissions will be defined within the Django admin interface, and access control checks will be enforced in the application views and APIs.

- 3) *Administrative Management*: An admin account will manage permissions for each role. This account can manually assign and adjust roles for individual users, ensuring that users have the appropriate permissions based on their role in the clinic.

By utilizing PostgreSQL's built-in encryption features and implementing a detailed RBAC system with an administrative management interface, the project ensures the protection of sensitive patient data, restricts access based on user roles, and provides flexibility for role management.

Specific Design Elements

- 1) *User Interface (UI) Design*: The UI will be designed using wireframes and mockups, incorporating feedback from clinic staff to ensure a seamless user experience.
 - a) *Clear Navigation and Intuitive Menus*: Ensuring easy and efficient access to all system functionalities.
 - b) *Visually Appealing and Easy-to-Understand Data Displays*: Presenting data in a clear, concise, and visually engaging manner.
 - c) *Accessibility Features*: Including high contrast and screen reader compatibility to make the system accessible to all users.
- 2) *Database Design*: The database schema will be designed to mirror the existing forms used by the clinic, ensuring a smooth transition and minimizing disruption.
 - a) *Data Encryption*: Sensitive patient data will be encrypted to ensure security.
 - b) *Role-Based Access Control (RBAC)*: Implementing RBAC to ensure that only authorized personnel can access specific data.
- 3) *Health Information Dissemination*: The system will include tools for sharing health information and promoting

preventive care through dedicated web pages for health campaigns.

- a) *Campaign Pages*: Web pages featuring PubMats, banners, and other educational materials.
 - b) *Automated Notifications*: Email and in-app notifications to inform users about health campaigns and updates.
 - c) *Resource Links*: Providing access to external health resources within the system.
- 4) *Patient Feedback Collection and Analysis*: The system will integrate user-friendly digital evaluation forms and automated reminders to collect and analyze patient feedback. This will enable the clinic to:
- a) *Collect Feedback*: Digital forms for patient feedback after consultations or treatments.
 - b) *Analyze Trends*: Tools to analyze feedback trends and generate reports for quality improvement initiatives.
- 5) *Report Generation*: This module generates customizable reports on various metrics such as patient visits, treatment outcomes, and feedback analysis.
- a) *Customizable Reports*: Detailed reports based on specific criteria.
 - b) *Export Options*: Ability to export reports in PDF and Excel formats.
 - c) *Visualization Tools*: Tools for generating graphs and charts to visualize data trends.
- 6) *Notifications*: The notification system sends alerts and reminders for health campaigns, medication schedules, and important clinic updates via email and in-app notifications.
- a) *Automated Alerts*: Scheduled notifications for appointments, medication reminders, and health campaigns.
 - b) *Custom Notifications*: Functionality for creating and sending custom notifications.
 - c) *Notification Log*: Maintaining a log of all sent notifications for auditing purposes.
- 7) *Medical Certificate Issuance Optimization*: This feature streamlines the process of issuing medical certificates by allowing clinic staff to quickly access and input relevant patient information using predefined templates.
- a) *Template-Based Certificates*: Ensuring consistency and accuracy in issued certificates.
 - b) *Data Access*: Quick retrieval and input of patient data.
 - c) *Verification Process*: Steps for verification and approval by authorized medical personnel.

The screenshot shows the 'BASIC INFORMATION' section of the PIS. It includes fields for First Name (John), Last Name (Ford), Course/Year (BSCPfE-3), ID Number (12345678), Birthdate (January 1, 2024), Sex (Male), Home Address (Amongtalay, street 1, Cebu), Civil Status (Single), Religion (Catholic), Personal Contact# (09123456789), Nationality (Filipino), Weight(kg) (55), Height(cm) (158), and BMI (20.1). On the right, there's a 'Existing Medical Conditions' section listing Asthma, Shrimp Allergies, and Tambah, along with a note about a 2020 Broken hand fracture. A 'Hospitalization/Operation' section also lists the 2020 incident.

