



The Development of a Web Application for Tracking Bedridden Patients by Village Health Volunteers

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Abstract: This study aims to develop and evaluate a web-based application for monitoring bedridden patients in a rural community in Loei Province, Thailand. The system was designed to support Village Health Volunteers (VHVs) in recording patient data, monitoring health conditions, and coordinating care with healthcare providers more efficiently. A research and development (R&D) approach was employed, following the System Development Life Cycle (SDLC), including requirement analysis, system design, development, testing, and deployment. The system was evaluated using a structured questionnaire based on information system quality dimensions. A total of 37 VHVs participated in the study. Data were collected before and after implementation and analyzed using descriptive statistics (mean and standard deviation) and paired-samples t-tests. The results showed that overall system quality was rated at the highest level ($\bar{x} = 4.51$, S.D. = 0.49). The highest-rated dimensions included ease of use ($\bar{x} = 4.60$), usefulness ($\bar{x} = 4.58$), and system security ($\bar{x} = 4.55$). User satisfaction was also high ($\bar{x} = 4.39$), with system performance receiving the highest rating ($\bar{x} = 4.66$). Paired-samples t-test results indicated statistically significant improvements after implementation ($t = 8.41-10.34$, $p < 0.001$). These findings demonstrate that the application improves monitoring efficiency, enhances data accuracy, and supports effective communication in community healthcare settings, providing a practical, scalable digital health solution to strengthen primary healthcare services in rural areas.

Keywords: Web application; bedridden patients; village health volunteers; community health

1. Introduction

Caring for bedridden patients is a critical public health issue, particularly in rural communities where access to healthcare services is limited. As populations age and chronic illnesses increase, the number of individuals who are confined to bed and require long-term care continues to rise. Such patients often rely heavily on family members or community-based health volunteers for daily assistance, medical follow-up, and psychological support. In Thailand, this challenge is particularly significant in remote areas where healthcare facilities and professional medical personnel are scarce. In such contexts, community-based care

models have become indispensable for ensuring that patients receive continuous, holistic care. However, traditional approaches such as periodic home visits, manual data recording, and phone-based communication often result in incomplete information, delayed interventions, and inefficiencies in coordination among healthcare providers [1]. Recent studies have highlighted the increasing role of digital health technologies in improving healthcare monitoring and service delivery. Remote patient monitoring systems, cloud-based health platforms, and mobile health applications have been widely developed to support patient care and health data management in both clinical and community settings [2-4]. These technologies enable real-time health monitoring, enhance data accessibility, and improve coordination between healthcare providers and patients.

With the increasing adoption of digital technologies in healthcare, web-based applications have emerged as effective and sustainable tools for improving health data management and service delivery. Digital platforms enable the integration of patient information, facilitate real-time data collection, and support remote monitoring to enable timely clinical decisions. Moreover, such systems can enhance collaboration between Village Health Volunteers (VHVs), healthcare professionals, and administrative units by providing a centralized database for communication and reporting. Previous studies have shown that community health applications not only enhance service efficiency and reduce administrative burdens but also improve patient satisfaction and engagement with healthcare services [5]. These tools have proven especially beneficial in rural areas where resource limitations make traditional service delivery less effective, demonstrating their potential to bridge gaps in healthcare accessibility.

From a theoretical perspective, the development of digital healthcare systems is strongly supported by the concept of Health Information Systems (HIS), which focuses on the systematic collection, storage, processing, and dissemination of health information to support healthcare management and decision-making. Effective health information systems improve the accuracy, accessibility, and interoperability of patient data, enabling healthcare professionals to coordinate care more efficiently and respond to patient needs promptly. [6] In community healthcare contexts, such systems can assist healthcare workers and volunteers in monitoring patient conditions, organizing home visits, and maintaining updated health records. In addition, the adoption of new digital technologies in healthcare environments can be explained through the Technology Acceptance Model (TAM), which identifies perceived usefulness and perceived ease of use as key determinants influencing users' willingness to adopt technological systems [7-8]. Systems that are easy to use and demonstrate clear benefits for users' daily tasks are more likely to be successfully implemented and sustained in real-world healthcare environments. Therefore, the design of digital healthcare systems should consider both functional effectiveness and user-centered design to ensure that end users can effectively use the technology.

In Na Khaem Subdistrict, Loei Province, the number of bedridden patients has steadily increased in recent years, placing considerable pressure on VHVs who are tasked with providing continuous and comprehensive care. The VHVs must monitor health conditions, record patient data, and coordinate with healthcare centers to ensure consistent follow-up and treatment. Without a systematic digital platform, these tasks tend to be time-consuming, error-prone, and difficult to track over time. This situation highlights the urgent need for a web-based system designed specifically to support VHVs' operations, ensure accurate and secure management of patient data, and enhance the efficiency of community-based healthcare services [9]. The novelty of this study lies in the development of a community-based digital monitoring system specifically designed for Village Health Volunteers (VHVs). Unlike conventional healthcare information systems that primarily support hospital operations, the proposed system focuses on supporting home-based patient care, visit scheduling, and real-time reporting within rural community healthcare settings. Therefore, this research contributes both a practical digital health solution and an implementation model for community healthcare systems in rural Thailand.

Therefore, this study aimed to develop a web application for monitoring bedridden patients in Na Khaem Subdistrict, Loei Province, and to evaluate its quality through expert assessment, while examining VHVs' satisfaction as end-users. The proposed system integrates data management, visit scheduling, and reporting features into a single accessible platform. The findings from this study are expected to provide a practical and replicable model for applying digital tools to strengthen primary and community healthcare services in Thailand. Furthermore, the study contributes to the growing body of evidence supporting the integration of digital health innovations into rural health systems to promote equitable, efficient, and sustainable care delivery.

2. Research Methods

This research focuses on developing a web-based application to monitor bedridden patients in Ban Na Khaem, Na Khaem Subdistrict, Mueang District, Loei Province, to improve usability for local public health volunteers. Employing a research and development (R&D) approach, the study integrates system design with quantitative evaluation. The methodology is structured into two primary phases: (1) system development and (2) system evaluation, ensuring both functional efficiency and alignment with user needs.

