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FlyHealth: Aviation Medical Management and Services

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Abstract

Aviation medicine's critical role in ensuring aviation professionals' safety is marred by challenges at Poliklinik Primecare. Fragmented patient data, complex financial reports, and inefficient appointment reminders hinder patient care, operational efficiency, and financial transparency. Addressing these issues, "FlyHealth: Aviation Medical Management and Services" introduces a web-based system with three objectives: design, development, and testing. The innovative system centralizes patient data, streamlines financial reporting, and enhances appointment reminders. The development process employed the Agile methodology, emphasizing iterative development, user feedback, and incremental improvements. Key functionalities include a User Management Module for secure account management, an Appointment Management Module for efficient scheduling, a Medical Records Module for comprehensive patient record management, a Stock Monitoring Module using Just-in-Time (JIT) technology for inventory management, and a Financial Reporting Module for transparent financial tracking.The system demonstrated significant improvements in data management efficiency, appointment adherence, and financial accuracy. User feedback indicated high satisfaction with the system's usability and effectiveness.Further development could focus on integrating advanced analytics for predictive maintenance of medical equipment, expanding the system's capabilities to support mobile health monitoring for aviation professionals, and incorporating AI-driven decision support for medical practitioners.

1. Introduction

The aviation industry places paramount importance on ensuring the safety and well-being of its professionals, particularly pilots and cabin crews, acknowledging the critical role they play in the industry's success. In this context, Poliklinik Primecare in Putrajaya emerges as a pivotal healthcare provider dedicated to serving the medical needs of these aviation professionals.

Despite its crucial role, the existing aeromedical management system at Poliklinik Primecare encounters significant challenges. The system grapples with fragmented patient data, presenting obstacles to seamless retrieval and storage. This fragmentation not only complicates essential processes like medical certification and assessment but also raises concerns about the overall standard of care provided. Furthermore, the system struggles with intricate financial reporting protocols, leading to errors, inaccuracies, and inefficiencies that impact resource allocation. The longstanding issue of inadequate appointment reminders further exacerbates operational inefficiencies, risking missed appointments and potentially compromising service reliability. These difficulties underscore the urgent need for a comprehensive solution.

In response to these challenges, the FlyHealth program is conceived to revolutionize and optimize aeromedical services in clinics through the structured design approach, development, and user acceptance testing of a web-based Aviation Medical Management System. The FlyHealth system targets three primary user categories: administrators, staff, and aviation professionals. It comprises five modules, each addressing key aspects of aviation management. The User Management Module enhances system security by allowing administrators to manage user accounts and permissions efficiently. The Appointment Management Module streamlines the scheduling, tracking, and optimization of medical appointments. The Medical Records Module facilitates effective patient record management, a crucial component for aviation certification. The Stock Monitoring Module employs Just-in-Time (JIT) technology for pharmaceutical management efficiency, and the Financial Reporting Module enhances transparency by tracking clinic income and expenses. Overall, FlyHealth is designed to revolutionize aviation medical equipment management, emphasizing safety and well-being for aviation professionals at Poliklinik Primecare.

This article consists of five parts. The first part explains the background of the project. The second section summarizes the literature review. The third part describes the project methodology and the findings from the system analysis and design. The implementation and testing of the system is shown in the fourth part. The final section summarizes the project.

2. Related Work

This section explains Aviation medical management for Poliklinik Prime Care, and studies the existing system and proposed system.

2.1 Aviation medical management for Poliklinik Prime Care

The aviation sector has witnessed significant growth and transformation due to innovative technological advancements, resulting in decreased unit costs and increased economic viability of air travel [1]. The International Air Transport Association (IATA) [1] predicts a 50% development in the aviation sector over the next decade, driven by the growing preference for quick and convenient air travel. As the industry expands, ensuring the safety of passengers and aviation professionals becomes crucial. Aviation medicine plays a vital role in this context, offering a comprehensive approach to the psychological and physiological aspects of aviation, contributing to the safety and well-being of pilots, crew, and passengers.

Poliklinik Primecare currently faces challenges in the documentation and management of aviation professionals, medication records, and patient reports. Disjointed and cumbersome processes, including the use of Excel for aviation professionals' data, manual documentation for stock medicines, and paper-based methods for patient reports, highlight the need for a more efficient and thorough aviation medical management system. The fragmented nature of the current registration procedures emphasizes the urgency for a streamlined and technologically advanced solution.

FlyHealth aims to address the challenges identified at Poliklinik Primecare by introducing a comprehensive Aviation Medical Management System. This system focuses on gathering, archiving, and analyzing crucial data related to aviation health operations, offering a solution to the disjointed processes observed in the current documentation methods. Through a structured approach design, FlyHealth provides a user-friendly interface for efficient financial management, record monitoring, and data entry. The goal is to revolutionize aviation medical management, replacing labor-intensive methods with advanced technology to enhance clinic operations, ensure compliance with safety standards, and improve the overall safety and health of aviation professionals.

2.2 Management Information Systems and Operational Strategies

A Management Information System (MIS) is a computer-based system that provides managers with tools to effectively organize, evaluate, and manage departments within an organization. MIS facilitates the efficient processing of data and information, assisting in decision-making, coordination, control, analysis, and visualization of information within an organization. This system includes software that helps manage data, provides necessary information for strategic planning, and supports management and operational activities [2]. Just-in-Time (JIT) is an inventory management strategy designed to increase efficiency and reduce waste by receiving goods only as they are needed in the production process. This approach minimizes inventory levels and carrying costs, coordinating the arrival of materials and components at the production site exactly when they are needed. By reducing in-process inventory and associated costs, JIT improves production efficiency and overall operational performance [3]. First-in, First-Out (FIFO) is an inventory management method where the oldest inventory items are used or sold first. This approach ensures that inventory is rotated regularly and reduces the risk of obsolescence. In a FIFO system, goods received first are also the first to be issued or sold, which is particularly important in industries with limited shelf life. This method is commonly used in various

contexts such as manufacturing, retail, and supply chain management to maintain efficient inventory flow and minimize waste. [4]

2.3 Study of Existing Related Systems

This section is to study three existing systems that are equivalent to the system that is built. The features and functionality of the existing systems are discussed and a comparison with the developed clinic management system is made. Three similar existing systems chosen are the Clinical Management and Appointment Booking System (CMABS) [5], BookDoc [6], and Qmed.asia[7]. **Table 1** outlines the comparison.

The Clinical Management and Appointment Booking System offer robust user management and appointment scheduling features, ensuring efficient interactions in the healthcare industry. However, it lacks stock monitoring and comprehensive medical and financial reporting capabilities, limiting its applicability in the aviation-focused project. The BookDoc system excels in effective scheduling and user-friendly interfaces, with a strong emphasis on medical documentation. While it provides detailed medical information, it falls short in stock monitoring. Qmed.asia stands out by acknowledging the importance of effective resource management through stock monitoring, aligning well with the project's emphasis on optimizing resource distribution.

These comparative findings, the development of the FlyHealth system focused on tailoring user management to meet the specific needs of aviation professionals. FlyHealth is committed to tailoring user care to the unique requirements of aviation professionals. By offering a system that perfectly satisfies the demands of aviation professionals, this customization is intended to suit the specific needs of the aviation sector and contribute to the improvement of aviation medicine's efficiency and safety. FlyHealth enhances user experience by addressing specific needs through customization, introducing features like an automated doctor assignment tool in the appointment management module. Notably, FlyHealth stands out by incorporating real-time stock monitoring and restocking notifications in the stock monitoring module, ensuring a continuous supply of medical resources in an area where existing systems differed in approach. Furthermore, recognizing distinctions among existing systems, FlyHealth offers adaptability as a web-based system accessible on both web and mobile devices, bridging the gap between mobile-based applications and web-based platforms and catering to the dynamic nature of aviation medicine.

