Web-Based Digitalization of In-Patient Prescriptions and Medication Orders Management System

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Abstract: - Administering medication to a patient is a complicated process that can lead to errors at various stages, from prescribing to delivering the medication. The most common reasons for errors include illegible prescriptions, prescribing the wrong medication or dose, verbal misunderstandings of similar-sounding drug names, dispensing medications with identical names, and failure to send prescriptions to the pharmacy. To address these issues, an electronic medication management system was developed to automate the medication process, provide instant access to patient information, and reduce the workload of healthcare workers. The system is accessible only to authorized personnel, such as hospital administrators, doctors, nurses, and pharmacists, via a web-based platform with a wireless intranet connection. The system covers the medication process from (a) prescribing/ordering, (b) transcribing and verifying, and (c) dispensing and delivering and has significantly reduced the time it takes to transcribe, verify, confirm, order, and dispense medications, making the process much faster than the manual approach. A survey of users found that the system performed well in terms of performance, usability, functional suitability, and compatibility by obtaining a strongly agreed result of 4.61 average weighted mean. Moreover, the test value is equal to -44.427 which is outside the range of the critical values (-2.001 to 2.001).

Key Words: — ***Healthcare Workers, Prescription, Medication order, Management System, Intranet.***

I. INTRODUCTION

Across the world, health services aim to help patients when they are ill and help them maintain good health. It gives patients and their families a way to enter the health system, continuous care coordination, and a person-focused strategy. Without affordable and secure healthcare, it will be impossible to achieve the Sustainable Development Goals of the United Nations, which place a high priority on healthy lives and encourage well-being for all [1]. One of the top goals for healthcare providers in clinical settings is patient safety. Errors in medication are the main danger to patients' health [2]. The United States National Coordinating Council for Medication Error Reporting and Prevention defines a

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Medication error as any preventable incidents that can potentially result in incorrect medication utilization or harm to patients while the medication is under the supervision of healthcare providers, patients, or consumers. These events can be attributed to various aspects such as professional practices, healthcare products, procedures, and systems. Examples include prescribing and order communication errors, issues with product labeling, packaging, and naming, mistakes in compounding, dispensing, distribution, administration. This broad definition emphasizes that errors can be prevented at various levels [3]. On the other hand, the nurse-to-patient ratio was revealed to be one of the factors significantly associated with medication administration error [4] which harms patients and medical professionals all over the world. Even though this is a worldwide issue, studying it and searching for solutions would require placing it within the context of each country, as each one has particular opportunities and challenges [5]. However, the collection and evaluation of error data throughout the healthcare delivery process will reduce the chances of medication errors and improve patient safety [6].

According to the World Health Organization, countries, especially here in the Philippines, are facing many obstacles when it comes to medicine access. These said obstacles include the ever-increasing price of it, and most of the time, essential medicines are out of stock. However, the main problem for them is not just the drugs' availability but their appropriate use [7]. Health professionals are in short supply worldwide, with nurses making up the majority of the current deficit. The WHO estimates that the world will require an additional 9 million nurses by 2030 [8].

It was mentioned that one of the factors significantly associated with medication administration error is the nurse-to-patient ratio. In the Philippines, an estimated 700,000 Registered Nurses work in the country, according to official records by the Philippine Regulation Commission [9], and data from a study here in the Philippines revealed that there were 8.03 nurses for every 10,000 people as of October 31, 2021. As of this stage, nurses make up nearly half of all healthcare professionals in the country [10]. Since a greater demand for qualified nurses is available, there is a nursing shortage. Ironically, despite a large number of Registered Nurses and is the top exporter of nurses worldwide, the healthcare system in the country is still dealing with the impact of the crisis [9]. The usual nurse-to-patient ratio in government institutions is 1:60 [11], above the standard the Department of Health set, which is 1:12 [12] and appears unattainable.

Based on the two exclusive focus group discussions conducted by Hospital Management Asia together with a total of nine hospitals in the Philippines, namely Asian Hospital & Medical Center, Central Luzon Doctors Hospital, Lorma Medical Center, Makati Medical Center, St. Elizabeth Hospital, Davao Doctors Hospital, Manila Doctors Hospital, Mary Mediatrix Medical Center and National Kidney and Transplant Institute wherein each hospital had a representative by a Medical or Nursing Directors, Heads of Quality, pharmacists and patient safety officers. The conference's main objective is to identify how medication errors affect each facility, how they are currently dealing with the issue, and what steps they plan to take moving forward. As specified by the hospitals that cooperated in the discussions, automated or advanced IT systems may help with the analysis. Utilizing technology and developing real-time tracking and data monitoring enables hospitals to immediately detect trends or recurring issues that need to be focused on [5].

