CENTRALISED DATA FOR DIALYSIS PATIENTS

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A proposal submitted
in partial fulfilment of the requirements for the award of
Bachelor of Science (Hons.) Software Engineering

Faculty of Engineering and Science
University Tunku Abdul Rahman

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DECLARATION

I hereby declare that this project report is based on my original work except for citations and quotations, which have been duly acknowledged. I also declare that it has not been previously and concurrently submitted for any other degree or award at UTAR or other institutions.

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APPROVAL FOR SUBMISSION

I certify that this project proposal entitled **"CENTRALISED DATA FOR DIALYSIS PATIENTS"** was prepared by **CHENG HAO LUN** has met the required standard for submission in partial fulfilment of the requirements for the award of Bachelor of Science (Hons.) Software Engineering at University Tunku Abdul Rahman.

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CENTRALISED DATA FOR DIALYSIS PATIENTS

ABSTRACT

In the recent years, there is an increase of the number of the dialysis centres in Malaysia in order to convenient the patients who require haemodialysis treatment. Besides that, the increase of the dialysis centres is also because of the increase of the number of the patients. Due to the number of dialysis patient is still relatively small in the previous year, hence little attention is given to them until the recent year the government has decided to allocate some budget to provide more services to them. This project aims to develop a centralised data for the dialysis patients. The target audiences for this system are the dialysis patients and the dialysis centres. The main objective of this project is to provide convenience for the dialysis patient in managing their data and information. This project is divided into two modules, which are patients' view of their personal information and dialysis centre's view to update the patient record. Due to the time constraint, some of the features for example dialysis booking facilities, phone verification and phone application will not be added into the system. This system will be designed and developed using the rapid application development model and the technology used for the development will be PHP and MySQL. MySQL is used to manage the database that store the data of the patients.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF SYMBOLS / ABBREVIATIONS

NGO	Non-Government Organization
PHP	Hypertext Pre-processor
RAD	Rapid Application Development
DDMS	Dialysis Data Management System
ER	Entity Relationship
ASP	Active Server Pages
JSP	Java Server Pages
HTML	Hyper Text Markup Language

LIST OF APPENDICES

APPENDIX **TITLE** **PAGE**

CHAPTER 1

INTRODUCTION

1.1 Background

Due to today's advancement of technology, works are needed to be done in effective and efficient way hence most of the works are being accomplished with the help of technology. Malaysia is a developing country and this is the reason most of the things are in the progress of development.

Currently, most of the dialysis centres are having their own system to manage their patients' data for their own records and references. Some of the dialysis centres even manage their patients' data manually. This is because they are looking for a cost effective medical services that will fulfil the needs of the community as well as assist their financial stability. In addition, there are not many dialysis patients in Malaysia in the previous days and the data managing system and the dialysis machines are expensive. Most of the private dialysis centres in a perception that they should invest more on the dialysis machine instead of the data managing system in order to earn profit.

Due to this issue, the patients do not have the detail of their medical information and dialysis visiting records. In the recent years, Malaysia Government are trying to provide more facilities for the patients who require haemodialysis treatment by increasing the number of dialysis centres so that the patients are able to obtain the treatment wherever they are going. On the other hand, there are some problems arise as well. Dialysis centres are the place where the patient information

and record are stored and the other dialysis centres require the patient's latest information before they can provide the treatment for the patient due to the rules and regulations from the Ministry of Health and the safety issues. Hence, the patients have to plan well before they make a visit to other dialysis centre. They are required to request for their latest information and data from previous dialysis centre to be sent to the dialysis centre they are going to visit either through fax or email.

With the assistance of technology, data storage centralization is to store and share the data available for the person involved. This data storage is to provide a safety for the confidential of the data of person involved and enable the person involved to obtain the data or files in the storage. Relative mobility allows for quick and easy access to the important data from most of the places in Malaysia. Now, the patients are able to manage the data themselves instead of the data is managed by the dialysis centres only. In other words, the data is not only kept in the dialysis centres but also in the patient's hand. Hence, wherever the patient goes, the medical information and records are always in the patient's hand. They can always send their information to the dialysis centres they are going to visit or send to the doctor in charged in case of any emergency. The dialysis centres also able to retrieve the patient information through online. All the data will be stored in the server which this server could be managed by The Malaysian Red Crescent Society, one of the NGO.

1.2 Problem Statement

With the availability of new technologies, most of the works can be simplified and enable the work to be accomplished in fast and effective way. The reasons for the development of this system are listed as below:

- **Time Constraint**

  The patients are required to plan well before they make a visit to other dialysis centre. All the information and visiting records of the patients are stored at the dialysis centres. Hence, when the patients want to visit other

dialysis centres, they need to request for their latest information and data to be sent to the dialysis centre they are going to visit either through fax or email. It is time consuming and energy draining.

