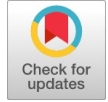# Agile Software Development of Clinical Healthcare Management Information System for Public Health

Ronel J. Bilog, Marc Lester F. Quintana

Abstract: Organization should manage information just as like as it manages its other resources correctly to fully maximize the usefulness of information especially in the field of healthcare. The use of software model to create information systems made it possible. To support the healthcare of the community, the appearance of Rural Health Unit is much needed. This study will discuss the problems encountered by the health professionals and health workers of Rural Health Unit in the Province of Alaminos, Laguna on the existing manual processes of storing and retrieving of patients' data that are mainly used in assessing the public health of the community. With this situation, the researchers developed a Clinical Healthcare Management Information System for public health. This paper will also focus on the development of the system using Agile model and evaluation adapted from ISO 25010 to test its effectiveness.

Keywords: Agile Software Model, ISO Evaluation, Management Information System, Public Health, Rural Health Unit.

I. INTRODUCTION

Technology is considered to be the driving force behind improvements in healthcare. Technology plays an integral role in the community healthcare setting for a better health sustenance of the community. Quality of care delivered to patients from healthcare professionals is highly dependent on technological advancement and innovations [1]. At present Alaminos, Laguna has 16 Barangays. On the 2015 census, it has a population of 47,859. The municipality is situated 78 kilometers east of Manila with a land area of 57.46 sq. km [2]. With the large and still growing numbers of population in the municipality, it is essential for Alaminos, Laguna to support their community healthcare by the appearance not only of the private medical clinics of different medical professionals but also of Rural Health Unit that located in the Town Proper of Alaminos and Health Centers in every Barangays. The Primary Health Care Delivery System of the Municipality of Alaminos, Laguna is its Rural Health Unit (RHU). The services offered carry out to implement different Department of Health Programs such as general consultation for all cases, the issuance of medical certificates, prenatal checkup, expanded program on immunization, deworming, reproductive health concerns, tuberculosis prevention and control, dental services, rabies control even up to providing laboratory services to its citizens. There are manually recorded patients' medical records in papers and kept in folders and filing cabinets. RHU with its mandate to provide basic health care access for the public needs to perform other activities such a retrieval of information from clients and patients, accuracy in data gathering and data processing in order for maximize the allocated resources that are done by hand that are mainly used in assessing the public health of the community and budget allotment in medicines supported by the municipal government. Healthcare Professionals and Barangay Health Workers (BHW) are involved in handling information from patients/clients. Information management, data accuracy, allocation of resources and timely execution of processes normally done manually, keeping records in papers and filing cabinets are facing these difficulties. To give assistance to the public healthcare of the Municipality of Alaminos, the Clinical Healthcare Information Management System (CHIMS) was developed. It has a main feature to centralize all barangay health units' databases in the Municipality of Alaminos administered by the Rural Health Unit. Medical professionals and the staff can store and retrieve all their patients' records in a centralized database including their checkups, prescriptions, and even follow up checkups. The system provides an easier generation of information which is accurate, complete with a standard clinical data documentation; provides automatic sorting and summary of data efficiently; provides graphical reports that can help analyze data easily that can be helpful in decision-making based; provides search tools where they can search a specific patient record in the database; generating medical records; can access efficiently and reliably in retrieval and update of patient records , significantly reduce errors in data entry; data is more organized for an increase decision support, legibility basis for data mining of structured medical data for health research and preventive measures in clinical care; continuous improvement in clinical judgment relying on accessible medical reports and a faster monitoring of care from the primary health care setting such as the Rural Health Unit; and map report formats for easy interpretation of medical reports per barangay.

II. AIM OF THE PAPER

This paper aims (1) to develop the Clinical Healthcare Management Information System for Public Health using Agile Software.

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Model; (2) to evaluate the CHIMS using the evaluation adapted from ISO 25010 in terms of:

a. Functionality;
b. Usability;
c. Reliability;
d. Performance; and
e. Security.

III. RELATED STUDIES

The researches of Freda show that having electronic record plays an important role in supporting efficiency, accuracy and accessibility of information. These features are considered and are included in the developed Online Clinical Healthcare Information Management System for Public Health Assistance [3].

Computers served a mostly administrative function for health which are being in the Rural Health Unit to assist the public healthcare of Alaminos, Laguna in the automation of records [4].

Patterson said that electronic devices such as computers will be paperless due to an electronic system in place which will be implemented in Rural Health Unit by the use of the developed system [5].

