TIS3351 Advanced Database

TT1V

Assignment 2 Report

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Chapter 1: Overview

In the assignment 2, two information systems will be designed for an imaginary clinic named Klinik Penawar. Klinik Penawar is a new primary care clinic that covers a wide range of healthcare services and is ready to help serve the patients in the neighborhood. The investor of Klinik Penawar hopes to grow its business in a bigger market one day. After five years, Klinik Penawar is matured enough and is ready to expand its business. The investor of Klinik Penawar had decided to open branches in many neighborhoods. An information system will be created for the start-up Klinik Penawar; while the Klinik Penawar that is more mature in terms of business operation will be utilizing a new information system different from the one that is used during the start-up period.

1.1 Company Activities

This section discusses the company activities of Klinik Penawar. In terms of operation activities, Klinik Penawar undertakes a wide range of activities to earn profit. It is assumed that the services provided by Klinik Penawar include diagnosis and treatment for common sicknesses such as flu and sore throat, small surgery like hemorrhoid banding, basic laboratory testing such as Covid-19 test, health screening such as high cholesterol and blood pressure test, and vaccination such as tetanus jab. The doctors in the clinic manage the medical treatment with the help of nurses. The nurses also work to support the day-to-day running of Klinik Penawar. The number of staff in Klinik Penawar might be small as it is a new clinic, but the number of staff should increase once Klinik Penawar is ready to expand the business.

While in terms of financial activities, the financial activity of Klinik Penawar is assumed to be managed by the director of Klink Penawar who could be the head doctor at the beginning. By the time the business of Klinik Penawar has expanded, the financial activity of each clinic should be managed by several chief financial officers. When Klinik Penawar has expanded to more branches, Klink Penawar should have multiples investors where the dividends will be shared according to the interest.

1.2 Information Systems Requirements & Use Cases

This section describes the requirements of the two information systems and the respective use cases of Klinik Penawar. The actor of the information systems of Klinik Penawar is the doctor and the nurse.

1.2.1 Start-Up Klink Penawar

This section describes the requirements and the use cases of the information systems used by Klinik Penawar while it is new to the market.

Table 1.1: Use case and Requirements of Start-Up Klink Penawar

Use Case	Requirement
Register new patient	Nurse will register a new patient that has never visited the clinic before. The nurse will see a form of patient registration where the nurse needs to fill in the patient information such as name, IC number, and mobile phone number. The actor in this use case is the nurse.
View appointment	The doctor and the nurse can view the scheduled appointment. They will see a list of appointments for the day. The actor in this use case is the doctor and the nurse.

Make an appointment	Nurse will book a visit session for the patient who is scheduled for the next visit. The nurse will book a visit session for the patient who had visited the clinic before that called to book for appointment. The nurse will see an appointment form where the nurse has to fill in the patient's name, IC number, mobile phone number, and the desired appointment time. The actor in this use case is the nurse.
View medical record	The doctor and the nurse can view the medical record of the patient for diagnosis purposes. The medical record contains the patient information such as the patient previous diagnosis and related treatment, and patient visit date. The actor in this use case is the doctor and the nurse.
Write medical record	The doctor will write the medical record. The doctor will see a form where the doctor has to fill up the patient's diagnosis, and the related treatment such as the medicine and the dosage the patient has to take. The actor in this use case is the doctor.
View bill	The doctor and the nurse can view the bill of the patient. They will see the bill under the patient's name. The actor in this use case is the doctor and the nurse.
Generate bill	The nurse will generate a bill for the patient for payment purposes. On the form, the nurse has to choose the treatment or the medicine the patient has received and its related dosage, and the nurse also has to enter the amount of the consultant fee. The system will calculate the amount for each bill. The actor in this use case is the nurse.
View storage	The nurse can check the storage of medical equipment such as syringes and cotton, and the quantity of medicine in the clinic. The actor in this use case is the nurse.
Update storage	The nurse checks the storage of medical equipment. If restock, the nurse can update the quantity through a form where the nurse has to re-enter the latest amount. The actor in this use case is the nurse.

1.2.2 Matured Klink Penawar

This section describes the requirements and the use cases of the information systems used by Klinik Penawar while it has been a five-years-old matured company.