2.1 Problem study and survey

This study began with an exploration of the problems associated with caring for bedridden patients in Na Khaem Subdistrict, Mueang District, Loei Province. Data collection was conducted through a variety of methods, including in-depth interviews with Village Health Volunteers (VHVs) and caregivers of bedridden patients to understand current health data-tracking and recording processes, as well as the limitations and needs of actual users. Field observations were also conducted, with researchers visiting VHVs' homes to collect data on workflows, data recording methods, reporting practices, and problems encountered in real-world settings. This was coupled with a document review to examine academic literature, research, and existing systems for bedridden patient care and health information systems, which served as the basis for designing a new system. The results revealed that most VHVs still record data on paper or transmit it through conventional communication channels, leading to delays, disorganization, and difficulty in tracking data retrospectively. Therefore, developing a web application that systematically stores data and provides easy access is an appropriate approach to addressing this issue.

2.2 System design and development

The researchers used data from field surveys, interviews, and document reviews to design a system that effectively addresses the real needs of bedridden patient care. The system architecture was developed based on user requirements, emphasizing data accuracy, accessibility, and security. Database structures and system functions were carefully defined to ensure smooth integration between health volunteers and healthcare providers. This design process aimed to create a user-centered, reliable, and efficient digital platform to enhance the management and monitoring of bedridden patients in the community healthcare context.

2.2.1 System design

1) Context diagram. Based on the analysis of the system's problems and requirements, the system diagram was drawn as shown in Figure 1.

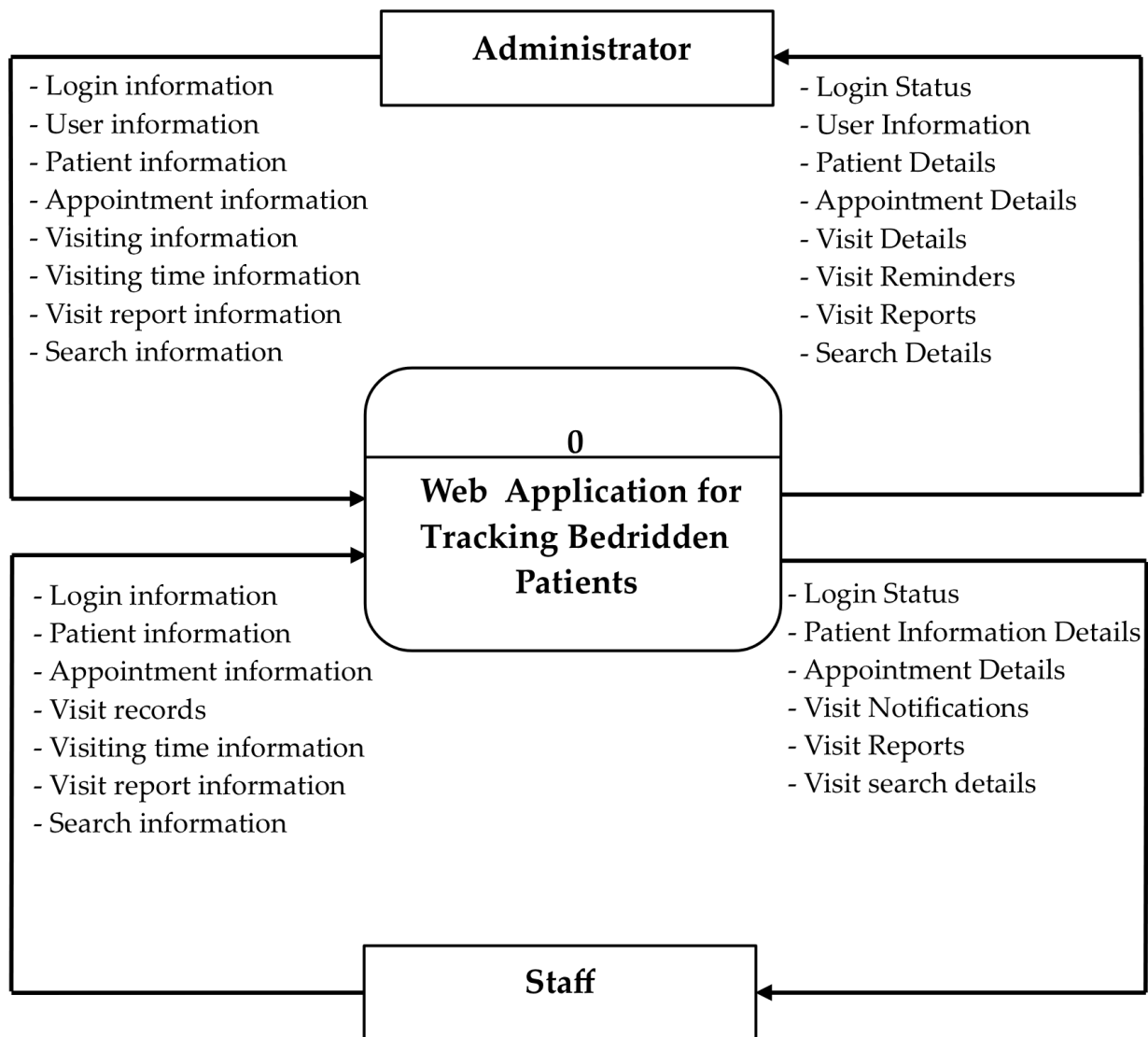


Figure 1. Context Diagram

Figure 1 shows a context diagram of the web application for tracking bedridden patients, showing interactions between the system and two main external entities—Administrator and Staff. It illustrates the flow of information, including login, patient data, appointments, visit records, reports, and search details, exchanged between users and the system.

