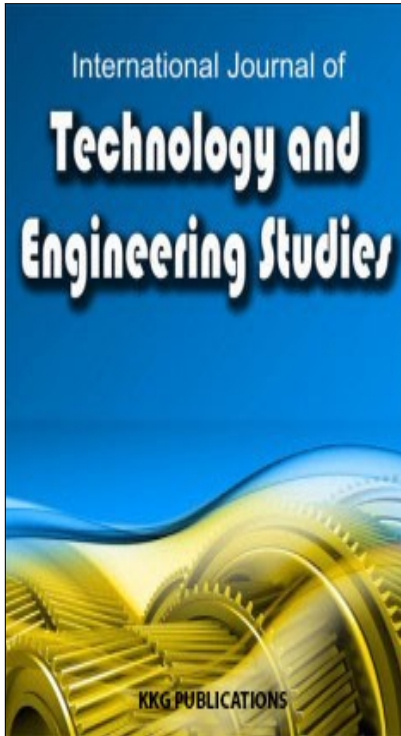
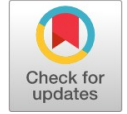


This article was downloaded by:
Publisher: KKG Publications



Key Knowledge Generation

Publication details, including instructions for author and subscription information:

<http://kkgpublications.com/technology/>

Patient Management Information System for the University of the Immaculate Conception College Department Clinic

JUVIE PAULINE L. RELACION

University of the Immaculate Conception, Davao City, Philippines

Published online: 24 October 2017

To cite this article: J. P. L. Relacion, "Patient management information system for the University of the Immaculate Conception college department clinic," *International Journal of Technology and Engineering Studies*, vol. 3, no. 5, pp. 213-223, 2017.
DOI: <https://dx.doi.org/10.20469/ijtes.3.40005-5>

To link to this article: <http://kkgpublications.com/wp-content/uploads/2017/3/IJTES-40005-5.pdf>

PLEASE SCROLL DOWN FOR ARTICLE

KKG Publications makes every effort to ascertain the precision of all the information (the "Content") contained in the publications on our platform. However, KKG Publications, our agents, and our licensors make no representations or warranties whatsoever as to the accuracy, completeness, or suitability for any purpose of the content. All opinions and views stated in this publication are not endorsed by KKG Publications. These are purely the opinions and views of authors. The accuracy of the content should not be relied upon and primary sources of information should be considered for any verification. KKG Publications shall not be liable for any costs, expenses, proceedings, loss, actions, demands, damages, expenses and other liabilities directly or indirectly caused in connection with given content.

This article may be utilized for research, edifying, and private study purposes. Any substantial or systematic reproduction, redistribution, reselling, loan, sub-licensing, systematic supply, or distribution in any form to anyone is expressly verboten.

PATIENT MANAGEMENT INFORMATION SYSTEM FOR THE UNIVERSITY OF THE IMMACULATE CONCEPTION COLLEGE DEPARTMENT CLINIC

JUVIE PAULINE L. RELACION *

University of the Immaculate Conception, Davao City, Philippines

Keywords:

Medical Records
School Clinic
Patient Management Information System
Engineering
Medicine
Inventory
Electronic Medical Record System

Received: 01 September 2017

Accepted: 27 September 2017

Published: 24 October 2017

Abstract. The study aimed to provide a convenient way of storing and managing patients' records and inventory. This study focuses on the patient management information system for the University of the Immaculate Conception College Department Clinic. Specifically, it develops an automated system to track patients, information, and medicine inventory, design a database for patients' information records and medicine inventory reports, and generate patients, records, and medicine inventory reports. This study used iterative and incremental models. The general idea is to construct an application through repeated cycles and in smaller portions at a time. Findings from this study revealed that the designed system developed an automated system to track patients, information, and medicine inventory and create a database of patients, records, and medicine inventory. The findings help the efficiency of clinic staff in providing clinical services to patients. With the help of this system, the team could also reduce any unpleasant complaints from the patients. Moreover, because of its ability to generate printed output for patients, records, and medicine inventory reports, the staff could fulfill his/her requirements to the administrator.

INTRODUCTION

This chapter introduces the background of the study, the statement of the problem, statement of the objectives, significance of the study, the scope and limitations, the conceptual framework, and the related works of literature used in the study.