Fig. 5: Student Medical Record

The screenshot shows the 'USC Clinic Announcements' section. It features a large green banner with the text 'School Event'. Below the banner is a 'Click here' button. To the left, there's a profile picture of Dr. Milan Hale (Part-time Doctor) and a message about clinic opening and closing times. The sidebar on the left includes links for Home, Medical Record, Dental Record, Consultations, and Evaluation.

Fig. 6: Home Page

Agile Development, Prototyping, and Usability Testing

The development process will follow Agile methodologies, with iterative development cycles that incorporate regular feedback from clinic staff. Prototypes will be created to showcase key features and gather feedback early in the process, allowing for adjustments and refinements. Usability testing will be conducted with a small group of clinic staff members to assess the system's intuitiveness, ease of use, and overall effectiveness in their workflows.

Risk Management

Effective risk management is essential to the success of the USC Clinic's PIS modernization project. By identifying potential risks early and developing strategies to mitigate them, the project can stay on track and achieve its objectives. Below are the key risks associated with the project and their corresponding mitigation strategies:

1) User Adoption Risks

Risk: Resistance from clinic staff to adopt the new system, leading to underutilization or operational inefficiencies.

Mitigation Strategies

- Involve clinic staff in the design and testing phases to increase buy-in and ensure the system meets their needs.

- Provide extensive training programs tailored to different user groups within the clinic.
- Implement a feedback loop to continuously improve the system based on user input.

2) System Integration Risks

Risk: Difficulties integrating the new system with the clinic technologies and workflows, causing disruptions.

Mitigation Strategies

- Conduct a thorough assessment of the clinic and their workflows to identify integration points.
- Use standard protocols and interfaces for system integration to minimize compatibility issues.
- Develop and test integration modules in a controlled environment before full deployment.

3) Technical Risks

Risk: Technical failures or performance issues with the new system, leading to operational downtime.

Mitigation Strategies

- Select reliable hardware and software solutions.
- Establish a comprehensive testing plan, including stress tests to evaluate system performance under load.
- Develop a contingency plan to address potential system failures, including backup and recovery procedures.
- Schedule regular maintenance and updates to keep the system running smoothly.

4) Project Management Risks

Risk: Delays or budget overruns due to poor project management or unforeseen challenges.

Mitigation Strategies

- Use project management tools to track progress, manage resources, and communicate with stakeholders.
- Establish clear timelines, milestones, and deliverables from the outset.
- Conduct regular project reviews and adjust plans as necessary to stay on track.

By proactively identifying these risks and implementing the above mitigation strategies, the USC Clinic can enhance the likelihood of a successful transition to a modernized Patient Information System. This structured approach to risk management ensures that potential issues are addressed before they can impact the project's progress and outcomes.

C. Validation and Deployment

This section details the strategies and processes for ensuring the quality, functionality, and successful adoption of the PIS within the USC Clinic.

Validation and Testing

A comprehensive validation and testing plan will be implemented to ensure that the PIS meets the requirements identified during the needs assessment and adheres to the design principles outlined. This plan includes:

- 1) *Unit Testing:* Individual components and modules of the PIS will be tested in isolation to verify their functionality and correct operation.
- 2) *Integration Testing:* The interaction and data flow between different modules of the PIS will be tested to ensure seamless integration and data integrity.
- 3) *Performance Testing:* The system will be subjected to performance testing to assess its responsiveness, speed, and ability to handle expected workloads.
- 4) *User Acceptance Testing (UAT):* A select group of users, including a representative sample of students, faculty, staff, and healthcare providers, will be invited to test the PIS in a controlled. Their feedback will be used to identify any usability issues, bugs, or areas for improvement.
- 5) *Iterative Feedback and Refinement:* Based on the feedback from the UAT, iterative rounds of testing and refinement will be conducted to ensure the system meets the needs of all user groups.