- **Decrease the workload of the dialysis centre and increase efficiency**

  The increase of number of patient is indirectly increasing the workload of the dialysis centres. There are more data that need to be processed. Hence, this may result in low efficiency. Although, this problem can be solved by increasing the manpower but this may result in an increment of the expenses. With the development of this system, the patients can manage their information themselves and send their information and data to the desired dialysis centre themselves.

- **Paperless and eco-friendly**

  By using this traditional method, it is not eco-friendly and requires some extra cost because more information is passing through fax and hardcopy. Due to the increase of dialysis centre and the number of patient, this also indicates that more paper will be used to keep the record of the patient. Thus, the system developed will be able to minimise the use of paper and help to save cost for the dialysis centres.

1.3 Project Objectives

General Objectives

- The general objective of the project is to provide a tool for the patients who require haemodialysis treatment to manage their own information. The project aim is to enable the patient to view and send their latest information to the specific dialysis centre through online.

- The dialysis centres are able to retrieve the patient's information and record through online.

- The dialysis patient's medical records are able to be updated by dialysis centres and blood test centres upon agreed by the patient through online.

Specific Objectives

- The specific objective of the project is to develop a web based information management system for the dialysis patients to manage their information and enable the patients to send their latest medical information to the dialysis centre or hospital when needed.
- Besides that, it also enables the dialysis centres to update the patients' latest information easily.

1.4 Project Scope

The target audiences of this project are the dialysis patients and dialysis centres. The dialysis centres are able to search the patient's name based on the patient's identity card number and view the patient's record. Besides that, the dialysis centres are able to update the patient's visiting record and also the patient's latest medical information for example what is the surgery or illness that the patient was undergoing as well as the latest blood test detail of the patient for example the hepatitis A, B and C test result, HIV test.

Lastly is the patient is able to view their information and records and able to send their information to the particular dialysis centre or to the clinic or hospital if needed.

The project is divided into two main modules.

Module 1: Patients' view of their personal information.

The patients are able to view their personal information and send their information to the dialysis centres, hospital or clinic when needed.

The patients are able to view their information including the medical information and records but they do not have the rights to update the records. Besides that, the system will also compile the information that required by the dialysis centre, clinic, or hospital when needed.

Module 2: Dialysis centre's view to update the patient's record.

This is for dialysis centre to view the patient's information and update the patient's record after the visit.

After every visit of the patient, the nurse at the dialysis centre can easily update the record of the patient through online for future references.

Besides that, the dialysis centres are required to update the patient's latest medical information if the patient undergoes any surgery or illness. The surgery record and the illness records are important for the dialysis patient in order to avoid any side effect of the medicine being used to the patient.

Due to the limitation of time available for the development of data centralization system, this system is only gather the data of the dialysis patient through the dialysis centres.

Things not included:

1. SMS verification facility for confirmation of data sending and updating.
2. Phone application to ease the information retrieving and updating.

The system will need to have further development to ensure the security and provide more facilities for the dialysis patient. The facilities that can be provided to the patient are to check for the dialysis centres as well as make booking appointment for dialysis treatment.

The expected deliverable of this project would be the two modules that stated above and with complete features as described above.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter will discuss on the literature review that covered the following topics:

- Dialysis
- Guidelines for the healthcare institution providing renal dialysis
- Dialysis data management
- Centralised data
- Related work

2.2 Dialysis

According to Berns, J.S. (2013), dialysis is a treatment for the patient who are having kidney failure / renal failure / stage 5 chromic kidney diseases or also can be known as end-stage renal disease. The kidneys of the patients who face such diseases are not able to remove the fluid and waste products from the body. Dialysis is providing artificial replacement for lost kidney function to remove the fluid and waste.