Background of the Study

Every medical facility governs a significant amount of information, some of which is the maintenance of the business, insurance, personnel, and the financial record; a proper management of supplies and equipment documents, current licensures and certifications; and some papers held in reserve for the life of the practice. The vast bulk of information, however, comes from patients, records [1]. The maintenance of patients, records is the most critical function of any medical facility. Administrative and clinical medical assistants spend a lot of time managing patients, records [1].

As pointed out by [2] the most common method of recording patients, record information for most hospitals and medical practices in the U.S are the paper-based records [2].

Also, no matter how comfortable the majority of doctors are with the manual way of recording patients, records, it requires a significant amount of storage space compared to electronic medical records. Moreover, the authors [1] enumerated a few disadvantages of having a manual medical record or a

paper-based record. One of the downsides is one person can use the paper-based record at a time. Second, it can be easily misplaced or misfiled. Third, equipment and storage space are required. Lastly, manual medical recording is more susceptible to errors [1].

Healthcare providers can finish their patient charting quicker with the help of the electronic medical record system, allowing more patient schedule. [3] With this type of system, the efficiency was heightened which fosters a more efficient medical practice. Furthermore, it helps prevent filing errors and eliminates any threats of losing the patients, information since the system can automatically provide a backup and is accessible almost anywhere [3]. Also, [4] quality of healthcare was enhanced, time spent on the paperwork was lessened, patients, satisfaction was increased, and financial savings were some of the advantages of using electronic medical record systems [4].

The University clinic manages the information of the patients and monitors the inventory of apparatus manually. They usually keep their records on a paper. Because of this, the researcher proposed a system that would record and save the necessary information needed using a computer.

This study aims to apply modern technology to the University of the Immaculate Conception (UIC) College Department Clinic, i.e., to provide a convenient way of storing and managing patients, records and inventory.

*Corresponding author: Juvie Pauline L. Relacion

†Email: jrelacion@uic.edu.ph

To achieve this goal, the researcher will design a system appropriate for the University clinic by creating and testing the system.

Statement of the Problem

This study aims to develop a patient management information system for the University of the Immaculate Conception College Department Clinic. This study seeks to answer the following questions:

1. Does the system manage patients' information and medicine inventory efficiently?
2. Does the system generate printed output?

Statement of the Objectives

The objective of this study was to create a patient management information system for the University of the Immaculate Conception College Department Clinic, which was capable of storing patients' information and monitoring the inventory of medicines in the clinic. This study aimed to provide solutions to the following specific objectives:

1. To develop an automated system to track patients' information and medicine inventory.
2. To design a database for patients' information record and medicine inventory report.
3. To generate patients' records and medicine inventory reports.

Significance of the Study

The purpose of the study was to develop a patient management information system for the University of the Immaculate Conception College Department Clinic. The researcher deemed the following as beneficiaries of this device:

The system can help the school nurse keep a report of all the staff, faculty, and students' medical record. With the system, the school nurse can monitor the inventory of all the medicines in the clinic. With the help of the system, the student assistant does not need to ask for the patient's information repeatedly.

The system can help the doctor in keeping track of the medical history of the patient. With the help of the system, administrator, faculty, student, and staff do not need to fill out

forms repeatedly every time they visit the school clinic.

Scope and Limitations

The system is a stand-alone system designed for University of the Immaculate Conception College Department Clinic. This system has two levels of users; the administrator or the Nurse and the student assistant. At the administrator level, they will have their own password through which they can modify the patients' records and have the authority over all modules. In addition, the administrator has access to go through the inventory of the medicines in the clinic. Moreover, it will have the power to add and delete accounts for the student assistant. While the student assistant level can only view the data, search, and update the primary medical record on the day the patient comes into the clinic. This system will not replace the note or description stated by the nurse but as a guide to track or monitor the movement of the patient's file.

The designed system has many functions. First, it includes registration module in which it lists patient and saves it to the database. Second, it can add new data to the database. Third, it can update the existing data in the program. Fourth, it can delete any current data from the program. Fifth, it can add new data to the database and lastly, it has the ability to search data. In addition, the system has a database integration. It means that if the administrator updates the patients, records, the record is also updated. It can also store hundreds of information pieces. Moreover, the system keeps track of the inventory of the medicines available in the clinic. It will display the availability of the drug as to how many pieces are left. Furthermore, the system generates printed data. It prints outpatients' information and medicine inventory report.