2) Data flow diagram

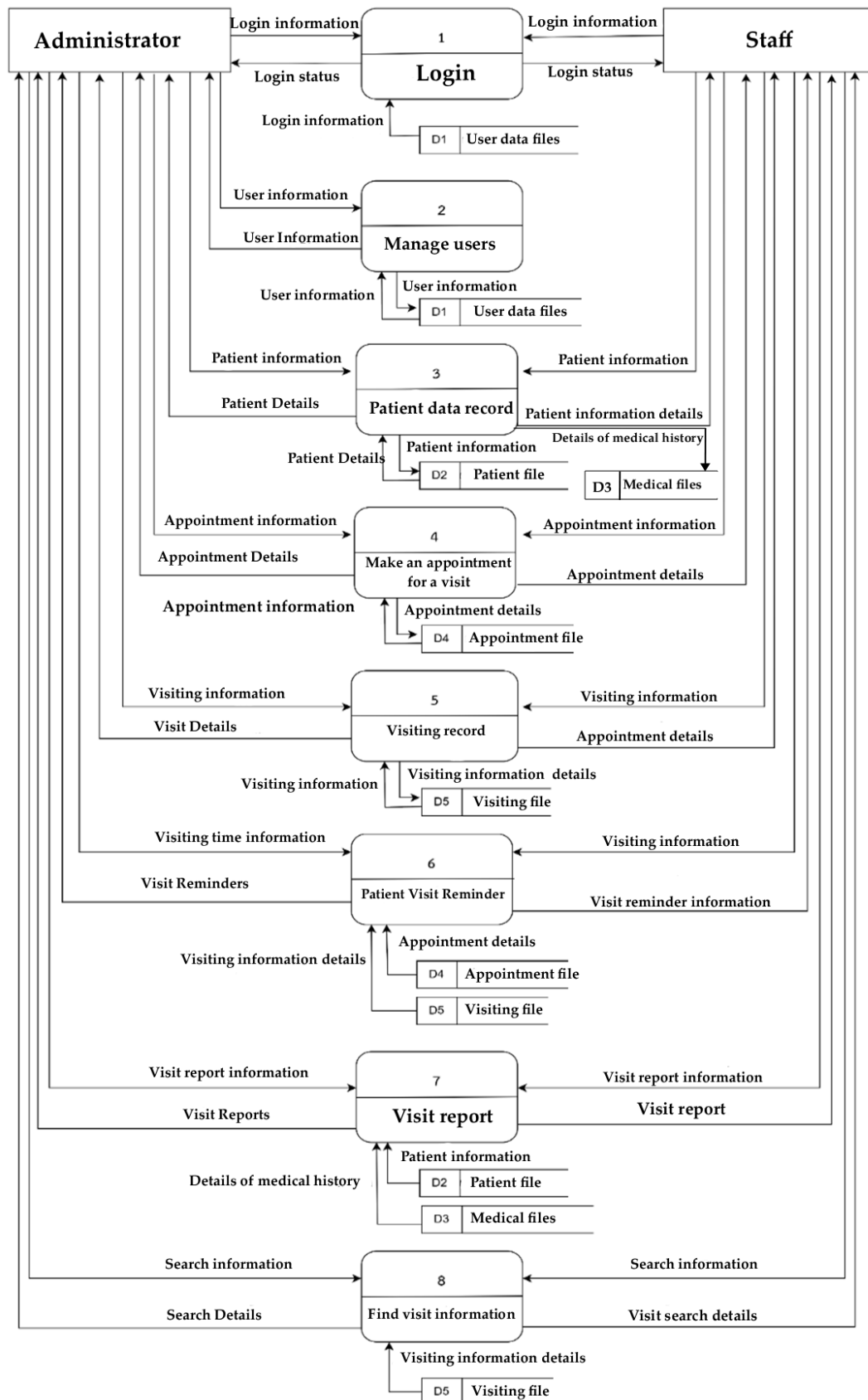


Figure 2. Data Flow Diagram level 0

Figure 2 shows a data flow diagram of the healthcare management system, illustrating interactions between the Administrator and Staff. The system includes key processes such as login, user management, patient data recording, appointment scheduling, visiting records, reminders, report generation, and information search, with data stored in related files (user, patient, medical, appointment, and visiting files)

2.2.2 System development

System development is the structured process of designing, developing, implementing, and testing a software system to ensure it meets specified user requirements and operational objectives. In this study, the web-based monitoring system for bedridden patients was developed to support Village Health Volunteers (VHVs) in recording patient information, monitoring health conditions, and coordinating with healthcare providers efficiently. The development of the web-based monitoring system was grounded in the System Development Life Cycle (SDLC) framework, specifically utilizing an iterative prototyping model. This framework was selected as it allows for continuous refinement based on feedback from healthcare professionals and VHVs. The process encompassed five structured phases: (1) Requirement Analysis, gathered through field surveys and interviews; (2) System Design, focusing on a user-centric three-tier architecture; (3) Implementation, using PHP and MySQL; (4) Testing, ensuring functionality and security; and (5) Deployment and Evaluation in a real-world community healthcare setting.

1) Web Application Development

The proposed system was developed as a web-based application, allowing users to access the platform via standard web browsers without installing additional software. This approach enhances accessibility and enables Village Health Volunteers and healthcare staff to use the system from various locations using computers, tablets, or smartphones. The system architecture follows a three-tier model, consisting of the presentation, application, and data layers. The presentation layer provides the user interface that allows users to input and view patient information through web pages designed with responsive design principles. The application layer handles system logic, including patient data management, visit scheduling, health monitoring, and report generation. The data layer is responsible for storing and managing patient records and system data within a structured relational database. The development process involved several key technical components:

(1) Front-end development was used to design interactive user interfaces that allow users to easily record patient visits, update monitoring information, and access reports.

(2) Back-end development manages system functionality, processes user requests, and communicates with the database to retrieve and store patient data.

(3) A relational database management system (RDBMS) was used to organize and maintain structured health data, including patient profiles, monitoring records, and user account information.

During development, special attention was given to usability and simplicity, considering that Village Health Volunteers may have varying levels of digital literacy. Therefore, the interface was designed with clear navigation, simple data entry forms, and easily accessible reporting features. Before system deployment, the web application underwent functional testing and system verification to ensure that all modules operated correctly and that the system could reliably support the monitoring and management of bedridden patient information within the community healthcare environment.

2) System Security and Data Protection

To ensure confidentiality, integrity, and security of patient information, the developed web-based monitoring system incorporates several security mechanisms, including secure data transmission, user authentication, and role-based access control. These mechanisms were designed in accordance with widely accepted information security practices for healthcare information systems.

(1) Data Encryption

All data transmitted between the user interface and the web server is protected using the Secure Sockets Layer/Transport Layer Security (SSL/TLS) encryption protocols. This mechanism ensures that sensitive health information, such as patient records and monitoring data, cannot be intercepted or modified during transmission. In addition, sensitive user credentials, including passwords, are not stored in plain text within the system database. Instead, passwords are protected using cryptographic hashing algorithms with salting techniques, which significantly reduce the risk of credential compromise in the event of unauthorized database access.

(2) User Authentication

The system implements a secure login authentication mechanism to verify the identity of authorized users before granting access to the platform. Each user must log in using a unique username and password assigned by the system administrator. The authentication process verifies the credentials against encrypted records stored in the system database. To prevent unauthorized access, the system also incorporates session management techniques, including automatic session expiration after a period of inactivity and protection against repeated failed login attempts.