Table 1 *Comparison between existing systems and developed systems*

System / *Features*	*CMABS[5]*	*BookDoc [6]*	*Qmed.Asia [7]*	*FlyHealth*
User Management	√	√	√	√
Appointment Management	√	√	√	√
Stock Monitoring	×	×	√	√
Medical Report	×	√	√	√
Financial Report	×	√	√	√
System Type	Web-based	Mobile Application	Web Application	Web-based

3. Methodology

This section describes the methodology, analysis, and design phases of developing a system. The functional and non-functional requirements for the entire developed system are described and discussed in detail. The system analysis results, which are technical diagrams such as context diagram, data flow diagram (DFD) level 0, and entity-relationship diagram (ERD) of the proposed system are shown in this section. Diagrams.net, an online diagramming tool, was used to create these technical diagrams. Besides that, the wireframe of the system is also displayed in this section.

3.1 Agile Model

The "FlyHealth: Aviation Medical Care Management & Services" project is implementing the Agile methodology in aviation medical care management, as outlined by [8]. Agile's adaptability and emphasis on user feedback align with the project's objectives, allowing it to navigate the dynamic nature of aviation medical care efficiently. The methodology's iterative and incremental approach enables swift responses to changing requirements in this fast-paced field. **Table 2** summarizes the software development tasks.

Table 2 *Software development activities and their task*

Phase	Task	Output
Initiation Phase	• Define project objectives and scope • Collaborate with key stakeholders. • Gather initial requirements and user stories	• Vision and strategic direction of the project • User Stories and Requirements • Functional and non-functional requirements
Planning Phase	• Develop a project plan and schedule • Define roles and responsibilities • Develop a product backlog based on requirements • Plan sprint iterations and set sprint goals	• Comprehensive project plan and schedule • Gantt chart and diagram • Dynamic product backlog • Sprint plan, selected user stories
Execution Phase (Sprints)	• Conduct daily stand-up meetings • Implement selected user stories • Perform rigorous testing • Seek continuous feedback from stakeholders • Conduct sprint demo and review sessions	• Daily progress, goals • Tangible features and functionality • Stakeholder feedback • Constructive feedback • System prototype • Test cases and test results
Monitoring and Controlling Phase	• Perform sprint reviews • Conduct sprint retrospectives	• Evaluation of sprint goals • Reflection on sprint processes
Closure Phase	• Gradual system implementation • Plan additional sprints for specific features	• Incremental access to features • Strategy for system enhancements • Full System

3.2 System Requirement

Researching, identifying, and recording user needs and expectations for a software solution to solve a problem is requirements analysis [9]. It requires understanding and describing system functionality and performance needs from users, customers, and developers' viewpoints. System requirements include user, software, hardware, and functional and non-functional requirements. These specs are customized to the system, its users, and the organization's requirement-writing style [10]. Table 3 shows Aviation Medical Management and Services functional needs. Non-functional requirements define system behaviour, not functions. Both forms of criteria are essential for system comprehension and development. Table 4 lists Aviation Medical Management and Services' non-functional requirements.

Table 3 *Functional requirements*

No	Module	Description
1	User Management Module	• Allow administrators to create, update, and manage user accounts. • Enable administrators to assign roles and permissions to users. • Ensure system security through robust user account management. • Provide a secure login mechanism for the users.
2	Appointment Management Module	• Allow medical staff to schedule, reschedule, or cancel appointments. • Enable assignment of medical staff to appointments. • Provide a view of appointment schedules for efficient management. • Allow aviation professionals to book appointments, view available slots, and receive reminders.

Table 3 *Functional requirements(cont)*

No	Module	Description
3	Stock Monitoring Module	• Monitor and manage pharmaceutical stock levels efficiently. • Track medication availability and set reorder points. • Implement a just-in-time (JIT) inventory technique for controlling stock. • Optimize inventory levels to minimize wastage and shortages.
4	Medical Report Module	• Store, access, and manage comprehensive patient medical records. • Ensure data accuracy and security in handling medical information. • Allow medical staff to access and update patient records.
5	Financial Report Module	• Generate financial reports and statements. • Track clinic revenue and expenses for financial transparency. • Facilitate informed decision-making regarding clinic finances.

Table 4 *Non-functional requirements of the proposed system*

No	Requirement	Description
1	Performance	• The system should be providing quicker response for user interactions • The system should be able to function on any web browser
2	Operational	• The system should be available for use 24/7 with planned maintenance communicated in advance. • The system should provide a user-friendly interface.
3	Security	• The system should be only accessed by authorized administrators and staff • User credentials should be stored securely using industry-standard encryption techniques.
4	Cultural and Political	• The system should support transactions in Malaysian Ringgit (MYR) and display financial information accordingly. • The system should comply with local regulations, including data privacy laws and aviation industry standards

3.3 System Analysis

A Data Flow Diagram (DFD) shows how data flows between internal operations, external entities, and data repositories in an information system. The upcoming section on FlyHealth: Aviation Medical Management and Services will include a Context Diagram, DFD Level 0, DFD Level 1, ERD, and Flowchart. **Figure 1** shows the system context diagram. The DFD Level 0 diagram's boundaries and data transformation operations are shown in **Appendix A**. The administrator has complete control, using create, read, update, and delete operations. The ERD for FlyHealth: Aviation Medical Management and Services is shown in **Appendix B**. This diagram displays the database's entities, attributes, and relationships. **Appendices C** and **D** depict flowcharts for the Aviation Medical Management and Services system, systematically outlining the essential operations. The system primarily involves two roles: administrator and medical personnel. According to the flowcharts, both administrators and personnel log into the system to start the procedure.