The system is for the University of the Immaculate Conception College Department only, specifically for the Annex Campus. The patient cannot view his/her medical records on his/her school account.

Conceptual Framework

This section provides the graphical outline that represents the concept of this study.

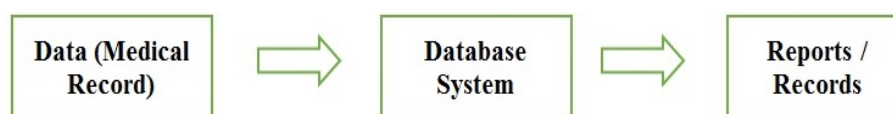


Fig. 1. Conceptual framework of the study

REVIEW OF RELATED LITERATURE AND STUDIES

The researcher has found the following literature and studies as relevant to the study being proposed:

According to [5], the purpose of medical records is to document health information about patients painstakingly. It contains the diagnoses and treatments of diseases [5]. Moreover, [5] pointed out that medical records are currently being transformed from traditional paper-based records (handwritten or typed) to electronic medical records [5]. Furthermore, the use of electronic medical records has the following advantages: (a) less storage space, (b) facilitates adequate quality assurance, analysis of practice patterns, and research activities, (c) faster retrieval of data, (d) minimal loss of medical records, (e) a complete set of backup records, (f) expedites the transfer of data between facilities, (g) practice enhancer and a public relations tool [5].

The concept of transforming paper medical records into an electronic medical record is based on this literature. It further supports the study with the stated advantages over paper medical records. Just like in most countries, Nigeria is challenged with the increasing demand for healthcare medical treatments and services [6]. As pointed out by [6], hospitals should have all the patients' medical history documented in the medical records. It must be maintained correctly and appropriately [6].

The study designed by [6] solved the problems associated with the paper-based records. They converted the manual way of searching, cataloging, saving, and recovering of patients' medical information into the electronic medical record. In addition, they added a computer-based application. The application can generate patient's report upon registration and check-out of the hospital. They proposed this study to ensure a more practical outcome that is less time-consuming, more accurate, reliable, and efficient method to facilitate keeping patients' records [6], [7], [8].

The need to maintain patients' medical records was based on this journal article. The proposed study is similar to this one for it converts the manual way of searching, cataloging, saving, and recovering of patients' medical information into the electronic medical record through the use of database system. [9] stated in his study that Electronic Patient Records (EPR) have become predominantly increasing in healthcare services since the year 1990 worldwide. The continuous improvement of patient care was made possible because of EPR. Having an electronic medical record is now a priority for all medical facilities to use [9].

The Department of Hamad Medical Corporation (HMC) sponsored research to provide an opportunity to explore the potential of EPR. The study was designed to bridge the gap between the complex dynamic involvement in the management

and use of patients' records. Some of the discontents expressed in the existing paper-based record systems were the lack of confidentiality, poor legibility, less storage capacity, and many records being misfiled. These problems were brought to the administrators of HMC for there was a need to address the issues regarding the existing manual patients' record system [9]. The disadvantages of the paper-based record are emphasized in this study. Thus a call for improvement is needed.

In 2012, in a news column in a website, Philippine Council for Health Research and Development, by lined by [10], it was found out by Dr. Marie Irene sy that the retrieval time using the electronic medical record system was decreased from 2.41 minutes initially to less than 5 minutes of retrieval. Because of this, the efficiency of health workers was increased, data quality improved, modern records management enabled, and both operationally and strategically data-guided decision-making made possible [10].

Furthermore, previously, it would take an average of four to five minutes to sort through a roomful of envelopes containing patients' records. Also, a new record will be made if the patients' records were not found with additional charges. But with the new system, retrieval of patients' records will just take a few seconds upon admission [10], [11], [12].

The efficiency of having an electronic medical record is based on this news article. According to an author, Region IX, Zamboanga Peninsula has an inadequate data banking system or retrieval system. The author emphasized that the database on health statistics of the region must be modernized and be made accessible. Having an updated database generates timely and consistent data to improve health information to the public [13], [14], [15]. This research report is the basis of the importance of having an electronic medical record system in the College Department Clinic of the University.