Big data have become increasingly important in the aspect of inter-organizational sharing and collaborative use in healthcare according to Fabian [6]. The idea of an online system was adopted by the researcher for the Online Clinical Healthcare Information Management System.

According to Minniti, Blue, Freed and Ballen, technology flourishes for consumers to join in reporting and healthcare as a model for improving care that was adopted by the researcher as one of the features of the developed system [7].

The Clinical Healthcare Information Management System that will be developed mainly focuses on how to provide an efficient and effective system that would help the Health Unit and Health Centers. It keeps records on the database for easy retrieval and storing of medical records.

IV. METHODOLOGY

A. System Development

The researcher used the descriptive research method utilizing the developmental research design for Clinical Healthcare Management Information System for Public Health. Descriptive research is "aimed at casting light on current issues or problems through a process of data collection that enables them to describe the situation more completely than was possible without employing this method."

The study utilized the descriptive design, a type of non-experimental design that basically explains and describes the nature of the situation. Descriptive design is to gather information about the present existing condition [8].

The researchers facilitated the use of a project development method to aid the researchers develop a system following the concept of Agile Development Life Cycle model as a guide through step-by-step process during the system analysis and design. Developmental research is the methodical study of emerging, designing, and assessing instructional programs, processes and products that must

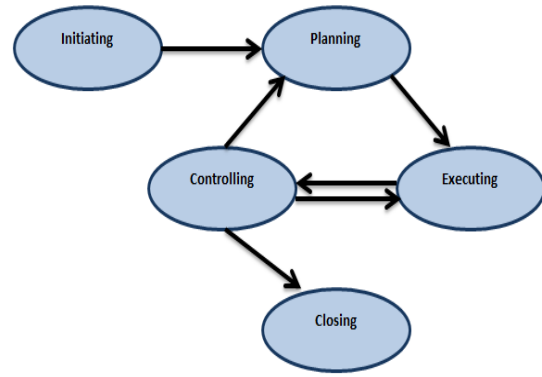meet the criteria of internal consistency and effectiveness [9].

Figure 1. Agile Development Life Cycle [10]

B. System Evaluation

After the CHIMS has been developed, it was then submitted for evaluation. An evaluation questionnaire checklist was used by the researcher adapted from ISO 25010 to assess the newly designed and developed Clinical Healthcare Management Information System for Public Health at Rural Health Unit and Health Centers of Alaminos, Laguna.

The population of the respondents for this research according to its frequency with a total size of five (5) health practitioners (direct end-users), ten (10) barangay health workers (direct end-users), and three (3) IT practitioners. Using the general responses obtained from the evaluation questionnaire checklist, whether they agree to a given statement or not using the parameters 5 - Strongly Agree; 4 – Agree; 3 – Neutral; 2 – Disagree; and 1 - Strongly Disagree. Means of the scores are calculated using weighted mean.

$$\overline{X} = \frac{\sum fx}{N} \qquad (1)$$

$\overline{x}$	=	Weighted Mean
N	=	Total Number of Respondents
x	=	Number of Respondents
$\sum$	=	Summation

In analyzing and interpreting the responses given by the respondents, the researchers facilitated the use of a five (5) Point Likert Scale:

Table 1. Five Point Rating Scale

Weighted Mean	Verbal Interpretation
4.50-5.00	Very Effective (VE)
3.50-4.49	Effective (E)
2.50- 3.49	Moderately Effective (ME)
1.50-2.49	Ineffective (I)
1.00-1.49	Very Ineffective (VI)

V. RESULTS AND DISCUSSIONS

A. Developed CHIMS using Agile Software Model

Contact the web administrator about the username and password of the user as well as the other user-level for accessing the system.
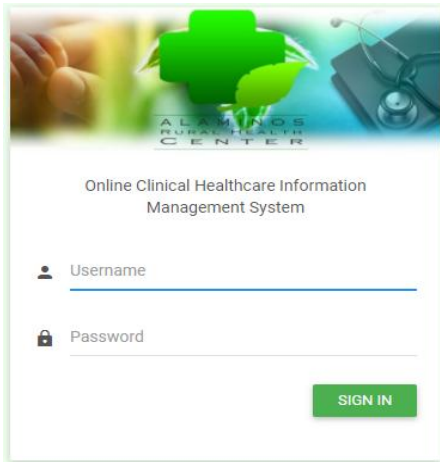

Figure 2. Login Page

The main screen of the web serves as the dashboard. There are menus on the left side namely: Home, Patient Info, User Level, Forms, Records, Reports, Healthcare Map & Help. Each button has its own function.

