

Enhancing Personalized Healthcare with an Effective E-Healthcare Management System

Suraya Nurain Kalid, Sin-Ban Ho, Amalina Ibrahim, Johan Harris Nor Azman, Szu-Jean Tan,
Jia-En Cheong

Faculty of Computing and Informatics, Multimedia University, Persiaran Multimedia, 63100,
Cyberjaya, Selangor, Malaysia

Suraya.nurain@mmu.edu.my

Abstract. To ensure comprehensive individual healthcare, it is essential to establish a sound healthcare system. Apart from providing high-quality healthcare services, this system prioritizes patient-centeredness and accessibility for all individuals. Proper support and care for healthcare professionals should be ensured while minimizing resource wastage. A well-functioning healthcare system should incorporate new technologies and innovations to enhance efficiency and deliver quality care. The confidentiality and careful handling of patient records and hospital data are of utmost importance. However, many hospitals still rely on traditional record-keeping methods, such as paper-based systems and physical files. This practice poses risks of record loss, whether due to factors like insect damage or unfortunate disasters. In addition, improper handling of records may allow unauthorized individuals to access sensitive information. Therefore, this paper aims to address the abovementioned issues by proposing a methodology to develop an effective e-healthcare management system. This research will integrate various modules, including medical user management, consultation appointment, medication stock management, bed management, staff directory, and vaccination appointment mechanisms that are beneficial for hospital management.

Keywords: e-healthcare, consultation, medical documentation, stock management, vaccination appointment

1. Introduction

Healthcare is one of the most critical industries in any country. Healthcare's primary purpose is to promote and preserve health, to prevent and manage diseases, accidents, and impairments, and to improve the overall quality of life (Dobre et al., 2019). It entails diverse experts, including doctors, nurses, therapists, chemists, technicians, and other healthcare workers, who work together to provide patient-centred care. In order to ensure a good healthcare system, many factors need to be taken into consideration.

In 2020, we were challenged by the COVID-19 pandemic, which caused our healthcare system to utilize online services fully. However, not all hospitals are equipped with the technology to provide online services, and they still rely on traditional record-keeping methods (Hertin & Al-Sanjary, 2018). A statistic shows 87% of providers still use paper and manual processing to collect patient data (Anderson, 2020). Data entry is an important process as we need to ensure the precision of data and avoid any errors during data entry. However, manual data entry is prone to error. Research by Zeleke et al., 2019 shows that the error rate of capturing data using pen and paper is higher than that of electronically. In addition to that, data confidentiality may also be an issue when data keeping is not done correctly. Besides that, some areas, such as bed management, can be improved. Currently, vacant beds in the wards are checked by manual checking, and it will be an additional task for the nurses in the ward and the Admission Officer to ensure that the rooms are cleaned before the next patient occupies the room.

With the issues mentioned, this study aims to develop an e-Healthcare Management System (eHMS) that can improve the efficiency of the healthcare system, boost the efficiency and productivity of medical professionals and administrators, and improve medical user experience by integrating different modules such as medical user management, consultation appointment, medication stock management, bed management, staff directory, and vaccination appointment into a single platform.

The paper is organized into four sections. Section 2 discusses the literature review from the previous studies and the related works. Section 3 states the methodology used for the eHMS. The results will be discussed in Section 4, and last but not least, Section 5 will conclude the study.

2. Literature Review

2.1. DeLone and McLean Information System

A person or organization that gathers, transforms, and retains data while using technology to distribute and use it is called an information system (IS). Information systems assist managers and staff members in evaluating issues, comprehending complicated phenomena, creating innovative products, and aiding decision-making, coordination, and control procedures (Çelik et al., 2022). DeLone and McLean analyzed the information system and created a model. By defining, outlining, and illuminating the relationships between six categories of success characteristics, the DeLone and McLean Information System Success Model, which is frequently used in information systems, seeks to provide a thorough knowledge of information system success. (DeLone and McLean, 2003, Çelik et al., 2022, Rokhman et al., 2022). The six categories of success characteristics are as per Figure 1.

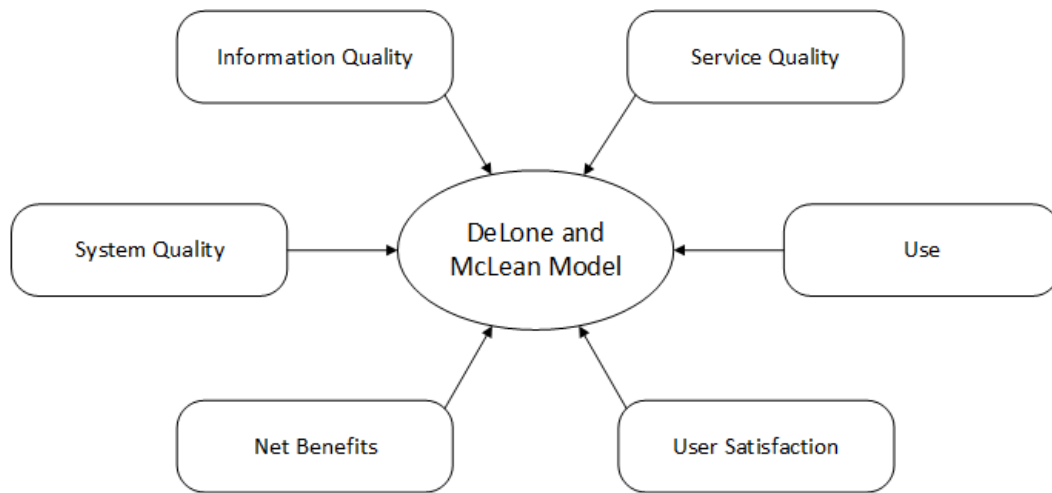


Fig. 1: The six categories of success characteristics based on DeLone and McLean model.

The first category is system quality. System quality is more on the technicality of the system, such as the functionality and reliability of the system. Next, the information's accuracy also determines the information system's success. Accurate, high-quality and meaningful information will improve problem-solving and decision-making. The information system should also be responsive and able to meet the needs and expectations of the users. The information system should be able to respond quickly with accurate and relevant information. When an information system is responsive, it can address the users' needs timely and effectively.

The success of the information system is also determined by the user's actual usage and acceptance of the information system to complete their work or tasks. A good information system is an information system that is actively utilized by the users (Blumenthal & Tavenner, 2010). Users' utilization of the system indicates that it is useful and can increase their productivity. User satisfaction describes the overall performance of the information system. User satisfaction can be determined based on the system's reliability, ease of use, and usefulness. The last category that determines an information system's success is net benefits.

A successful information system should improve the management of existing processes, problem-solving processes, decision-making, cost-effectiveness, increase productivity and give high-quality services. The DeLone and McLean model provides a comprehensive framework for assessing the effectiveness of information system performance and aids in understanding such systems' success. (DeLone and McLean, 2003, Holden and Karsh, 2010, Rahi et al., 2021).

