# System Analysis and Design of Patient Information System Using Design Thinking Methodology

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Abstract—In the Philippines, healthcare facilities, mainly those financed by the government, are commonly overcrowded or overbooked, resulting in prolonged patient wait times and delays in patient service. The requirement to fill out registration paperwork by hand lengthens the procedure and impacts patient satisfaction. The researchers employed a design thinking technique that includes empathy, define, and ideate phases to further examine the current system's requirements to make it more convenient and optimize data flow. The researchers were able to identify non-value-added operations that may be removed by restructuring the present patient information systems used in public hospitals using interviews, surveys, and analytical tools and procedures. As a result, the researchers were able to create a proposed plan that is more efficient in data management and flow. The concept of employing medical cards (MediCard) with a OR code inscribed on the front was developed in order for patients to receive medical care immediately and for hospital employees to do their tasks properly. It is concluded that multiple stages of analysis enabled the researchers to develop a more comprehensive system design.

*Index Terms*—MediCard, user interface, design thinking approach, QR code

# I. INTRODUCTION

Patient registration is an essential aspect of the processes within different healthcare facilities (hospitals, clinics, etc.) as it directly impacts the people seeking help and assistance. It is essential to accurately identify the patients' information as caregivers use their historical data to decide on their treatments; misidentifying patients during this step could compromise their safety and health [1]. The requirement to fill out patient registration forms is a must since this is considered the basis of their medications; a patient registration form mainly contains the patient's personal, physical, and medical information, as well as their legal and financial responsibilities. This process is performed by hand, which is a factor that contributes to a lengthy process. Healthcare facilities in the Philippines, specifically those funded by the government, often experience overcrowding or

overbooking since it is believed that it is their duty to attend to those in need—this instance produces long patient waiting times [2]. Patient waiting time is defined as "the amount of time for patients seeking care at healthcare units before being attended for consultation and treatment" [3]. This could affect customer satisfaction, compromise patient safety, and increase patient care delays.

The researchers considered the role of barangay hall staff (health department) in making it convenient and accessible for residents to fill out their personal, physical, and medical information. Additionally, their data will be stored in an instrument that can accommodate advanced technology; this notion expresses the distinction of this paper as the researchers discerned a concept that allows the information to be stored not only in hospitals or barangays but also within the medical cards. The medical card (MediCard) contains the patient's personal, physical, and medical information using a QR code. Since barangays are involved, the patient information system is integrated with the government system, making it easy for residents to retrieve their information.

# A. Objectives

This study aims to: discover how technology may make working in a medical environment more convenient, where everything is combined in a single system, discuss how an improved information system provides significant benefits to entities involved, and provide an efficient method of transferring patient information to different departments in the hospital.

## II. LITERATURE REVIEW

# A. Patient Information System

Sejfia [2015] studied establishing a patient registration system at Kosovo's public hospitals to increase job efficiency. One situation that required an urgent solution was the tendency to overlook patients and their needs during an eventful hospital shift. The findings showed that the patients had distinct circumstances. Thus, a Patient Information System was implemented to identify their needs and prevent neglecting to give them [4]. In line with this, Lieberthal [2008] recognized the importance of the Electronic Medical Record (EMR),

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also referred to as Electronic Health Record (EHR). It eliminates paper charts and provides regulated, safe, and fast digital access to patient demographic, medical, social, and financial information [5].

According to research, Patient Health Record (PHR) systems are examples of a new generation of user-centric information systems developing in health care [6]. These systems provide a framework for implementing a new vision of health care that empowers individuals and facilitates patient-provider communication to improve health outcomes and lower costs. This progress has led to data sets and capabilities, which present new opportunities and challenges for users, systems, and industries. Keeping track of patients and staff, calculating invoices, etc., requires processing and record-keeping in many medical areas, according to Adebayo et al. [2014]. The Patient Information Management System (PIMS) was intended to handle essential information swiftly and effectively. The developed system's proper analysis and evaluation show it meets basic standards, demonstrating efficient, practical, and trustworthy recordsan management system [7].

