Contributing Factors to the Challenges of Patient Health Monitoring in Rural Healthcare Units: Basis for a Proposed Integrated Patient Management Portal

Francis Cuares and Riah E. Encarnacion
0009-0006-5479-2033 and 0000-0003-3760-7468
Department of Graduates Studies
Surigao del Norte State University, Surigao city, Philippines
fcuares@ssct.edu.ph, rencarnacion@ssct.edu.ph

Abstract*: In the current era of abundant information, technological advancements have greatly impacted various fields particularly the healthcare sector. This research explores the difficulties encountered by rural healthcare facilities in Barangay Poblacion, Bacuag, Surigao del Norte, in monitoring patient health and suggests implementing a remote patient management platform to enhance healthcare delivery. Using a mixed-method approach, the study involved 37 participants, predominantly young females. The research identified key challenges such as limited access to healthcare facilities, a shortage of medical staff, communication issues, and insufficient healthcare resources. Although patient registration and monitoring of vital signs were relatively effective, challenges remained in scheduling appointments, availability of medical tests, and patient education. The overall positive perception of the current system (average weighted mean of 3.59) indicates room for improvement through the proposed remote patient management platform. This platform aims to improve real-time monitoring, data accuracy, and communication between patients and healthcare providers, thereby enhancing healthcare outcomes in rural areas.*

Keywords: Digital health systems, Rural healthcare, Patient health monitoring, Remote patient management

I. INTRODUCTION

Rural healthcare units often face challenges that lead to issues such as waiting long time, uncertainty about appointment availability, no available ambulance vehicle, and no 24/7 on duty. These factors often cause disparities in health outcomes between rural and urban populations. These obstacles need to highlight the very most efficient solution to be implemented in the healthcare management of the Municipality of Bacuag, Surigao del Norte. The manual system of managing patient health information often involves paper-based records and face-to-face consultations. It has been the backbone of healthcare units for many years. It involves maintaining physical records of patients' medical histories, diagnoses, treatments, and other health-related information. The healthcare providers rely on these records to make informed decisions about patient care.

However, the manual system has several limitations including time-consuming, prone to human error, and can lead to information being lost or misinterpreted. Additionally, it does not allow real-time monitoring of patient's health status. Over time, the increase in patient numbers and complexity of medical cases have prompted a shift from manual record-keeping to computer-based systems. It helps the health care sector in managing patient records and prescriptions. The rural healthcare unit of Barangay Poblacion, Bacuag, Surigao del Norte, is currently relying on manual method. The gap is the lack of real-time, continuous monitoring of patients' health status in the manual system. This is particularly crucial for patients with chronic conditions or those requiring post-acute care. The inability to monitor these patients' health status in real-time can lead to delayed interventions and suboptimal health outcomes.

Copyright to IJARSCT
www.ijarsct.co.in

DOI: 10.48175/IJARSCT-18912

ISSN
2581-9429
IJARSCT

112

The advancement of technology has changed the way of life. It has made various positive changes in almost every field whether it is medical, business, education, sports. The health sector, in particular, most medical clinic facilities have witness a big impact that enable modern clinics to serve many patients as possible [1].The adoption of these technologies represents an important measure to improve the quality and efficiency of health care services. In fact, it is a key feature for the construction of a more equitable, effective, and safe health care system [2].Indeed, the rapid growth and diffusion of digital health, including health information sources such as electronic medical records (EMRs), has made online access to information by patients and health care professionals. It is considered as a crucial component of health care delivery [3].

The need for this study highlighted the importance of high-quality healthcare services for all the citizens of the rural area. By addressing these challenges faced by our healthcare providers, the research aims to assess the current monitoring system among patients in the rural healthcare units. The idea is to comprehensively analyze the challenges faced by healthcare services of rural healthcare units and propose an integrated patient management that streamline the management of resident's medical information. By doing so, it can reduce paperwork and eradicate manual record-keeping. Upon the implementation of the automated system, it would enable nurses and staff to efficiently track patients and potentially serve a greater number of individuals in the community. The proposed automated system is expected to enhance the overall quality of healthcare services for both citizens of rural area and health providers.

II. OBJECTIVES OF THE STUDY

The study aims to achieve the following objectives:

- To assess the factors that contribute to the challenges faced by the patients and rural healthcare units in Barangay Poblacion, Bacuag, Surigao del Norte.
- To evaluate the current system of patient healthcare monitoring in the rural healthcare units.
- To propose an innovative remote patient management portal that integrates real-time monitoring for smooth communication between healthcare providers and patients.
- To formulate recommendations to further improve the patient healthcare monitoring in the rural healthcare units.