(3) Role-Based Access Control

To further enhance system security, role-based access control (RBAC) was implemented. Users are assigned specific roles based on their responsibilities within the community healthcare system. The system currently supports three primary user roles:

1. Village Health Volunteers (VHVs) – allowed to record patient visits, update monitoring data, and submit health reports.
2. Healthcare staff – allowed to review patient records, monitor health conditions, and coordinate follow-up care.
3. System administrators – responsible for managing user accounts, system configuration, and database maintenance.

This access control structure ensures that users can only access information and functions relevant to their roles, thereby minimizing the risk of unauthorized data modification.

(4) Data Backup and System Protection

To prevent data loss and maintain system reliability, the system performs regular database backups and stores backup files securely on the server. These measures ensure that patient information can be restored in the event of system failure or technical disruptions.

Overall, these security mechanisms ensure that the developed web-based monitoring system provides a secure and reliable environment for managing sensitive healthcare data while supporting the operational needs of Village Health Volunteers in community healthcare settings.

2.3 Population and Sample

2.3.1 Population

The population in this study consisted of five experts who evaluated the quality of the developed system and 42 Village Health Volunteers (VHVs) from Ban Na Khaem, Na Khaem Subdistrict, Mueang District, Loei Province [9].

2.3.2 Sample

1) Five experts assessed the quality of the system, including two information technology specialists and three experts in VHV data analysis.

2) The target population consisted of 42 active Village Health Volunteers (VHVs) in Ban Na Khaem. To ensure statistical reliability, the sample size was determined using the Krejcie and Morgan [10]. Based on the formula, for a finite population of 42, with a 95% confidence level and a 5% margin of error, the recommended minimum sample size is 38. In this study, 37 VHVs met the inclusion criteria and participated in the evaluation, representing an 88% response rate of the total population. This high participation rate is considered statistically robust and highly representative, enabling valid conclusions in this community-based research context.

2.4 Research Tools

2.4.1 Characteristics of research tools

1) Web application for monitoring bedridden patients at Ban Na Khaem. The primary research tool developed in this study was a web-based application designed as a prototype system to monitor and manage data for bedridden patients in Ban Na Khaem Subdistrict, Loei Province. The system aimed to support Village Health Volunteers (VHVs) and healthcare professionals in maintaining accurate, up-to-date, and easily accessible patient information. Its core functions included patient data storage, visit scheduling, real-time visit recording, reminder notifications, and the generation of summary reports for health monitoring and evaluation. The web application was developed using the PHP programming language and MySQL as the database management system, implemented in Visual Studio Code and phpMyAdmin. The system architecture followed a user-centered design approach to ensure efficiency, reliability, and data security. The platform was structured with two primary user roles—administrators and staff—allowing for differentiated access to patient information and system management. This tool served as the foundation for evaluating both system performance and user satisfaction in subsequent research phases.

2) System quality assessment by experts. To evaluate the technical quality and functionality of the developed system, a structured framework was designed by five experts. The evaluation criteria were adapted from ISO/IEC 25010, the standard for software product quality, which outlines eight key dimensions: Functional Suitability, Performance Efficiency, Compatibility, Usability, Reliability, Security, Maintainability, and Portability. The researchers categorized the quality evaluation issues into 11 points.

The assessment utilized a five-point Likert scale, ranging from “lowest” to “highest,” to quantify expert opinions on each criterion. The results of this evaluation provided critical insights into the system's technical strengths and potential areas for improvement in its design and operation. The use of multidisciplinary experts ensured that the evaluation covered both technological and public health perspectives, reflecting the system's interdisciplinary nature and community applicability.

3) User satisfaction questionnaire. Drawing on the Technology Acceptance Model (TAM), a user satisfaction questionnaire was used to measure the perceived usefulness and ease of use of the developed web application among end users, specifically the 37 Village Health Volunteers in Ban Na Khaem. The questionnaire was structured into five rating levels (from “highest” to “lowest”) and covered four major aspects: content quality, system design, usability, and operational efficiency.

4) An evaluation form for comparing the results before and after using a web application. The evaluation of the developed web-based monitoring system was conducted using a structured questionnaire administered to Village Health Volunteers (VHVs) before and after the system's implementation. The purpose of this evaluation was to compare user perceptions regarding the effectiveness of the traditional monitoring process and the newly developed web-based system. The questionnaire consisted of five key evaluation dimensions: (1) ease of data recording, (2) efficiency of patient monitoring, (3) accuracy of health data management, (4) communication with healthcare providers, and (5) overall user satisfaction. Each dimension was measured on a five-point Likert scale, with 1 representing the lowest level of agreement and 5 the highest. The pre-implementation evaluation was conducted before the system's introduction to measure baseline perceptions of VHVs regarding the traditional process of monitoring bedridden patients, which typically involved manual data recording, paper-based documentation, and communication via phone calls or informal reporting. Following the deployment and practical use of the developed web-based system, the post-implementation evaluation was conducted using the same questionnaire. This allowed for a direct comparison of user perceptions before and after the system was introduced.

2.4.2 Validity and reliability of the evaluation instrument

To ensure the credibility and rigor of the evaluation results, the validity and reliability of the research instrument were assessed systematically before data collection. The evaluation

questionnaire used in this study was developed based on relevant literature on digital health systems, user satisfaction evaluation, and community healthcare information systems.

1) Content validity Content validity was examined using the Index of Item-Objective Congruence (IOC) method. The questionnaire was reviewed by three experts specializing in health informatics, community healthcare management, and information system development. Each expert evaluated the relevance and clarity of the questionnaire items in relation to the research objectives using a three-point rating scale (-1 = not relevant, 0 = uncertain, 1 = relevant). The IOC values for all questionnaire items ranged from 0.67 to 1.00, exceeding the acceptable threshold of 0.50, indicating that the items were appropriate and consistent with the research objectives.