As also stated by the World Health Organization (2016), one of the potential solutions to a medication error is through an Automated information system [1], wherein it is a system that typically manages to combine data, hardware (computer), components (monitor, keyboard, modem, printer, display, and more.), software, and telecommunications resources to gather, record, process, store, communicate, retrieve, and display information, such as in personnel systems, financial systems, and inventory control systems [13].

The researchers will design a Medication Management System. This system is one of the prominent Automated Information Systems that is used in the field of Health Services. This automated solution will help hospitals and pharmacies with several medication cycles [14]. The system encourages hospitals to manage medicines more effectively, safely, and with a high-quality approach. It includes assisting physicians, nurses, and pharmacists through digital prescriptions, ordering, checking, reconciling, dispensing, and recording medication administration [15] which considers the necessities of patients and clinical staff. Automation also reduces manual and time-consuming tasks [14].

The researchers chose to take on this study due to the alarming number of medication error cases worldwide. Not just the developing countries but also the developed ones also experienced this kind of medication error. By doing this study, the researchers can take minimal steps to improve the healthcare system here in our country. They will be focusing on the public hospital setting as this is where we think has the most issue regarding medication errors due to their poor nurse-patient ratio; nurses need help to do their tasks resulting in this kind of error. Doing so could lessen the risks of these medication errors in the field.

II. Methodology

The figure below is the conceptual framework of this research, it encompasses the Input, Process, and Output (IPO) elements in software development, along with the evaluation of the system using ISO MODEL 20510: Software Quality Standards. This framework provides a structured approach to understanding the key components involved in developing software solutions, evaluating their outcomes, and assessing their compliance with quality standards.

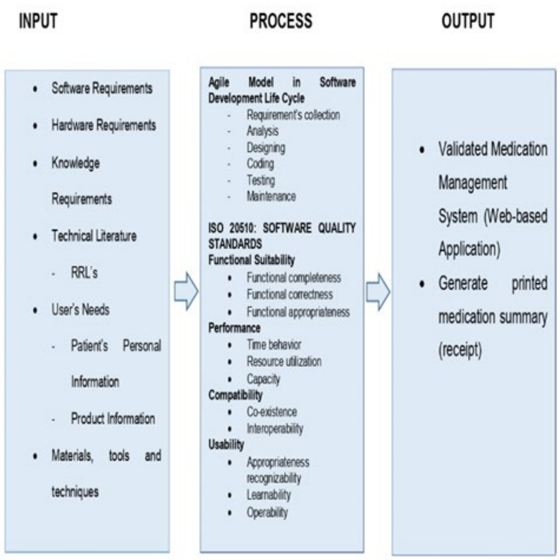

Fig.1. Conceptual Framework

Fig.1. shows the conceptual framework of the study consisting of three parts: the input, process, and output.

The input stage of the conceptual framework focuses on various elements that provide the necessary foundation for software development. These inputs include requirement specification, encompassing software requirements, hardware requirements, knowledge requirements, technical literature, user's needs, and materials, tools, and techniques. Requirement specification outlines the functional requirements of the system such as, Software requirements define the specific functionalities, features, and performance expectations. Hardware requirements specify the necessary devices use for intranet access. Knowledge requirements encompass the expertise and skills needed by the development team. Technical literature or also called Review of Related Literature provides insights and guidance, and user's needs such as patient's personal information and medicine product information, ensure that the software solution meets the expectations and usability requirements. Materials, tools, and techniques refer to the resources and methodologies utilized during the software development process.

The process stage of the conceptual framework adopts the Agile Model within the Software Development Life Cycle (SDLC). This iterative and flexible approach consists of several key stages.

The process starts with requirements collection, where the software's functional and non-functional requirements are gathered from an interview with some healthcare workers or the end-users. Analysis follows, examining the requirements to understand the scope, constraints, and dependencies of the software project. Designing the researchers began to develop the possible design of the system based on the defined user's requirements and system requirements. Coding implements the software solution based on the design specifications. Testing ensures the functionality, performance, and quality of the software. Lastly, maintenance involves ongoing support and updates to keep the software operational, secure, and aligned with user needs.

The process of the system also involves evaluating the software outcomes based on specific criteria, along with assessing the system using ISO MODEL 20510: Software Quality Standards. The outputs include functional suitability, performance, compatibility, and usability. Functional suitability assesses the extent to which the software meets the specified requirements, including aspects such as functional completeness, correctness, and appropriateness. Performance evaluation focuses on the software's time behavior, resource utilization, and capacity to ensure efficient operation. Compatibility analysis examines the software's co-existence and interoperability with other systems. Usability evaluation considers appropriateness recognizability, learnability, and operability, ensuring user-friendly software.

