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ClinicSync: An Electronic Medical Records System for King's College of the Philippines' Clinic - Benguet Campus

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Abstract*- The reliance on paper-based records at the King's College of the Philippines clinic led to significant inefficiencies, including slow data retrieval, inventory mismanagement, and fragmented patient histories. This capstone project developed and deployed ClinicSync, a custom Electronic Medical Records system, using the Extreme Programming methodology to ensure alignment with user needs. Validation through rigorous testing confirmed the system's effectiveness, achieving a 97.8% acceptance rate and a "Good" usability score (SUS=79.7). ClinicSync successfully enhances data accuracy and clinic workflow efficiency. Future enhancements, including offline functionality and predictive analytics, are recommended to further solidify its impact on student healthcare delivery.*

Keywords*: Electronic Medical Records (EMR), School Clinic Information System, Digital Health Transformation, Healthcare Workflow Optimization, Clinic Management System*

INTRODUCTION

Paper-based health information systems rely on handwritten charts, forms, and logbooks to record patient data. These systems are widely documented as time-intensive, prone to incomplete or inaccurate entries, and difficult to retrieve, particularly in busy or resource-constrained environments (Bisrat et al., 2021; Volkan et al., 2024). Documentation errors and misplaced records may lead to delayed clinical decisions and compromised patient safety.

In school clinics, manual recording remains common for documenting consultations, prescriptions, dental procedures, and annual physical examinations, especially in institutions with limited digital infrastructure (Basil et al., 2022). International studies consistently report that Electronic Medical Records (EMRs) improve healthcare quality, efficiency, and standardization of clinical processes (Uslu & Stausberg, 2021; Hodgson et al., 2021; Lee et al., 2024).

In the Philippine context, the eHealth Strategic Framework highlights the importance of interoperable digital health systems to improve healthcare delivery and information accessibility (Sylim et al., 2022). Empirical studies in rural and institutional clinics show that EMR adoption improves patient tracking and reporting, despite challenges in user training and ICT readiness (Acacio-Claro et al., 2020; Dorado et al., 2024).

Despite extensive EMR research, limited studies focus on lightweight EMR implementations in school clinic environments, where workflows differ from hospital settings and operational resources are constrained. At King's College of the Philippines (KCP) – Benguet Campus, the clinic continues to rely on paper-based systems for consultations, dental services, inventory management, and annual check-ups. This reliance results in fragmented records, slow data retrieval, and inconsistent inventory monitoring.

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To address these gaps, this study developed ClinicSync, an EMR system tailored to the operational realities of a school clinic. This paper presents the development and evaluation of ClinicSync following the IMRAD structure.

METHODOLOGY

Research Design

The study employed a developmental research design using the Extreme Programming (XP) methodology. XP emphasizes short development cycles, continuous user feedback, and incremental releases, making it suitable for systems requiring close alignment with real-world workflows

Setting and Respondents

The study was conducted at the KCP – Benguet Campus clinic, serving both Basic Education and College departments. Respondents included clinic nurses, a physician, and a dentist, who participated in requirements elicitation, prototype validation, and system evaluation. Students and staff participated as end-users during usability testing, limited to appointment scheduling features.

Requirements Gathering

Requirements were gathered through field observation, semi-structured interviews, and document analysis. Existing clinic workflows—medical consultation, dental care, item borrowing and return, medicine inventory, and annual check-ups—were analyzed.

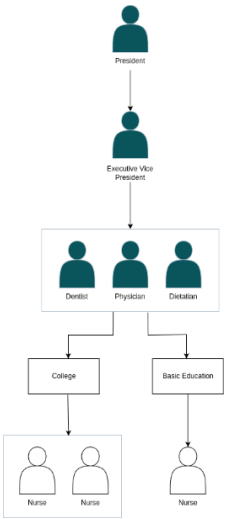

Figure 1. *Clinic Organizational Structure*

Figure 1 illustrates the organizational structure of the KCP clinic.