2.2. Healthcare Management System

Every healthcare institution must have a good healthcare management. Healthcare management involves not only patient records but also tracking and managing appointments and maintaining staff records. Due to the level of importance of the healthcare industry, it is crucial to have an excellent healthcare management system (Tian et al., 2019, Haldane et al., 2021). A robust healthcare management system improves efficiency in providing care to patients. Efficient and effective healthcare service delivery will improve patient experiences (Yang et al., 2019, Teisberg et al., 2020).

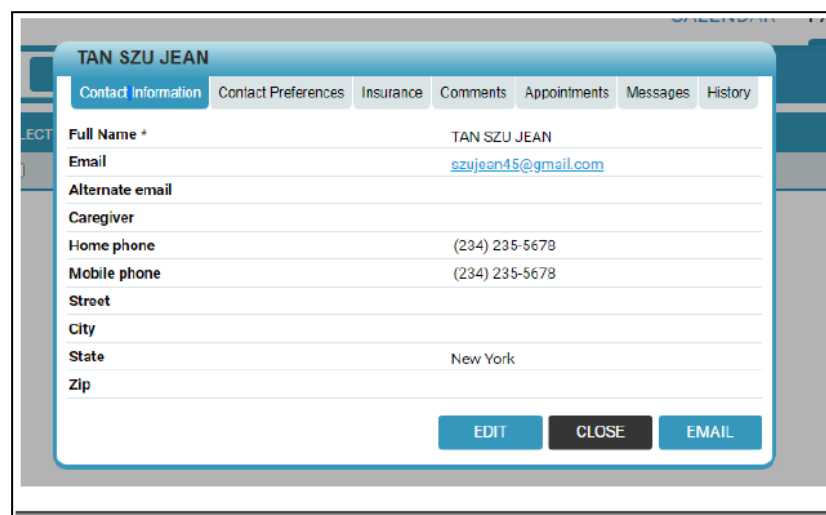
A healthcare management system will ensure the safety of patients' information by providing electronic medical records and medication management systems. Electronic medical records and medication management systems are not only essential for patients. However, they can also improve the efficiency of medical staff to keep track of the records. At the same time, having an electronic

mechanism for keeping records can reduce waste, keep costs under control, and provide cost-effective care without sacrificing quality (Carey et al., 2016, Keshta & Odeh, 2021, Quan et al., 2023).

Patient records, medical research, and population health statistics generate massive volumes of data in healthcare. A solid healthcare management system enables effective data collection, storage, analysis, and sharing. This data-driven approach enables healthcare practitioners to make better decisions, identify patterns, measure outcomes, and develop strategies for improving healthcare delivery and population health (Berrouiguet et al., 2018, Mujawar et al., 2020). By focusing on these elements, healthcare organizations may provide high-quality care, improve outcomes, and enhance patient and provider experiences.

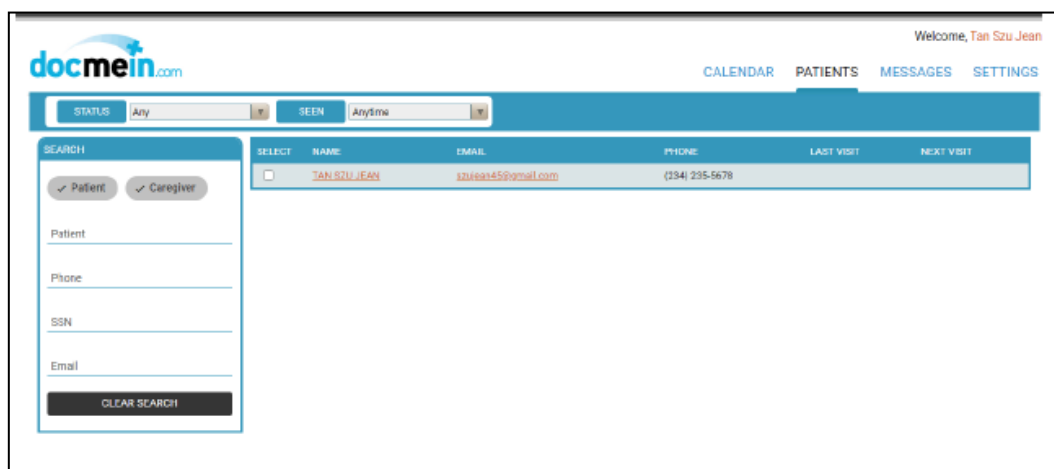
2.3. DocMeIn.com

DocMeIn.com is the first system that is being examined. Medical staff can access their appointment schedule using a calendar view. The medical personnel will notably benefit from this approach because it visually displays their job and appointment schedule. However, it is essential to recognize a few drawbacks of this approach.



The screenshot shows a user profile for TAN SZU JEAN. The profile is displayed in a modal window with a title bar and several tabs: Contact Information, Contact Preferences, Insurance, Comments, Appointments, Messages, and History. The 'Contact Information' tab is active, showing fields for Full Name, Email, Alternate email, Caregiver, Home phone, Mobile phone, Street, City, State, and Zip. The values are: Full Name: TAN SZU JEAN, Email: szujean45@gmail.com, Home phone: (234) 235-5678, Mobile phone: (234) 235-5678, State: New York. At the bottom right of the modal are three buttons: EDIT, CLOSE, and EMAIL.

Fig. 2: The figure shows the user's details under the contact information page.



The screenshot shows the DocMeIn.com user management page. The page has a header with the DocMeIn.com logo and a welcome message for Tan Szu Jean. There are navigation tabs: CALENDAR, PATIENTS, MESSAGES, and SETTINGS. Below the header, there are filters for STATUS (Any) and SEEN (Anytime). On the left, there is a search section with buttons for Patient and Caregiver, and input fields for Patient, Phone, SSN, and Email. A CLEAR SEARCH button is at the bottom of the search section. On the right, there is a table with columns: SELECT, NAME, EMAIL, PHONE, LAST VISIT, and NEXT VISIT. The table contains one row for TAN SZU JEAN with the email szujean45@gmail.com and phone (234) 235-5678.

Fig. 3: The figure shows the DocMeIn.com user management page.

Figure 2 and Figure 3 depict how the system captures the details of medical users. However, the medical user management system lacks a section where medical staff can input the medical user's medical record. As a result, medical staff cannot access and review the users' medical history. This limitation poses difficulties for medical staff, as manually maintaining such records is time-consuming and labour-intensive, which may reduce their job efficiency (Kannan & Jian, 2022, Anaam et al., 2023). It would be more efficient and convenient to include a dedicated section in the system for entering the medical records of each user.

2.4. VitaSoft - FreeMed

Moving on to the second system analyzed, VitaSoft - FreeMed, the system does provide a proper system record for the medical user, as shown in Figure 4. However, booking appointments is cumbersome and manual for the users. Introducing an appointment feature would significantly enhance the efficiency of the appointment process, benefiting both users and staff alike.

Fig. 4: The VitaSoft – Free Med user medical records.

2.5. OpenEMR

The final system analyzed is OpenEMR. OpenEMR is a robust system offering several valuable features, including comprehensive medical record and appointment scheduling systems, per Figure 5. However, there is a limitation in the system regarding the ability to mark appointments as “cancelled.” When an appointment is cancelled, the system removes all associated data. From a record-keeping perspective, retaining all data in the management system, including information about cancelled appointments, is highly recommended. It is crucial to differentiate between deleted data and cancelled data, as they serve distinct purposes.