METHOD AND MATERIALS

This section described how the patient monitoring system for UIC college ANNEX campus was developed. The process model, research locale, and evaluators of the study were stated in this segment.

Process Model

This study used the Iterative and Incremental model in the development of the software. In the iterative and incremental model, the whole requirement is divided into various builds. These builds are then divided up into smaller, more easily managed modules. Each module passes through the requirements, design, implementation, and testing phases. It starts with a si-

mple implementation of the subset of the software requirement. It then enhances the new versions iteratively, until the system is ready to be implemented and developed. For every iteration, design modifications and new functional capabilities are made and added, respectively.

In this study, the researcher finds the iterative and incremental model appropriate in the development of the system because starting the construction with a minimal set of user requirements can lead to simpler and faster development of a working system. Since the method allows for revisiting previ-

ous phases of the development, problems that are encountered earlier can be addressed and solved right away. Although the system produced from the first increment is not the full implementation, it will give the programmer better ideas on how to go through the phases again with the addition of other requirements. Moreover, the researcher anticipates that the conditions will change during the development and upon presentation to the administration and the users, as well.

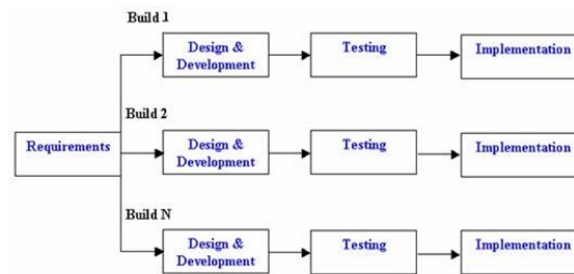


Fig. 2. Incremental and Iterative Model Diagram

Research Locale

The study was conducted at the University of the Immaculate Conception School Clinic Annex campus located at Bonifacio St., Davao City, where the school nurse, doctor, assistants, staff, faculty, and students were more prioritized since they were the ones involved in conducting such research.

Evaluators of the Study

The evaluators of the study are two (2) school nurses from the University clinic, one (1) doctor assigned to the University, four (4) student assistants, five (5) students from the different College programs, and five (5) faculty members from the University.

Data Specifications

The table shows the data and the data types used in the study.

TABLE 1
DATA TYPES USED IN THE STUDY

Data	Data type	Data	Data type
Username	Varchar	Temperature	Integer
Password	Varchar	BP	Integer
Name of staff	Character	Prescription	Character
Birthday	Varchar	Complaints	Character
Age	Integer	Name of Administrator	Character
Contact number	Integer	Name of SSP	Character
Address	Varchar	Name of Maintenance	Character
Last Name of Patient	Character	Name of Medicine	Character
First Name of Patient	Character	Quantity of medicine	Integer
Course	Character	Expiration date of medicine	Varchar
Year	Varchar	Department	Character
Weight	Integer	Height	Integer
Date	Date and Time		

Screen Specifications



Fig. 3. User log-in

Figure 3, shows the user login form of the system. A correct username and/or password is required to enter the main form of the system. On entering an incorrect username and/or

password, the system will prompt a dialog box similar to the Figure below (Figure 4).

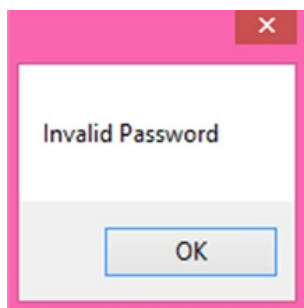


Fig. 4. Incorrect username and/or password

Figure 4, will prompt if the user typed in a correct user-name but the incorrect password. This message will also prompt if the user typed in a wrong username and correct password.

This will also be displayed if the user types in an incorrect username and password.