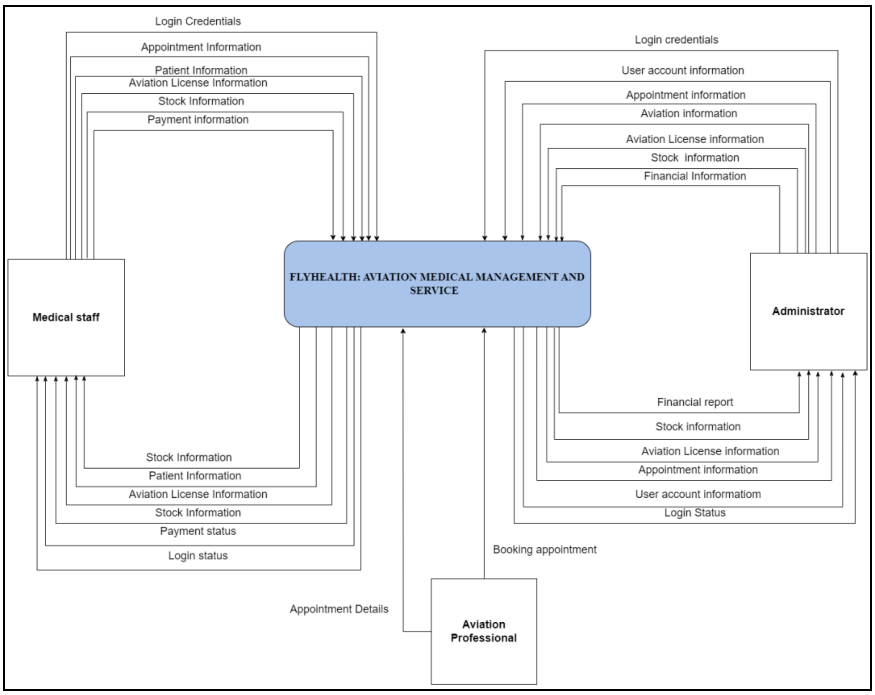


Fig. 1 *Context diagram of FlyHealth*

3.4 System Design

The project will begin the design phase after analyzing all user needs. Before coding, the interface and database will be built to visualize the system. In FlyHealth, system architecture defines the structural framework and interaction dynamics. This architecture allows administrators, medical personnel, and aviation experts to communicate with FlyHealth: Aviation Medical Management and Services via specific interfaces. The Model-View-Controller (MVC) design, recognized for its organization, is used to represent system data and business logic in FlyHealth. The view provides user interfaces, and the controller mediates. User interactions connect with FlyHealth, update the model, and may alter views using MVC concepts. **Figure 2** shows a well-structured architecture with connections that, beyond structural design, enable efficiency and scalability, demonstrating a dedication to excellence in aviation medical management and services

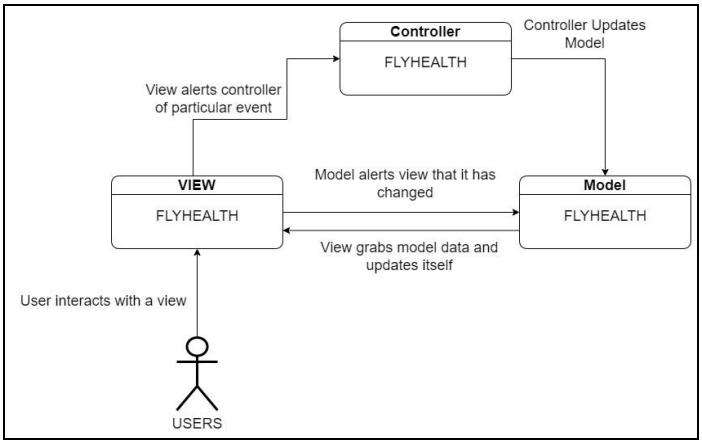


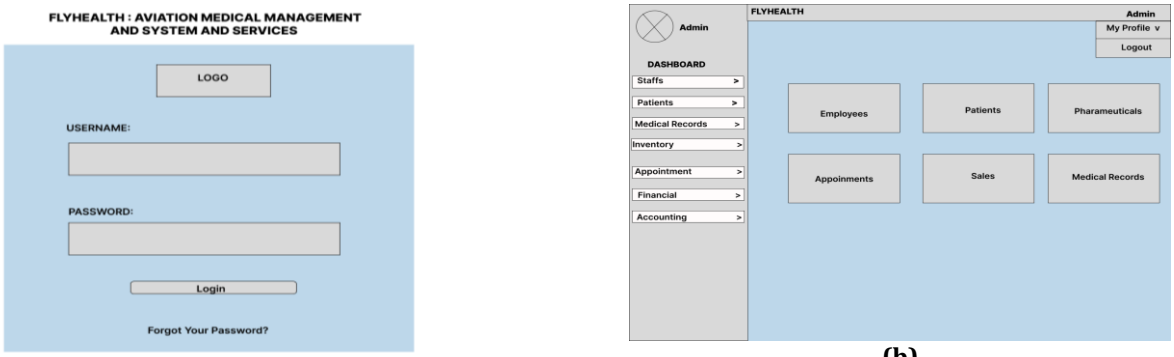
Fig. 2 *System architecture of FlyHealth*

The following are the tables from the database that have been designed and extracted from the class diagram. They were created using Microsoft SQL Server 2014.

i. `his_admin (ad_id, ad_fname, ad_lname, ad_email, ad_pwd, ad_dpic)`
ii. `his_docs (doc_id, doc_fname, doc_lname, doc_email, doc_pwd, doc_dept, doc_number, doc_dpic)`
iii. `Appointment (AppointmentID, Name, Category, Email, PhoneNumber DateTime)`

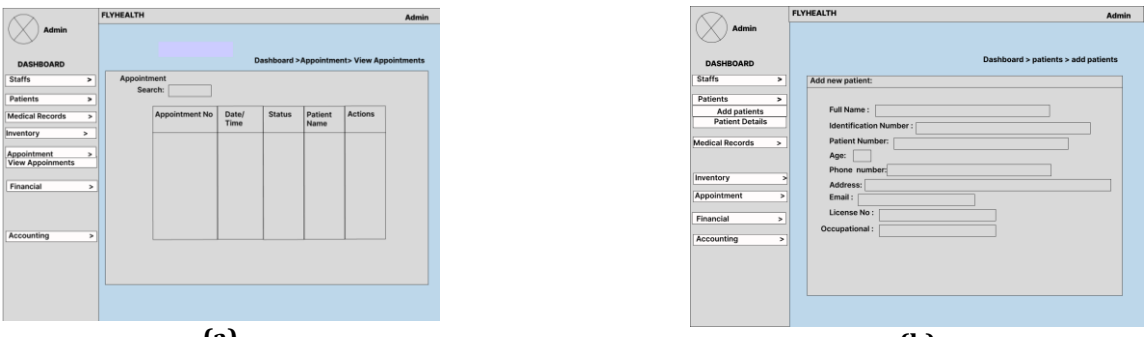
iv. his_patients (pat_id, pat_fname, pat_lname, pat_dob, pat_age, pat_ic, pat_comp_name, pat_date_reg, pat_number, pat_addr, pat_phone, pat_type, pat_license_number, pat_payment_type, services, pat_license_exp_date)
v. his_prescriptions (pres_id, pat_ic, pres_pat_name, pres_pat_age, pres_pat_number, pres_number, pres_pat_addr, pres_pat_type, pres_date, pres_pat_ailment, pres_ins)
vi. his_prescription_medicine (med_id, pres_id, purchase_id, phar_quantity, created_datetime)
vii. his_purchasing (purchase_id, pharmaceutical_name, quantity_purchased, vendor, purchase_date, exp_date, price_per_strip, total_price, selling_price_per_strip)
viii. pharmaceutical_batches (batch_id, purchase_id)
ix. his_vendor (v_id, v_number, v_name, v_adr, v_email, v_phone, v_desc, med_rep_name, med_rep_phone)
x. license_renewals (renew_id, expiry_id, pat_id, new_exp_date, status, pat_ic)
xi. license_expirations (expiry_id pat_id pat_ic)
xii. payment_details (payment_id, pat_id, total_prescription_price, consultation_fee, total_fee, payment_method, date_created)
xiii. tbl_events (id, title, start, end)

User interface (UI) design is the process of creating the visual components that make up the interface of a product or service. For example, user interfaces consist of visual components such as colors and fonts [7]. Wireframing, or prototyping, is a common step in the user interface process. The goal of UI design is to create products that are easy to use, attractive, and help people achieve their goals efficiently and effectively. For this project, I used Figma to create user interface design wireframes. In **Figure 3**, interface of FlyHealth 4(a): Login 4(a), Figure 4(b): administrator dashboard(b). In **Figure 4**, interface of FlyHealth 5(a): appointment page 5(a), Figure 5(b): patient details(b). In **Figure 5**, the interface of FlyHealth 6(a): stock monitoring page 6(a), Figure 6(b): financial report page(b).