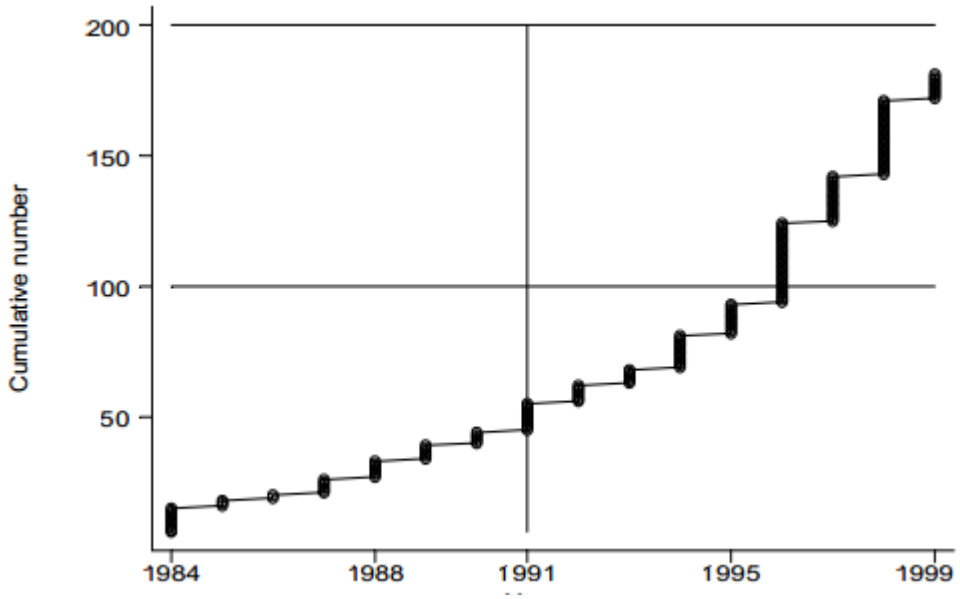


Figure 1 : Growth in number of dialysis centres, 1984 -1999

(Source : Lim, T.O., Lee, D.G. and Morad, Z., 2000)

In Malaysia, there were 181 dialysis centres as at 1st June 1999 and the numbers of the dialysis centres were increasing gradually from year to year due to the increase of the dialysis patients as shown in Figure 1.

State	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Negeri Melaka	6	4	4	6	8	10	2	10	4	13	22	20
Johor Darul Takzim	2	5	7	3	4	5	3	4	9	10	15	17
Negeri Sembilan	2	3	12	8	8	2	12	15	6	3	7	17
Pulau Pinang	5	5	9	3	7	10	5	12	7	15	17	11
Selangor & W.Persekutuan	21	32	38	33	40	31	33	36	46	68	28	32
Perak Darul Redzuan	2	5	6	5	8	8	8	7	8	12	14	16
Terengganu Darul Iman	0	2	5	0	0	0	1	3	4	4	6	4
Kedah & Perlis	2	2	2	3	9	4	4	5	6	2	3	5
Kelantan Darul Naim	0	0	0	4	3	2	3	3	4	4	5	2
Sarawak	1	2	3	6	5	7	8	7	9	13	12	11
Pahang Darul Makmur	4	4	1	3	5	3	5	10	5	4	10	8
Sabah	0	3	2	2	3	2	3	2	3	1	8	11

State	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Negeri Melaka	40	32	69	74	82	95	111	91	147	151	145	95
Johor Darul Takzim	18	27	45	42	57	79	71	104	131	136	145	125
Negeri Sembilan	19	30	39	48	74	73	90	94	116	113	133	123
Pulau Pinang	14	16	30	73	70	85	109	124	102	120	130	86
Selangor & W.Persekutuan	39	32	40	63	82	76	90	102	121	116	122	105
Perak Darul Redzuan	19	24	28	28	57	62	64	75	106	101	110	91
Terengganu Darul Iman	4	16	15	18	27	37	34	36	37	76	87	66
Kedah & Perlis	18	12	19	18	26	54	47	59	68	64	85	72
Kelantan Darul Naim	2	5	7	10	6	11	15	26	31	59	60	65
Sarawak	16	13	21	20	36	46	33	44	51	67	58	55
Pahang Darul Makmur	14	12	13	20	17	44	36	47	48	52	51	60
Sabah	7	4	11	12	18	16	24	32	25	36	35	39

Table 1 : Dialysis Treatment Rate by State, per million state population, 1980 - 2003

(Source : National Renal Registry, 2003)

The Star (2013) stated that Minister Datuk Seri Liow Tiong Lai said that the dialysis patients who are suffering from end-stage renal disease had tripled more than the past decade with 26,159 patients undergoing treatment in 2011.

Lim, T.O., Lee, D.G. and Morad, Z. (2000) explained that the common causes of this disease in Malaysia are diabetes mellitus and glomerulonephristis. Diabetes mellitus is caused by deficiency and diminished effectiveness of endogenous insulin while glomerulonephristis is a disease that injured the part of the kidney that filters the blood (National Kidney Foundation, 2013). According to Lim, T.O., Lee, D.G. and Morad, Z. (2000), there are two types of dialysis treatment in Malaysia, which are haemodialysis and continuous ambulatory peritoneal.