2) Reliability analysis to examine the internal consistency of the evaluation instrument. A pilot test was conducted with 30 Village Health Volunteers (VHVs) who had characteristics similar to the target participants. The questionnaire's reliability was analyzed using Cronbach's alpha. The results showed an overall reliability coefficient of 0.92, indicating a high level of internal consistency. The reliability coefficients for each evaluation ranged from 0.86 to 0.91, which are considered acceptable according to established research standards. These results demonstrate that the questionnaire possessed adequate validity and reliability and was appropriate for evaluating user perceptions of the developed web-based monitoring system

2.5 Data Collection

After the web-based application development was completed, the researcher conducted a pilot implementation to evaluate its functionality, usability, and effectiveness in a real-world community health context. The data collection process was systematically organized to obtain both expert assessments and user feedback, ensuring a comprehensive evaluation of the system's performance and user experience. The procedures were carried out as follows.

2.5.1 Expert system evaluation Five experts participated in the system quality evaluation to assess the technical performance and overall functionality of the developed web application. The experts were selected based on their professional experience in business computer systems, information technology, and public health. Each expert was given access to the system prototype and instructed to perform specific data-entry, patient-monitoring, and report-generation tasks.

Following the testing phase, the experts completed a standardized quality assessment form that measured four key criteria: system functionality, ease of use, data security, and processing efficiency. Their feedback provided essential insights into the system's strengths, limitations, and technical robustness. The data collected in this phase were used to refine the application and validate its readiness for real-world deployment.

2.5.2 User testing and satisfaction assessment

A sample of 37 Village Health Volunteers (VHVs) from Ban Na Khaem Subdistrict participated in the user testing phase to examine the system's usability and practical applicability during actual patient monitoring activities. Each participant received a brief training session on operating the web application, including instructions on logging in, recording patient data, scheduling visits, and generating reports. After testing the system in real community settings, the VHVs completed a satisfaction questionnaire designed to measure their perceptions of the system's content quality, design, usability, and operational efficiency. The data from this phase demonstrated the system's real-world effectiveness in supporting community health volunteers in their day-to-day patient care responsibilities.

2.5.3 Data collection and preparation for analysis

All completed evaluation forms and satisfaction questionnaires were systematically collected and verified for completeness and consistency. The researcher then organized the data into two categories: expert evaluation data and user satisfaction data. The quantitative data were coded and entered into a database for subsequent statistical analysis, while qualitative comments from experts

and users were summarized to identify common themes and improvement suggestions. This integrated approach ensured that both technical performance metrics and user experience perspectives were included in the final analysis, providing a comprehensive understanding of the web application's effectiveness and potential for further development in community healthcare contexts.

2.6 Data Analysis

The data collected from both expert evaluations and user satisfaction surveys were analyzed using descriptive statistics to summarize the data and assess the overall quality and performance of the developed web application. This approach was chosen to provide a clear and systematic representation of participants' responses, focusing on trends, averages, and the dispersion of opinions. The analysis procedures were carried out as follows.

2.6.1 Frequency and percentage were employed to illustrate the distribution of responses across each rating level in the evaluation and satisfaction questionnaires. This statistical technique enabled the researcher to identify how often specific response options were selected and the proportion of participants who rated the system at various levels of quality or satisfaction. By examining these distributions, the study could determine the general tendencies and levels of agreement among experts and users regarding the system's effectiveness and usability.

2.6.2 The arithmetic mean (average) was used to represent the central tendency of expert and user evaluations, indicating the overall levels of system quality and user satisfaction. Mean scores were calculated for each dimension of the assessment, including system functionality, ease of use, security, processing efficiency, and overall satisfaction. Higher mean values indicated stronger agreement and more favorable evaluations of the system's performance. This method provided a concise summary measure that reflects the perceived quality and effectiveness of the developed web application in supporting community health activities.

2.6.3 The standard deviation was calculated to measure the degree of variability or dispersion in the responses among participants. A low standard deviation indicated that the responses were consistent and clustered closely around the mean, suggesting general agreement among evaluators. Conversely, a high standard deviation suggested a greater diversity of opinions. This measure enabled the researcher to assess the stability and reliability of responses, offering deeper insight into the consistency of expert and user perceptions of the system's design, functionality, and overall usability.

2.6.4 The paired-samples t-test was used to compare user perceptions before and after system implementation. The analysis included means, standard deviations, t-values, and p-values to determine whether differences between the two conditions were statistically significant.

The use of these descriptive statistical methods enabled the researcher to systematically interpret the evaluation data and present the results in a structured and meaningful way. The analysis provided empirical evidence on the web application's quality, effectiveness, and user satisfaction, forming the basis for further discussion and conclusions.

3. Research Results

The research results are divided into three parts: results of web application development for bedridden patients, results of expert performance evaluation, and results of user satisfaction evaluation. Details are as follows.

3.1 Results of web application development for bedridden patients.

The web application developed for bedridden patients in Ban Na Khaem features a two-level user interface: administrators and staff. The system's interface is designed as follows

3.1.1 Login page

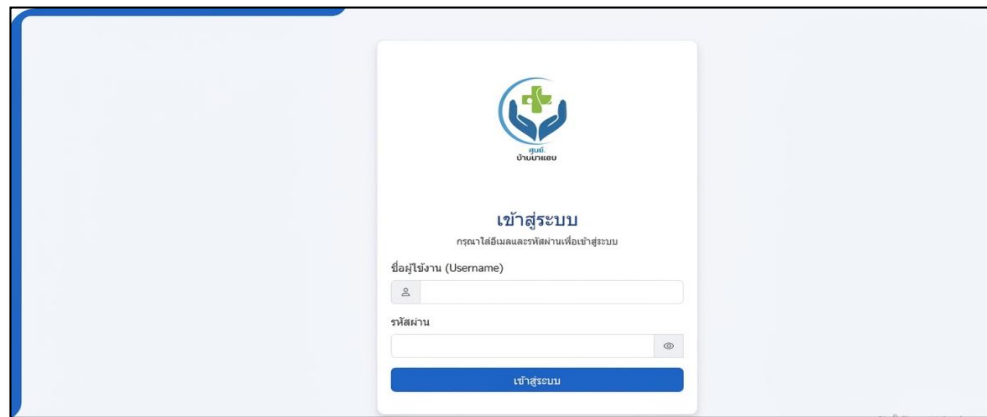


Figure 3. Login page

Figure 3 shows the login page. System administrators and staff must log in to access the system at the login page by entering a username and password.