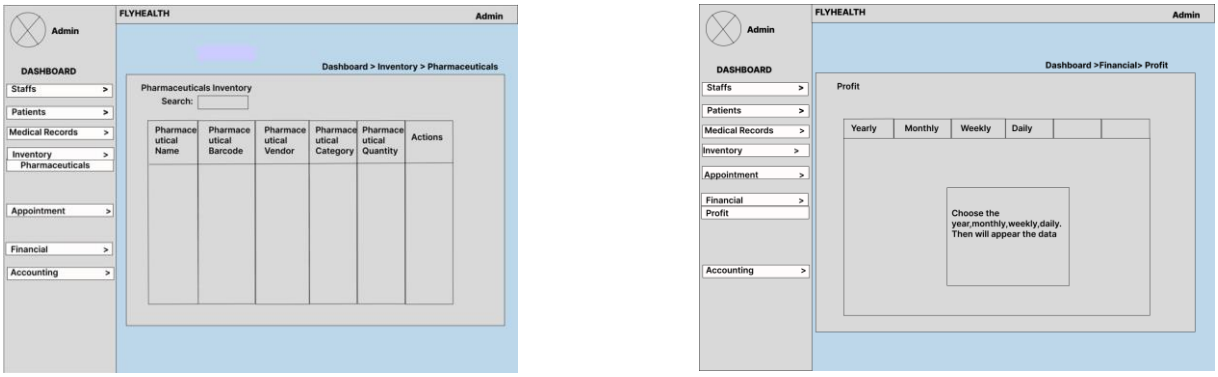
(a) **(b)**

Fig. 3 *Interface of FlyHealth (a) Login; (b) administrators' dashboard*



(a) **(b)**

Fig. 4 *Interface of FlyHealth (a) Appointment page; (b) Patient details*



(a) **(b)**

Fig. 5 *Interface of FlyHealth (a) Stock monitoring page; (b) Financial report page*

4. Results and Discussion

The FlyHealth system was developed as a web-based platform using HyperText Markup Language (HTML), Cascading Style Sheets (CSS), and Hypertext Preprocessor (PHP), with MySQL for database management. The implementation and testing of the system focused on ensuring its functionality and usability. Functional testing was conducted to validate that each feature of the application operated in conformance with the required specifications. This testing involved executing various features and comparing the actual outcomes with the expected results. Additionally, during the User Acceptance Testing (UAT) phase, the Questionnaire for User Interface Satisfaction (QUIS) model was employed to evaluate user satisfaction with the system's interface, ensuring it met standards for functionality and user-friendliness [11]. The results indicated that the system effectively met user requirements, improved efficiency in managing patient data and financial reports, and received positive feedback for its usability and performance. Detailed results from the UAT are provided in Appendix E.

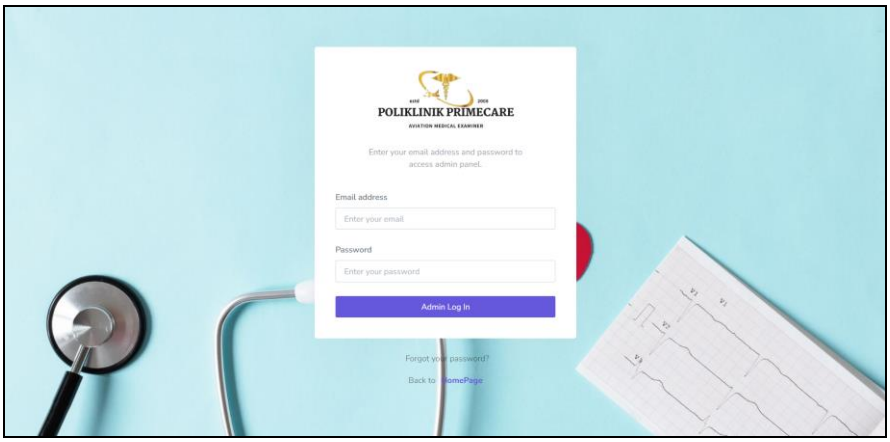


Fig. 6 *Administrator login interface*

The Login Module provides clinic administrators and medical personnel FlyHealth access. Logging in requires the appropriate username and password. A warning notice appears when a user enters an invalid login or password. Administrators immediately access the dashboard after logging in. **Figure 6** shows the developed system login interface. Seven test cases cover this module shown in **Table 5**. These tests verify the administrator's ability to add users, edit and delete existing users, and verify that users can log in, reset their passwords, and prohibit login with incorrect credentials.

Table 5: *Test case for login and user management module*

Test Case ID	Description	Expected Result	Actual	Pass/Fail
M1-1	To check whether administrator and staff can log in into the system	The user should be able to log in into the system	The user has successfully logged in into the system	Pass
M1-2	To check whether administrator could create account for other users	The administrator should be able to create account for another user	The administrator has successfully created account for another user	Pass
M1-3	To check whether the system will restrict login whenever a wrong credential is entered	The system should restrict login when an incorrect credentials has been entered	The system restricted the login when an incorrect or no credentials has been entered	Pass
M1-4	To check whether the user could change their password if they forgot it	The user should be able to change their password by key in the OTP received via E-mail	The user has successfully changed their password	Pass
M1-5	To check whether the system could display the users' information	The system should be able to display the users' information	The system successfully displayed the users' information	Pass
M1-6	To check whether the administrator could update the existing users' information	The administrator should be able to update the existing users' information	The administrator has successfully updated the users' information	Pass
M1-7	To check whether the administrator could delete existing user	The administrator should be able to delete existing user	The administrator has successfully updated delete existing user	Pass

Administrators can access all system components via the dashboard. From the sidebar, administrators can access user management, medical reports, appointment management, stock monitoring, and financial report modules. However, medical workers can only access courses specific to their department and role. **Figures 7 and 8** show the administrator's interface. There are a total of three test cases for this module shown in **Table 6**. The objective of these tests is to verify the functionality of displaying the dashboard for both administrators and medical staff, navigating through other modules via the dashboard, and logging out from the system. All three test scenarios were successful.

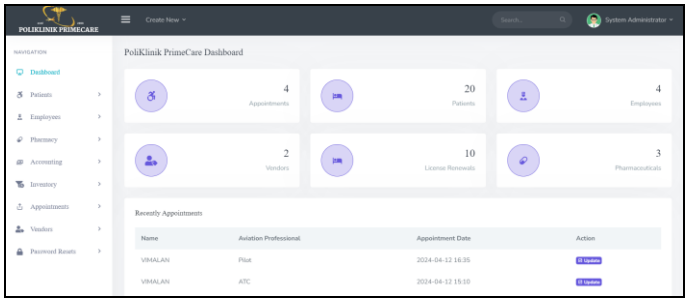


Fig. 7 *Administrator dashboard*

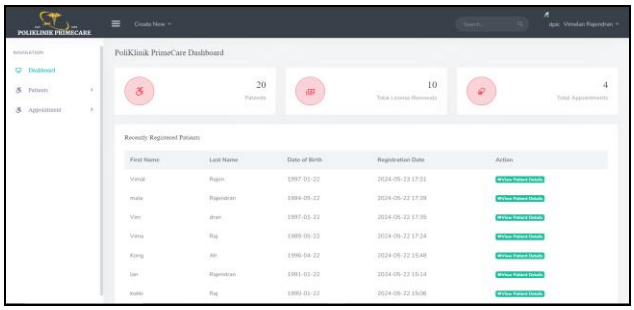


Fig. 8 *Medical staff dashboard*

Table 7*: Test case for administrator and staff dashboard*

Test Case ID	Description	Expected Result	Actual	Pass/Fail
M2-1	To check whether the system could display the dashboard for both administrator and medical staff	The system should be able to display the dashboard for both administrator and medical staff	The system has successfully displayed the dashboard for both the administrator and medical staff	Pass
M2-2	To check whether the administrator and medical staff can navigate through other modules via the dashboard	The user should be able to navigate through other modules via the dashboard	The user has successfully navigated to other modules via the dashboard	Pass
M2-3	To check whether the administrator and staff can log out from the system	The user should be able to log out from the system	The user has successfully logged out from the system	Pass