Table 1.2: Use case and Requirements of Matured Klink Penawar

Use Case	Requirement
Register new patient	Nurse will register a new patient that has never visited the clinic before. The nurse will see a form of patient registration where the nurse needs to fill in the patient information such as name, IC number, and mobile phone number. The actor in this use case is the nurse.

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View appointment	The doctor and the nurse can view the scheduled appointment. They will see a list of appointments for the day. The actor in this use case is the doctor and the nurse. The patient can view his appointment in his profile. The actor of this use case is the patient.
Make appointment	The patient who has visited the clinic before can book a visit session online without the help of a nurse. The patient will see an appointment form where the patient has to select the desired appointment time. The actor of this use case is the patient. The nurse can also make an appointment for the patient who had visited the clinic before under the patient's profile. The actor in this use case is the nurse.
View medical record	The doctor and the nurse can view the medical record of the patient for diagnosis purposes. The medical record contains the patient information such as the patient previous diagnosis and related treatment, and patient visit date. The actor in this use case is the doctor and the nurse.
Write medical record	The doctor will write the medical record. The doctor will see a form where the doctor has to fill up the patient's diagnosis, and the related treatment such as the medicine and the dosage the patient has to take. The actor in this use case is the doctor.
View bill	The doctor and the nurse can view the bill of the patient. They will see the bill under the patient's name. The actor in this use case is the doctor and the nurse.
Generate bill	The nurse will generate a bill for the patient for payment purposes. On the form, the nurse has to choose the treatment or the medicine the patient has received and its related dosage, and the nurse also has to enter the amount of the consultant fee. The system will calculate the amount for each bill. The actor in this use case is the nurse.
View storage	The nurse can check the storage of medical equipment such as syringes and cotton, and the quantity of medicine in the clinic. The actor in this use case is the nurse.
Update storage	The nurse checks the storage of medical equipment. If restock, the nurse can update the quantity through a form where the nurse has to re-enter the latest amount. The actor in this use case is the nurse.
View Timetable	The doctor and the nurse can view their work schedule. They will see their working time in a week. They can also see who is having an off day in the week. The actor in this use case is the doctor and the nurse.
Edit Timetable	The doctor and the nurse can edit their work schedule. They will see a form where they can choose their desired off day for the week with a certain condition such as no doctor or nurse having the same off day. The actor in this use case is the doctor and the nurse.

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1.3 Potential benefits of the information systems

This section describes the potential benefits that would be brought to Klinik Penawar if using the two information systems.

1.3.1 Start-Up Klink Penawar

By utilizing the information systems made for Klinik Penawar, the clinic can get rid of the traditional method of keeping the medical record of each patient in a tab. This brings ease of management to the staff as there is no need to find a patient's medical record in the sea of medical record tabs. Not to mention this also saves a lot of time, which consequently reduces the patient's waiting time so the staff can serve more patients. This also helps in the prevention of data loss. Imagine if a staff accidentally spills water from a mug to the paper from the medical record on the table, and the words are now unreadable. This is a very serious consequence since the patient's previous diagnosis and related treatment are now untraceable. Since Klinik will be either utilizing free tools or proprietary tools during the start-up stage, it can help save up costs to minimize the operation cost and maximize the revenue for each month. If the clinic is using some proprietary tool such as Microsoft Excel or Microsoft Access, there are a lot of online forums and communities to help solve certain issues met while using the tools.

1.3.2 Matured Klink Penawar

Since every branch of Klinik Penawar is using the same information system to do operation activities, there will be consistency exist in every branch. For example, the domain data type of the patients' gender would be in only one format. Other than that, the vendors would provide various kinds of services which will make the work easier. Any questions or issues that meet while using the platform could be raised to the vendors and wait for a solution. The vendors also provide training sessions to the staff of Klinik Penawar to teach them to use the system so that fewer mistakes would be made while using the system. Since the patient can book an appointment online, there is no need for assistance from the staff. This consequently saves labor cost since less employee has to be hired. The system also helps save time as the appointment can be done online in a blink of an eye, and the staff can arrange their working schedule and off days on the system very quickly.

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Chapter 2: Design Decision

2.1 Graphs

This section will conclude the topic discussed above by using graph presentation.

2.1.1 Data Flow Diagram

This is the data flow diagram for the start-up period of Klinik Penawar.