3.1.2 User management

รายชื่อผู้ใช้						
หน้าแรก / รายชื่อผู้ใช้						
รายชื่อผู้ใช้ทั้งหมด เพิ่มผู้ใช้ +						
ลำดับ	ชื่อจริง-นามสกุล	อีเมล	เบอร์โทรศัพท์	ตำแหน่ง	แก้ไข	ลบ
1	นายสุชาติ จิตดีสวัสดิ์	suchat.j@example.com	0891234567	user	แก้ไข	ลบ
2	นางจารุวรรณ บัวจันทร์	jaruwan.b@example.com	0898765432	admin	แก้ไข	ลบ
3	นายประพงษ์ แก้วมณี	praphong.k@example.com	0812345678	user	แก้ไข	ลบ
4	นางพิมพ์พา หอมดอก	pimpa.h@example.com	0892468135	user	แก้ไข	ลบ
5	นายสมชาย ชัยชนะ	somchai.c@example.com	0811122334	user	แก้ไข	ลบ

Figure 4. User management page

Figure 4 shows the user management page, accessible only by system administrators. They can add, remove, and edit first names, last names, email addresses, phone numbers, and job titles.

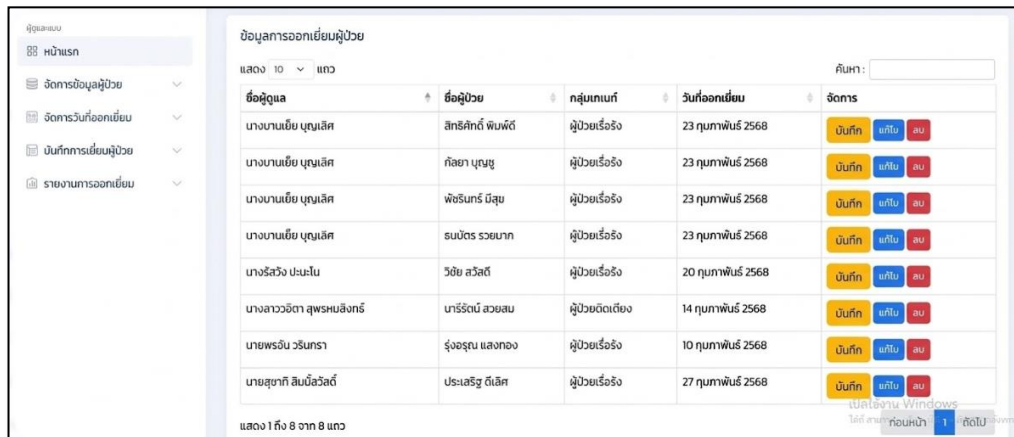
3.1.3 Patient data record

รายชื่อผู้ป่วย									
+ เพิ่มข้อมูลใหม่									
10 entries per page									
ลำดับ	เลขบัตรประชาชน	รหัสกลุ่มเกณฑ์ (อาการเฉลี่ย)	ชื่อ	นามสกุล	วันเดือนปีเกิด	เพศ	สิทธิการรักษา	เบอร์โทรศัพท์	แก้ไข
1	100000000003	ผู้สูงอายุ	ประสงค์	รัมย์สุข	10 ตุลาคม 2503	ชาย	บัตรทอง	0834567890	แก้ไข
2	100000000004	ผู้สูงอายุ	พัทธ์	สมายด์	25 มีนาคม 2508	หญิง	ข้าราชการ	0845678901	แก้ไข
3	100000000007	ผู้ป่วยเรื้อรัง	วิชัย	อภัยสุข	09 กันยายน 2505	ชาย	ข้าราชการ	0878901234	แก้ไข

Figure 5. Patient data record page

Figure 5 shows the screen for adding patient information. System administrators and staff can add, delete, and edit patient ID numbers, patient groups, first names, last names, dates of birth, genders, health insurance coverage, and phone numbers.

3.1.4 Visiting appointment



ชื่อผู้ดูแล	ชื่อผู้ป่วย	กลุ่มเกณฑ์	วันที่ออกเยี่ยม	จัดการ
นางบานเย็น บุณเลิศ	สิริศักดิ์ พันธ์ดี	ผู้ป่วยเรื้อรัง	23 กุมภาพันธ์ 2568	บันทึก แก้ไข ลบ
นางบานเย็น บุณเลิศ	กัญญา บุญชู	ผู้ป่วยเรื้อรัง	23 กุมภาพันธ์ 2568	บันทึก แก้ไข ลบ
นางบานเย็น บุณเลิศ	พัชรินทร์ มีสุข	ผู้ป่วยเรื้อรัง	23 กุมภาพันธ์ 2568	บันทึก แก้ไข ลบ
นางบานเย็น บุณเลิศ	ธนบัตร รวยมาก	ผู้ป่วยเรื้อรัง	23 กุมภาพันธ์ 2568	บันทึก แก้ไข ลบ
นางรังสิริ ประโม	วิชัย สวัสดิ์	ผู้ป่วยเรื้อรัง	20 กุมภาพันธ์ 2568	บันทึก แก้ไข ลบ
นางสาวอุษิตา สุพรรณสิงห์	มาร์ติน ลอยสม	ผู้ป่วยติดเชื้อ	14 กุมภาพันธ์ 2568	บันทึก แก้ไข ลบ
นายพรชัย วัฒนรา	รุ่งอรุณ แสงทอง	ผู้ป่วยเรื้อรัง	10 กุมภาพันธ์ 2568	บันทึก แก้ไข ลบ
นายสุชาติ สนิทสวัสดิ์	ประเสริฐ ดีเลิศ	ผู้ป่วยเรื้อรัง	27 กุมภาพันธ์ 2568	บันทึก แก้ไข ลบ

แสดง 1 ถึง 8 จาก 8 แถว

Figure 6. Visit appointment page

Figure 6 shows the appointment scheduling screen. System administrators and staff can add, remove, and edit patient information, including caregiver names, patient names, visit dates, and save the appointment.