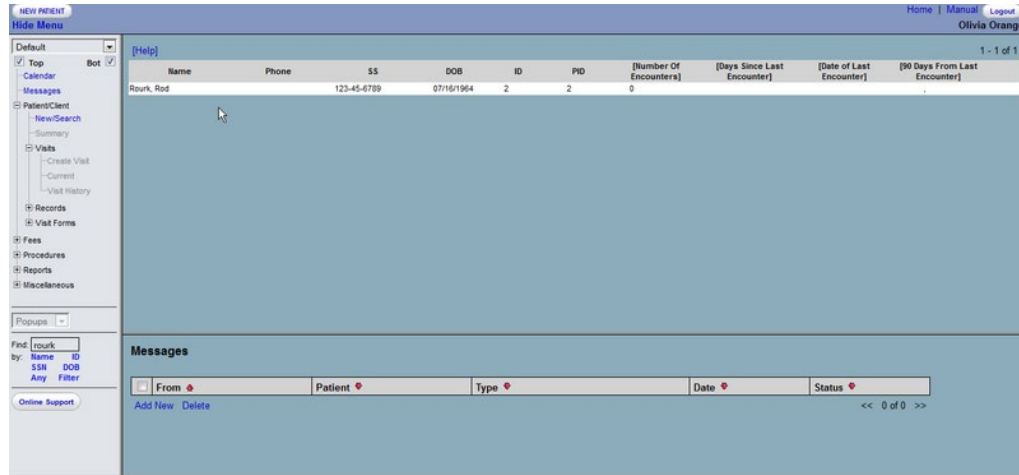


Fig. 5: The figure shows the OpenEMR appointment scheduling system.

3. Methodology

The healthcare industry in many developed countries has experienced significant integration with Information Technology, particularly inpatient treatment, documentation, and management. The primary objectives of a healthcare management system are to enhance the efficiency of medical data documentation and management, improve the efficiency of medical services and performance, and engage with users. This e-healthcare management system allows medical staff to gather and manage data digitally and efficiently.

Simultaneously, medical users will benefit from a seamless process for accessing their required medical services. The list of system features is as per Table 1. The system features that are listed are categorized based on users. This system will involve three users: the admin, the medical staff and the user.

Table 1: The table shows the list of features for each system user.

Admin	• Can log in • Can manage profile • Can add and manage users • Can add authorized admin and medical staff • Can view and reply to contact message
Medical Staff	• Can log in • Can manage profile • Can add and manage users • Can manage consultation appointment • Can manage medical record • Can manage vaccination appointment • Can manage medicine stock • Can manage bed
User	• Can register • Can log in • Can manage profile • Can book and view consultation appointment • Can book and view vaccination appointment • Can view medical record • Can submit a contact message • Can view the medical staff directory

3.1. Use Case Diagram

Figure 6 to Figure 8 shows the use case diagram for the eHMS. The target users of the system are the user (patient or caretaker), medical staff (nurse or doctors), and the administrator. Figure 6 shows the use case for the user. Users must register and log in before they can access the system. Once they have logged in to the system, the users can manage their profile, such as view and edit their personal details, book and view their vaccination appointment, book and view their consultation appointment and view their medical records. Besides that, the users can also view the medical staff directory and submit messages for any inquiries.

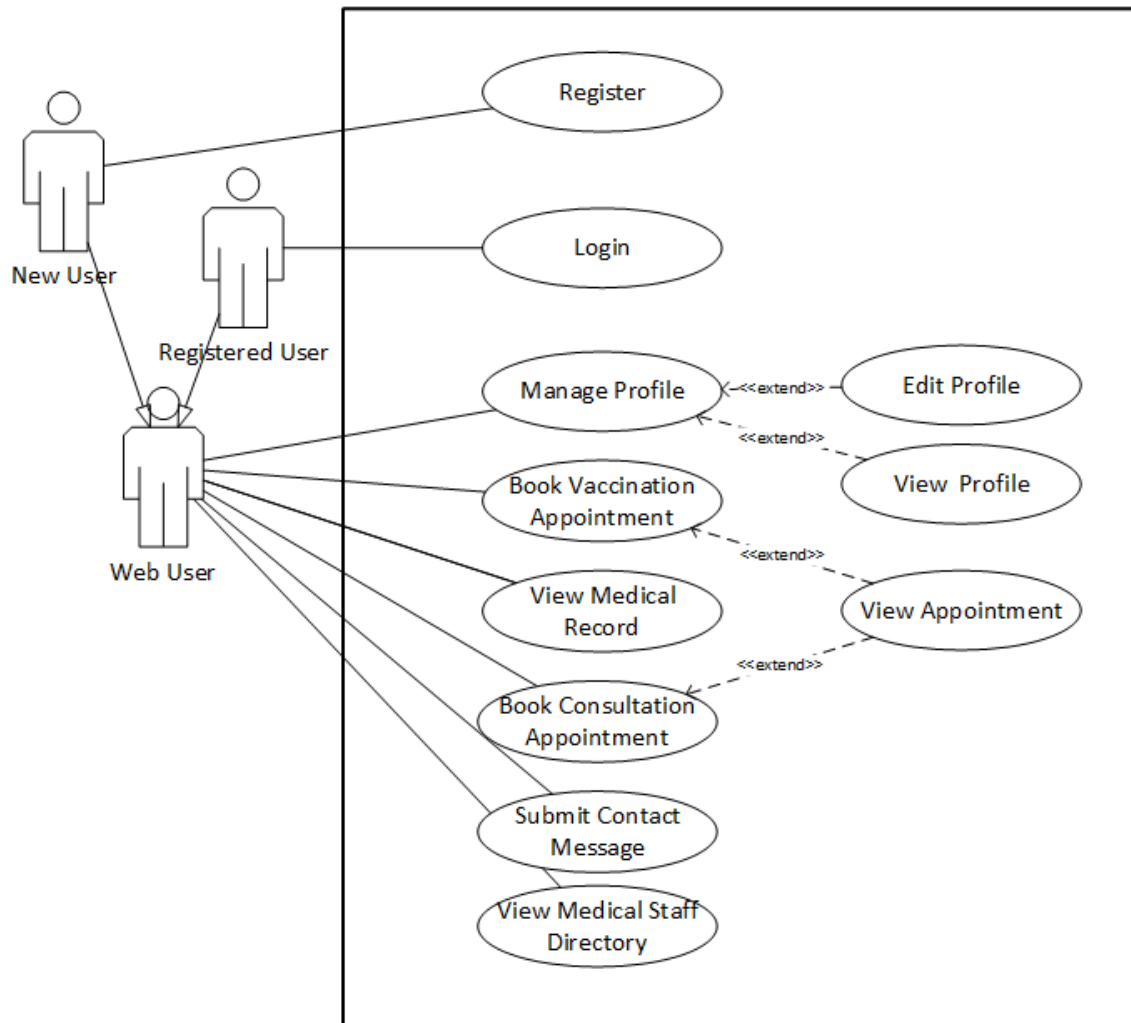


Fig. 6: Use case diagram for users of eHMS.