In addition, the system is evaluated using ISO MODEL 20510: Software Quality Standards. ISO MODEL 20510 provides a set of quality standards and guidelines for assessing the performance management system of an organization.

Lastly, the output stage would comprise the validated system, the "ClickMed," and the generated printed medication summary that could also serve as the receipt for the orders made. The system includes pages such as the dashboard, products, patients, place orders, order history, messages, and settings. The system's primary process starts from creating the patient's info down to generating the medication summary. The medication summary will be printed on an A6 size bond paper with details such as the patient's name, room number, attending doctor and nurse, and the medicine/s ordered (including the price and quantity). The receipt also includes the date and time when the order was placed, as well as when the order was completed.

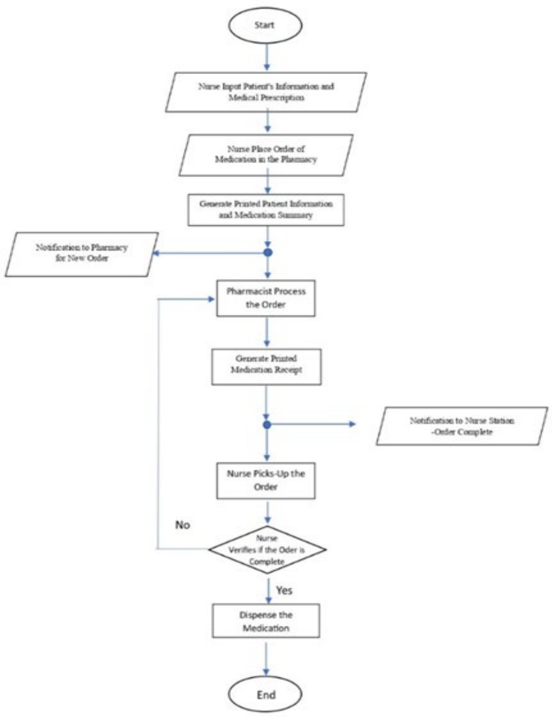

Fig.2. Process flow

Figure 2 shows the process flow of the system, where the nurse will input the patient's information and medical prescription into the system. Then, when the doctor gives the medication info of the patient, the nurse will place the order in the pharmacy. Then the nurse can generate the patient information and medication summary if needed.

Once the nurse places the order, a notification will pop up at the pharmacy for new orders. Once the pharmacy processes the order, it generates a printed medication receipt. Once the order is ready, a notification to the nurse station will pop up. Then the nurse picks up the order at the pharmacy. If there is a problem with the order, the pharmacy will process it again. And if the order is correct, the nurse will pick up the order and take it back to the nurse station.

2.1 Research design

This chapter presents the different methods and procedures used to gather ideas and analyze data intended to support the study. It implies more than simply the methods may be described as structured sets of steps, techniques, design products, and processes consisting of sub-phase that will guide the system developers in their choice of techniques that might be appropriate at each stage of the project and also help them manage, control and evaluate research.

2.2 System overview

ClickMed is a web-based application exclusively only for National Children's Hospital. The system panel can only be accessed by healthcare workers and administrators. Healthcare workers' accounts will be given only by the administrator of the web application. It has a patient management panel, wherein the nurse can input patients' information and medication while pharmacists can view the patient medication in the order history. Only the administrator can delete products and messages and can manage both nurses' and pharmacists' accounts. Additionally, the administrator can create or delete accounts.

2.3 Locale and participants of the study

This research will be helpful in the medication administration process of the healthcare workers at the National Children's Hospital, Quezon City, Philippines. As to the target of the study, the researchers are eyeing getting data from healthcare professionals, such as doctors, nurses, and pharmacists. Therefore, they conducted a survey which was gladly answered by a number of respondents, in which there were seven doctors, six pharmacists, and eighteen nurses, bringing the total of participants to 31. And in accordance with the Data Privacy Act of 2012 in the Philippines, the respondents' employment locations, as well as their sex, age, profession type, and institution name, are to remain confidential.

2.4 Research instrument

Data was gathered by the researchers using an interview as the instrument. The researchers interviewed online, asking participants questions to obtain their responses virtually. The researchers formulated the interview questions through a brainstorming session to collect data regarding the medication process. The researchers used the data collected to imitate the medication process by digitizing and testing the software developed.