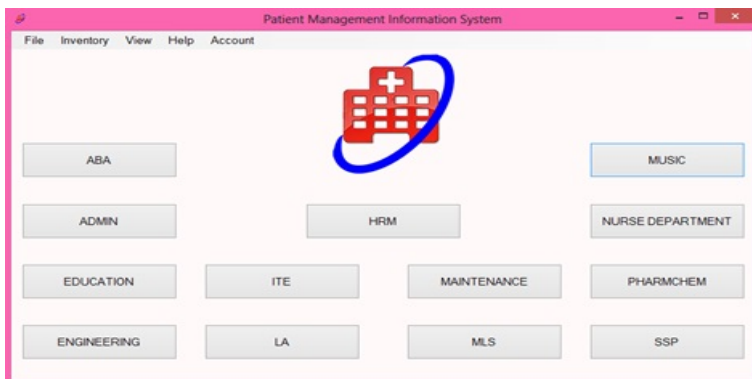
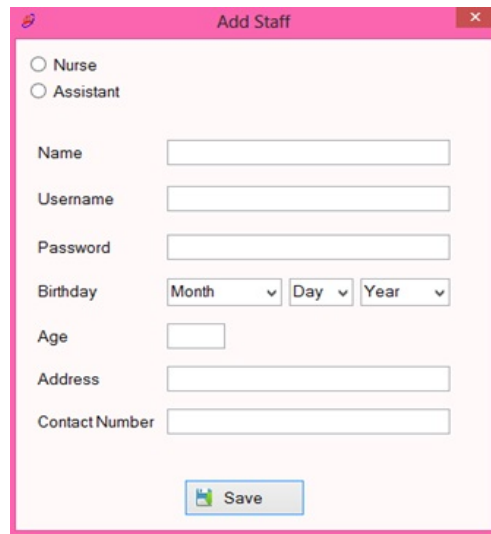


Fig. 5. Main form

Figure 5, shows the main form of the system. A clipart hospital is used as the logo for the system. The different courses offered by the school are presented in the main form, together with the administrator, maintenance, and SSP. These buttons view the patients' lists of that specific course and type. This form also holds the menu of the system. It has the file menu, inventory menu, view menu, help, and about the menu.

The file menu is clicked if new staff or new patient is added to the system. If the user decided to exit the program, it would be on this menu. Inventory menu is clicked if the user wants to view the medicine inventory of the clinic. Updating the expiration dates of the medicines is also in this menu. More importantly, printing the medicine inventory is on this menu.

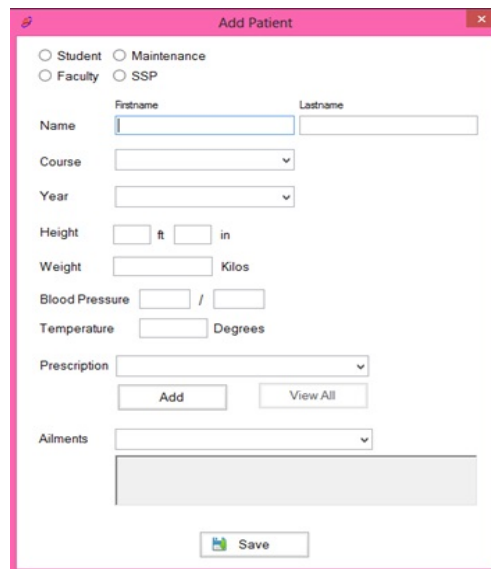


The 'Add Staff' form is a window with a pink title bar. It contains two radio buttons at the top: 'Nurse' and 'Assistant'. Below these are several input fields: 'Name', 'Username', 'Password', 'Birthday' (with dropdowns for Month, Day, and Year), 'Age', 'Address', and 'Contact Number'. A 'Save' button with a floppy disk icon is located at the bottom center.

Fig. 6. Add new user form

Figure 6, shows the Add New User form of the system. This form allows the administrator to create a new user. This form has two choices in the form of a radio button: one for the

nurse and the other is for the assistant. Necessary information is needed before the new user can be created such as the name, username and password, birthdate, address, and contact number



The 'Add Patient' form is a window with a pink title bar. It features four radio buttons: 'Student', 'Faculty', 'Maintenance', and 'SSP'. The form includes input fields for 'Firstname' and 'Lastname', a 'Name' label, 'Course', 'Year', 'Height' (with 'ft' and 'in' sub-fields), 'Weight' (with 'Kilos' label), 'Blood Pressure', 'Temperature' (with 'Degrees' label), 'Prescription', and 'Ailments'. There are 'Add' and 'View All' buttons below the Prescription field, and a 'Save' button at the bottom center.