The emergence of Covid-19 has sparked the need for a new digital solution that compromises the efficient needs of citizens [8]. Singapore took a strategic solution leading the path toward digital contract tracing innovation. The trace together app includes the function of the user to scan QR codes that would display user information directly. By having this kind of cutting-edge technology, Singaporeans could control and manage the spread of the disease. Not only that, but numerous businesses have also utilized the system for scan code safe entry purposes.

Ward et al. [2011] explored clinical information systems' impact on nurses' patient care and workflow to help hospitals transition to EHRs. The study examines rural referral hospital nurses' opinions of patient care workflow and procedure before and after using clinical information systems. The survey and information system expectations included scaled providers, interorganizational communication, better treatment, and patient care procedures. End-user training, user perspectives during deployment, and project expectations are highlighted [9]. A pilot study of an electronic patient information system for amblyopia patients is also given [10]. The study investigated whether the information system enhanced treatment quality by boosting efficiency, efficacy, and patient satisfaction. The influence of information systems on children and patients was evaluated qualitatively. According to the study, a patient information system is crucial because it can reduce the likelihood of wrong matches and improve the quality of care and patient empowerment.

## B. Design Thinking Methodology

Dolata and Schwabe [2016] concluded that the Design Thinking (DT) methodology is one of the most straightforward approaches considering its practiceoriented nature. The study claims that the mindset and the toolset contribute to massive success in academic research in the field of information systems [11]. Most DT research involves ethnographic approaches like interviews and observations. The application of DT contributes to the better traceability and understanding of the information system creative process. Human-centric stresses empathy to establish toward their subjects, primarily through intensive need identification through investigative activities and prototypes that focus on specific necessary functionality. It is significant to have an empathy design that would direct researchers searching for solutions and understanding user problems in design thinking.

DT reframes complex issues to provide user-centered solutions [12]. The Global Ebola Laboratory Data collection and reporting system was designed utilizing DT to help solve data gathering and reporting issues during the 2014 Ebola outbreak, particularly in Sierra Leone, Guinea, and Liberia. DT focuses on empathizing, defining, ideating, prototyping, and testing. The data collection and reporting system guided district, national, and international response interventions, including generating situation reports, monitoring epidemiological and operational situations, providing epidemic forecasts, and supporting Ebola-related research and the Ebola National Survivors programs. This iterative technique reacts to the system's needs, and the stages can be completed in parallel, out of sequence, and repeated as needed. The study found that applying DT to solve acute challenges in the national health information system during an outbreak has several benefits and should be encouraged.

DT emphasizes user empathy, diverse teams, and "action-oriented fast prototyping" of ideas [13]. Unlike the typical top-down, linear approach to health design, innovation emerges through intervention numerous ideation, prototyping, and testing rounds. DT was used to reimagine an elementary school curriculum to increase student interest in aviation and health care. Focusing on patient and provider needs can enhance health care's innovation, efficiency, and efficacy. DT performed better in all four tests. Despite methodological and quality restrictions, DT can create usable, acceptable, and effective remedies. According to the researchers, its fundamental components should be separated and compared to regular analysis. With this, Smiechowski [2021] suggest that DT methodology has helped them develop higher awareness and prioritize empathy for endusers needs by considering and thoroughly understanding a particular situation. A prototyping approach simplifies and manages user feedback when needs are identified. Inspiration, ideation, and implementation drive innovation [14]. Inspiration includes the circumstances that motivate the search for answers, resulting in a more sympathetic understanding of the issue; Ideas are produced and evaluated through a collaborative, iterative process [15].