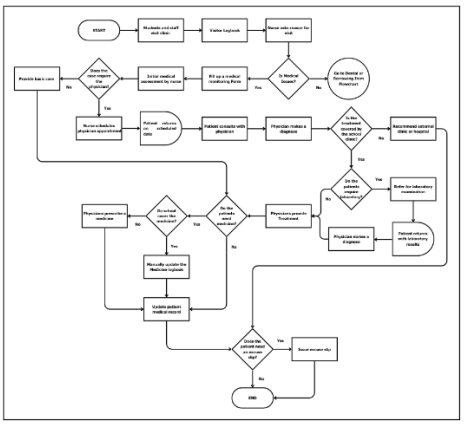

Figure 2. *Current Medical Concern Process in KCP Clinic*

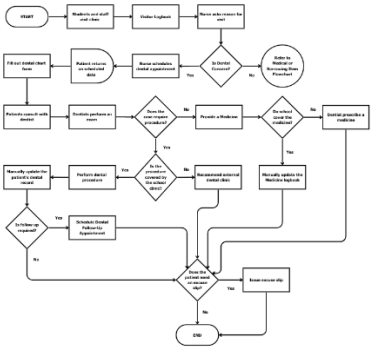

Figure 3. *Current Dental Concern Process in KCP Clinic*

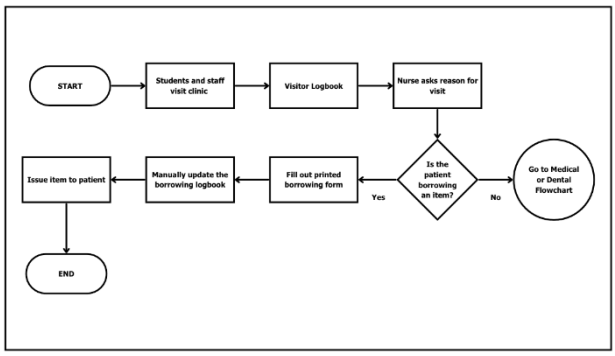

Figure 4. *Current Item Borrowing Process in KCP Clinic*

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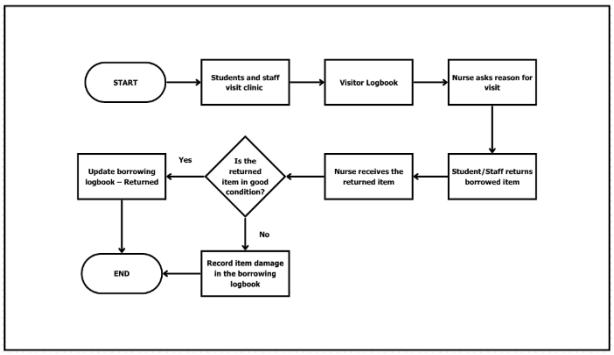

Figure 5. *Current Item Return Process in KCP Clinic*

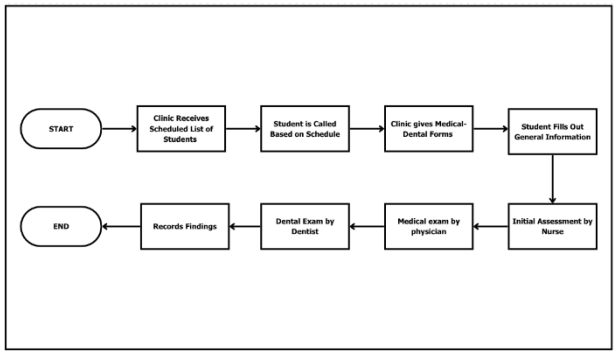

Figure 6. *Current Annual Checkup Process in KCP Clinic*

While Figures 2–6 summarize the manual workflows currently implemented for clinic operations.

Table 1. Limitations of the Current Manual System at the KCP Clinic

Clinic Activity	**Current Method**	**Challenges Faced**
Consultation Records	Students and staff sign logbooks; notes handwritten.	Hard to retrieve, track, or ensure complete records.
Dental Documentation	Charts filled and stored manually.	Risk of loss; cannot be linked to medical history.
Clinic Items Borrowing	Printed forms filled by nurses.	Miscounts, slow tracking, no quick inventory view.
Medicine Inventory	Logged manually when dispensed/restocked.	Inconsistent tracking; no alerts or summary reports.
BMI & Health Monitoring	Data recorded by hand in logbooks.	Tedious updates; no trend analysis or risk flags.
Annual Check-Ups	Managed using printed forms and paper schedules	Cumbersome for large groups; data must be encoded manually for reports
Data Storage	Stored in filing cabinets.	Space-heavy, disaster-prone, slow to access.

Table 1 presents the major limitations of the existing manual system, including fragmented records, slow retrieval, and inconsistent inventory tracking.

System Design and Architecture

ClinicSync adopted a three-tier web application architecture consisting of presentation, application, and data layers.