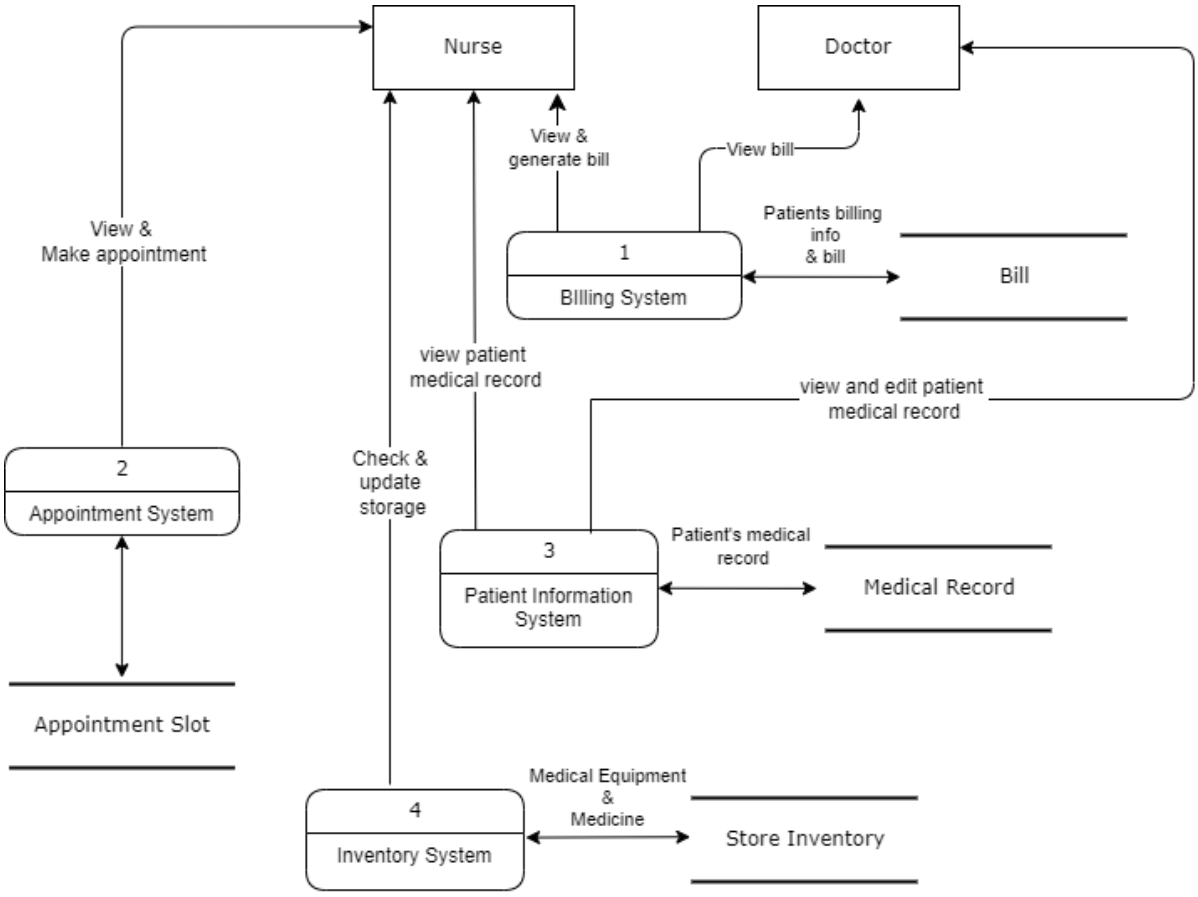

Figure 2.1: Data flow diagram of Start-up Klinik Penawar

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This is the data flow diagram for the matured period of Klinik Penawar.