Figure 3. Navigating the Dashboard

In this part of the system, you can see all the personal information being added to the system. Furthermore, you can see five tabs: Copy, CSV, Excel, PDF and Print. You can also search records by typing at the search bar.
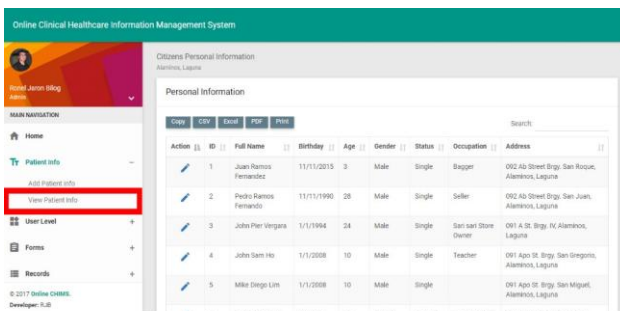

Figure 4. View Patient Info

In this page, you can add and edit personal information of patients. You need to complete all the requirements in the form in order for you to successfully save the additional personal information.
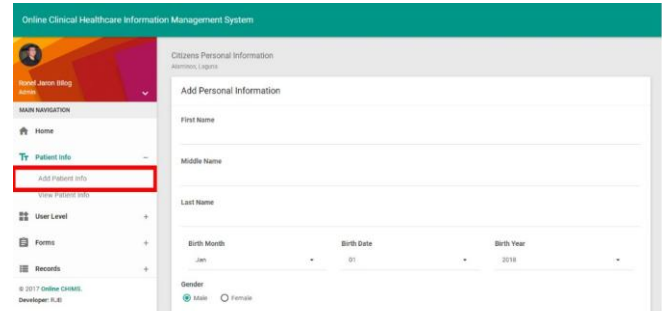

Figure 5. Add Patient Info

B. System Evaluation using ISO 25010

The Barangay Health Workers (BHW), Health Practitioners and IT practitioners were asked to evaluate the Clinical Healthcare Management Information System for Public Health based on the criteria on (ISO 25010:2011) Standards in Software Design and Development [11].

Table 2 and table 3 show the weighted mean obtained by the respondents in their technical evaluation in terms of the functionality of Clinical Healthcare Management Information System for Public Health. Legend: WM – Weighted Mean, VI – Verbal Interpretation

Table 2. Evaluation by the IT Respondents of the Functionality

Criteria	IT Practitioner		Overall Mean	
Functionality	**WM**	**VI**	**WM**	**VI**
1. Suitability – is the ease of use and learnability of the system.	5.00	VE	5.00	VE
2. Completeness - the state or condition of having all the necessary or appropriate parts of the system.	4.67	VE	4.67	VE
3. Correctness – the system quality of being free from error and accuracy.	5.00	VE	5.00	VE
Over-all Weighted Mean	**4.89**	VE	**4.89**	VE

Data reveal that the IT respondents highly accepted the functionality of the developed Clinical Healthcare Management Information System for Public Health with an average weighted mean of 4.89.

Table 3. Evaluation by the BHW and HP Respondents

Criteria	Barangay Health Worker		Health Practitioner		Overall Mean	
Functionality	**WM**	**VI**	**WM**	**VI**	**WM**	**VI**
1. The system is easy to access and navigate.	4.59	VE	4.70	VE	4.65	VE
2. The system displays patients' records clearly.	4.69	VE	4.73	VE	4.71	VE
3. The system is free from error and provides accurate results.	4.56	VE	4.43	E	4.50	VE
Over-all Weighted Mean	**4.61**	VE	**4.62**	VE	**4.62**	VE

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Data reveal that the respondents highly accepted the functionality of the developed Clinical Healthcare Management Information System for Public Health with an average weighted mean of 4.62.

Table 4 and Table 5 show the weighted mean obtained by the respondents in their technical evaluation in terms of the usability of Clinical Healthcare Management Information System for Public Health.

Table 4. Evaluation by the IT Respondents

Criteria	IT Practitioner		Overall Mean	
Usability	**WM**	**VI**	**WM**	**VI**
1. Learnability – the ease with which something can be learned with the system.	5.00	VE	5.00	VE
2. Operability – degree to which the system has attributes that make it easy to operate and control.	4.67	VE	4.67	VE
3. User Error Protection - the system protects users against making mistakes.	4.67	VE	4.67	VE
Over-all Weighted Mean	**4.78**	**VE**	**4.78**	**VE**

Data reveal that the IT respondents highly accepted the usability of the developed Clinical Healthcare Management Information System for Public Health with an average weighted mean of 4.78.