Figure 7 shows the use case diagram for the medical staff. Like users, medical staff must also log in to access the system. Medical staff can view and edit their profile and view the vaccination and consultation appointments made by the users. Medical staff can also edit the appointment details by changing the appointment status to “Scheduled”, “Confirmed”, “Completed”, or “Cancelled”. Besides that, medical staff can manage users’ medical records by adding new records and editing existing records.

Medical staff can manage the medicine stock by adding new medicine records and editing the medicine stock. Medical staff can also manage the bed details by adding new bed details and editing existing bed details. Medical staff can edit bed details by changing the bed status from empty to “Occupied” or “Cleaning”.

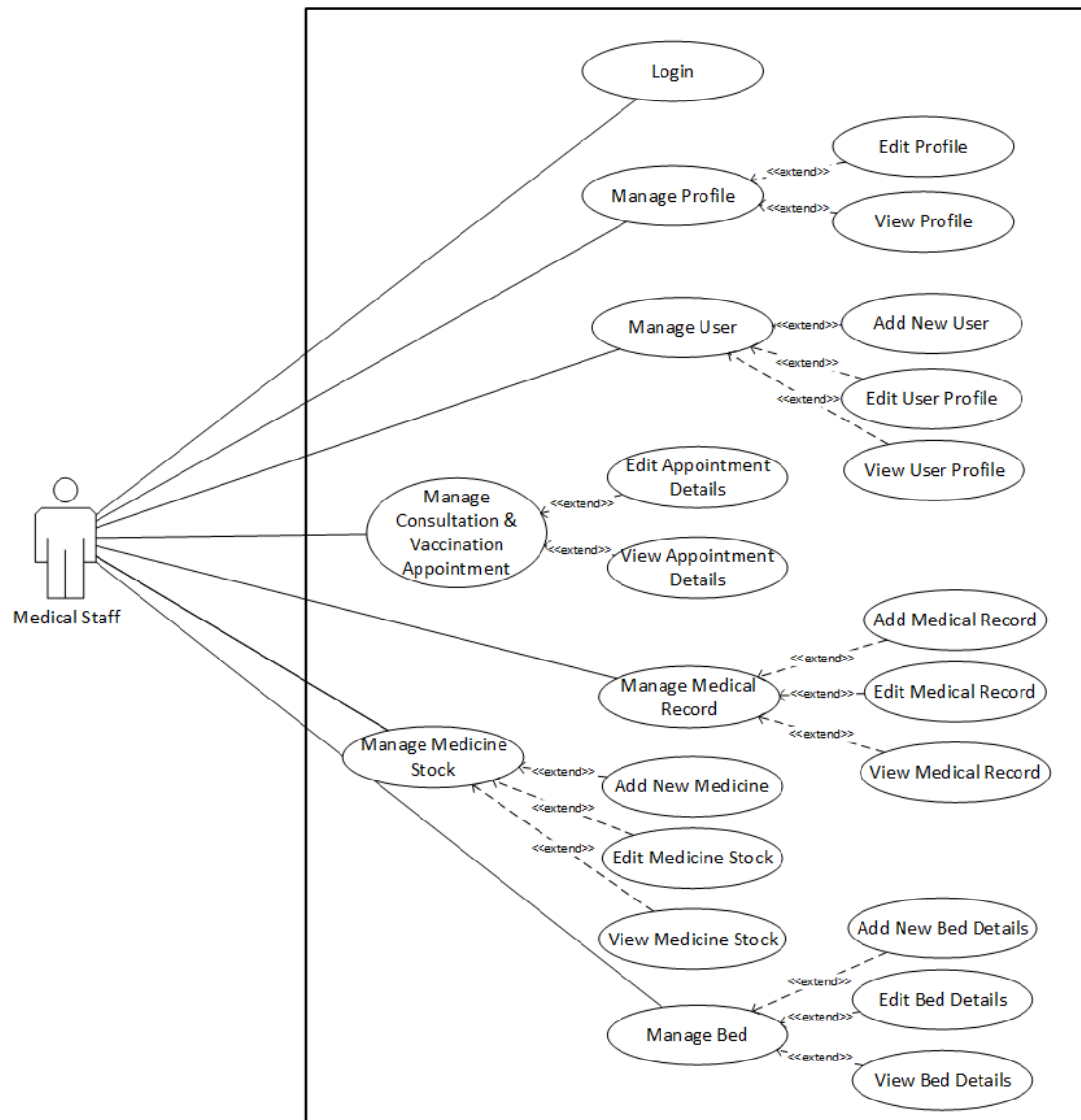


Fig. 7: Use case diagram for medical staff of e-Healthcare Management System (eHMS).

Figure 8 shows the use case diagram for the administrator. The administrator will need to log in to access the system. Admin able to manage their profile as well as users' profile. Suppose there are some issues where users cannot register independently or have some difficulties editing their profile details; the administrator can help by adding new users to the system and editing users' details. The administrator will also be able to add new medical staff and administrators.

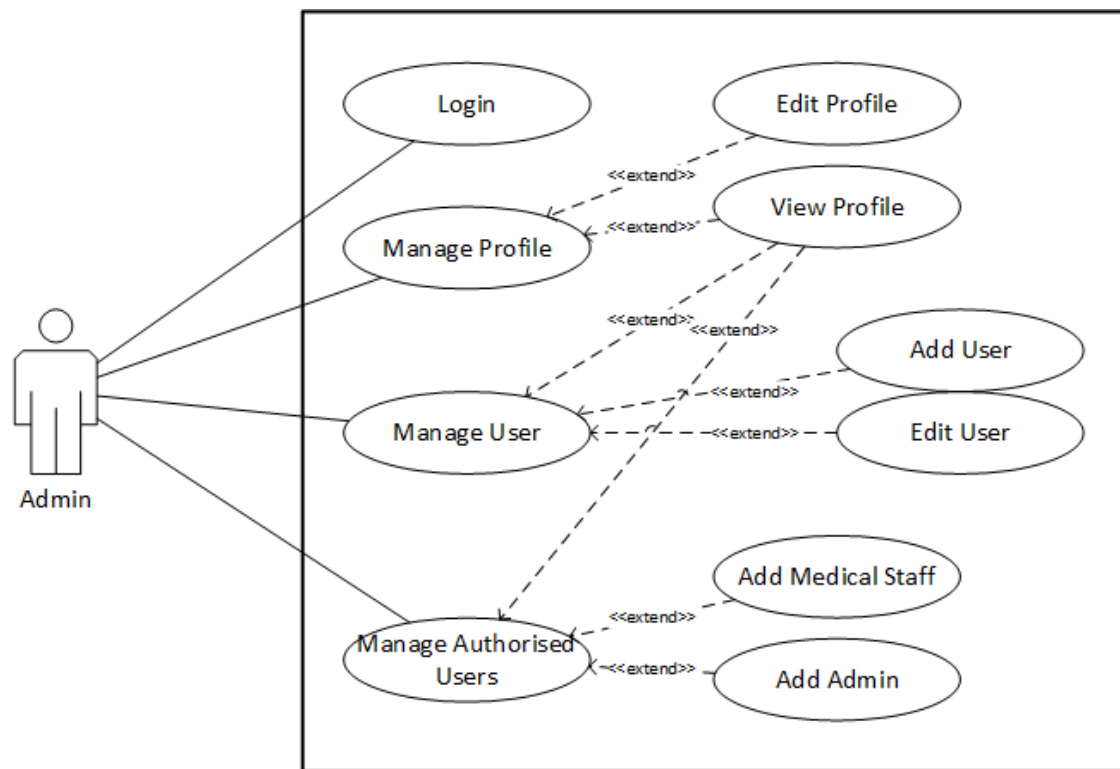


Fig. 8: Use case diagram for the eHMS administrator.