The researchers also used testing as a primary instrument in gathering data. The researchers utilized software testing to collect the data for the study. They facilitated the testing to verify the features and satisfy the study’s objectives. The process involved preparing the software and performing the actual testing. The testing is supported by recording the data which researchers used for the study.

Along with the interview and testing, the researchers also considered evaluation as a tool for data collection. The researchers presented the software to healthcare workers at an actual public hospital. The respondents—the people present in the simulation—were then given evaluation forms. The mentioned tool is for additional data collection. The statistician validated these questionnaires after the researchers constructed the questions. Following the evaluation, the researchers recorded and tallied the data obtained for the study.

2.5 Ethical consideration

The instructor of EcE Design Capstone 2 of Don Honorio Ventura State University required the researchers to let the questionnaires get validated before conducting the survey and evaluation. Following the validation, they complied with the requirements the Office of Students Affairs needed to complete an off-campus survey and assessment, which later granted permission.

On the other hand, in compliance with the hospital's rules and regulations, the researchers weren't able to secure videos while demonstrating and conducting the study. As a response, the protection and lawful capture, processing, and use of their data is the primary concern of the researchers.

Furthermore, following ethical principles and guidelines was also observed. The researchers always followed the Nurses' code of ethics to protect their dignity and well-being. The researchers secured a fully signed letter to conduct a study addressed to the National Children's Hospital before performing the analysis. Its healthcare workers should decide if they agree to participate in the study.

The study's respondents were treated according to ethical standards since the researchers understood that their participation was more than a way to collect data. Rest assured that the confidentiality of the data collected throughout the research is carefully kept, ensuring that none of the respondents will be in jeopardy or humiliated.

2.6 Data gathering procedure

The researchers collected the data at Cortez Residence, Sukul St., Brgy. Sta. Ines, Bacolor, Pampanga, Philippines, and National Children's Hospital at 264 E. Rodriguez Sr. Boulevard, Quezon City, Philippines. The data was gathered by connecting three devices using a router and by measuring and comparing how long the traditional medication process takes versus using the developed software. Moreover, to acquire data for the other objectives of the study, the researchers tested if the software could correctly record the transmitted and received medical information by performing further tests and assessing whether the process was successful. Furthermore, the researchers tested the simultaneous operation of the software in several trials on whether the software could perform its functionalities and objectives.

2.7 Statistical Treatment of Data

Responses to the questionnaire by the healthcare professionals were statistically analyzed with the data requirement of the study. Healthcare professionals were statistically analyzed with the data instruments of the study and descriptive statistics is used such as mean, median and mode are considered.

The following were utilized in the treatment of the data:

- Percentage – this was used as descriptive statistics or something that describes a part of a whole.
- Frequency – it is the actual response to a specific question in the questionnaire where the respondent ticks his choice.
- Weighted Mean – this was used to measure the respondents' assessments. Multiplying each value in the group by the appropriate weight factor does it and the product is summed up and divided by the total number of respondents.

  Formula:

$$W = \frac{\sum_{i=1}^{n} w_i X_i}{\sum_{i=1}^{n} w_i}$$

W = weighted average

n = number of terms to be averaged

w_i = weights applied to x values

X_i = data values to be averaged

- Statistical analysis techniques such as a Two-tailed T-test had been used to test for significant differences in the delivery times between manual and digital processes. This provided a statistical basis for comparing the two processes and determining which process had minimized the time and was more effective.

- A 5-Point Likert scale had been utilized to assess the intensity or strength of the Respondent's opinion by evaluating the level of agreement or disagreement with Questions derived from ISO 20510. Wherein the following are equivalent to: 1 -Strongly Disagree, 2 - Disagree, 3 - Agree, 4 - Strong Agree and 5 - Very Strongly Agree.

III. Results And Discussion

This section presents the results and discussions based on the methodology used to display the graphical presentation, analysis, and interpretation of data to show the comparison of the data gathered for the manual and digital medication processes. This section also includes proof that the researchers achieved the objectives. Other presentations proving the objectives were achieved could be found in appendices, specifically "Appendix V" proved the results of objectives no.1. This visual and data presentation would prove that the objectives set by the researchers were achieved. It also collects survey responses from three respondents, chosen through the system user's need: Doctors, nurses, and pharmacists, including their demographic data and survey responses.

3.1 Graphical presentation of gathered data from evaluation form

The following graphs below show the evaluation results for the system. This evaluation was based on "ISO 20510: Software Quality Standards" which focuses on providing consistent terminology for measuring, specifying, and evaluating a system or software quality. The researchers chose Functional Suitability, Performance, Compatibility, and Usability as the characteristic tool to gauge the quality of the system. These four were the most suited for the system as they display the system's need as a Medication Management System.