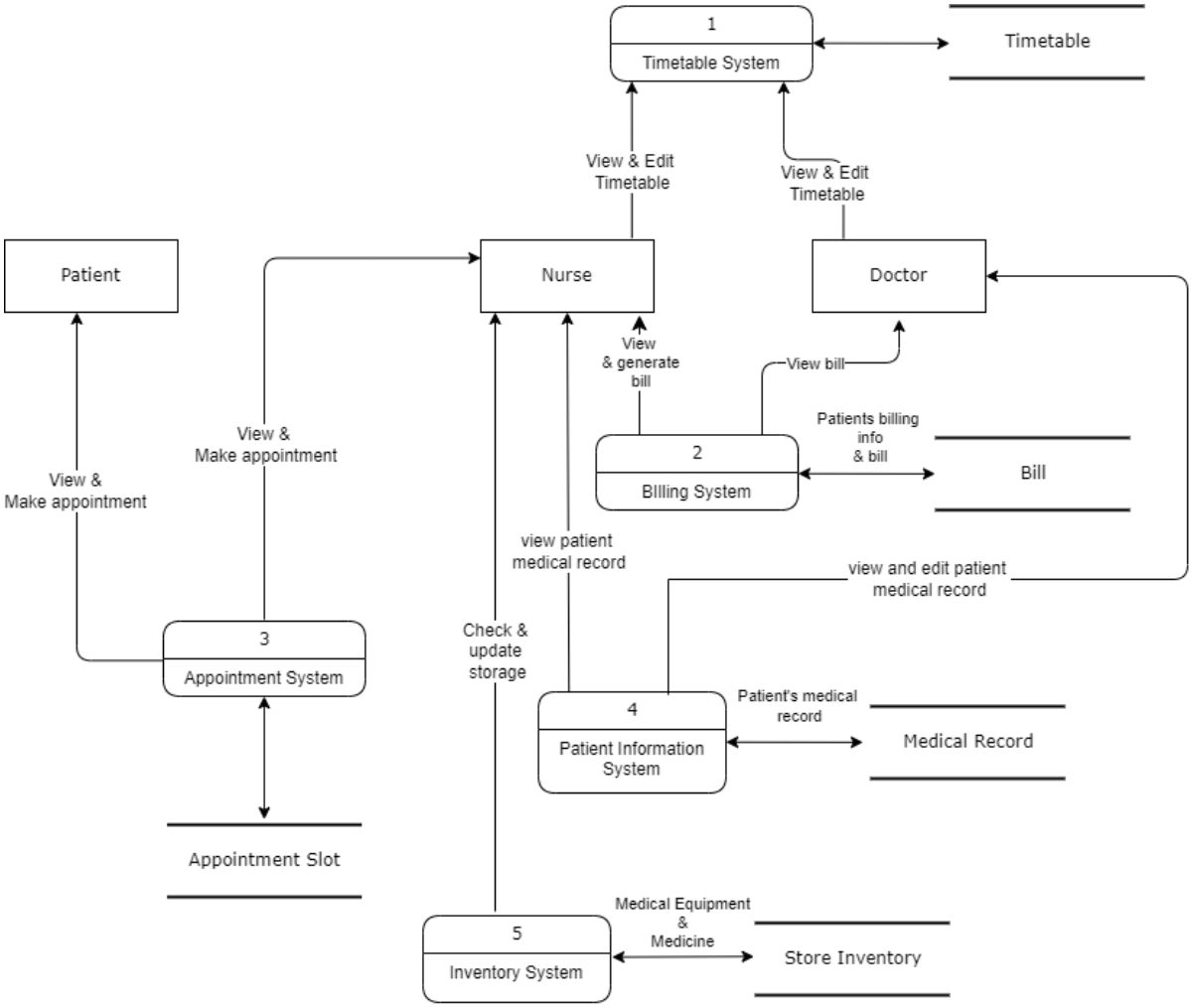

Figure 2.2: Data flow diagram of Matured Klinik Penawar

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2.1.2 Architecture Diagram

This is the deployment architecture diagram for the start-up period of Klinik Penawar. Klinik Penawar will be using free software such as Linux operating system, an application server such as XAMPP server, and MySQL as the database server.