Deployment

To minimize disruption to clinic operations, a phased deployment approach will be adopted. This involves:

- 1) *Pilot Deployment:* The initial pilot deployment will focus on 80 Percent of 1st year Students from the Department of Hospitality Management, Bachelor of Science in Tourism Management. This group will provide a representative sample for testing the system's functionalities and gathering comprehensive feedback. Faculty, staff, and healthcare providers will also be included in the pilot to ensure the system meets the needs of all user groups. The pilot group will be selected based on their diverse roles within the clinic and their willingness to provide feedback. The success of the pilot will be evaluated based on user feedback, system performance, and any reported issues.
- 2) *Full Implementation:* After successful completion of the pilot deployment and thorough staff training, the PIS will be fully implemented across the entire clinic. Ongoing support and maintenance will be provided to ensure the system's continued effectiveness.

Training and Support

To ensure the successful adoption of the PIS, comprehensive training and ongoing support will be provided to all clinic staff. This will include:

- 1) *Training Sessions:* Conducted to familiarize staff with the system's functionality, navigation, and data entry procedures. Topics covered will include basic navigation, patient registration, medical record management, report generation, and security best practices.
- 2) *User Manuals and Documentation:* Comprehensive user manuals and online documentation will be provided as a reference for staff.

- 3) *Dedicated Support:* Available to address any questions or issues that arise during and after the implementation process.

By thoroughly testing the PIS with the selected target demographic, deploying it in a phased manner, and providing comprehensive training and support, the project team aims to ensure a smooth transition to the new system and maximize its benefits for the USC Clinic.

Justification for Student Usage

To justify the significant use of the Patient Information System (PIS) by students, it is essential to highlight the benefits and necessity of student engagement.

1) *Access to Personal Health Records:*

Students will have immediate access to their medical and dental records, allowing them to track their health history, treatments, and medications. This empowerment encourages them to be more proactive and informed about their health.

2) *Health Awareness Campaigns:*

The PIS will serve as a central hub for health awareness campaigns. This ensures they stay informed about relevant health topics and initiatives.

3) *Feedback Mechanism:*

The integrated feedback system allows students to provide input on the services they receive. This not only helps improve the clinic's services but also engages students by giving them a voice in their healthcare experience.

4) *Convenience and Accessibility:*

With a web-based platform, students can access the PIS from anywhere at any time. This convenience is a significant draw, as it fits seamlessly into their busy schedules and tech-savvy lifestyles.

By highlighting these points, it becomes evident that the PIS offers significant benefits that align with the needs and lifestyles of students. This strong justification supports the anticipated high engagement and usage of the system by the student population.

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Appendix A: List of Project Deliverables For Project Checking

Deliverable Number	Details	Due Date
D1	Research Manuscript	June 8, 2024
D2	Project Software Components	September 16, 2024
D3	Technical Documentation for the app's core functionalities	September 23, 2024
D4	Functional Prototype of Application	September 30, 2024
D5	Application Testing at USC Clinic	October 7, 2024
D6	Application Retooling	October 21, 2024

Appendix B: Work Plan

Activity/ Task	July			August				September				October				Nov		Expected Output	Person Assigned	
	Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17		
Research Implementation																				
1.1 Download Software		■																	Team is ready for software development	
1.2 Database			■	■															Database schema designed and implemented	
1.2.1 Design database schema			■																All	
1.2.2 Implement database structure				■															All	
1.3 Profile System Development					■	■	■	■										Profile system with integrated student and staff databases		
1.3.1 Define staff and student profiles					■	■													Janren Renegado	
1.3.2 Implement profile creation						■													Ron Vanz Petiluna	
1.3.3 Integrate profile system with database							■												Galen Elijah Sabequill	
1.3.4 Implement student database								■	■										All	
1.3.5 Implement staff database									■	■									All	
1.4 Consultation System Development									■	■	■	■						Consultation system with scheduling		
1.4.1 Implement appointment scheduling functionality									■	■	■	■							Ron Vanz Petiluna	
1.4.2 Integrate consultation system with profiles									■	■	■	■							Janren Renegado and Galen Elijah Sabequill	
1.5 Finalizing UI													■	■					Finalized user interface design	
1.5.1 Implement UI enhancements																			Ron Vanz Petiluna	
1.5.2 Improve UI based on clinic staff feedback													■	■					All	
1.6 Bug Testing														■					Resolved bugs and stabilized system	
1.6.1 Identify and document bugs														■					All	
1.6.2 Prioritize and fix bugs and stabilized system														■					All	
1.7 System Testing															■	■			Fully tested and validated system and System tested in a clinic facility	
1.6.1 Conduct comprehensive system tests														■	■				All	
1.6.2 Improve UI based on clinic staff feedback														■	■				All	