#### III. METHODS

## A. Current Service Blueprint

Fig. 1 shows the actual process of the patient registration system in the hospital. The service blueprint thoroughly explains the stages of the interaction of the

actors; every action corresponds to the beginning and end of the process. Significantly, having a service blueprint helps employees or actors know their task emphasizing the importance of a customer-focused approach among staff. It identifies failure sites, that is, weak links in the chain of service operations, which may then be used as the focus of ongoing quality improvement efforts.

The service blueprint determined which processes in the hospital's patient registration procedure add value and which do not. In the given blueprint, the non-value-added process is patients filling out forms at the hospital or clinic. Due to the manual nature of the process, the hospital cannot quickly arrange data and distribute it to clinicians.



Figure 1. Current service blueprint of patient registration process.

## B. Use Case Diagram

The Unified Modeling Language (UML) has helped the researchers to visualize how the purpose patient registration system would work. Fig. 2 provides the significant actors that would be included in the process. The actors included are the barangay health residents, department staff, nurses, and hospital doctors. The system's primary user is the patient that would have the Medicard with an imprinted QR code.

The diagram begins when a resident applies for a medical card at the barangay clinic. The barangay health department only processes medical applications after verifying residency. Next, the barangay provides a form to fill out; this case also requires residency verification. Then, the barangay health department staff would enter residents' information. Following that is printing the medical card and distribution to the following owners. Patients will get a medical card to use at the hospital by completing the process. The nurse scans the medical card to get patient details, which reduces paperwork. Nurses can also quickly transfer patients' health details to doctors in just a few clicks. Doctors can then consult and diagnose patients. After the consultation, the nurse can update the patient's medical information, including storing new information.

The new patient registration system's analysis helps patients and hospitals with data management and storage issues. Automation would assist the hospital by reducing paperwork, facilitating patient data transmission, and arranging patient data promptly.



Figure 2. Use case diagram for patient information system.

## C. Hierarchy plus Input-Process-Output (HIPO) Chart

The proposed system starts when a patient/resident applies for a medical card that scans their medical details and ends when patients are discharged from the hospital with a complete diagnosis and prescription updated into their medical card. It reduces the need for patients to fill out the same information repeatedly by generating a QR code from their data. Staff from the barangay health department helped patients/residents enter personal, medical, and physical data. The personal information would include the following: Name, Date of Birth, Birthplace, Gender, Age, Permanent Address, Mobile/Telephone Number, Contact Person, Blood type, etc. Medical information would include the patient's allergies and underlying conditions, while physical information would include the patient's height, weight, etc. The system scans the patient's unique QR code to obtain personal, medical, and physical data. This eliminates the need for pre-registration forms. The system would then look for a doctor who could see the patient. The patient's information is sent to the doctor's computer once confirmed, eliminating the need to ask. After the consultation, the doctor or nurse enters the patient's diagnosis, medications, and new readings. Patients can scan their QR codes at the pharmacy to get prescriptions. All patient information would be stored in hospital records. The patient will have updated patient information until their next hospital visit after the consultation or discharge.

### IV. DATA COLLECTION

The researchers used questionnaires and interviews to determine which can be improved to achieve a more

efficient process. According to the survey, patients have more similarities than differences; the researchers chose to focus on a specific age group because they are often the most vulnerable and disadvantaged, especially since they frequently visit the hospital for check-ups.

According to an interview, patients fill out forms before seeing doctors or hospital staff. A new design could reduce form-filling time by 10-15 minutes. Some patients feel stressed and overwhelmed, while others are calm. An investigation of patient and medical worker experiences led researchers to conclude that implementing a system to facilitate efficient transactions between patients and hospitals is necessary as manual paperwork wastes significant time attending to patients.

#### V. RESULTS AND DISCUSSIONS

#### A. Future Service Blueprint

A new procedure has been added to the future service blueprint. As seen in Fig. 3, the patient or resident must apply for a medical card, which will act as their identification card anytime they need a medical examination or operation. This kind of technology would benefit the patient or resident and the hospital workers and physicians who keep track of patient information for monitoring health purposes. This would minimize the need for the patient to fill out the same information repeatedly. Medical cards would also help organize the information, reducing the likelihood of data errors and missing patient information. Instead of constantly filling out medical paperwork, people may have a medical card that contains their most recent or up-to-date medical information, alerting clinicians to the patient's current health.