Fig. 7. Add New Patient Form

Figure 7, shows the Add New Patient Form of the system. This form adds a new patient to the system. It has four choices: student, faculty, maintenance, and SSP. This is used for patient registration. Once the type of patient is identified, the name,

course, and year will be filled out. The prescription refers to the medicine endorsed to the patient, and the complaint refers to the reason why the patient went to the clinic.

The screenshot shows a window titled "Add Medicine" with a pink border. It contains the following fields: a text input for "Name", a numeric input for "Quantity", and three dropdown menus for "Expiration Date" labeled "Month", "Day", and "Year". A "Save" button with a floppy disk icon is located at the bottom center.

Fig. 8. Add new medicine form

Figure 8, is the form for adding a new medicine to the system. The name of the medicine will be entered along with

how many are to be added to the stock. The expiration date of the drug will also be included.

The screenshot shows a window titled "Medicine Inventory" with a pink border. It features a menu bar with "File", "Inventory", "View", "Help", and "Account". Below the menu is a search bar and a table of medicines. The table has three columns: "Name", "Quantity", and "Expiration".

Name	Quantity	Expiration
Serlyl	39	2/4/2016
Captopril	15	3/1/2015
Decolgen	31	8/3/2015
Dompedone	40	4/1/2016
Hydite	20	11/25/2014
Loperamide	48	9/5/2015
Loristadine	27	8/8/2015
Mefenamic Acid 500mg	72	12/14/2016
Paracetamol 500mg	67	12/9/2015
Sabutamol Nebule	24	7/16/2016
Simeco	24	2/26/2017
Xyzal 10mg	19	12/1/2014
Alcohol 70% 500ml	30	8/8/2018
Bactidol Gargle 500ml	20	8/8/2018
Band-Aid	71	8/8/2018

Fig. 9. Medicine inventory form

Figure 9, is the medicine inventory form of the system. It shows the list of drugs available in the clinic. The number as

to how many are left in stock is also shown in the form. It also shows the expiration date of the medicine.

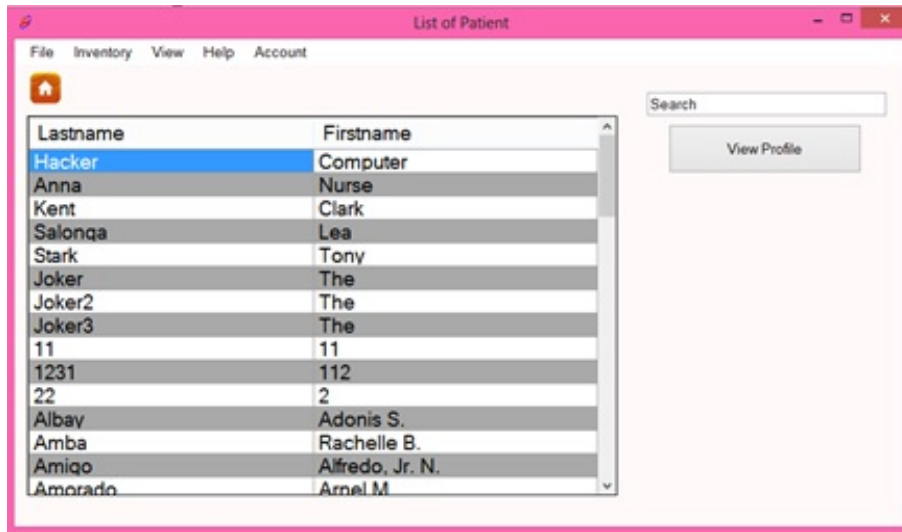


Fig. 10. View patient form

Figure 10, shows the View Patient form of the system. This will prompt if the View Patient sub-menu under View menu is clicked. It lists all the patients stored in the system. This form has the search label in which by typing the first letter of the last

name or first name of the patient, it will show the name of the patient having those letters. Also, by highlighting a name on the grid and by clicking the View Profile button, it displays the record of that patient (Figure 13).