4. Results

4.1. e-Healthcare Management System (eHMS) Preview

This section will discuss the preview of the system based on the research objectives. Figure 9 and Figure 10 show the vaccination appointment booking form and consultation appointment booking form. Medical users can use these forms to book their vaccination and consultation appointments. For vaccination appointment booking, users are required to select the required vaccine. The medical staff will determine the vaccination date and time, and the medical user can accept or cancel the appointment as per Figure 11. In order to book a consultation appointment, users are required to select their preferred doctor, state their medical concerns and choose their preferred date and time. The list of appointments will be displayed on the users' dashboard as per Figure 12.

Fig. 9: Book vaccination appointment form that allows medical users to book vaccination appointments.

Book An Appointment

Book an appointment online with no hassle. We will get back to you and fix a meeting with doctors. Please check on your appointment dashboard for a confirmed appointment.

You have successfully request for a consultation appointment. Please check "My Consultation Appointment" for your appointment status.

Select Preferred Doctor

Medical Concern/Reason (Optional)

Select Appointment Date

mm/dd/yyyy
📅

Select Appointment Time

9:00 a.m.

10:00 a.m.

11:00 a.m.

12:00 p.m.

1:00 p.m.

2:00 p.m.

3:00 p.m.

4:00 p.m.

5:00 p.m.

6:00 p.m.

☐ By submitting the form, I acknowledge that my information will be used and referred during the registration process.
 ☐ By submitting the form, I acknowledge that the appointment made via online **DOES NOT** constitute to a **CONFIRMED** appointment.

Make An Appointment

Fig. 10: Book consultation appointment forms allowing medical users to book appointments.

My Vaccination Appointment

Instruction

Show 10 entries
Search:

Vaccination ID	Vaccine	Vaccination Date	Vaccination Time	Vaccination Status	Action
V00010	Moderna	N/A	N/A	Cancelled	✓ ✎ ✕
V00011	Sinovac	2022-04-28	09:00:00	Completed	✓ ✎ ✕
V00012	Johnson and Johnson	2022-04-29	10:30:00	Scheduled	✓ ✎ ✕
V00013	Pfizer	N/A	N/A	Booked	✓ ✎ ✕
V00014	Pfizer	N/A	N/A	Booked	✓ ✎ ✕

Showing 1 to 5 of 5 entries
Previous **1** Next

Fig. 11: Medical user vaccination appointment list.

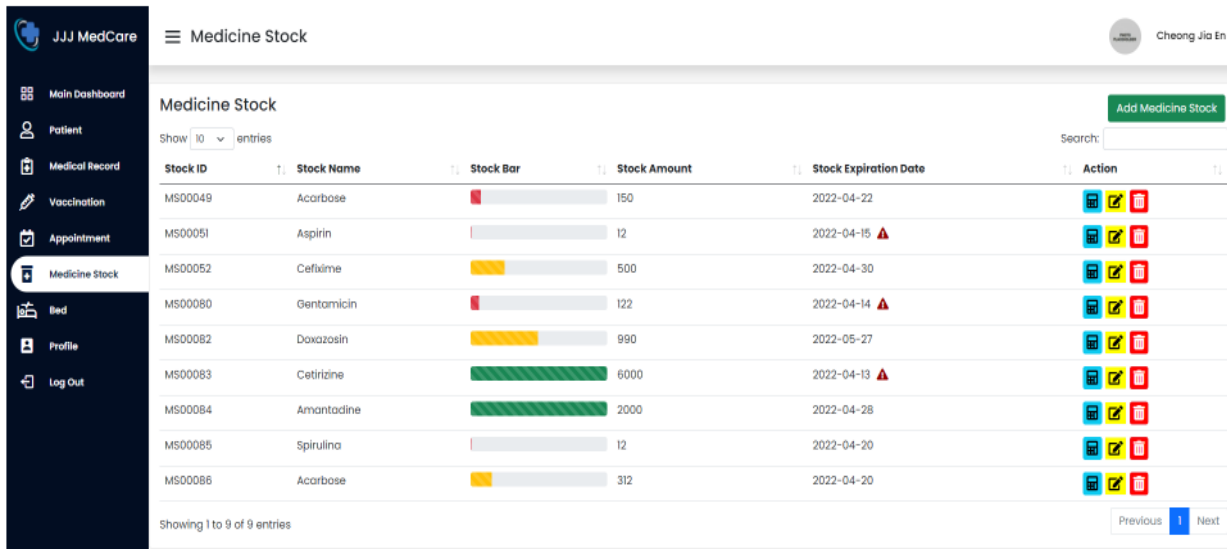
My Consultation Appointment

Instruction

Appointment ID	Appointment Date	Appointment Time	Preferred Doctor	Appointment Status	Action
AP00018	2022-04-01	14:00:00	Doctor Josh Hart	Cancelled	✓ ✎ ✕
AP00019	2022-04-22	18:00:00	Doctor Sasuke Uchiha	Cancelled	✓ ✎ ✕
AP00020	2022-04-22	18:00:00	Doctor Sasuke Uchiha	Cancelled	✓ ✎ ✕
AP00021	2022-04-22	09:00:00	Doctor Sasuke Uchiha	Cancelled	✓ ✎ ✕
AP00022	2022-04-29	18:00:00	Doctor Sasuke Uchiha	Booked	✓ ✎ ✕
AP00023	2022-04-19	14:00:00	Doctor Joseph Sterling	Scheduled	✓ ✎ ✕
AP00024	2022-04-29	18:00:00	Doctor Sasuke Uchiha	Booked	✓ ✎ ✕
AP00025	2022-04-28	14:00:00	Doctor Joseph Sterling	Completed	✓ ✎ ✕
AP00026	2022-04-29	12:00:00	Doctor Joseph Sterling	Confirmed	✓ ✎ ✕
AP00027	2022-04-23	09:00:00	Doctor Joseph Sterling	Booked	✓ ✎ ✕

Fig. 12: Medical user dashboard that shows the list of future and history consultation appointments.