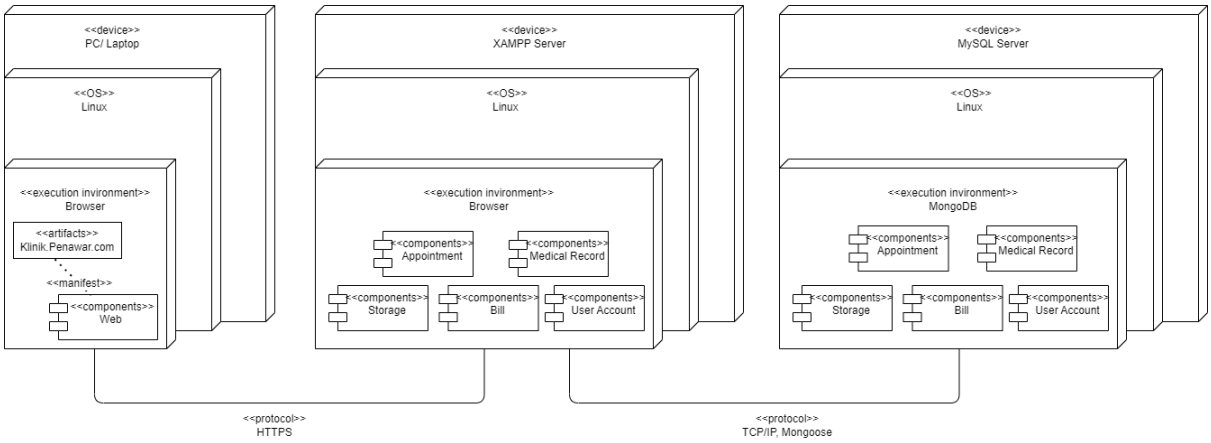

Figure 2.3: Deployment Architecture diagram of Start-up Klinik Penawar

This is the architecture diagram for the matured period of Klinik Penawar. Klinik Penawar will be able to afford to pay licensing fees and support from application vendors. Klinik Penawar will be using the products provided by IBM such as an application server and also database server.

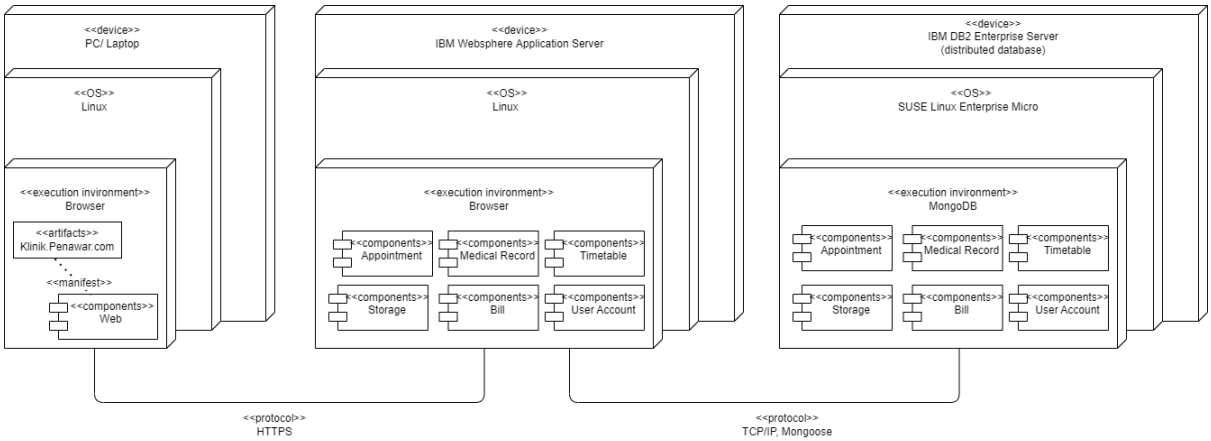

Figure 2.4: Deployment Architecture diagram of Matured Klinik Penawar

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2.1.3 Use Case Diagram

This is the data flow diagram for the start-up period of Klinik Penawar as referred to in section 1.2.1.