III. RELATED LITERATURE

3.1 Electronic Health Records

The researchers Peretz, Arnaert, and Ponzoni[4] delved into the economics of remote patient monitoring (RPM) programs for elderly patients with chronic conditions. Their systematic review highlights the inconsistent reporting of cost data, underscoring the need for high-quality economic evaluations to guide decision-making in RPM implementation.

The study of Bayley et al. [5] explored the use of electronic health records (EHRs) in comparative effectiveness research (CER), particularly in the context of hypertension treatment. Their study revealed significant challenges in data extraction, including issues related to missing data, data errors, and inconsistencies. Despite these obstacles, the study underscores the value of EHR data over traditional data collection methods and calls for collaborative efforts to optimize EHRs for CER.

Tiase et al. [6] examined the integration of patient-generated health data (PGHD) with electronic health records (EHRs). Their scoping review identifies the challenges and opportunities in leveraging PGHD for clinical use, highlighting the potential to enhance patient care through more comprehensive health data integration.

A public health information management system designed for primary health care units boasted robust management functions and has received high satisfaction ratings from both patients and medical institutions. Its implementation has notably improved disease prevention awareness and primary care efficiency [7].

The increasing production of Patient-Generated Health Data (PGHD) facilitated by the widespread adoption of health wearables is becoming indispensable for tailoring patient-centered care and holds significant potential for informing precision medicine efforts. To integrate PGHD into Remote Patient Monitoring (RPM) as a core component of personalized, precision healthcare, improved collaboration among PGHD stakeholders is essential along with a deeper understanding of human factors, device design considerations, and organizational readiness within healthcare settings.

Copyright to IJARSCT

www.ijarsct.co.in

DOI: 10.48175/IJARSCT-18912

2581-9429
IJARSCT

113

Implementation of systematic PGHD management practices is crucial, facilitated by the dissemination of shared guidance on best practices. This study is part of a broader project aimed at developing practical guidance that can be piloted in healthcare settings toward this objective [8].

3.2 Web-based Health Record System

A novel web application for health record management simplifies the storage and retrieval of patient data for hospitals. The system is developed from scratch, emphasizing easy access for doctors to upload and retrieve patient information without relying on existing systems. The innovation represents a step forward in managing health records efficiently [9].

Hong and Song [10] are advocates for a cloud-based personal health record system (PHRS) that empowers patients to manage their medical records actively. This system supports the dynamic creation of clinical document architecture documents from mobile devices, enhancing patient involvement in their healthcare management. The use of medical coding standards promises improved interoperability between different EHR systems.

Xu et al. [11] presents a comprehensive framework, Cloud-MHMS, designed to enhance m-Health monitoring systems by incorporating mobile network and cloud computing technologies. This framework aims to address the challenges of processing personalized health data by introducing three core modules: Cloud Storage and Multiple Tenants Access Control, Healthcare Data Annotation, and Healthcare Data Analysis Layers. The integration of these modules facilitates a seamless health monitoring experience, ensuring data privacy, semantic interoperability, and personalized treatment plan selection.

3.3 Synthesis

The literature on health monitoring and management systems unveils a dynamic field characterized by technological innovations and complex challenges. From cloud-based m-Health frameworks to the intricacies of integrating patient-generated data with EHRs, these studies underscore the critical role of technology in transforming healthcare delivery. Despite the obstacles, the collective efforts of researchers, clinicians, and IT specialists are paving the way for more efficient, patient-centered, and accessible healthcare solutions.

IV. METHODOLOGY

4.1 Research Approach and Design

This study utilized a mixed-methodology approach with a sequential explanatory design. The qualitative component provided insights into the experiences and perceptions of the rural citizens regarding healthcare services at Barangay Poblacion. Meanwhile, the quantitative component offered statistical data to support the findings and assess the effectiveness of the proposed web-based patient information management system.

4.2 Research Instrument

This survey evaluated the challenges in monitoring health status in Barangay Poblacion, Bacuag, Surigao del Norte, aiming to develop a remote patient management portal. The survey gathered demographic details and focused on issues like healthcare accessibility, availability of medical personnel, communication, and resource adequacy. It also considered operational problems in rural healthcare units, such as equipment shortage and transportation barriers. The questionnaire includes both closed-ended and open-ended questions and was administered to a sample of 37 respondents. The goal is to understand rural healthcare challenges better and develop efficient solutions.