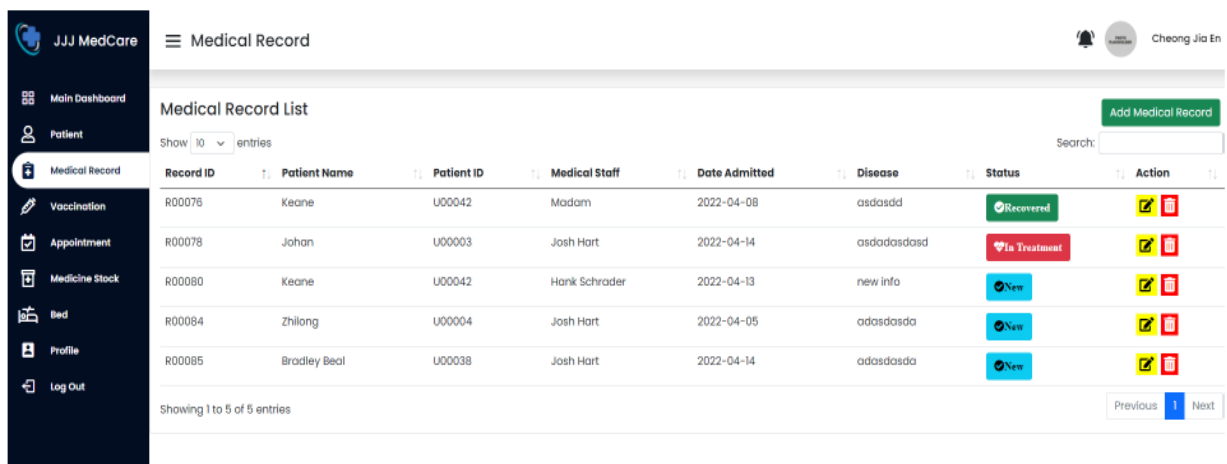
The medical staff can monitor the stocks of available medicine and medicines reaching the expiry date from the medicine stock page. On the medicine stock page, medical staff can track any medicine that is decreasing in quantity and medicine that is reaching the expiration date. Medical staff can also delete unused medicine, edit the medicine details, and replenish the medicine stocks as per Figure 13.



Stock ID	Stock Name	Stock Bar	Stock Amount	Stock Expiration Date	Action
MS00049	Acarbose		150	2022-04-22	  
MS00051	Aspirin		12	2022-04-15 	  
MS00052	Cefixime		500	2022-04-30	  
MS00080	Gentamicin		122	2022-04-14 	  
MS00082	Doxazosin		990	2022-05-27	  
MS00083	Cetirizine		6000	2022-04-13 	  
MS00084	Amantadine		2000	2022-04-28	  
MS00085	Spirulina		12	2022-04-20	  
MS00086	Acarbose		312	2022-04-20	  

Fig. 13: List of medicines.

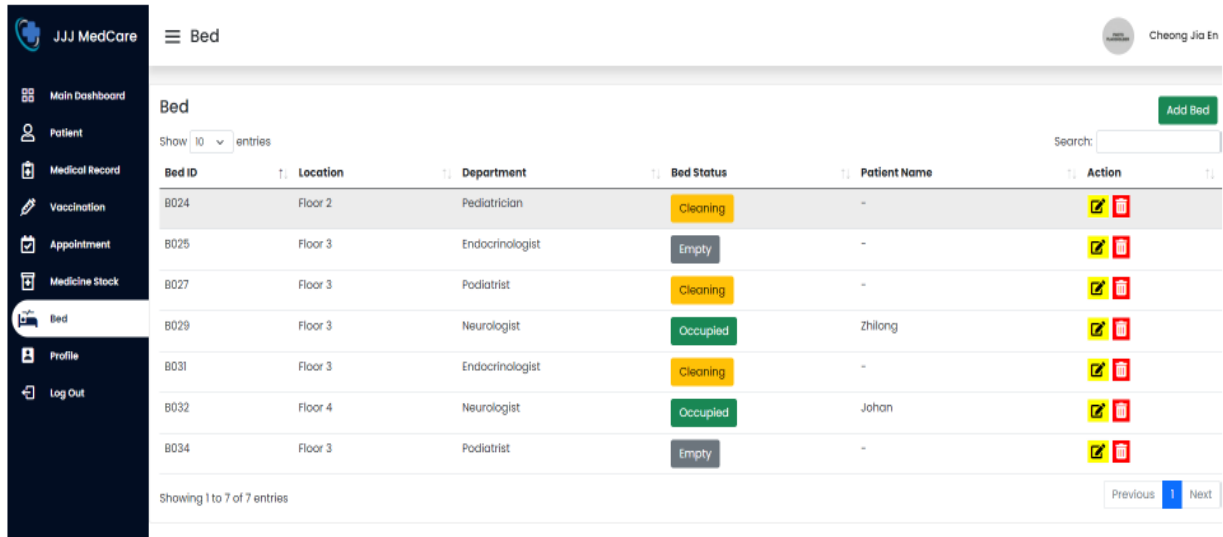
Figure 14 shows the list of medical users' records. Medical staff can manage the medical users' records, such as viewing the medical users' names, IDs, attending medical staff, medical conditions, and admission dates. From the list, the medical staff can also determine the medical user's current status, such as a newly registered user or currently in treatment. Medical staff can edit and delete the medical users' records as well.



Record ID	Patient Name	Patient ID	Medical Staff	Date Admitted	Disease	Status	Action
R00076	Keane	U00042	Madam	2022-04-08	asdasdd		 
R00078	Johan	U00003	Josh Hart	2022-04-14	asdasdasdad		 
R00080	Keane	U00042	Hank Schrader	2022-04-13	new info		 
R00084	Zhilong	U00004	Josh Hart	2022-04-05	adasdasda		 
R00085	Bradley Beal	U00038	Josh Hart	2022-04-14	adasdasda		 

Fig. 14: List of medical users' records.