Table 5. Evaluation by the BHW and HP Respondents

Criteria	Barangay Health Worker		Health Practitioner		Overall Mean	
Usability	**WM**	**VI**	**WM**	**VI**	**WM**	**VI**
1. The system is easy to understand and easy to use.	4.56	VE	4.59	VE	4.58	VE
2.The system is user-friendly and pleasing to the eye.	4.47	E	4.84	VE	4.66	VE
3.The system protects users against making mistakes.	4.47	E	4.57	VE	4.52	VE
Over-all Weighted Mean	**4.50**	**VE**	**4.67**	**VE**	**4.58**	**VE**

Data reveal that the respondents highly accepted the usability of the developed Clinical Healthcare Management Information System for Public Health with an average weighted mean of 4.58. Table 6 and Table 7 show the weighted mean obtained by the respondents in their technical evaluation in terms of the reliability.

Table 6. Evaluation by the IT Respondents

Criteria	IT Practitioner		Overall Mean	
Reliability	**WM**	**VI**	**WM**	**VI**
1. Maturity – the system meets needs for reliability under normal process.	4.67	VE	4.67	VE
2. Availability – the system is effective and available when required for use.	4.67	VE	4.67	VE
3. Recoverability – in the event of a failure, the system can recover the data directly affected and re-establish the desired state of the system.	4.33	E	4.33	E
Over-all Weighted Mean	**4.56**	**VE**	**4.56**	**VE**

Data reveal that the IT respondents highly accepted the reliability of the developed Clinical Healthcare Management Information System with an average weighted mean of 4.56.

Table 7. Evaluation by the BHW and HP Respondents

Criteria	Barangay Health Worker		Health Practitioner		Overall Mean	
Reliability	**WM**	**VI**	**WM**	**VI**	**WM**	**VI**
1. The system provides reliable records and reports under normal process.	4.53	VE	4.78	VE	4.66	VE
2. The system is effective and available when required for use.	4.47	E	4.57	VE	4.52	VE
3. The system can recover the data in the event of a failure and re-establish the desired state of the system.	4.63	VE	4.38	E	4.51	VE
Over-all Weighted Mean	**4.54**	**VE**	**4.58**	**VE**	**4.56**	**VE**

Data reveal that the respondents highly accepted the reliability of the system with an average weighted mean of 4.56. Table 8 and Table 9 show the weighted mean obtained by the respondents in their technical evaluation in terms of the performance.

Table 8. Evaluation by the IT Respondents

Criteria	IT Practitioner		Overall Mean	
Performance	**WM**	**VI**	**WM**	**VI**
1. Time behavior – the response and processing times and amount rates of the system, when performing its functions meets requirements.	5.00	VE	5.00	VE
2. Resource Utilization – the amounts and types of resources used by the system, when performing its functions, meet requirements.	4.67	VE	4.67	VE
3. Capacity – the maximum amount of system's factor meets requirements.	4.67	VE	4.67	VE
Over-all Weighted Mean	**4.78**	**VE**	**4.78**	**VE**

Data reveal that the IT respondents highly accepted the performance of the developed Clinical Healthcare Management Information System for Public Health with an average weighted mean of 4.67.

Table 9. Evaluation by the Barangay Health Worker and Health Practitioner Respondents

Criteria	Barangay Health Worker		Health Practitioner		Overall Mean	
Performance	**WM**	**VI**	**WM**	**VI**	**WM**	**VI**
1. The system response and processing times when performing its functions meets requirements.	4.56	VE	4.59	VE	4.58	VE
2. The system when performing its functions provides helpful records and reports.	4.47	E	4.84	VE	4.66	VE
3. The system maximum capacity of handling data meets requirements.	4.47	E	4.57	VE	4.52	VE
Over-all Weighted Mean	**4.50**	**VE**	**4.67**	**VE**	**4.58**	**VE**

Data reveal that the respondents highly accepted the performance of the developed Clinical Healthcare Management Information System for Public Health with an average weighted mean of 4.63. Table 10 and Table 11 show the weighted mean obtained by the respondents in their technical evaluation in terms of the security of Clinical Healthcare Management Information System for Public Health.