3.1.5 Patient visit record



ลำดับ	ชื่อผู้ดูแล	กลุ่มเกณฑ์	ชื่อผู้ป่วย	อาการ	น้ำหนัก	ส่วนสูง	อุณหภูมิ	ชีพจร	แผลกดทับ	ลักษณะแผล	แก้ไข	ลบ
1	นางบานเย็น บุณเลิศ	ผู้ป่วยเรื้อรัง	สิริศักดิ์ พันธ์ดี	ป่วยหนัก	87.00	167.00	37.00	22	มี	แผลขนาดเล็ก	แก้ไข	ลบ
2	นางสาวอุษิตา สุพรรณสิงห์	ผู้ป่วยติดเชื้อ	สุภา สนิท	อ่อนแรง	55.00	160.00	36.00	85	มี	แผลเปิด	แก้ไข	ลบ
3	นายพรชัย วัฒนรา	ผู้ป่วยเรื้อรัง	อนันต์ เพชรสุข	ปวดเมื่อยทั่วร่างกาย	50.00	155.00	36.00	78	ไม่มี	แผลเปิดขนาดเล็ก	แก้ไข	ลบ

แสดง 1 ถึง 3 จาก 3 แถว

Figure 7. Patient visit record page

Figure 7 shows the user interface (UI) of the patient visit recording page, designed as an efficient community health data management information system. This screen contains crucial information for monitoring patient conditions, including caregiver name, patient category, patient's name and surname, and initial symptoms. It also includes sections for recording vital signs and in-depth physical data such as weight, height, body temperature, and pulse, as well as assessing complications like pressure ulcers and wound characteristics, allowing staff to evaluate risks immediately. The system supports real-time data management via edit and delete buttons for individual entries, along with search and pagination to easily review large amounts of data.

3.1.6 Patient visit report

Figure 8. Visit report page

Figure 8 shows the visit report page for bedridden patients. The table includes information such as the caregiver's name, the patient's name, the visit date, and the patient's symptoms. Next is a section for reporting physical and vital signs data, including weight (kg), height (cm), temperature (°C), pulse (bpm), and blood pressure (mmHg). There are also columns for assessing pressure ulcers and additional details, used to record other important information such as mobility assessment, care methods, complications, and other problems, providing the medical and care team with complete information for long-term planning.

3.2 System quality assessment results

The system quality assessment was conducted by five experts specializing in information technology, business computing, and public health. Their evaluations focused on functionality, usability, security, and processing efficiency. The summarized results, presented in Table 1, reflect the overall performance and technical reliability of the developed web-based application.

Table 1. Results of the evaluation of the quality of the Ban Na Khaem bedridden patient tracking system

Quality Assessment	$\bar{X}$	S.D.	Rating
Functional system performance	4.45	0.51	High
System functionality	4.52	0.48	Highest
Ease of use	4.60	0.45	Highest
System efficiency	4.48	0.50	High
Accuracy of Health Data Management	4.50	0.47	Highest
System security	4.55	0.49	Highest
Information Quality	4.53	0.46	Highest
System Reliability	4.47	0.52	High
Maintainability	4.44	0.54	High
Accessibility & Compatibility	4.46	0.53	High
Decision Support / Portability	4.58	0.47	Highest
Total	4.51	0.49	Highest

Table 1 presents the quality evaluation of the bedridden patient tracking system in Ban Na Khaem. Overall, the system achieved the highest level of evaluation ($\bar{x} = 4.51$, S.D. = 0.49), reflecting strong user satisfaction across all dimensions. Key strengths were identified in ease of use ($\bar{x} = 4.60$), decision support/portability ($\bar{x} = 4.58$), system security ($\bar{x} = 4.55$), information quality ($\bar{x} = 4.53$), system functionality ($\bar{x} = 4.52$), and accuracy of health data management ($\bar{x} = 4.50$), all of which were rated at the highest level. In contrast, aspects such as functional performance, efficiency, reliability, maintainability, and accessibility/compatibility were rated highly, with mean scores ranging from 4.44

to 4.48. These results indicate that the developed web application effectively integrates usability with strong data protection. This balance is particularly important for community-based healthcare systems, where overly complex but secure systems may hinder adoption. Moreover, the high rating for decision support suggests that the system not only stores data but also provides meaningful insights to support healthcare decision-making.

3.3 Results of system satisfaction assessment

The user satisfaction assessment was conducted with a sample of 37 Village Health Volunteers who utilized the web-based application in real community settings. Their feedback, summarized in Table 2, reflects perceptions of system design, content quality, usability, and operational efficiency, providing valuable insights into user acceptance and overall satisfaction.

Table 2. Satisfaction evaluation results of the use of the Ban Na Khaem bedridden patient tracking system

Satisfaction assessment	$\bar{X}$	S.D.	Rating
Content	4.30	0.39	High
Website design and layout	4.23	0.26	High
Website system performance	4.66	0.21	Highest
Total	4.39	0.14	High

Table 2 presents the satisfaction levels toward the management system for tracking bedridden patients in Ban Na Khaem, showing an overall high level of satisfaction ($\bar{x} = 4.39$, S.D. = 0.14). Among the evaluated aspects, website efficiency received the highest rating ($\bar{x} = 4.66$, S.D. = 0.21), indicating that the system performs effectively in supporting field operations and sustaining user engagement. Content quality ($\bar{x} = 4.30$, S.D. = 0.39) and website design and layout ($\bar{x} = 4.23$, S.D. = 0.26) were also rated highly. These findings suggest that the system's interface is well aligned with the actual workflow and digital literacy of community health volunteers, resulting in ease of use, a reduced learning curve, and lower resistance to technology adoption.

3.4 Comparison of user perceptions before and after system implementation

Table 3. Comparison of user perceptions before and after system implementation

Evaluation dimension	Before Mean (SD)	After Mean (SD)	t-value	p-value
Ease of Data Recording	3.12 (0.64)	4.48 (0.52)	9.21	< 0.001
Efficiency of Patient Monitoring	3.05 (0.71)	4.55 (0.50)	10.34	< 0.001
Accuracy of Health Data Management	3.18 (0.68)	4.50 (0.49)	8.87	< 0.001
Communication with Healthcare Providers	3.22 (0.66)	4.47 (0.54)	8.41	< 0.001
Overall Satisfaction	3.25 (0.69)	4.60 (0.47)	9.76	< 0.001

Significance level: $p < 0.05$

The results in Table 3 compare user perceptions before and after the implementation of the web-based monitoring system. The analysis used a paired t-test to determine whether there were statistically significant differences between the two periods. The findings indicate that all evaluation dimensions improved substantially after the system was implemented. Specifically, the mean ease-of-data-recording score increased from 3.12 to 4.48, while the patient-monitoring efficiency score improved from 3.05 to 4.55. Similarly, the accuracy of health data management increased from 3.18 to 4.50, and communication with healthcare providers improved from 3.22 to 4.47. Overall user satisfaction also increased significantly from 3.25 to 4.60 after system implementation. The paired t-test results demonstrate that all observed differences were statistically significant ($p < 0.001$). These results

suggest that the developed web-based system significantly enhanced Village Health Volunteers' ability to record patient data, monitor patient conditions, and coordinate healthcare services more effectively.