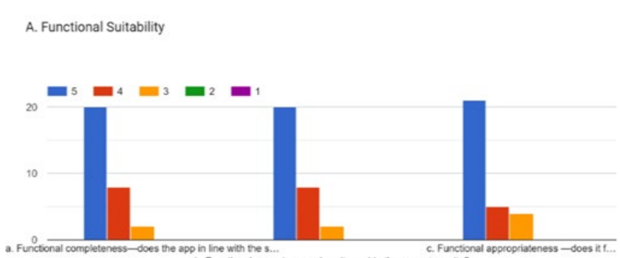

Fig.3. bar graph of responses on functional suitability

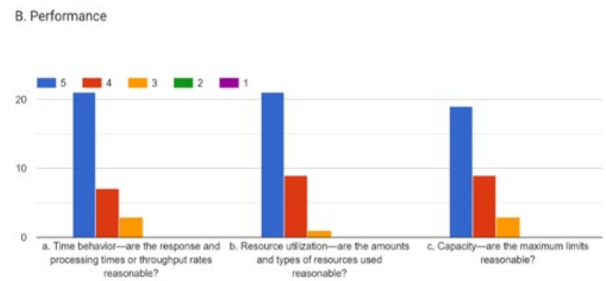

Fig.4. Bar graph of responses on performance

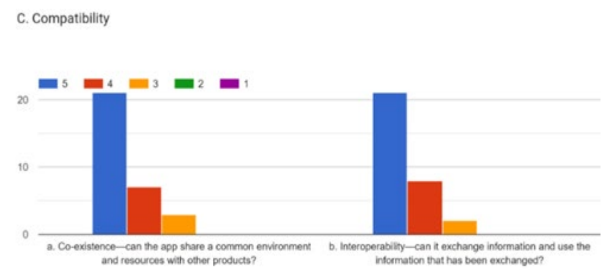

Fig.5. Bar graph of responses on compatibility

The data on the Figure 5 suggests that the app generally exhibits good compatibility in terms of co-existence (ability to share a common environment and resources with other products) and interoperability (ability to exchange and utilize information). However, there are a few instances where the app may face compatibility challenges or limitations in terms of co-existing with other products and exchanging/utilizing information.

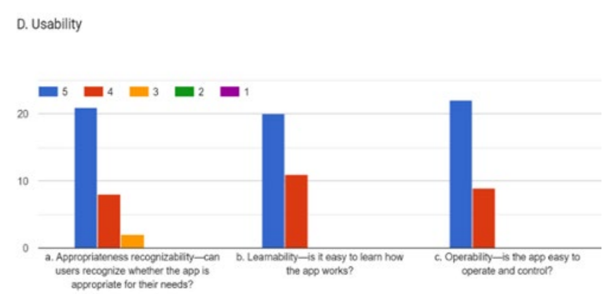

Fig.6. Bar graph of responses on usability

The data on the Figure 6 suggests that the app generally exhibits good usability in terms of appropriateness recognizability (users can recognize its suitability), learnability (it is easy to learn how the app works), and operability (it is easy to operate and control). However, there are a few instances where users may have difficulties in determining the app's appropriateness, learning how it works, and operating or controlling it effectively.

3.2 Analysis and interpretation of graphical presentation of gathered data from evaluation form

Figure 3 to 6 shows that data gathered from the evaluation forms were accomplished by different respondents but mostly nurses, having the raw numbers of eighteen nurses out of 31 respondents; the remaining two consist of seven doctors and six pharmacists completing the 20 respondents that we got from the survey that we conducted. These 20 consist of 11 females and 6 males, with the remaining 3 preferring not to say their respective genders. The age bracket of the respondents stretches from 18 y/o up to 45 y/o, seeing that the oldest was a pharmacist and the youngest one was a nursing student who's taking his/her internship in a hospital setting.

3.3 Interpretation on the Level of Agreement of the Evaluation Form of the Survey Questionnaire through their Weighted Mean.

The table below shows the questions that the researchers have made in line with ISO 20510. The table also shows the weighted mean with its corresponding verbal interpretation for the conducted survey questionnaires.