Figure 3. Future service blueprint of patient registration process.

## B. User Interface

The researchers have prepared a User Interface (UI) with an online platform that could effectively show how the data flows within the Patient Information System.

Fig. 4 shows the user interface for registrars and nurses. (a) shows the primary login page where users can access their dashboards. (b) shows where registrars can enter their usernames and passwords. (c) shows the registrar's dashboard with two options: register a patient and view records. (d) shows a registrar's patient data form. (e) shows what the MediCard would look like before printing. (f) shows patients who have successfully obtained a MediCard and an option to print a copy if they lose it. (g) shows the nurse's dashboard, where they may scan the patient's MediCard, monitor appointments, doctor availability, patients, and analytics. Once the MediCard is scanned, the user can view the patient information stored in the QR code (h). (i) shows the patient information screen. (j) shows how nurses can add medical and physical patient details. (k) illustrates system analytics based on doctors' diagnoses and patients' appointments. The Department of Health can use this to analyze illness trends. (l) displays the hospital departments where nurses upload patient data. (m) shows a list of doctors in a department and the option to upload patient information.



Figure 4. UI for registrar and nurse.

Fig. 5 shows the pages available when the doctor logs in to the system. (a) displays the doctor's upcoming appointments and recent consultations. The doctor can click on the patient's name to see their medical records. (b) shows the doctor's daily appointments and medical information. (c) shows a doctor's diagnosis, prescription, and patient details. The doctor can then add the diagnosis and medication to the MediCard. (d) shows a doctor's patient record and diagnosis.



Figure 5. Doctor's user interface when diagnosing a patient.

### C. System Evaluation

Massive wait times for patient registration are delaying medical procedures. The researchers found that technology could solve patient concerns and problems. By using good system design and analysis, waiting can be reduced. In the new proposed patient registration process flow, waiting time has been eliminated by using a QR code that allows patients to scan their medical cards efficiently. The solution eliminates medical process delays and improves data and analytics. Instead of filling out forms, QR codes allow for more detailed and comprehensive medical reports. Having a system that handles multiple tasks eliminates non-value-adding processes and promotes patient and hospital convenience.

#### VI. CONCLUSION

The offered analysis used various methods and methodologies to establish system design concepts, resulting in a more consistent framework. The researchers compared and analyzed previous relevant studies to make their research more feasible and relevant to the topic. They suggested ways to improve their study design to help hospitals and patients transfer medical information and get an accurate diagnosis. Knowing about the user experience has helped develop suggestions for improving the system so that hospital-patient data exchanges are as seamless as possible.

With the help of the POV statements, the researchers were able to develop a prototype patient information system that attends to any situational needs of the patients and successfully assists the users in storing and transferring data efficiently. Similarly, with the help of the HMW questions, the manual registration process of filling-out forms was eliminated to increase their satisfaction further. Not only that, but with the use of the convenient system processes, the confidence level of patients grew when attending a medical consultation alone. Furthermore, the HMW questions assisted in helping the hospital/clinic staff perform their duties efficiently, cutting down any waste/delay time in helping people with the registration process, and storing and transferring data information.

#### CONFLICT OF INTEREST

The authors declare no conflict of interest.

#### AUTHOR CONTRIBUTIONS

Ma. Bernadeth M. Oliverio was responsible for creating and analyzing the diagrams. Along with Devon Earl Panes, they both created the prototype or the UI design for the system. Trinah Mae C. Vinluan completed the task of editing and finalizing the paper. Engr. Grace Lorraine Intal was responsible for confirming the paper's contents. All authors contributed to the review of related literature and discussions, and they all approve of the final version.

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