4. Discussion

The development of the web application for tracking bedridden patients in Ban Na Khaem Subdistrict successfully addressed the limitations of traditional monitoring methods, such as paper-based records and manual communication. The system enabled Village Health Volunteers (VHVs) to efficiently record patient data, schedule home visits, receive reminders, and generate real-time reports. The division of users into two levels—administrators and staff—facilitated secure data management and ensured that sensitive patient information was properly protected. The system provides several advantages, including increased access to healthcare practitioners through teleconsultations, improved outcomes via remote monitoring, and enhanced disease management through mobile health applications and wearable devices. [11]. The expert evaluation revealed that the system achieved high quality in all aspects, especially in security and performance, with an overall mean score of 4.51 reflecting the highest level of user satisfaction. Notably, ease of use, decision support/portability, and system security received the highest ratings, suggesting that the system is not only user-friendly but also effectively supports healthcare decision-making while ensuring data protection. These results highlight the importance of designing systems that align with the practical needs and capabilities of Village Health Volunteers (VHVs). Importantly, the results demonstrate that the developed system can directly support community healthcare monitoring in practical terms. Specifically, the system facilitates (1) structured patient data recording, (2) real-time monitoring and reporting, and (3) improved communication between VHVs and healthcare providers. These functionalities address key limitations of traditional monitoring approaches, such as manual record-keeping and fragmented communication, and contribute to more efficient and coordinated healthcare service delivery in rural communities. This finding aligns with Maramba et al. [12], who emphasized that usability, efficiency, and security are essential design principles for sustainable e-health systems. Similarly, Luitel et al. [13] highlighted that the successful adoption of mobile and web health technologies depends largely on performance reliability and ease of use by frontline health workers.

In addition, the high user satisfaction score among VHVs demonstrates the system's practicality and acceptance. Users particularly appreciated the system's efficiency and ease of use, which supported patient follow-up and reporting tasks, indicating that the information provided is relevant and understandable and that the interface is appropriately designed for users with varying levels of digital literacy. These findings suggest that the system successfully aligns with user needs and workflow characteristics, thereby reducing barriers to technology adoption. Overall, the high satisfaction levels across all dimensions demonstrate that the system not only performs effectively but also provides a positive user experience, which is essential for promoting long-term adoption and improving the efficiency of community-based healthcare monitoring. This is consistent with Aitken et al. [14], who emphasized that user trust and perceived usefulness play critical roles in the implementation of digital health technologies. Furthermore, the system developed from the study has attractive features for visiting nurses and supports their essential tasks. The system can help with effective case management for older adults requiring in-home care and reduce nurses' workload [15]. Overall, the developed web application demonstrates strong potential as a scalable model for digital transformation in primary healthcare. By integrating real-time data recording, automated scheduling, and reporting functions, the system strengthens the efficiency of VHVs and ensures continuous, accurate monitoring of bedridden patients. Future improvements could involve mobile device integration and interoperability with national health databases to enhance accessibility and continuity of care further.

Table 4. Comparison of the proposed system with previous studies

Points of comparison	Sumner et al. [2]	Cao et al. [3]	Lee et al. [15]	Proposed System (This Study)
System Type	Remote patient monitoring system	Cloud-based health monitoring platform	Web-based healthcare networking system	Web-based community health monitoring system
Target Users	Healthcare professionals	Medical institutions	Healthcare providers	Village Health Volunteers
Key Features	Clinical monitoring and data collection	Centralized patient data management	Care coordination and communication	Patient data management, home visit scheduling, monitoring, and reporting
Limitations	Focused on hospital environments	Requires professional healthcare infrastructure	Limited focus on community volunteers	Implemented in a specific community
Contribution of This Study	Provides community-based monitoring for VHVs	Designed for rural community health volunteers	Supports home-based patient care by VHVs	Provides a digital monitoring model for rural community healthcare

5. Conclusions

This study aimed to develop and evaluate a web-based application designed to support Village Health Volunteers (VHVs) in monitoring bedridden patients in Na Khaem Subdistrict, Loei Province, Thailand. The developed system integrates patient data management, visit scheduling, home visit recording, and reporting functions into a unified digital platform that facilitates community-based healthcare monitoring. The evaluation results demonstrate that the system achieved a high level of quality and user satisfaction, confirming its technical reliability and practical suitability for community healthcare environments. Importantly, the comparison between pre-implementation and post-implementation results provides clear evidence of the system's effectiveness. Before system adoption, user perceptions across key dimensions such as ease of data recording, efficiency of patient monitoring, accuracy of health data management, and communication with healthcare providers were at a moderate level. After implementation, these scores increased significantly to a high level, with all differences being statistically significant ($p < 0.001$). These findings indicate that the developed system substantially improves operational efficiency, reduces manual workload, enhances data accuracy, and strengthens coordination among healthcare stakeholders. Beyond its measurable performance improvements, the system offers significant practical implications for rural healthcare management. By replacing traditional paper-based processes with a digital platform, the system enables more efficient and structured data handling, supports timely decision-making, and enhances the continuity of patient care. The integrated scheduling and reporting features further enable VHVs and healthcare providers to plan and monitor home visits more systematically. In real-world applications, the proposed system can serve as a practical digital tool for supporting the daily operations of VHVs and community healthcare personnel. It can also assist local healthcare centers and administrative units in managing patient information more effectively and improving service coordination. Given its design and adaptability, the system has strong scalability potential and can be implemented in other rural

communities facing similar healthcare challenges. From a broader perspective, this study demonstrates how digital health technologies can be effectively integrated into primary healthcare systems to enhance service delivery and support community-based care. The system provides a replicable model for leveraging digital tools to improve healthcare accessibility, efficiency, and sustainability, particularly in resource-constrained settings. Future work should focus on extending the system through mobile application integration to support real-time data entry during home visits, as well as enhancing interoperability with national health information systems. Further studies involving larger populations and multiple regions are recommended to evaluate long-term effectiveness, scalability, and impact on patient health outcomes. Overall, this study highlights the significant potential of digital health innovations to transform community healthcare practices. By demonstrating clear improvements before and after system implementation, the research provides strong empirical support for the adoption of web-based monitoring systems in rural healthcare contexts.

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