Aviation professionals can schedule their appointments on the FlyHealth website by providing their details and selecting a date and time. The administrators can manage the appointment calendar by blocking unavailable dates. Both medical staff and administrators can manage appointments for aviation professionals. **Figure 9** displays the interface of the Appointment Website for Aviation Professionals. To streamline comprehension, test cases for the Appointment Management Module are presented in **Table 8** There are a total of six separate test cases associated with this module. These test cases evaluate elements related to scheduling and administering appointments for aviation professionals to ensure proper functionality. This includes establishing appointments, blocking unavailable dates, monitoring appointments by administrative personnel and medical professionals, sending reminders, and preventing duplicate bookings. All these aspects are thoroughly examined in the testing process. As per the findings presented in Table 8, each of the six possible outcomes of the examination was successful.

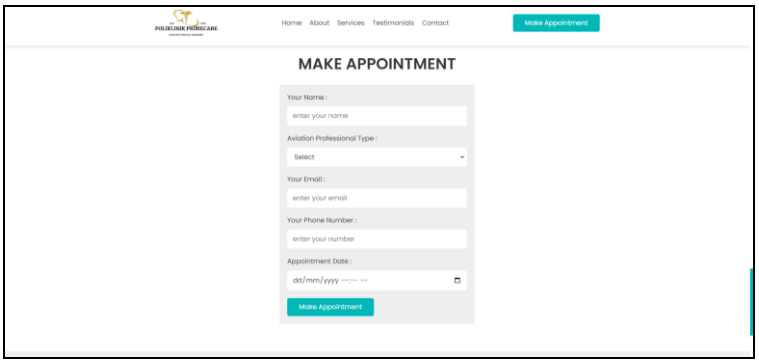


Fig. 9 *Interface of appointment website for aviation professionals*

Table 8: Test case for appointment management module

Test Case ID	Description	Expected Result	Actual	Pass/Fail
M3-1	Verify aviation professionals can make appointments.	The appointment is created and visible in calendar.	Appointment created and visible.	Pass
M3-2	Verify administrators can block unavailable dates.	Date is blocked and marked as unavailable.	Date successfully blocked.	Pass
M3-3	Verify system prevents double booking of appointments.	System does not allow double booking.	Double booking not allowed.	Pass
M3-4	Verify appointment confirmation email is sent.	Confirmation email sent immediately.	Confirmation email sent promptly.	Pass
M3-5	Verify administrators can cancel an appointment.	Appointment canceled and notification sent.	Appointment canceled and notified.	Pass
M3-6	Verify system updates availability status after booking.	Calendar reflects updated availability status.	Calendar updated correctly.	Pass

The medical staff must register patients with aviation professional details and select from services like "License Renewals" or "License Renewals and Medical Treatment." This facilitates treatment necessary for license renewal and medication provision. WhatsApp reminders are sent 45 days before license expiration. Renewal processes are recorded based on patient age and professional requirements, alongside recording patient medical history. **Figure 10** displays interfaces for patient registration, license renewals, and prescriptions. Five test cases in **Table 9** validate functionalities including patient registration, service selection, detail updates, and reminder sending. All nine test scenarios were successful.

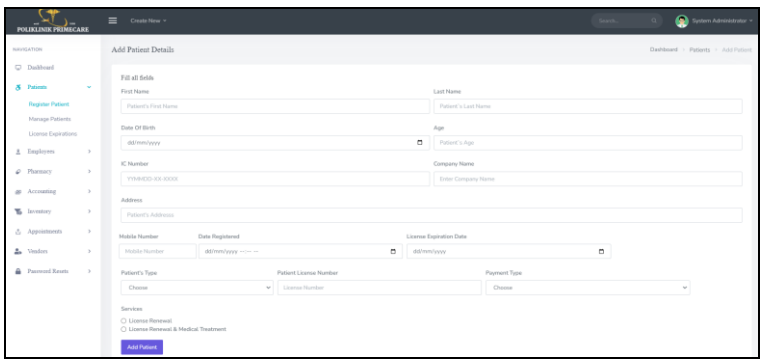


Fig. 10 *Interface of patient registration aviation professionals*

Table 9: Test case for medical report module

Test Case ID	Description	Expected Result	Actual	Pass/Fail
M4-1	Verify patient registration with aviation professional details.	Successful registration with complete details.	Registration completed successfully.	Pass
M4-2	Verify selection of "License Renewals and Medical Treatment" service.	Successful selection of service.	Service selected successfully.	Pass
M4-3	Verify WhatsApp reminder sent 45 days before expiration.	Reminder sent successfully.	Reminder sent successfully.	Pass
M4-4	Verify recording of patient's medical history.	History recorded successfully.	History recorded successfully.	Pass
M4-5	Verify medical staff's access to patient's medical history.	Access and view history without issues.	History accessed and viewed.	Pass

In the stock module, medical staff can add pharmaceuticals to the inventory with details such as quantity, expiry date, and purchasing price. The system tracks expiry dates and manages batches using the FIFO algorithm to ensure proper usage order. The stock module also monitors quantities using the Just-In-Time (JIT) algorithm to maintain optimal levels and minimize waste. Regular notifications and reports assist in efficient inventory management. **Figure 11** shows the stock management interface. **Table 10** includes 10 test cases validating functionalities such as adding pharmaceuticals, monitoring stock with JIT, tracking expiration with FIFO, generating low stock alerts, removing expired items, updating details, and maintaining an inventory log. All test scenarios were successful.

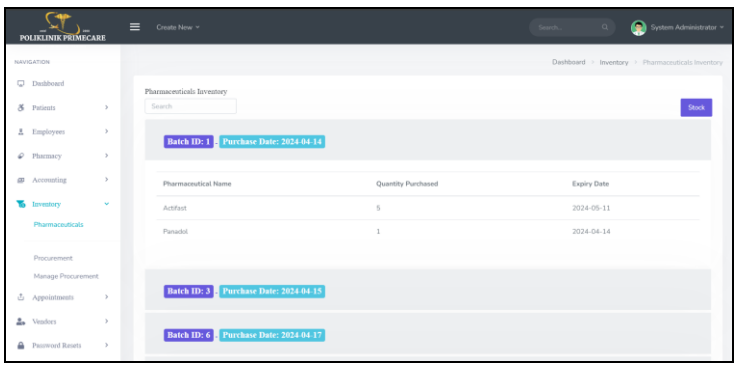


Fig 11 *Stock management*

Table 10: *Test case for stock monitoring module*

Test Case ID	Description	Expected Result	Actual	Pass/Fail
M5-1	Verify addition of pharmaceuticals to inventory with details.	Pharmaceuticals added with all details recorded.	Pharmaceuticals added successfully.	Pass
M5-2	Verify tracking of expiry dates and batch management using FIFO.	Expiry dates tracked and batches managed with FIFO.	Expiry dates tracked, FIFO managed.	Pass
M5-3	Verify monitoring of pharmaceutical quantities using JIT algorithm.	Quantities monitored and maintained with JIT.	Quantities monitored using JIT.	Pass
M5-4	Verify alerts for low stock levels.	Alerts generated for stock below threshold.	Alerts generated for low stock.	Pass
M5-5	Verify removal of expired pharmaceuticals from inventory.	Expired pharmaceuticals removed successfully.	Expired pharmaceuticals removed.	Pass
M5-6	Verify system maintains a log of all inventory actions.	Detailed log maintained and accessible.	Inventory log maintained accurately.	Pass

The administrator can access detailed sales reports for the clinic, including weekly, monthly, and yearly summaries, allowing easy tracking of revenue from various services. The module generates financial reports like revenue, sales, and patient treatment summaries, customizable by period or financial criteria, providing a clear financial overview. Patients can also make payments and generate receipts through this module. **Figures 12** and **13** show interfaces for patient payments and clinic sales. **Table 11** outlines nine test cases, validating functionalities such as accessing sales reports, generating revenue and sales reports, customizing financial reports, processing payments, and generating receipts. All test scenarios were successful.