Table 10. Evaluation by the IT Respondents of the Security

Criteria	IT Practitioner		Overall Mean	
Security	**WM**	**VI**	**WM**	**VI**
1. Confidentiality – the system confirms that data are available only to those authorized to have entree.	5.00	VE	5.00	VE
2. Integrity – the system prevents unauthorized access to, or change of data.	4.67	VE	4.67	VE
3. Accountability – the system actions of an entity can be found uniquely to the entity.	5.00	VE	5.00	VE
Over-all Weighted Mean	**4.89**	VE	**4.89**	VE

Data reveal that the IT respondents exhibited weighted mean scores that described the system to be secured in terms confidentiality (5.00), integrity (4.67) and accountability (5.00). This means that the IT respondents highly accepted the security of the developed system with an average weighted mean of 4.89.

Table 11. Evaluation by the Barangay Health Worker and Health Practitioner Respondents of the Security

Criteria	Barangay Health Worker		Health Practitioner		Overall Mean	
Security	**WM**	**VI**	**WM**	**VI**	**WM**	**VI**
1. The system confirms that data are available only to those authorized practitioners.	4.69	VE	4.92	VE	4.81	VE
2. The system prevents unauthorized access to, or change of data.	4.75	VE	4.65	VE	4.70	VE
3. The system provides user accounts for different practitioners.	4.81	VE	4.92	VE	4.87	VE
Over-all Weighted Mean	**4.75**	VE	**4.83**	VE	**4.79**	VE

Data reveal that the respondents highly accepted the security of the developed Clinical Healthcare Management Information System for Public Health with an average weighted mean of 4.79. After the evaluation of the developed system, majority of the respondents considered the system very effective but with some feedbacks on the flaws and errors of the Clinical Healthcare Management Information System for Public Health.

Table 12. General Evaluation of the System

Evaluation Criteria	Weighted Mean	Interpretation
Functionality	4.71	VE
Usability	4.65	VE
Reliability	4.56	VE
Performance	4.65	VE
Security	4.82	VE
Overall Weighted Mean	**4.68**	VE

Table 12 shows the overall assessment of the respondents of the Clinical Healthcare Management Information System for Public Health. Based from the software evaluation, the system can provide fast, accurate, reliable and secured data. The process of medical records can be performed in faster and easier manner through online.

VI. CONCLUSION

Based on the findings and data of the study, the researchers drawn the following conclusions:

1. The respondents evaluated Clinical Healthcare Management Information System for Public Health with respect to ISO 25010:2011 - Standards in Software Design and Development and they accepted it as "very effective" on the performance as to functionality, usability, reliability, performance and security.

2. Based on the overall weighted mean of 4.68, it was very effective to use Agile software model when developing Healthcare Management Information System.

3. Based on the overall weighted mean of 4.68, the researcher concludes that Clinical Management Information Management System can be implemented in Alaminos, Laguna to support its public health for thorough testing and implementation.

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AUTHORS'PROFILE

Ronel J. Bilog, finished his Bachelor's Degree in Information Technology at Laguna State Polytechnic University – San Pablo City Campus (LSPU-SPCC) and his Master's Degree in Information Technology at Rizal Technological University (RTU) in Mandaluyong City. Presently, he is taking his Doctorate Degree in Information Technology at AMA University (AMAU) in Quezon City, Philippines. He is a former Information Technology Instructor at LSPU-SPCC and Laguna University in Sta. Cruz, Laguna. He is an active member of Philippine Society of Information Technology Educators (PSITE). He is a current Junior Lecturer at City College of Calamba (CCC), Calamba City. His research interest focuses on developmental research in technology, computer science, data management and data mining.

Marc Lester F. Quintana, earned his Bachelor's Degree in Nursing at STI-Colleges of Luzon, Inc. (STICLI), his Master's Degree in Nursing Administration where he finished CUMLAUDE at Golden Gate Colleges (GGC) in Batangas City and his Executive Doctorate in Educational Leadership at University of Makati (UMAK) in Makati City, Philippines. He is a former College Instructor at Dalubhasaan ng Lunsod ng San Pablo (DLSP) in San Pablo City, Laguna and a former Assistant Director for Research at Laguna University (LU) in Sta. Cruz, Laguna. He currently an Assistant Professor at City College of Calamba (CCC), Calamba City. He is a Registered Nurse in the Philippines and in the United States of America in the state of California. He is also a member of the technical panel of the Association of Local Colleges and Universities -Commission on Accreditation (ALCUCOA). He received numerous accolades and recognition in the region including being a National Awardee at the 2nd Ripple Awards for his work in HIV/AIDS in the country. His research interest focuses on health and well-being, nursing, environmental and sociological research and collaborative studies highlighting innovations and technology. He is a public servant and a proud Filipino.