The interviews were conducted with a subset of respondents from the survey sample to gather qualitative data. These interviews delved deeper into the challenges faced by healthcare services at the health care units. The potential challenges of patient health monitoring system became a basis for a remote patient management portal of rural healthcare units, and the obstacles to its implementation. The interviews with the consent of the participants were transcribed for analysis. The qualitative data collected from the interviews will complement the quantitative data from the surveys, providing a more holistic view of the issues under investigation.

4.3 Data Collection

This study collected the data with utmost respect for ethical guidelines. That means ensuring confidentiality for all participants, making participation completely voluntary, and ensuring everyone understands and consents to being part of the study. Once the data were gathered, it was organized carefully, assigning codes to make it easier to understand. Then, for the quantitative data, statistical techniques was used to analyze it, while the qualitative datawas analyzed using thematic analysis to extract meaningful insights.

4.4 Research Participants and Sampling Method

The population of interest includes thirty-seven (37) participants in health providers in Barangay Poblacion, Bacuag, Surigao del Norte, Philippines. A purposive sampling technique was employed to select the respondents who are directly involved in health service provision and operational transactions within the health providers. Purposive sampling was chosen to ensure that the selected respondents have the relevant knowledge and experience to provide valuable insights into the research questions.

4.5 Data Analysis

This section outlines the methods employed to analyze both quantitative and qualitative data collected in the study. The analysis aims to provide a comprehensive understanding of the challenges in healthcare services at Barangay Poblacion and the potential benefits of implementing the challenges of patient health monitoring system: basis for a remote patient management portal of rural healthcare units.

Table 1.0 The Interpretation of Range of the Weighted Mean

Range of the Weighted Mean	Interpretation
4.51 – 5.00	Strongly Agree (for the questions asked)
3.51 – 4.50	Agree (for the questions asked)
2.51 – 3.50	Moderately Agree (for the questions asked)
1.51 – 2.50	Disagree (for the questions asked)
1.50 and below	Strongly Disagree (for the questions asked)

The standard deviation was used to determine the degree of variation or dispersion among the respondents. A low standard deviation indicates that the data points tend to be close to the mean (also called the expected value) of the set, while a high standard deviation indicates that the data points are spread out over a wider range of values.

V. RESULTS AND DISCUSSION

This chapter discusses the analysis and interpretation of the data gathered from participants' responses in answering the specific questions of the study to complete this study properly, it is necessary to analyze the data collected in order to test the hypothesis and answer the research questions. As already indicated in the preceding chapter, data is interpreted in a descriptive form.

5.1 Demographic of the Respondents

Table 1.0 Profile of the Respondent in terms of Gender

Gender	Frequency	Percentage %
Male	15	41
Female	22	59
Total	**37**	**100**

Many of my participants are female, which comprises 22 or 59.5% as compared to 15 or 40.5% male participants. This implies that majority of the participants who participated in the survey are female.

Table 2.0 Profile of the Respondent in term of level of Age

Age	Frequency	Percentage %
[0-10]	0	0
[11-20]	24	65
[21-30]	6	16
[31-40]	6	16
[41-50]	1	3
[51-60]	0	0
[61-70]	0	0
[71-Above]	0	0
Total	**37**	**100**

Table 2.0 presents the profile of the respondent according to the Age of the respondents. As can you see on the table there are 24 or 64.9% of the respondent are 11-20 years old, 6 or 16.2% are 21-30 years old and 6 or 16.2% are 31-40 years old while 1 or 2.7% are 41-50 years old. This implies that majority of the respondent's age who participated in the survey are 11-20 years old.

5.2 Assessment of the Contributing Factors to the Challenges Faced by the Patients and Rural Healthcare Units in Monitoring the Health Status of Patients in Barangay Poblacion, Bacuag, Surigao del Norte

Table 3.0 The Factors that Contribute to the Challenges Faced by the Patients and Rural Healthcare Units in Monitoring the Health Status of Patients in Barangay Poblacion, Bacuag, Surigao del Norte