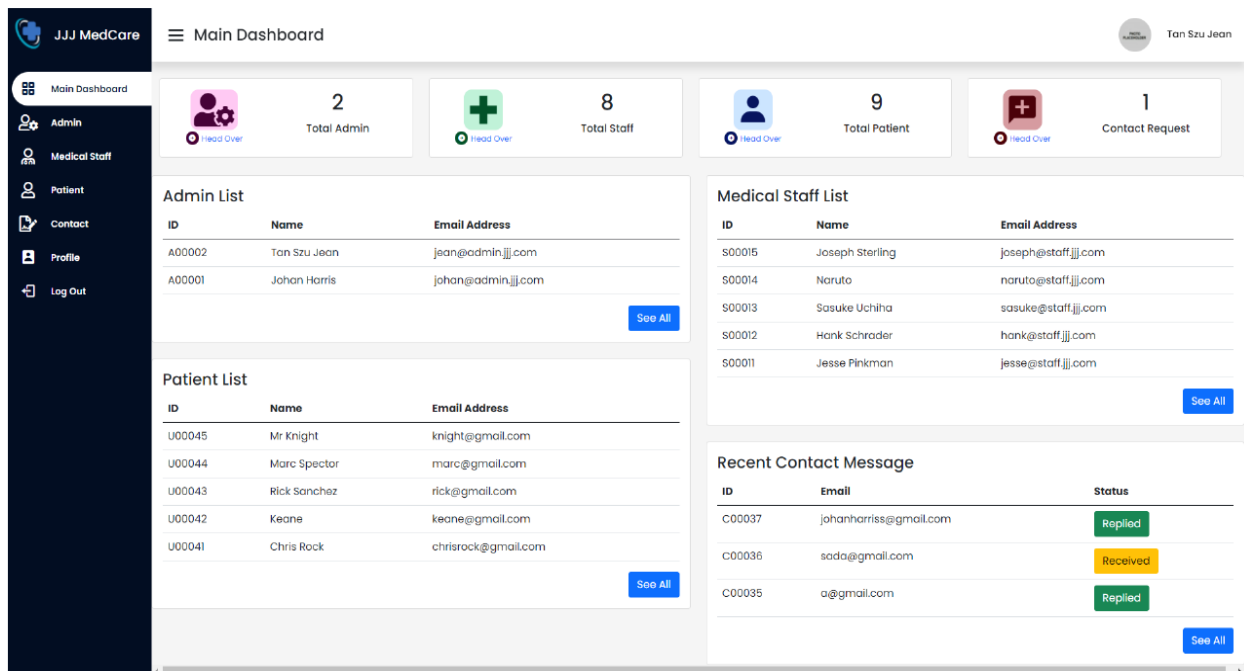
Figure 15 shows the list of inpatient ward bed records. Medical staff can manage the ward bed records, such as viewing the bed id, the department and the bed location, the bed status such as vacant, occupied or in the cleaning process, and the patient name currently using the bed. Medical staff can edit and delete the bed records as well.



Bed ID	Location	Department	Bed Status	Patient Name	Action
B024	Floor 2	Pediatrician	Cleaning	-	[Edit] [Delete]
B025	Floor 3	Endocrinologist	Empty	-	[Edit] [Delete]
B027	Floor 3	Podiatrist	Cleaning	-	[Edit] [Delete]
B029	Floor 3	Neurologist	Occupied	Zhulong	[Edit] [Delete]
B031	Floor 3	Endocrinologist	Cleaning	-	[Edit] [Delete]
B032	Floor 4	Neurologist	Occupied	Johan	[Edit] [Delete]
B034	Floor 3	Podiatrist	Empty	-	[Edit] [Delete]

Fig. 15: List of beds.

As per Figure 16, the medical staff's main dashboard will show the summary of all records, such as the vaccination appointment, patient list and medicine stock. Medical staff can get an overview of the vital records on this page.



Admin List		
ID	Name	Email Address
A00002	Tan Szu Jean	jean@admin.jjj.com
A00001	Johan Harris	johan@admin.jjj.com

Medical Staff List		
ID	Name	Email Address
S00015	Joseph Sterling	joseph@staff.jjj.com
S00014	Naruto	naruto@staff.jjj.com
S00013	Sasuke Uchiha	sasuke@staff.jjj.com
S00012	Hank Schrader	hank@staff.jjj.com
S00011	Jesse Pinkman	jesse@staff.jjj.com

Patient List		
ID	Name	Email Address
U00045	Mr Knight	knight@gmail.com
U00044	Marc Spector	marc@gmail.com
U00043	Rick Sanchez	rick@gmail.com
U00042	Keane	keane@gmail.com
U00041	Chris Rock	chrisrock@gmail.com

Recent Contact Message		
ID	Email	Status
C00037	johanharris@gmail.com	Replied
C00036	sada@gmail.com	Received
C00035	a@gmail.com	Replied

Fig. 16: Medical staff dashboard.

4.2. System Testing

The proposed system has been tested and the summary is as per Table 2.

Table 2: Test results for the main features

Test ID	Test Case	Expected Result	Actual Result	Status
1	<u>User Login</u> Enter valid email and valid password. Click the “Login” button	– Users should be able to login to the system. – The system should display a home page with the name of the user.	– User is able to login. – Index page with name of user in the navigation bar is displayed.	Pass
2	<u>Admin Login:</u> Enter valid email and valid password. Click the “Login” button.	– Admin should be able to login to the system. – The system should display an admin dashboard	– Admin is able to login. – Admin dashboard is displayed	Pass
3	<u>Staff Login:</u> Enter valid email and valid password. Click the “Login” button.	Staff should be able to login to the system.	– Staff is able to login. – Staff dashboard is displayed	Pass
4	<u>User Register</u> Enter valid email and valid password. Click the “Register” button.	– User should be able to register. – It will automatically head to login page	User is registered.	Pass
5	<u>Edit User Profile</u> Enter the correct details and click “Edit profile” button.	User should be able to edit and view latest changes.	User is able to view changes.	Pass
6	<u>User Profile Change Password</u> Enter the correct password and match the new password. Click “change password” button.	– User should be able to change the password – User can use the new password to login	User password changed	Pass
7	<u>Add Admin</u> Enter the correct details and click “Add admin” button.	– Admin should be able to add – Admin should be able to view new admin at the list	– Admin is able to add – Admin can view new admin at the list	Pass
8	<u>Add Medical Staff</u> Enter the correct details and click “Add medical staff” button.	– Admin should be able to add – Admin should be able to view new staff at the list	– Admin is able to add – Admin can view new medical staff at the list	Pass
9	<u>Add Patient</u> Enter the correct details and click the “Add Patient” button.	– Admin should be able to add – Admin should be able to view new patient at the list	– Admin is be able to add – Admin can view new patient at the list	Pass

10	<u>User Appointment Form</u> Enter the correct details and check the two checkboxes. Click the “Book your appointment button”	– User should be able to book a slot. – User can view book slot at User Dashboard under My Consultation appointment.	User is able to book	Pass
11	<u>User Vaccination Form</u> Enter a choice of vaccine and checking the two checkboxes. Click the “Book your appointment button”	– User should be able to book a slot. – User can view book slot at User Dashboard under My Vaccination appointment	User is able to book	Pass
12	<u>Staff Add Appointment</u> Enter the correct details and click the “Add Appointment” button.	– Staff should be able to add – Staff should be able to view new appointment at the list	– Staff is able to add – Staff is able to view new appointment at the list	Pass
13	<u>Add Medical Record</u> Enter the correct details and click the “Add Medical Record” button.	– Staff should be able to add – Staff should be able to view new medical record at the list	– Staff is able to add – Staff is able to view new medical record at the list	Pass
14	<u>Edit Medicine Stock</u> Enter the details to edit on not expired stock and click the “Edit medicine stock” button.	Staff should be able to edit medicine stock before its expiry date	– Staff is able to edit – Staff is able to view the changes in the list	Pass
15	<u>Add Bed</u> Enter the correct details and click “Add Bed” button	– Staff should be able to add – Staff should be able to view new bed at the list	– Staff is able to add – Staff is able to view new bed at the list	Pass

5. Conclusion

An e-Healthcare Management System is a web-based platform aimed at medical users and medical personnel to improve management efficiency and expedite business processes between patients and medical staff. This initiative addresses issues arising in healthcare organizations, particularly in Malaysia. Medical staff in healthcare institutions should leverage the convenience of technology to streamline the processes connected with running a healthcare organization. Furthermore, by combining the modules into the e-Healthcare Management System, the management system will boost the efficiency and productivity of medical professionals while decreasing the time and expense of manually handling specific responsibilities. Despite similar technology, the healthcare industry innovates and advances over time. As a result, it is vital to constantly build and develop new and improved features to aid in healthcare management. Finally, the system’s new features will help solve a fraction of the industry’s problems.