Table.1. Interpretation on the Level of Agreement of the Evaluation Form of the Survey Questionnaire through their Weighted Mean

Questionnaires	*Weighted Mean*	*Verbal Interpretation*
A. Functional Suitability		
a. Functional completeness—does the app in line with the specification? Does it have the functions it was supposed to have?	*4.61*	*Strongly Agree*
b. Functional correctness—does it provide the correct results?	*4.61*	*Strongly Agree*
c. Functional appropriateness —does it fulfill its function?	*4.59*	*Strongly Agree*
B. Performance		
a. Time behavior—are the response and processing times or throughput rates reasonable?	*4.59*	*Strongly Agree*
b. Resource utilization—are the amounts and types of resources used reasonable?	*4.65*	*Strongly Agree*
c. Capacity—are the maximum limits reasonable?	*4.52*	*Strongly Agree*
C. Compatibility		
a. Co-existence—can the app share a common environment and resources with other products?	*4.59*	*Strongly Agree*
b. Interoperability—can it exchange information and use the information that has been exchanged?	*4.61*	*Strongly Agree*
D. Usability		
a. Appropriateness recognizability—can users recognize whether the app is appropriate for their needs?	*4.61*	*Strongly Agree*
b. Leamability—is it easy to learn how the app works?	*4.65*	*Strongly Agree*
c. Operability—is the app easy to operate and control?	*4.71*	*Strongly Agree*
AVERAGE WEIGHTED MEAN:	*4.61*	*Strongly Agree*

In defining an analysis from the data acquired during the conducted survey questionnaire, the researchers employed a Five-Point Likert Scale indicating 5 as the highest and 1 as the lowest through their weighted mean, therefore the rating scale below was generated from the computation of the ratio between the maximum value minus 1 over the maximum value of the aforementioned scale. A Likert scale tends to offer five options for answering a statement or question, allowing respondents to express their degree of agreement or sentiment about the subject or statement on a positive-to-negative scale (McLeod, 2019). The rating scale will be used to evaluate the system's performance and usability as well as its functionality and compatibility when the respondent test/use the system.

Weighted Mean Formula:

$$Weighted\ Mean = \frac{\sum_{i=1}^{n}(x_i * w_i)}{\sum_{i=1}^{n} w_i}$$

The weighted mean is determined by multiplying each data point in a collection by a value provided by some aspect of whatever contributed to the data item (Carter, 2010). The study employs it to determine the respondents' degree of agreement regarding the system's performance, usability, functional appropriateness, and compatibility. The aim is to ensure that the proposed system will be advantageous and will reduce medication errors for healthcare professionals.

Table.2. Scale Used for the Verbal Interpretation on the Level of Agreement of the Gathered Data

Weighted Mean	**Verbal Interpretation**
4.21 – 5.00	Strongly Agree
3.41 – 4.20	Agree
2.61 – 3.40	Neutral
1.81 – 2.60	Disagree
1.00 – 1.80	Strongly Disagree

3.4 Analysis and Interpretation of Level of Agreement of the Evaluation Form of the Survey Questionnaire through their Weighted Mean.

Data from table 2 reveals an average weighted mean of 4.61, which signifies that the respondents strongly agreed on the performance, usability as well as functional suitability, and, compatibility of the proposed system. It has received a high rating overall, and based on factors such as its functional suitability, the system can be considered to be deployed in the selected Locale. Respectively, the system was rated 4.61, 4.61, and 4.59 for its completeness, correctness, and appropriateness. respondents strongly agree with the time behavior of the system to be highly responsive, gaining a 4.59 weighted mean; resource utilization for performance has prevailed from a strongly agreed 4.65 weighted mean; a strong assent was indicated too on the limitation of capacity as to performance indicator, having a 4.52 weighted mean; compatibility-wise, everything is considered strongly agreeable according to the respondents as it gathers 4.59, and 4.61 weighted means for its co-existence and interoperability; while, having the highest weighted mean with 4.61, 4.65, and 4.71 is of the Usability of the system, wherein the respondents strongly agrees that they can easily recognizes that the app is appropriate to what they need, they also expresses that the system is easy to learn and operate.

3.5 Illustration Of the Time Taken of The Step-By-Step Process for Digital Vs. Manual Procedure

The following table below presents the step-by-step medication process on digital and manual procedures. The procedure starts from login up to the pharmacist notifying the nurse that the order is completed. These tables aim to provide a comparison of the digital and manual procedures of the medication process. It also offers an overview of the time required for each step in both procedures, providing valuable insights into the duration of the medication process.