Appendix C: COST ESTIMATES

(NOTE: In making the cost estimates please include contingency which is about 20% of the total cost.)

Proposed Budget for Materials

<i>Item Description</i>	<i>Quantity</i>	<i>Cost/Unit</i>	<i>Subtotal</i>
[1]Open-Source Software Licenses		0	0 PHP
[2]Desktop PC	2	80,000	80,000 PHP
		Total	80,000 PHP

Miscellaneous Costs

Documentation Costs			
<i>Description</i>	<i>Quantity</i>	<i>Cost/Unit</i>	<i>Subtotal</i>
Printing	100	5	500 PHP
		Total	500 PHP
Transportation and Accommodation Costs			
<i>Description</i>	<i>No. of persons</i>	<i>Rate/person</i>	<i>Subtotal</i>
Gas, Fare	3	5,000	5,000 PHP
		Total	5,000 PHP
Incidental Costs			
<i>Description</i>	<i>Quantity</i>	<i>Cost/Unit</i>	<i>Subtotal</i>
Miscellaneous	1	3,000	3,000 PHP
Contingency	1	3,000	10,000 PHP
		Total	13,000 PHP

Appendix D: Diagrams

Figure D-1. Conceptual Framework

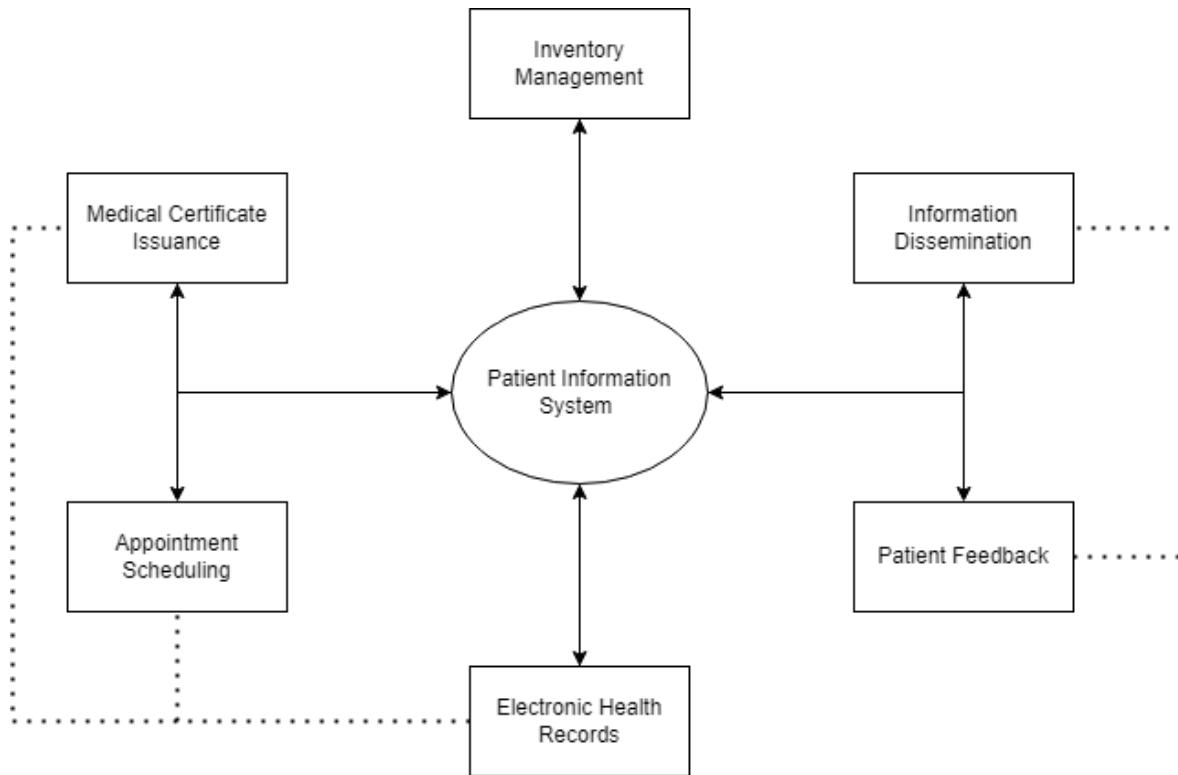
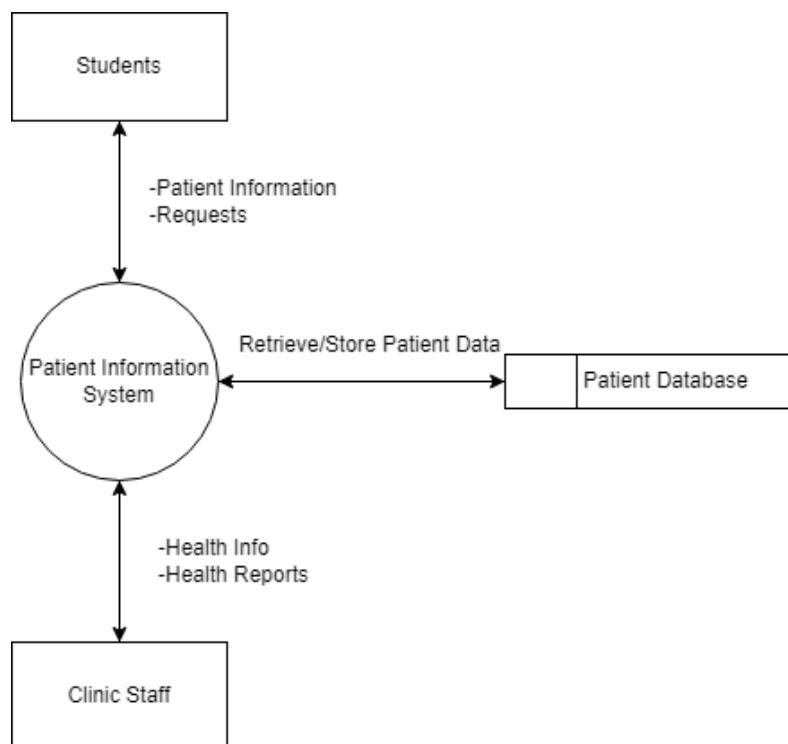


Figure D-2. Context Diagram



Appendix E: UI Mockups

Figure E-1. Login

LOGIN

User

Password

Login

[no account yet?](#)

[Register](#)

Figure E-2. Register

REGISTER

Email

Create Password

Confirm Password

Figure E-3. Information Sheet

BASIC INFORMATION

First Name: John Last Name: Doe
CourseYear: BS-Cp-3 Birthdate: 1995-01-01

EMERGENCY CONTACT

Parent's Name: Jane ID Number: 09123456789
Guardian: Mark Mobile#: 1234567890

HEALTH CHECKLIST

FAMILY HISTORY

Author: Diabetes Heart Disease Hypertension Cancer Others:

PAST HISTORY

Mosquitoes Mumps Chicken Pox Hepatitis Allergies

Register

Figure E-4. Login#2

LOGIN

User

Password

Login

[no account yet?](#)

[Register](#)

Figure E-5. Login + PubMat

LOGIN

User

Password

Login

[no account yet?](#)

[Register](#)

NATIONAL Nutrition MONTH

Figure E-6. User Home Page

USC PIS

John Doe student

USC Clinic Announcements

PLEASE APPLY FOR MEDICAL AND DENTAL EXAMINATION!!