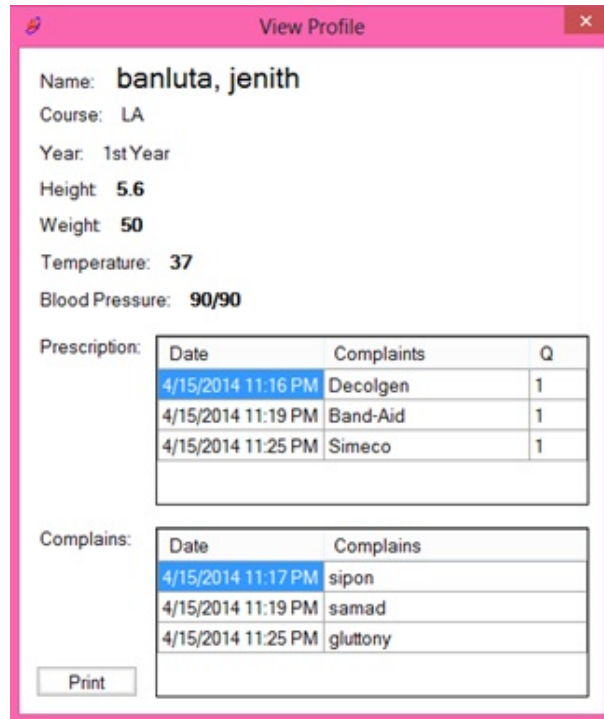


Fig. 11. View patient profile form

Figure 11, is the View Patient Profile Form of the system. The transactions done by the patient are listed in his/her profile. It also shows the day and time when he/she visits the clinic for

medical attention. The prescribed medicine and ailments he/she had at the moment are also recorded. This form can also be printed using the Print button found at the lower left of the form.

University of the Immaculate Conception
Bonifacio St. Davao City

Patient Record

Name: banluta, jonith
Course: LA
Year: 1st Year
Height: 5.6
Weight: 50
Temperature: 37
Blood Pressure: 90/90

Prescription:

Date	Medicine	Q
4/15/2014 11:16 PM	Decolgen	1
4/15/2014 11:19 PM	Band-Aid	1
4/15/2014 11:25 PM	Simeco	1

Complains:

Date	Complains
4/15/2014 11:17 PM	sipon
4/15/2014 11:19 PM	samad
4/15/2014 11:25 PM	gluttony

Fig. 12. Print form of patient's record

Figure 12, is ready to print form of the patient's record. The name of the school is used as a header. With this, patients can now have their copy of the medical record.

Immaculate of the Immaculate Conception
Bonifacio St. Davao City

Monthly Inventory of Medicines Dispensed
A.Y 2014 - 2015, Summer
April 1 - 30, 2014

Medicines	Stock Received	Original Quantity	Dispensed	Current Stocks
Aspirin				
Captopril				
Decolgen				
Dopendone				
Hydral				
Loperamide				
Loratadine				
Mefenamic Acid 500mg				
Paracetamol 500mg				
Salbutamol Nebule				
Simeco				
Systol 10mg				
Alcohol 70% 500ml				
Bacterial Gargle 500ml				
Band Aid				
Bum Ointment 30g				
Caladryl Lotion 30ml				
Efficascent Oil 25ml				
Eye Mo Red 7.5ml				
Pyralax 10ml				
Tanycin Ointment 10g				
Vicks VapoRub 50g				

Fig. 13. Medicine inventory print form

Figure 13, shows the ready to print form of medicine inventory. The name of the school is used as a header. The month is also displayed on the record, as well as the school year and semester it was done.

DISCUSSION

Every medical facility governs a significant amount of information. The vast bulk of data, however, comes from patients' records. As pointed by many authors, the paper-based record has disadvantages. It requires a significant amount of

storage space, it can be easily misplaced or misfiled, more time is spent on paperwork, there is a lack of confidentiality, there is poor legibility, and it is susceptible to errors.

For fighting the disadvantages of using paper-based records, electronic medical records were born. With this type of system, efficiency was heightened which fosters a more efficient medical practice, and it decreased time spent on paperwork. This is also the reason why this study is conducted.

This study aims to develop patient management information system for the University of the Immaculate Conception College Department Clinic, i.e., to create an electronic medical record system that is capable of storing patients' information and monitoring the inventory of medicines in the clinic.

The system has two levels or different users which is the administrator or the Nurse and the student assistant. Also, it is database integrated, and it generates a report.