Table.3. Digital Process Step-by-step Timed Data

DIGITAL						
STEP 1 (Login to Add Patient then Submit)	STEP 2 (Place order Submit up to check PDF (order history))	STEP 3 (Enter Messages then notify the nurse for order completion)	STEP 4 (Travel time of Nurse to Pharmacy. Pharmacist received order)	STEP 5 (Pharmacist check order history then Verify orders (open PDF))	STEP 6 (Enter Messages then notify the nurse for order completion)	TOTAL
[MINUTES]	[MINUTES]	[MINUTES]	[MINUTES]	[MINUTES	[MINUTES]	[SECONDS]
2:52	1:03	1:11	0	1:09	0:37	391.2
2:51	1:03	1:11	0	1:09	0:37	390.6
2:52	1:04	1:12	0	1:10	0:38	393.6
2:53	1:02	1:13	0	1:08	0:36	391.2
2:50	1:05	1:10	0	1:11	0:39	393
2:49	1:01	1:09	0	1:07	0:35	384.6
2:54	1:06	1:14	0	1:12	0:40	423.6
2:48	1:00	1:08	0	1:06	0:34	381.6
2:55	1:07	1:15	0	1:13	0:41	426.6
2:47	0:59	1:07	0	1:05	0:33	378.6
2:56	1:08	1:16	0	1:14	0:42	429.6
2:46	0:58	1:06	0	1:04	0:32	375.6
2:57	1:09	1:17	0	1:15	0:43	432.6
2:45	0:57	1:05	0	1:03	0:31	372.6
2:58	1:10	1:18	0	1:16	0:44	435.6
2:44	0:56	1:04	0	1:02	0:30	369.6
2:59	1:11	1:19	0	1:17	0:45	438.6
2:43	0:55	1:03	0	1:01	0:29	366.6
3:00	1:12	1:20	0	1:18	0:46	441.6
2:42	0:54	1:02	0	1:00	0:28	363.6
3:01	1:13	1:21	0	1:19	0:47	444.6
2:41	0:53	1:01	0	0:59	0:27	360.6
3:02	1:14	1:22	0	1:20	0:48	447.6
2:40	0:52	1:00	0	0:58	0:26	333.6
3:03	1:15	1:23	0	1:21	0:49	450.6
2:39	0:51	0:59	0	0:57	0:25	330.6
3:04	1:16	1:24	0	1:22	0:50	453.6
2:38	0:50	0:58	0	0:56	0:24	327.6
3:05	1:17	1:25	0	1:23	0:51	480.6
2:37	0:49	0:57	0	0:55	0:23	324.6
				AVERAGE WEIGHTED MEAN:		62.9667

Table.4. Manual Process Step-by-step Timed Data

MANUAL						
STEP 1 (Login to Add Patient then Submit)	STEP 2 (Place order Submit up to check PDF (order history))	STEP 3 (Enter Messages then notify the nurse for order completion)	STEP 4 (Travel time of Nurse to Pharmacy. Pharmacist received order)	STEP 5 (Pharmacist check order history then Verify orders (open PDF))	STEP 6 (Enter Messages then notify the nurse for order completion)	TOTAL
[MINUTES]	[MINUTES]	[MINUTES]	[MINUTES]	[MINUTES	[MINUTES]	[SECONDS]
2:52	1:03	1:11	6:00	1:09	0:37	751.2
2:51	1:03	1:11	6:00	1:09	0:37	750.6
2:52	1:04	1:12	6:01	1:10	0:38	754.2
2:53	1:02	1:13	5:59	1:08	0:36	750.6
2:50	1:05	1:10	6:02	1:11	0:39	754.2
2:49	1:01	1:09	5:58	1:07	0:35	743.4
2:54	1:06	1:14	6:03	1:12	0:40	785.4
2:48	1:00	1:08	5:57	1:06	0:34	739.8
2:55	1:07	1:15	6:04	1:13	0:41	789
2:47	0:59	1:07	5:56	1:05	0:33	736.2
2:56	1:08	1:16	6:05	1:14	0:42	792.6
2:46	0:58	1:06	5:55	1:04	0:32	732.6
2:57	1:09	1:17	6:06	1:15	0:43	796.2
2:45	0:57	1:05	5:54	1:03	0:31	729
2:58	1:10	1:18	6:07	1:16	0:44	799.8
2:44	0:56	1:04	5:53	1:02	0:30	725.4
2:59	1:11	1:19	6:08	1:17	0:45	803.4
2:43	0:55	1:03	5:52	1:01	0:29	721.8
3:00	1:12	1:20	6:09	1:18	0:46	807
2:42	0:54	1:02	5:51	1:00	0:28	694.2
3:01	1:13	1:21	6:10	1:19	0:47	810.6
2:41	0:53	1:01	5:50	0:59	0:27	690.6
3:02	1:14	1:22	6:11	1:20	0:48	814.2
2:40	0:52	1:00	5:49	0:58	0:26	687
3:03	1:15	1:23	6:12	1:21	0:49	841.8
2:39	0:51	0:59	5:48	0:57	0:25	683.4
3:04	1:16	1:24	6:13	1:22	0:50	845.4
2:38	0:50	0:58	5:47	0:56	0:24	679.8
3:05	1:17	1:25	6:14	1:23	0:51	849
2:37	0:49	0:57	5:46	0:55	0:23	676.2
				AVERAGED WEIGHTED MEAN:		109.6269