Factors of Challenges	Question Statements	Weighted Mean	Category Value	Interpretation
Accessibility of Healthcare Facilities	The healthcare facilities are not accessible for patients in Barangay Poblacion.	2.73	2.85	Moderately Agree
	The healthcare services in Barangay Poblacion, Bacuag is difficult to access.	2.78		
	The access to reliable transportation to reach healthcare facilities is difficult.	3.05		
Availability of Medical Personnel	The medical personnel are not available in providing regular health monitoring services.	2.73	2.85	Moderately Agree
	I experience delays in receiving medical care due to a shortage of medical personnel at healthcare facilities in Barangay Poblacion, Bacuag.	2.78		
	Due to the lack of medical staff, residents in Barangay Poblacion, Bacuag frequently endure extended travels to neighboring areas for essential healthcare, resulting in added inconvenience and transportation costs.	3.05		
Communication with Healthcare Providers	It is difficult to communicate with healthcare providers in your area regarding your health concerns.	2.73	2.94	Moderately Agree
	There is a delay in the response time of healthcare providers when you try to	3.35		

Factors of Challenges	Question Statements	Weighted Mean	Category Value	Interpretation
	contact them for health-related queries.			
	I am having problem understanding the health information given to me by the healthcare providers.	2.73		
Availability of Healthcare Resources	The medical facilities and resources available in Barangay Poblacion are insufficient to meet the healthcare needs of the community.	3.22		
	There is a shortage supply of essential medical equipment and supplies (e.g., diagnostic tools, medications) at healthcare facilities in Barangay Poblacion, Bacuag.	3.41		
	The specialized healthcare services (e.g., emergency care, maternal care, mental health services) are not readily available at healthcare facilities in Barangay Poblacion, Bacuag.	3.24	3.29	Moderately Agree
	Average Weighted Mean		**2.99**	**Moderately Agree**

Table 3.0 identifies four main challenges in monitoring health status in Barangay Poblacion, Bacuag, Surigao del Norte: accessibility of healthcare facilities, availability of medical staff, communication with healthcare providers, and availability of healthcare resources.Accessibility is an issue due to unreliable transportation, reflected by a moderate agreement via weighted means (2.73, 2.78, and 3.05).Availability of medical personnel is another concern, with weighted means (2.73, 2.78, and 3.05) indicating a staff shortage that causes care delays and travel to neighboring areas.Communication with providers is difficult, shown by weighted means (2.73, 3.35, and 2.73) that reflect delays in response times and issues understanding health information.Lastly, the availability of healthcare resources is insufficient, as demonstrated by weighted means (3.22, 3.41, and 3.24) that highlight a shortage of essential medical equipment and specialized services.These challenges, reflected in category values of 2.86, 3.14, 2.94, and 3.29, offer insights for creating a remote patient management portal.

5.3 Evaluation of the Current System of Patient Healthcare Monitoring in the Rural Healthcare Units
As can be seen on Table 4.0, the features within a system, accompanied by their corresponding frequencies, percentages, and ranks based on their occurrence frequency. It provides insights into the relative importance or demand for each feature within the system, highlighting areas of focus and priority for development or improvement.

Table 4.0 Evaluation of the Current System of Patient Healthcare Monitoring in the Rural Healthcare Units

Challenges in Rural Healthcare Units	Frequency	Percentage %	Rank
Limited access to medical equipment	30	44	1
Shortage of healthcare professionals	17	25	2
Inadequate funding for healthcare services	15	22	3
Lack of awareness about preventive healthcare measures	5	7	4
Other (please specify): _____	1	2	5
Total	68	100%	

Table 4.0 provides a breakdown of system features, their frequencies, percentages, and ranks based on occurrence frequency. Limited access to medical equipment is most demanded (44%), followed by Shortage of healthcare professionals (25%) and Inadequate funding for healthcare services (22%). Lack of awareness about preventive healthcare measures and other factors also contribute. These insights guide system development and enhancement priorities.

Table 5.0 Distance to Healthcare Facilities

Distance to Healthcare Facilities	Frequency	Percentage %	Rank
Less than 1 kilometer	15	37.5	2
1-5 kilometers	17	42.5	1
5-10 kilometers	5	12.5	3
More than 10 kilometers	3	7.5	4
Total	40	100%	

Table 5.0 breaks down system features by frequencies and percentages, indicating the relative importance of each. The most demanded feature is 1-5 kilometers (42.5%), followed by Less than 1 kilometer (37.5%), 5-10 kilometers (12.5%), and more than 10 kilometers (7.5%). These insights inform system development and enhancement priorities.