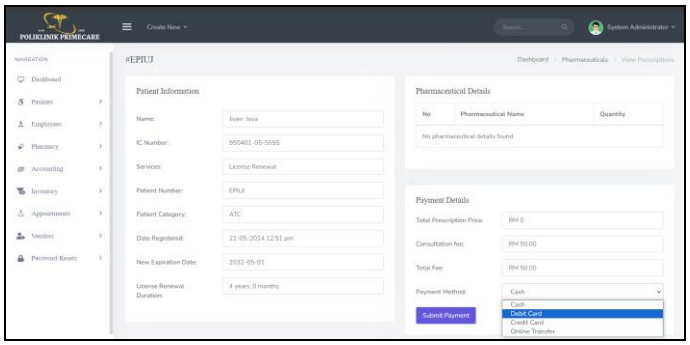


Fig.12 *Interface patient payment*

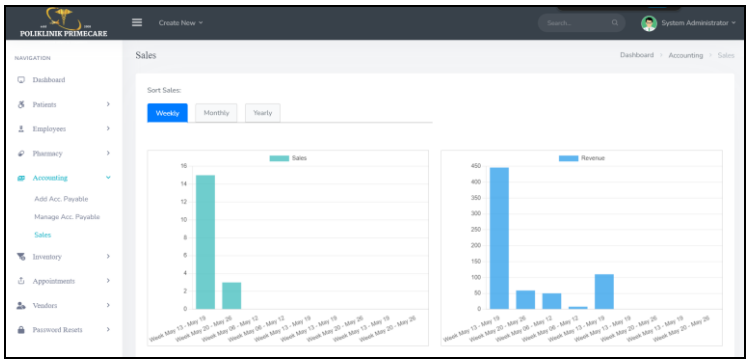


Fig.13 *Interface clinic sales*

Table 11: *Test case for financial report module*

Test Case ID	Description	Expected Result	Actual	Pass/Fail
M6-1	Verify administrator access to weekly sales reports.	Weekly sales report generated and accessible.	Weekly sales report generated and accessible.	Pass
M6-2	Verify administrator access to monthly sales reports.	Monthly sales report generated and accessible.	Monthly sales report generated and accessible.	Pass
M6-3	Verify administrator access to yearly sales reports.	Yearly sales report generated and accessible.	Yearly sales report generated and accessible.	Pass
M6-4	Verify module generates revenue reports.	Revenue report is generated successfully.	Revenue report generated successfully.	Pass
M6-5	Verify module generates sales reports.	Sales report generated successfully.	Sales report generated successfully.	Pass
M6-6	Verify module generates patient treatment reports.	Report on total number of patients generated.	Report on total number of patients generated.	Pass
M6-7	Verify financial report customization by time periods.	Financial reports customized for selected period.	Financial reports customized for selected period.	Pass
M6-8	Receipts generated successfully after payments.	Payments processed successfully.	Payments processed successfully.	Pass
M6-9	Verify patients can generate receipts for their transactions.	Receipts generated successfully after payments.	Receipts generated successfully after payments.	Pass

5. Conclusion

In conclusion, The FlyHealth System project successfully designed, developed, and tested a web-based Aviation Medical Management System, achieving its objectives by creating specialized modules for appointment

management, patient enrollment, inventory management, and financial supervision. The system offers numerous advantages: it improves clinic efficiency, ensures secure data through login credentials, simplifies staff management, and streamlines appointment scheduling. Additionally, it automates patient registration and reporting, manages inventory effectively with FIFO and JIT algorithms, and provides detailed financial reports. However, the system's complexity requires thorough training, and high installation costs and the need for a reliable internet connection may hinder accessibility for smaller or remote clinics. To enhance usability and efficiency, future improvements should focus on simplifying the user interface, integrating advanced data analytics and AI, ensuring interoperability with other healthcare systems, and enhancing security with multi-factor authentication. Comprehensive training and robust technical support are essential for seamless integration and ongoing use, positioning FlyHealth as a leading solution in aviation medical clinic management.

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Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of the paper.

Author Contribution

The author confirms sole responsibility for the following: study conception and design, data collection, analysis and interpretation of results, and manuscript preparation.

References

[1] H. Dakkina, "Aviation Health Management," in Aviation Safety and Healthcare Management, 2019, p. 51.

[2] K. C. Laudon and J. P. Laudon, Management Information Systems: Managing the Digital Firm, 15th ed. Boston, MA, USA: Pearson, 2019.

[3] W. J. Stevenson, Operations Management, 13th ed. McGraw-Hill Education, 2020.

[4] H. A. Taha, Operations Research: An Introduction, 9th ed. Pearson, 2011.

[5] Sugashini, Syed Anwar, Jeevarasan, and Hemnath, "Clinical Management and Appointment Booking System," Fifth Dimension Research Publication, vol. 3, pp. 403-407, Mar. 2023.

[6] "BookDoc," Home - BookDoc, October 2023. [Online]. Available: https://www.bookdoc.com/. [Accessed: 10-Nov-2023]

[7] Qmed Asia," Qmed Asia - Malaysia's Best Online Doctor Consultation | Health Screenings & More, 2018. [Online]. Available: https://qmed.asia/en. [Accessed: 09-Jun-2024].