Table 3 and Table 4 provides the time of the step-by-step process for the digital and manual procedures. As the researchers have not been able to gather sufficient data for the manual process, the researchers just assume that it is equal to the digital process that's been simulated by the nurse. The six steps that the researchers used are as follows: Step 1 starts with the nurse logging in on the system up to completing the submission of the new patient info; The next step would be the nurse placing the order to verify it on the pdf file (Order History). Next, would be the nurse sending a message or notification to the pharmacy. The 4th step would be the travel time of the nurse to the pharmacy so that the pharmacist would be able to confirm and receive the order. The 5th step is the checking and verification of the orders on the pdf file (Order History) by the pharmacist. Then, the last step (assuming the order was already prepared) would be the pharmacist sending a message to the nurse station to notify that the order is ready for pickup.

The data gathered shows that there was an obvious difference in step 4 which is the "Travel time of the nurse from the Nurse Station to Pharmacy". This difference happened by getting the time from the digital and manual process, to which the pharmacy received the order of the nurse. There were 0 seconds for the digital due to the real-time notification provided by the system (assuming the pharmacist was on-hand with its device). While on manual, the nurse timed a rough estimate of 6 minutes till the pharmacist marked the orders as received (travel time and filing included). Therefore, the researchers concluded that there was a significant difference in the time between digital and manual processes.

3.6 Analysis And Interpretation of Data Gathered from The Time Delivery of Manual and Digital Medication Process

The researchers conducted T-test using Microsoft Excel as the software. The t-test value is equal to -44.427 which is outside the range of the critical values (-2.001 to 2.001), therefore the researchers reject the null hypothesis. Which means there is no significant difference between the means of the two group of data.

Based on the large difference between the calculated t-value and the critical value provided, the result shows a statistically significant difference between the means of the two groups being compared, with a high degree of confidence. In other words, the null hypothesis is rejected, which states that there is difference between the means, and the alternative hypothesis is accepted, which states that there is a difference with a very high degree of confidence. With this result we can conclude that the digital process reduced the time consumed for processing and recording medications, compared to the manual process.

3.7 Summary Of Findings

The researchers obtained 31 healthcare workers as participants, consisting of 7 doctors, six pharmacists, and 18 nurses. Based on the results obtained from the survey questionnaires, an average weighted mean of 4.61 was revealed, which signifies that the respondents strongly agreed on the performance, usability as well as functional suitability, and compatibility of the proposed system.

On the other hand, the researchers carried out a series of 30 test scenario each for digitized and manual processes wherein the calculated t-test value is -44.427 which falls outside the critical value range of -2.001 to 2.001. As a result, the researchers reject the null hypothesis showing no statistically significant difference between them while the alternative hypothesis is accepted, indicating that there is a difference with a very high degree of confidence between the manual and digital medication process. The values shown here was the result of the T-test computation from the values in Table 13 and Table 14.

Overall, the t-test contributed in presenting the statistical basis for comparing the delivery times of manual and digitally processing of medications and discovering significant differences in delivery times.

IV. Conclusion

Upon the completion of the proposed study, the researchers concluded that the study is effective based on the obtained data from the series of testing performed and evaluated. It was also demonstrated successfully after multiple simulation trials, and the objectives have been obtained. The researchers successfully developed an electronic medication management system that records patients' personal information, and medical prescriptions and has acquired the functionality of ordering medicines via the web application. Moreover, the system provided a real-time two-way notification system for nurses and pharmacists to update the status of ordered medications. Additionally, the system was able to help healthcare workers minimize their workload and their time in the repetitive transcription of medication orders and lessened their redundant verification and confirmation of medication when ordering and dispensing medicines from the pharmacy. Lastly, digitized medication processes can have advantages, including lessening time in processing medication and recording medications and whereas manual processes can take longer.

Recommendation:

For future research, the following recommendations are suggested for the improvement of the study:

- Include additional features such as the 24Hr medication summary, doctor's order sheet, and medication sheet which are included in the paper-based manual medication process.
- Integrate the system on handheld devices, so the healthcare workers can just roam around their area with just a mobile device and be able to use it as is.
- Improve the user interface of the system to make it more user-friendly.

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