Table 6.0 Barriers to Access

Barriers to Access	Frequency	Percentage %	Rank
Lack of transportation options	14	25	3
Poor road conditions	6	11	4
Financial constraints	17	30	2
Limited operating Financial constraints hours of healthcare facilities	19	33	1
Other (please specify):_____	1	1	5
Total	57	100%	

Table 6.0 The table breaks down system features by frequencies and percentages, revealing their relative importance. Limited operating hours of healthcare facilities is most demanded (33%), followed by financial constraints (30%) and lack of transportation options (25%). Poor road conditions and other factors also contribute. These insights guide system development and enhancement.

Table 7.0 Waiting Time for Medical Attention

Waiting Time for Medical Attention	Frequency	Percentage %	Rank
Less than 30 minutes	20	51	1
30 minutes to 1 hour	17	44	2
1-2 hours	2	5	3
More than 2 hours	0	0	4
Total	39	100%	

Table 7.0 outlines system features, their frequencies, percentages, and ranks. Less than 30 minutes is most demanded (51%), followed by 30 minutes to 1 hour (44%), and 1-2 hours (5%). These insights guide system development and enhancement.

Table 8.0 Communication Channels

Communication Channels	Frequency	Percentage %	Rank
In-person appointments	33	77	1
Phone calls	8	19	2
Emails or online messaging	2	4	3
Other (please specify): _____	0	0	4
Total	43	100%	

Table 8.0 details system features, their frequencies, percentages, and ranks. In-person appointments are most demanded (77%), followed by phone calls (19%) and emails/online messaging (4%). These insights inform system development and enhancement priorities.

Table 9.0 Areas of Evaluation of the Current System of Patient Healthcare Monitoring in the rural healthcare units.

Areas of Evaluation of the Current System	Question Statements	Weighted Mean	Interpretation
Patient Registration	Is the patient registration process efficient and organized?	3.59	Agree
Appointment Scheduling	Are appointments scheduled in a timely manner?	3.38	Moderately Agree
Vital Signs Monitoring	Are vital signs regularly monitored during patient visits?	3.78	Agree
Healthcare Provider Interaction	Do healthcare providers communicate effectively with patients?	3.73	Agree
Medical Tests and Procedures	Are necessary medical tests and procedures readily available onsite?	3.35	Moderately Agree
Medication Management	Are medications prescribed appropriately based on patient needs?	3.81	Agree
Follow-up and Referral System	Is there a systematic follow-up process for patients after their visit?	3.46	Moderately Agree
Patient Education and Empowerment	Are patients provided with educational materials and resources?	3.16	Moderately Agree
Privacy and Confidentiality	Is patient privacy and confidentiality maintained during interactions?	3.46	Moderately Agree
	Average Weighted Mean	**3.59**	**Agree**

Table 9.0 evaluates the current patient healthcare monitoring system in rural units. Overall, the system is viewed positively with an average weighted mean of 3.59, indicating agreement. Strengths include patient registration (3.59), vital signs monitoring (3.78), healthcare provider interaction (3.73), and medication management (3.81). Areas for improvement include appointment scheduling (3.38), availability of medical tests (3.35), and patient education (3.16). Follow-up systems and privacy also received moderate agreement with a weighted mean of 3.46. These results pinpoint where enhancements can improve patient healthcare monitoring.

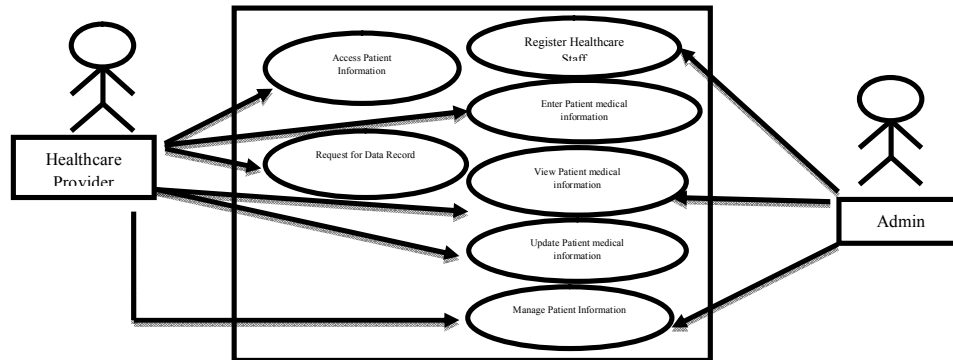**5.4 The Proposed Innovative Remote Patient Management Portal**