School Event

Dr. Milan Hale Part-time Doctor

Clinic Opening and Closing time
USC clinic schedule is now updated.
Monday to Friday: 7:30 - 6:00PM. Saturday 7:30 - 12:00NN

Home **Medical Record** **Dental Record** **Consultations** **Evaluation**

Figure E-7. User Home Page + Announcement Figure E-8. User Side Health Info

Figure E-8. User Consultation History

Figure E-10. User Evaluation

Figure E-9. Consultation Form

Figure E-11. User Evaluation #2

Figure E-12. Admin Side

USC PIS

Dr. Milan Hale
Part-time Doctor

Home Student Records Inventory Schedules Approval

USC Clinic Announcements

School Event

Click here

Dr. Milan Hale
Part-time Doctor

Write your announcements here:

Post school clinic events

Figure E-13. Admin Side #2

USC PIS

Dr. Milan Hale
Part-time Doctor

Home Student Records Inventory Schedules Approval

USC Clinic Announcements

School Event

Click here

Notifications
John Doe applied for consultation

Dr. Milan Hale
Part-time Doctor

Write your announcements here:

Post school clinic events

Figure E-14. Admin Side Student Records

USC PIS

Dr. Milan Hale
Part-time Doctor

Home Student Records Inventory Schedules Approval

Student name 1

Student name 2

Student name 3

Student name 4

Student name 5

Figure E-15. Inventory Management

Medicine Name	Dosage Form	Strength	Quantity in Stock	Expiration Date	Supplier
Paracetamol	Tablet	500 mg	150	12/2024	HealthMed Co.
Ibuprofen	Tablet	200 mg	200	08/2024	MedSupply Ltd.
Cetirizine	Tablet	10 mg	100	03/2025	HealthCare Inc.
Metformin	Tablet	850 mg	80	03/2025	HealthMed Co.
Losartan	Tablet	50 mg	60	06/2024	GoodHealth Pharma
Omeprazole	Capsule	20 mg	90	09/2023	MedSupply Ltd.
Amoxicillin	Tablet	500 mg	120	01/2024	HealthCare Inc.
Cetirizine	Tablet	10 mg	75	02/2024	HealthMed Co.
Atenolol	Tablet	50 mg	110	04/2025	GoodHealth Pharma
Azithromycin	Tablet	250 mg	95	12/2023	MedSupply Ltd.
Acetaminophen	Tablet	325 mg	130	07/2024	HealthCare Inc.
Levofloxacin	Tablet	100 mg	140	05/2025	HealthMed Co.
Furosemide	Tablet	40 mg	90	01/2024	MedSupply Ltd.
Prednisone	Tablet	10 mg	60	11/2024	GoodHealth Pharma
Aspirin	Tablet	100 mg	150	03/2024	HealthCare Inc.
Motaprol	Tablet	50 mg	85	06/2024	HealthMed Co.
Clopidogrel	Tablet	75 mg	110	12/2024	MedSupply Ltd.
Teriflunomide	Tablet	5 mg	70	08/2023	GoodHealth Pharma
Hydrocodone	Capsule	15 mg	100	04/2025	HealthCare Inc.
Doxycycline	Capsule	100 mg	150	09/2023	HealthMed Co.
Gabapentin	Capsule	300 mg	80	03/2025	MedSupply Ltd.
Tramadol	Tablet	50 mg	65	05/2024	GoodHealth Pharma
Tamsulosin	Capsule	0.4 mg	95	12/2024	PharmaCare Inc.