References

- 3 Things to Know About Healthcare Management Systems. (2015). Roberthalf.com. <https://www.roberthalf.com/blog/management-tips/3-things-to-know-about-healthcare> (Accessed: 2023).
- A detailed view of Hospital Management System (HMS). (2021). Mocdoc.in. <https://mocdoc.in/blog/a-detailed-view-of-hospital-management-system-hms> (Accessed: 2023).
- Alan, D., Barbara, H. W., & David, T. (2005). System Analysis and Design with UML Version 2.0 an Object-Oriented Approach. *John Wiley & Sons, Inc*, 6, 8.
- Anaam, E. A., Haw, S. C., Ng, K. W., Naveen, P., & Thabit, R. (2023). Utilizing Fuzzy Algorithm for Understanding Emotional Intelligence on Individual Feedback. *Journal of Informatics and Web Engineering*, 2(2), 273-283.
- Anderson, D. (2020). Instamed's tenth annual report finds high consumer demand for digitization in healthcare payments. Retrieved from <https://www.businesswire.com/news/home/20200428005090/en/InstaMed%25E2%2580%2599s-Tenth-Annual-Report-Finds-High-Consumer>
- Asian Hospital & Healthcare Management. (2023). Available at: <https://www.asianhmm.com/healthcare-management> (Accessed: 2023).
- Berrouiguet, S., Perez-Rodriguez, M. M., Larsen, M., Baca-García, E., Courtet, P., & Oquendo, M. (2018). From eHealth to iHealth: transition to participatory and personalized medicine in mental health. *Journal of Medical Internet Research*, 20(1), e2.
- Blumenthal, D., & Tavenner, M (2010). The “meaningful use” regulation for electronic health records. *New England Journal of Medicine*, 363(6), 501-504.
- Carey, D. J., Fetterolf, S. N., Davis, F. D., Faucett, W. A., Kirchner, H. L., Mirshahi, U., ... & Ledbetter, D. H. (2016). The Geisinger MyCode community health initiative: an electronic health record-linked biobank for precision medicine research. *Genetics in medicine*, 18(9), 906-913.
- Çelik, K., & Ayaz, A. Validation of the Delone and McLean information systems success model: a study on student information system. *Education and Information Technologies*, 1-19.
- DeLone, W. H., & McLean, E. R. (2003). The DeLone and McLean model of information systems success: a ten-year update. *Journal of management information systems*, 19(4), 9-30.
- Dobre, C., Bajenaru, L., Marinescu, I. A., & Tomescu, M. (2019, May). Improving the quality of life for older people: From smart sensors to distributed platforms. In 2019 22nd International Conference on Control Systems and Computer Science (CSCS) (pp. 636-642). IEEE.
- Haldane, V., De Foo, C., Abdalla, S. M., Jung, A. S., Tan, M., Wu, S., ... & Legido-Quigley, H. (2021). Health systems resilience in managing the COVID-19 pandemic: lessons from 28 countries. *Nature Medicine*, 27(6), 964-980.
- Healthcare Management Degree Guide. (2023). Available at: <https://www.healthcare-management-degree.net/faq/what-is-healthcare-management/> (Accessed: 2023).
- Hertin, R. D., & Al-Sanjary, O. I. (2018). Performance of hospital information system in Malaysian Public Hospital: A review. *International Journal of Engineering & Technology*, 7(4.11), 24-28.
- Holden, R. J., & Karsh, B. T. (2010). The technology acceptance model: its past and its future in health care. *Journal of biomedical informatics*, 43(1), 159-172.

- Kannan, R., & Jian, C. J. (2022). Backup Automation Using Power Automate for Malaysian Vaccination Centres. *Journal of Informatics and Web Engineering*, 1(1), 23-34.
- Keshta, I., & Odeh, A. (2021). Security and privacy of electronic health records: Concerns and challenges. *Egyptian Informatics Journal*, 22(2), 177-183.
- Medical scheduling made easy* (2022) DocMeIn. Available at: <https://www.docmein.com/corp/> (Accessed: 2023).
- Mujawar, M. A., Gohel, H., Bhardwaj, S. K., Srinivasan, S., Hickman, N., & Kaushik, A. (2020). Nano-enabled biosensing systems for intelligent healthcare: towards COVID-19 management. *Materials Today Chemistry*, 17, 100306.
- Ong, W. X., Ho, S. B., & Tan, C. H. (2023). Enhancing Migraine Management System through Weather Forecasting for a Better Daily Life. *Journal of Informatics and Web Engineering*, 2(2), 201-217.
- OpenEMR*. (2015). Available at: <https://www.open-emr.org/> (Accessed: 2023).
- Osetskyi, V. (2019). Hospital Management System: Features, Modules, Functions, Advantages. Available at: <https://existek.com/blog/hospital-managment-system/> (Accessed: 2023).
- Quan, N. H. K., Singh, H., Khanh, T. H. T., & Rajagopal, P. (2023). A SWOT Analysis With A Digital Transformation: A Case Study For Hospitals In The Pharmaceutical Supply Chain. *Journal of Informatics and Web Engineering*, 2(1), 38-48.
- Rahi, S., Khan, M. M., & Alghizzawi, M. (2021). Factors influencing the adoption of telemedicine health services during COVID-19 pandemic crisis: an integrative research model. *Enterprise Information Systems*, 15(6), 769-793.
- Rokhman, F., Mukhibad, H., Bagas Hapsoro, B., & Nurkhin, A. (2022). E-learning evaluation during the COVID-19 pandemic era based on the updated of Delone and McLean information systems success model. *Cogent Education*, 9(1), 2093490.
- Surachai Torwong - สุรัชชัย. (2022). Software for health. Available at: <http://www.vitasoft.biz/en/index.php> (Accessed: 2023).
- Tian, S., Yang, W., Le Grange, J. M., Wang, P., Huang, W., & Ye, Z. (2019). Smart healthcare: making medical care more intelligent. *Global Health Journal*, 3(3), 62-65.
- Teisberg, E., Wallace, S., & O'Hara, S. (2020). Defining and implementing value-based health care: a strategic framework. *Academic Medicine*, 95(5), 682.
- Yang, Y., Zhang, X., & Lee, P. K. (2019). Improving the effectiveness of online healthcare platforms: An empirical study with multi-period patient-doctor consultation data. *International Journal of Production Economics*, 207, 70-80.
- Zelege, A. A., Worku, A. G., Demissie, A., Otto-Sobotka, F., Wilken, M., Lipprandt, M., Tilahun B., Röhrig, R. (2019). Evaluation of electronic and paper-pen data capturing tools for data quality in a public health survey in a health and demographic surveillance site, Ethiopia: Randomized controlled crossover health care information technology evaluation. *JMIR mHealth and uHealth*, 7(2). doi:10.2196/10995