Figure 2.0 Use Case Diagram of the Rural Healthcare Unit

The diagram in Figure 2.0 serves as a guide to understand the system's functionalities. It illustrates how users can manage, enter, and access patient information. By studying this diagram, we can explore how the system can simplify processes at rural health centers, thereby improving healthcare accessibility.
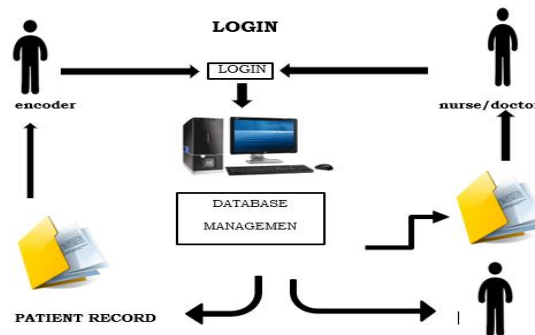

Figure 3.0 Deployment Architecture of the Study

The deployment architecture of the study that is shown in figure 3.0 involves a web-based system accessible via web browsers and mobile devices. Data is stored on a clinic server, utilizing a database, and the server also accesses a Patient Management Portal of Rural.
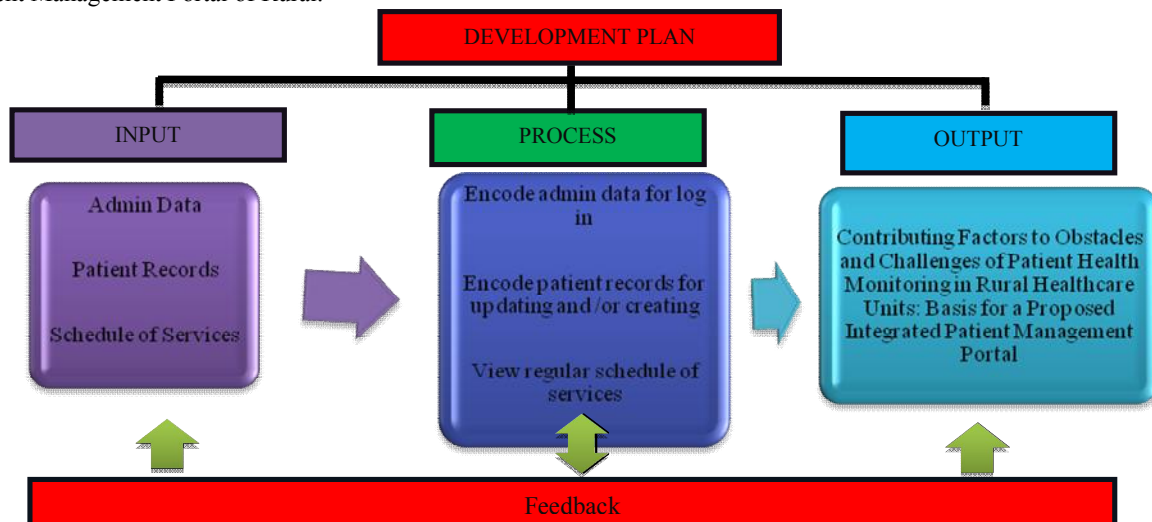
Figure 4.0 Conceptual Framework of the Proposed System

The development plan in figure 4.0 aims to improve patient health monitoring in rural healthcare units. It employs Agile Scrum methodology for flexibility and continuous improvement. The system, built with HTML, CSS, JavaScript, PHP, MySQL, and other web technologies, is designed to fit the needs of Bacuag's RHU healthcare services, enhancing access to healthcare information for students and staff.
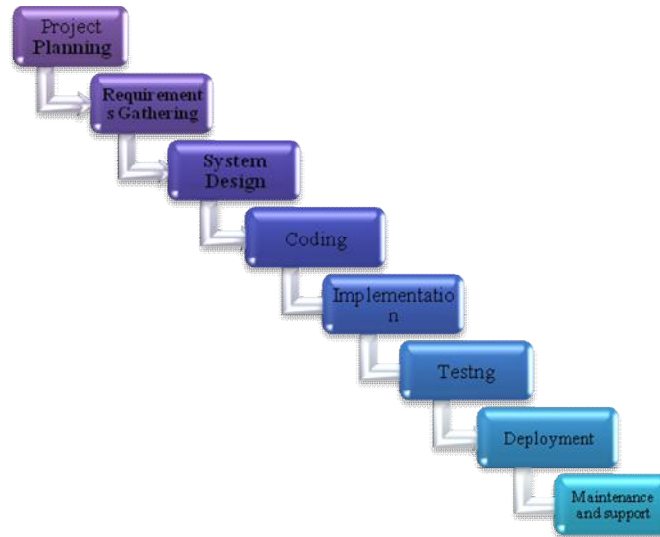