Figure E-16. Admin Side Patient Concerns

USC PIS

Dr. Milan Hale
Part-time Doctor

Home Student Records Inventory Schedules Approval

Concerns: High Fever

Symptoms: High temp, runny nose, headaches

Duration of symptoms: 2 days

Any previous treatments: paracetamol

Approve

Appendix F: STUDENT-ADVISER THESIS COUNSELING LOGBOOK

Department of Computer Engineering
School of Engineering

Modernizing the USC Clinic's Patient Information System: A Design and Implementation Project
2nd Semester, AY 2023-2024

Name of Adviser: Elline Fabian

Name of Assistant Adviser: Kenneth Carl Labarosa

Name of Students: Ron Vanz Petiluna, Janren Renegado, Galen Elijah Sabequil

DATE	PLACE / MEDIUM	TIME START/END	TOPIC DISCUSSED	ADVISER / ASST. ADVISER SIGNATURE
3-02-2024	Google Meet	8:10 - 8:30 pm	Introduction	
3-23-2024	Google Meet	9:00 - 10:00 pm	Manuscript Drafts	
4-03-2024	DCpE Conference Room	11:00 - 12:00 am	Manuscript Drafts/Proposal Presentation	
4-24-2024	Google Meet	8:00 - 8:50 pm	Proposal Presentation	
4-27-2024	DCpE Conference Room	12:00 - 1:00 pm	Representation	

Appendix G: List of Project Features For Project Checking

Patient Information System Features Table	Column 1	Column 2	Column 3
Feature	Project Checking	Good to Have	Future Iterations
Comprehensive Health Records	Yes		
Comprehensive Dental Records	Yes		
Health Information Dissemination	Yes		
Patient Feedback Collection	Yes		
User Authentication through Django (Basic)	Yes		
Role-Based Access Control (RBAC)	Yes		
Web-Based Platform	Yes		
Secure Data Storage (Basic)	Yes		
Scalability and Flexibility	Yes		
Data-Driven Reporting	Yes		
Health Campaign Pages	Yes		
Automated Notifications	Yes		
Medical Certificate Optimization	Yes		
Upload Files	Yes		
Advanced Security Measures			Yes
Appointment Scheduling			Yes
Medication Tracking			Yes
Inventory Management			Yes

Memorandum of Agreement for Collaborative Project

Project Title: Modernizing the USC-DC Clinic's Patient Information System: A Design and Implementation Project

Date: July 22, 2024

This Memorandum of Agreement outlines the collaboration between the University of San Carlos - Downtown Campus (USC-DC) School Clinic and CPE 3207L Group L (Petiluna, Renegado, Sabequil) regarding the design and implementation of a modernized Patient Information System (PIS).

1. Purpose

The purpose of this collaboration is to develop and implement a new Patient Information System (PIS) for the USC Clinic. The new PIS will aim to streamline clinic operations, improve patient care, enhance data accuracy, and provide valuable insights into clinic performance.

2. Project Scope

The scope of this project includes the following phases:

- Continuous Needs Assessment
- System Design
- Development and Testing
- Implementation and Training
- Evaluation

3. Roles and Responsibilities

- **USC School Clinic:**
 - Provide access to relevant information and resources.
 - Collaborate in the design process and provide feedback.
 - Facilitate staff participation in training sessions.
 - Evaluate the effectiveness of the implemented PIS.
- **CPE 3207L Group L (Petiluna, Renegado, Sabequil):**
 - Conduct the needs assessment.
 - Design, develop, and test the PIS software.
 - Deploy the PIS and provide training to clinic staff.
 - Address any technical issues or concerns.

4. Timeline

The project is expected to be completed within AY 2024-2025. A detailed timeline will be developed collaboratively.

5. Agreement

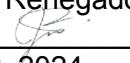
This Memorandum of Understanding signifies a mutual agreement between the parties to collaborate on the design and implementation of a modernized Patient Information System for the USC Clinic. It does not constitute a legal contract and is not legally binding.

Signature

- **USC School Clinic:**

- Name: Elena Plazl Pasuelo
- Title: USC Health Services Coordinator
- Signature: 
- Date: July 22, 2024

- **CPE 3207L Group L (Petiluna, Renegado, Sabequil):**

- Name: Ron Vanz Petiluna
- Signature: 
- Date: July 22, 2024
- Name: Janren Renegado
- Signature: 
- Date: July 22, 2024
- Name: Galen Elijah Sabequil
- Signature: 
- Date: July 22, 2024