CONCLUSION AND RECOMMENDATIONS

This study has been concerned with creating a patient management information system that is capable of storing patients, information and monitoring medicine inventory.

The designed system was able to develop an automated system to monitor patients' information and medicine inven-

tory and create a database of patients' records and medicine inventory. This helps the efficiency of clinic staff in providing clinical services to patients. With the help of this system, the staff was also able to reduce any unpleasant complaints from the patients. Moreover, because of its ability to generate printed output for patients' records and medicine inventory report, the staff was able to fulfill his/her requirements to the administrator.

To enhance the efficiency of the system, the following is the list of recommendations for future use.

The University of the Immaculate Conception has three campuses, the Bajada Campus, Main Campus, and Annex campus, respectively. It is best that the school clinics of the three campuses will have a unified database. Students can go to any of the school clinics without having to register their names again. Instead, their data will only be updated.

Furthermore, in the prescribed medicine part, the medicine should be categorized according to its ailments. Only the possible drug can be viewed on a specific illness.

Lastly, it will be more efficient if the system can be accessed online. With this, it can be accessed anytime.

Declaration of Conflicting Interests

No competing interests are declared by the authors.

REFERENCES

- [1] W. Q. Lindh, M. S. Pooler, C. D. Tamparo and B. M. Dahl, *Delmar's comprehensive medical assisting administrative and clinical competencies*. Boston, MA: Cengage Learning, 2010.
- [2] C. Lombardo. (2015). *The advantages and disadvantages of electronic medical record (EMR)* [Online]. Available: <https://goo.gl/cVRC4S>
- [3] Medical Records Team. (2009). *The World's Largest EMR Directory. What are the benefits of electronic medical records?* [Online]. Available: <https://goo.gl/TWbXY3>
- [4] D. Joos, Q. Chen, J. Jirjis and K. B. Johnson, "An electronic medical record in primary care: impact on satisfaction, work efficiency and clinic processes," in *Proceeding of American Medical Informatics Association (AMIA) Annual Symposium*, Washington, D.C., WA, pp. 394-398, 2006.
- [5] M. V. William, S. A. Flanders, R. Holman, W. F. Whitcomb, S. L. Chon, F. A. Michota, R. Gross and G. J. Merli, *Comprehensive hospital medicine: An evidence-based and systems approach*. Philadelphia, PA: Saunders Elsevier, 2007.
- [6] S. A. Asabe, N. D. Oye and M. Goji, "Hospital patient database management system: A case study of general hospital north-bank makurdi-Nigeria," *An International Journal of Advanced Computer Technology*, vol. 2, no. 3, pp. 65-72, 2013.
- [7] K. Sheahan. (2013). *What is the patient information management system?* [Online]. Available: <https://goo.gl/naRvZw>
- [8] F. J. Yang, "The user interface design of an intelligent tutoring system for relational database schema normalization." *International Journal of Technology and Engineering Studies*, vol. 2, no. 3, pp. 70-75, 2016.
- [9] F. H. Abdullah, "Electronic patient records system in Hamad medical corporation, Qatar: perspectives and potential use," Doctoral dissertation, Loughborough University, Loughborough, UK.
- [10] Philippines Council For Health Research And Development. (2008). *Electronic medical record system, CHITS, can retrieve patient record in five seconds expert* [Online]. Available: <https://goo.gl/L7QwyK>
- [11] S. Casteleyn, F. Daniel, P. Dolog and M. Matera, *Engineering web applications*. Heidelberg, Germany: Springer, 2009.
- [12] R. M. Roth, B. H. Wixom and A. Dennis, *System analysis and design*, Asia: John Wiley & Sons, 2010.

- [13] P. Naido, "Evaluation of clinics on the provision of youth friendly services in the Ethekewini Metro of Kwazulu Natal," *International Journal of Health and Medical Sciences*, vol. 1, no. 1, pp. 1-7, 2015.
- [14] M. C. Lacuesta, G. Ilagan and P. C. Sanz, *Health research agenda of Mindanao: A zonal report 2006-2010*, Manila, Philippines [Online]. Available: <https://goo.gl/qVbZYp>
- [15] J. J. Marciniak, *Encyclopedia of software engineering*, 2nd ed. New York, NY: John Wiley and Sons, Inc, 2001.

— This article does not have any appendix. —