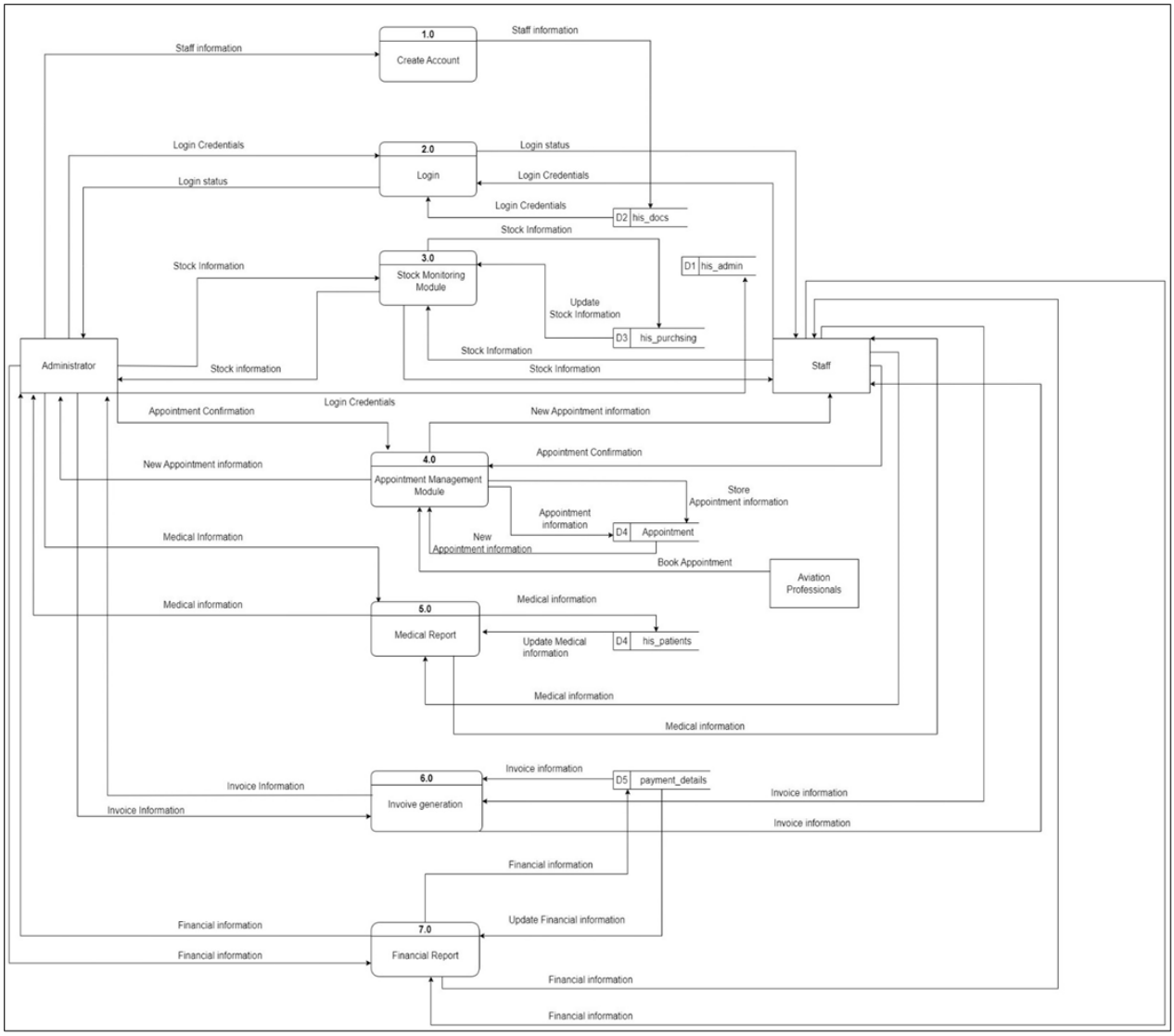
[8] I. Sommerville, Software Engineering, 9th ed. Boston: Addison Wesley, 2011.

[9] J. T. Catanio, "Requirements Analysis: A Review," in Advances in Systems, Computing Sciences and Software Engineering, Dordrecht, 2006.

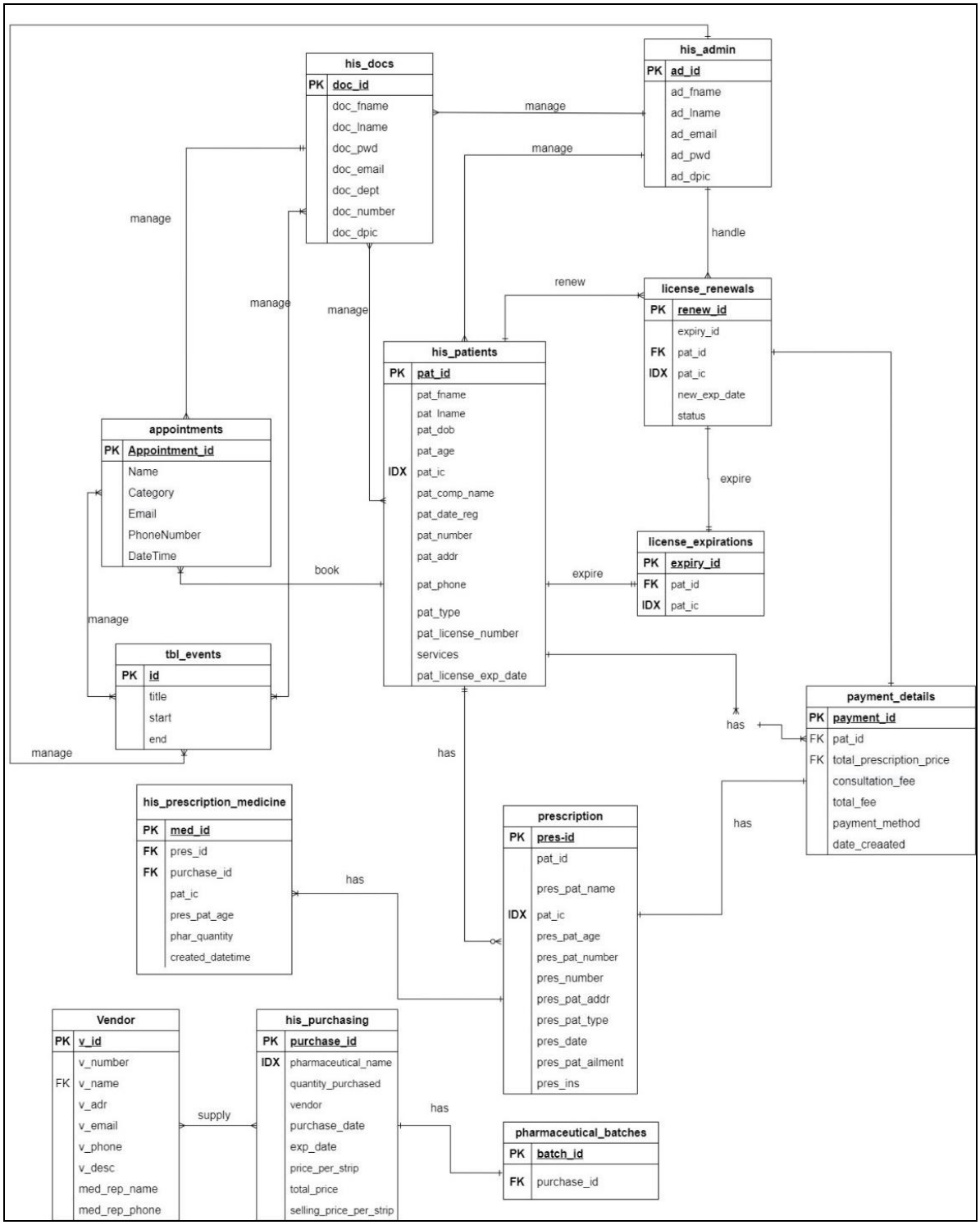
[10] V. Sharma and A. K. Tiwari, "A Study on User Interface and User Experience Designs and its Tools," World Journal of Research and Review, vol. 12, no. 6, pp. 41-44, Jun. 2021.

[11] J. P. Chin, V. A. Diehl, and K. L. Norman, "Development of an Instrument Measuring User Satisfaction of the Human-Computer Interface," in Proceedings of the SIGCHI Conference, Maryland, 1988, pp. 213-218.