Figure 5.0 Waterfall Methodology of the System

The waterfall approach in Figure 5.0 is used in developing the Integrated Patient Management Portal is systematic and step-by-step, like a recipe. It starts with gathering requirements, creating a system design, coding, testing, deploying to users, and maintaining and supporting the system. Unlike Agile Scrum, which is more flexible, the waterfall method completes one step entirely before moving to the next, ensuring an organized and effective project completion.
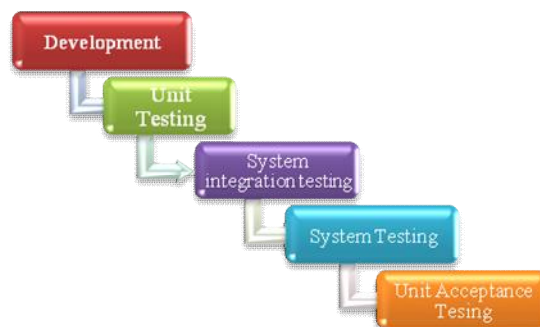

Figure 6.0 Integration System of the Study

The researchers used integration testing as a crucial step in software development, which helps identify any issues when different parts of the software work together. They followed several stages of testing, from individual pieces to the entire system, ensuring it functioned smoothly and met the user needs at Poblacion, Bacuag, Surigao del Norte's healthcare services. This testing aimed to ensure the software's reliability and quality.
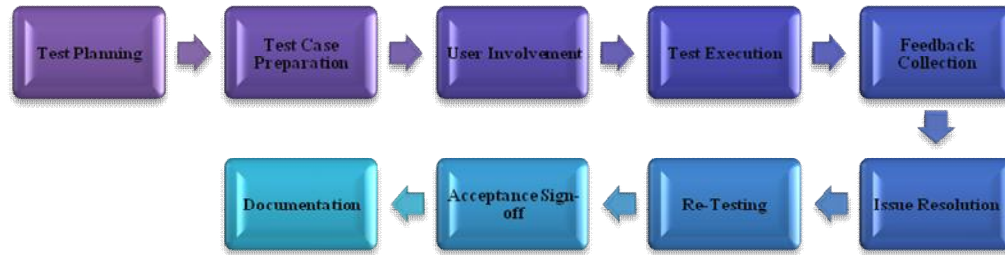
Figure 7.0 User Acceptance Testing UAT of the System

The researchers made sure to use User Acceptance Testing (UAT), shown in Figure 7.0, as the final step in creating the software. This testing phase is all about making sure the system works the way real users want it to. They followed a step-by-step process, starting with figuring out what users needed, then designing the system, and finally testing it out to make sure everything worked smoothly. By doing this, they aimed to ensure that the patient management portal of rural healthcare units at Poblacion, Bacuag, Surigao del Norte did exactly what users needed it to do.

5.5 Suggestions and recommendations to further enhancing and scaling up the provision of health services and operational transactions within the rural health organization

The proposal aimed to improve healthcare management and intervention in rural areas by ensuring round-the-clock health services, advanced facilities, effective patient communication, improved transportation, and community outreach. It also includes ready patient transport, equitable treatment, daily check-ups, adequate tools, technology solutions, patient engagement, expanded specialized services, accessibility, continuous improvement, data analytics, expanded insurance coverage, enhanced equipment, and a clean and efficient service environment. The challenges faced include limited access to medical care, insufficient resources, unreliable technology, and socio-economic barriers. The goal is to ensure people in rural areas receive the healthcare they need.

V. CONCLUSION AND RECOMMENDATIONS

In conclusion, this study highlighted the potential of technology to transform healthcare delivery in rural areas, especially with the introduction of remote patient management portals. By tackling issues like resource constraints and manual paperwork, the proposed system could greatly improve healthcare access and efficiency in Barangay Poblacion, Bacuag, Surigao del Norte. Using a mixed-method approach, the research has pinpointed areas needing improvement and suggested practical steps, such as investing in technology infrastructure and involving stakeholders. It's clear that integrating remote patient management systems could narrow the healthcare divide between rural and urban regions, ultimately advancing a fairer healthcare landscape. Further research is needed to expand on these findings and address evolving healthcare needs in other rural regions.