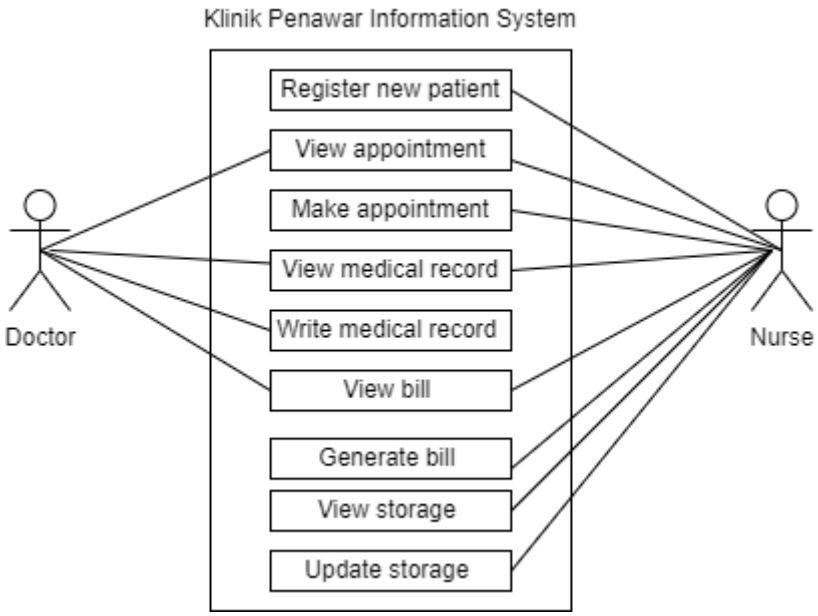

Figure 2.5: Use Case Diagram of Start-up Klinik Penawar

This is the data flow diagram for the start-up period of Klinik Penawar as referred to in section 1.2.2.

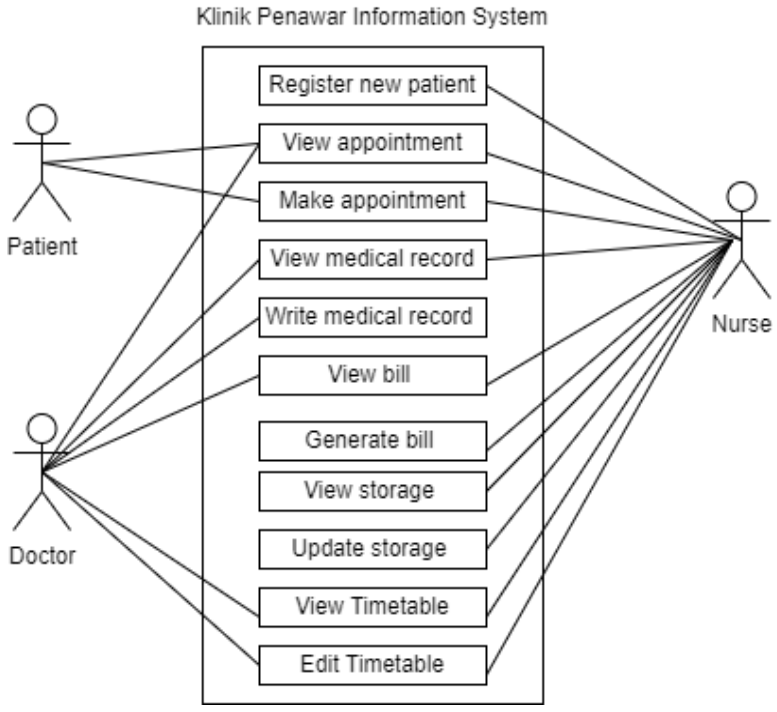

Figure 2.6:Use Case Diagram of matured Klinik Penawar

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2.2 Design Decision Explanation

This section discusses the design that would be included in the information systems. Necessary design is included based on certain assumptions and unnecessary design will be not in consideration.

2.2.1 Start-up Klinik Penawar

2.2.1.1 Data Warehouse

The concept of Data Warehouse is suggested to be implemented during the start-up period of Klinik Penawar. This is because implementing a data warehouse at the early stage of the business can help the future of the business from various angles. Making use of a data warehouse can help improve data analytics. For example, from the data, the doctor can know what time of the year has more patients. Perhaps during the rainy season, there will be more old people suffering from arthritis seeking medical help to end the sickness. Utilizing this advantage helps the director of Klinik Penawar to derive insights and marketing strategies that will guide the business and drive the competitors away. For instance, during the Monsoon season, there could be an increase of cases of flu due to the sudden change in temperature and the humid condition bringing the growth of bacteria. The clinic can put up a banner to promote flu jabs and increase the stock of various medicines that tackle flu from a range of affordable medicine to a more expensive and fast active medicine to fit different patients with different needs. Consequently, this brings greater revenue to Klinik Penawar and it can compete more strategically in the market.

2.2.2 Matured Klink Penawar

2.2.2.1 Data Warehouse

As mentioned in 2.2.1.1, a data warehouse is a good implementation to help drive data strategy. Imagine that there are 500 branches of Klinik Penawar throughout Malaysia, all the data collected in each database would be stored in the data warehouse every year. This huge amount of data if analyzed could generate very useful business insights to consolidate financial results. Hence, making Klinik Penawar a richer company.