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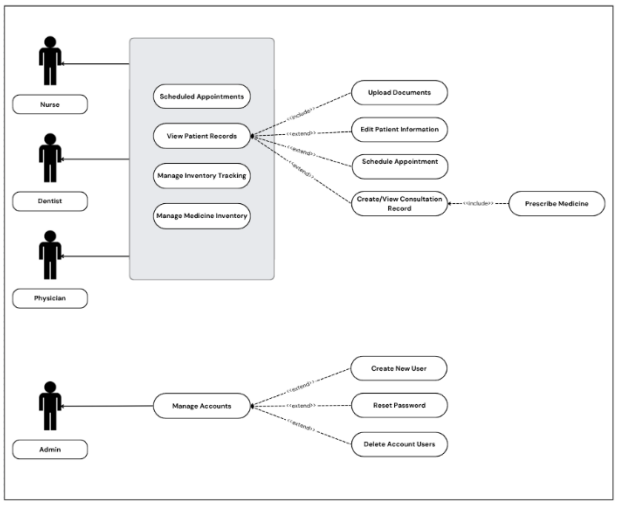

Figure 7. *Use Case Diagram of the ClinicSync System*

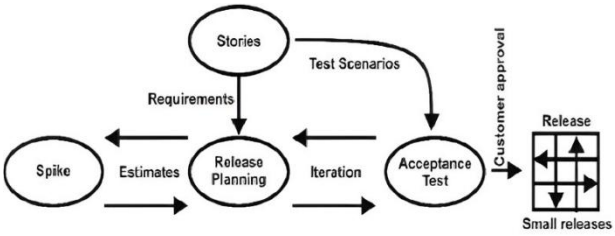

Figure 8. *Extreme Programming methodology (Liñan Espinoza, Echevarría Carpio, & Andrade-Arenas, 2023)*

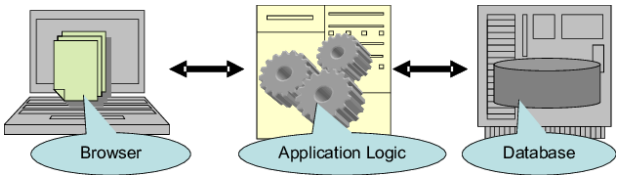

Figure 9. *Three-tier Web Application Architecture*

Figure 7 shows the Use Case Diagram of the ClinicSync system, highlighting interactions among clinic staff, administrators, and patients. Figure 8 presents the XP development lifecycle applied in the study, while Figure 9 illustrates the three-tier system architecture.

Evaluation Instruments

System evaluation employed scenario-based acceptance testing and the System Usability Scale (SUS). Acceptance testing required users to complete predefined tasks marked as pass or fail, while SUS measured perceived usability using a standardized 10-item questionnaire (Lewis & Sauro, 2018).

RESULTS

System Features

ClinicSync provides integrated modules for patient record management, real-time consultation documentation, medicine and equipment inventory tracking, appointment scheduling, emergency referral logging, and role-based account management.

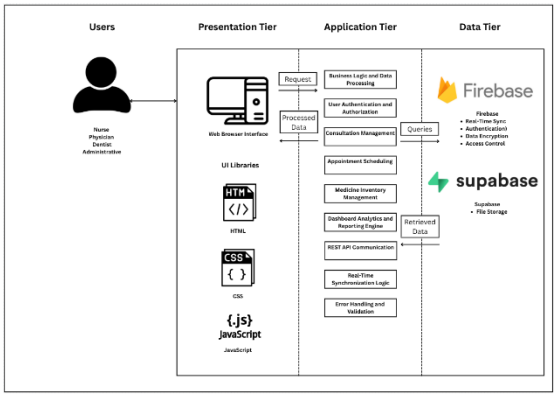

Figure 10 shows the ClinicSync dashboard, providing real-time summaries of patient visits, inventory alerts, and clinic activity analytics.

System Implementation

The system was implemented using HTML, CSS, and JavaScript for the frontend, with Firebase Authentication and Firestore providing backend services. Supabase was utilized for secure document storage. Development was completed across six XP sprints, each delivering functional increments validated by clinic staff.

System Testing

Scenario-based testing involved administrators, clinic staff, and patients. A total of 208 test scenarios were executed, with 202 successfully completed, resulting in a 97.8% overall acceptance rate.

Usability Evaluation

Sixteen participants completed the SUS questionnaire. The overall mean SUS score was 79.7, interpreted as *good* usability. Clinic staff recorded

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higher usability ratings than patients, reflecting familiarity with system workflows.

DISCUSSION

The results support existing literature demonstrating that EMR adoption improves documentation accuracy, workflow efficiency, and data accessibility (Uslu & Stausberg, 2021; Njogu, 2024). Unlike hospital-centered systems, ClinicSync demonstrates that a lightweight, context-specific EMR can be effectively deployed in a school clinic environment.

The application of XP facilitated continuous stakeholder involvement, reducing resistance to change and improving system usability. Role-based access control addressed data privacy and confidentiality concerns, consistent with national eHealth strategies (Sylim et al., 2022).

CONCLUSION AND RECOMMENDATIONS

ClinicSync successfully transformed paper-based clinic operations at KCP – Benguet Campus into a unified digital system. High acceptance rates and positive usability scores confirm the system's effectiveness in supporting clinic workflows.

Future work should include offline functionality, automated notifications, and expanded analytics. Further studies may explore multi-site deployments and longitudinal performance evaluation.

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