The study also suggest that rural healthcare units should prioritize investment in technology infrastructure to support the implementation of web-based patient information management systems. This includes ensuring access to reliable internet connectivity and providing adequate training for healthcare staff. There should be engagement with the stakeholders, including healthcare providers, administrators, and community members, is essential for the successful implementation of remote patient management portals. The collaboration between various stakeholders can facilitate the development of tailored solutions that meet the unique needs of rural healthcare settings.The ccontinuous monitoring and evaluation of the implementation process are crucial for identifying challenges and opportunities for improvement. There should be regular feedback from users should be solicited to assess the effectiveness of the system and make necessary adjustments. Patients must be educated with the system to ensure the successful adoption and utilization of remote patient management portals. Efforts should be made to empower patients with the knowledge and skills to actively participate in their healthcare management.

By tackling the challenges of patient health monitoring in rural areas means taking a well-rounded approach that combines new technology, teamwork, and ongoing learning. By putting these recommendations into action, there is a great possibility to improve the healthcare for rural communities.

VII. ACKNOWLEDGMENT

REFERENCES

[1] Pagliari C, Detmer D, Singleton P. Potential of electronic personal health records. BMJ. 2007 Aug 18;335(7615):330–3. doi: 10.1136/bmj.39279.482963.AD. http://europepmc.org/abstract/MED/17703042 .335/7615/330 [PMC free article] [PubMed] [CrossRef] [Google Scholar] [Ref list]

[2] Global Strategy on Digital Health 2020-2024. World Health Organization. 2019. [2020-11-07]. https://extranet.who.int/dataform/upload/surveys/183439/files/Draft%20Global%20Strategy%20on%20Digital%20Health.pdf . [Ref list]

[3] Dendere R, Slade C, Burton-Jones A, Sullivan C, Staib A, Janda M. Patient Portals Facilitating Engagement with Inpatient Electronic Medical Records: A Systematic Review. J Med Internet Res. 2019).

[4] Peretz, D., Arnaert, A., &Ponzoni, N. N. (2016). Determining the cost of implementing and operating a remote patient monitoring programme for the elderly with chronic conditions: A systematic review of economic evaluations. Journal of Telemedicine and Telecare 24(1) https://doi.org/10.1136/bmjopen-2020-040232. License CC BY-NC 4.0.

[5] Bayley, K., Belnap, T., Savitz, L. A., Masica, A. L., Shah, N., & Fleming, N. S. (2013). Challenges in using electronic health record data for CER: Experience of 4 learning organizations and solutions applied. Medical Care, 51(8). https://doi.org/10.1097/MLR.0b013e31829b1d48

[6] Tiase, V. L., Hull, W., McFarland, M. M., Sward, K. A., Del Fiol, G., Staes, C., Weir, C., & Cummins, M. R. (2020). Patient-generated health data and electronic health record integration: A scoping review. JAMIA Open, 3(4), 619–627. https://doi.org/10.1093/jamiaopen/ooaa052

[7]. Zhao, Y., Liu, L., Qi, Y., Lou, F., Zhang, J., & Ma, W. (2020). Evaluation and design of public health information management system for primary health care units based on medical and health information. J Infect Public Health, 13(4), 491-496. https://doi.org/10.1016/j.jiph.2019.11.004

[8]. Abdolkhani, R., Gray, K., Borda A., DeSouza, R., (2019). Patient-generated health data management and quality challenges in remote patient monitoring, JAMIA Open, Volume 2, Issue 4, December 2019, Pages 471–478. https://doi.org/10.1093/jamiaopen/ooz036

[9] Fernando, X. (2019). Journal of Information Systems and Management for Advanced Computing, 4 issues per year. ISSN: 2582-1369. https://doi.org/10.36548/jismac

[10] Hong, S., & Song, Y.-T. (2015). Empowering patients using cloud based personal health record system. In Proceedings of the IEEE/ACIS 16th International Conference on Software Engineering, Artificial Intelligence, Networking and Parallel/Distributed Computing (SNPD).

[11] Xu, B., Xu, L., Cai, H., Jiang, L., Luo, Y., & Gu, Y. (2017). Cloud-MHMS: Cloud-based mobile health monitoring system. Enterprise Information Systems 11(1):1-20 17-36. https://doi.org/10.1016/j.ijcce.2022.06.001