2.2.2.2 Distributed Database

Distributed Database management system is recommended to be implemented in Klinik Penawar throughout Malaysia. This is because it supports distributed databases across different sites compared to a centralized database where the end user has to request data stored in a single central site. The process of requesting data, to approve the request might not serve the needs of Klinik Penawar well. Imagine Klinik Penawar having 500 branches throughout Malaysia, and at the same time, one nurse of every clinic is trying to access the centralized database to request the patients' medical records. Since all the data is stored at one location only, it will create a bottleneck due to high traffic which makes the search and access time longer. Worst case scenario, if every access to medical record takes an extra five minutes, each patient's consultant time will be delayed. If currently, 10 patients are waiting for a consultancy from the doctor, it will waste an unnecessary amount of 50 minutes. In the end, it will affect the business of Klinik Penawar due to the long wait time as not every customer is patient enough to wait in a long queue. If we want to avoid driving the potential customers of Klinik Penawar to their competitors, distributed database management system should be a consideration, for example, one state could have one distributed database. Although there might be other considerations such as high implementation cost, data integrity control, and complexity of management in a distributed database, the decision-makers should balance the need of Klinik Penawar over the operation cost.

2.2.2.3 Transaction Management and Concurrency Control

Since the database of Klinik Penawar is a multiuser database, transaction management, and concurrency control are suggested to be implemented to ensure serializability and avoid data integrity and data consistency in the database environment. Situations such as lost updates should be avoided in the clinic. For example, a patient makes a phone call to Klinik Penawar in Taman Ulu Tiram in Johor Bahru to make an appointment while the patient's daughter is also on a phone call making an appointment for the father at the same time. The ideal situation is that the first appointment (a transaction) is committed when the second appointment (a transaction) is executed. Losing data could cause immeasurable consequences; one day Klink Penawar lost the patient's appointment data, what if another day the medical record of the patient is lost? The patients would have to go through the same treatment, subsequently causing the loss of the reputation of Klinik Penawar. Hence, transaction management and concurrency control are recommended for Klinik Penawar. The database administrator should consider concurrency control with locking methods, time stamping, and optimistic methods.

2.2.2.4 Database Administration and Security

Since Klinik Penawar are implementing a distributed database management system and data warehouse, it is recommended that the director also considered data administration for data management purpose. Hiring a data administrator can help in consultancy, data training and support, and also database operations and maintenance such as installation of the database. The end user such as the doctors and the nurses are usually unfamiliar with the computer, so it is best to have a database administrator to give support and teach the doctors and nurses how to use the database. A situation such as implementing a different database is unavoidable. It is best to have a database administrator coordinate the database in Klinik Penawar. The database administrator should also protect the system by defining the policies and standards such as every user must have passwords with a minimum of 8 characters.

While in terms of the security of the database, the database should be protected against unauthorized users and security vulnerabilities. Situations such as the end users setting blank passwords should be restricted by enforcing stronger and more complex password policies. Not to mention that installation of antivirus and periodic backup should be performed. The database access control should be restricted too by limiting the end users' use of database management system queries. For example, the nurse or doctor can only view their respective work timetable but not the other one other than their own. The nurse can only view the medical record but not edit it; only the doctor can edit the medical record.

2.3 Product name and weblink

This section includes the actual product used in the designed architecture diagrams and the respective references can be referred to below given the web link.

Table 2.1: Product name and weblink

Product Name	Web Link
XAMPP for Linux 7.4.28, 8.0.17 & 8.1.4	https://www.apachefriends.org/download.html
MySQL Community Server 8.0.28	https://dev.mysql.com/downloads/mysql/
Linux Ubuntu Desktop Operating System	https://ubuntu.com/desktop
IBM Websphere Application Server	https://www.g2.com/products/ibm-websphere-application-server/reviews
IBM DB2 Enterprise Database Server	https://www.shi.com/Product/36010312/IBM-DB2-Enterprise-Server-Edition
SUSE Linux Enterprise Micro	https://www.suse.com/shop/sle-micro/

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References

How to draw 5 types of architectural diagrams. (n.d.). Retrieved from Lucidchart : https://www.lucidchart.com/blog/how-to-draw-architectural-diagrams

What is Data Flow Diagram? (n.d.). Retrieved from Visual Paradigm: https://www.visual-paradigm.com/guide/data-flow-diagram/what-is-data-flow-diagram/