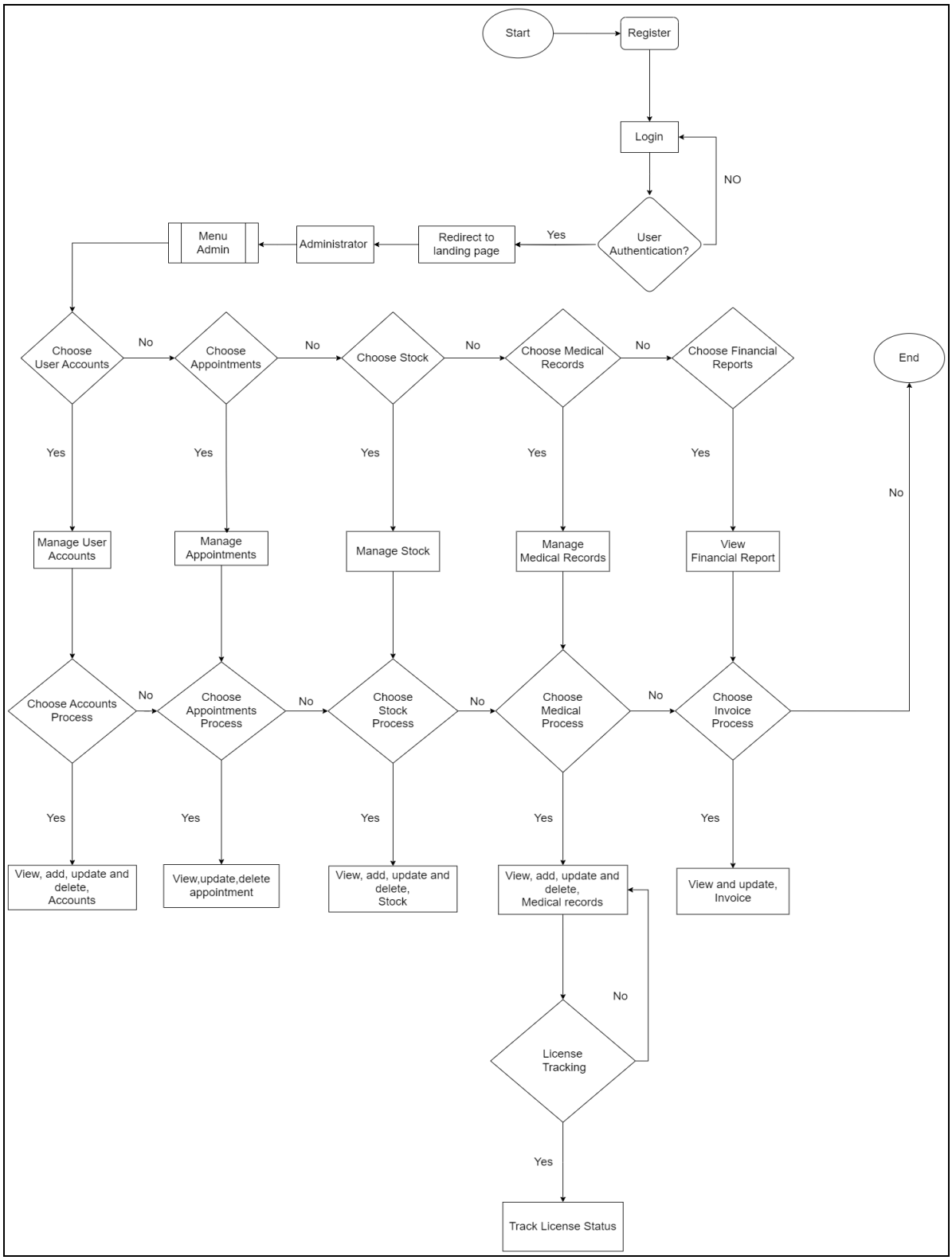
Appendix A: DFD Level 0 of FlyHealth



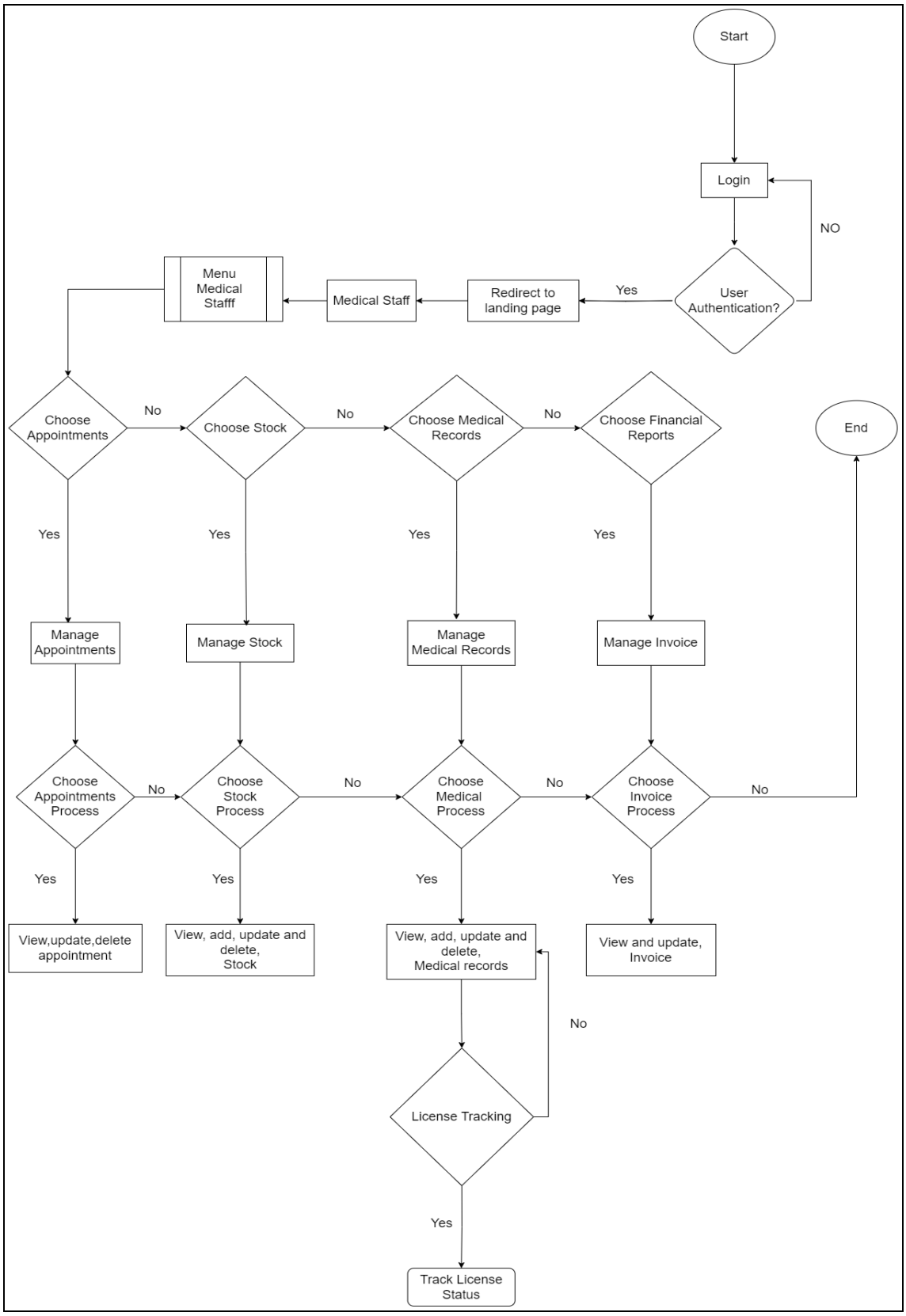
Appendix B: ERD of FlyHealth



Appendix C: Flowchart for admin



Appendix D: Flowchart for medical staff



Appendix E: Results of UAT