- During haemodialysis treatment, dialysis is carried out through an artificial membrane that housed in a dialyser that connected to the patient's arterio-venous fistula via an extra an extra corporeal circuit.

Figure 2 : Dialyser

- During continuous ambulatory peritoneal dialysis, dialysis is carried out across the natural peritoneal membrane in the abdomen. In order to have the access to the natural peritoneal membrane, a permanent catheter is required and the dialysate is infused via the catheter to dwell in the abdomen.

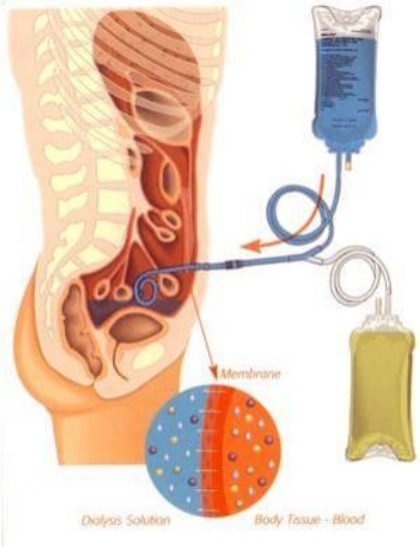


Figure 3 : Continuous ambulatory peritoneal dialysis

(Source : Baxter, 2013)

2.3 Guidelines for the healthcare institution providing renal dialysis

Many precaution steps have been taken by the dialysis centres. This is because of there are many contacts with the blood of the patient and the dialyser machines are shared among the dialysis patients.

According to Ministry of Health Malaysia (2012), the patients who are having Hepatitis B, Hepatitis C or Human Immuno-deficiency Virus required prevention and isolation practice. The patients are required to test for Hepatitis B, Hepatitis C or Human Immuno-deficiency Virus before they are initiating the first haemodialysis treatment or after returning from another haemodialysis facility. All the Hepatitis B, Hepatitis C or Human Immuno-deficiency Virus patients required to be isolated in a separate room and they should be dialyzed using separate machines, equipment and instruments. For the patients who are at the risk of acquiring viral infection, they are strongly recommended to dialyse with single use dialyser or the dialyser machine is dedicated for an unknown viral status until the particular patient is out of the window period for the respective infection. Dialysis patients are recommended to have their blood test for monthly intervals.

2.4 Dialysis Data Management

According to the Malaysian Society Nephrology (2011), National Renal Registry collects all the information of the kidney failure patients and all these data are required to estimate the treatment rates in the country as well as to assist the Ministry of Health, Non- Governmental Organization, private providers and industry in the planning and evaluation of the renal replacement therapy. The National Renal Registry requires the cooperation from the different sector that provides the dialysis services and renal replacement therapy in order to obtain the latest information of all the renal replacement therapy and dialysis in Malaysia.

Every dialysis centres are having their own method of gathering and managing their patients' information. Some dialysis centres are recording their patients' data in paper-based while some of the dialysis centres are having their own system to manage their patients' data and information. The examples for the systems that help to manage the dialysis patients' information are shown as below.

i. Therapy Data Management System

Figure 4 : Therapy Data Management System

(Source : Fresenius Medical Care, 2012)

According to Fresenius Medical Care (2012), Therapy Data Management System is developed by Fresenius Medical Care. This system helps in recording the weight of a patient before and after dialysis and preparing and pre-setting of the dialysis device. Besides that, this system also helps in documenting the treatment process, any addition al laboratory tests during the dialysis and any changes in the treatment procedures.

ii. Finesse Professional

Figure 5 : Finesse Professional

(Source : Fresenius Medical Care, 2012)

Based on Fresenius Medical Care (2012), this Finesse Professional system helps to simplify routine works, improve treatment quality and ease technical operation of procedures. It helps the dialysis centres in planning and organizing the daily routine works. This system collects patients' data through the entry of the nursing staff. This system has been developed in close operation which means that it is used by the staff and the users in the dialysis centre only.

All these systems are used to manage the patients' information and their visit records. Besides that, these systems are linked to dialysis machines and other important medical devices. All these data that collected are mainly for the internal use of the dialysis centres.

2.5 Centralised Data

For the current situation, every dialysis centres are holding their own patients' information and visiting records. The patients themselves do not have the visiting records and their medical information is all in paper-based manner. When they need to go for another dialysis centre for haemolysis treatment, the dialysis centre requires their information and the latest blood test result due to the precaution steps that provided by the Ministry of Health Malaysia in order to protect the patients from the infection of the Hepatitis B, Hepatitis C or Human Immuno-deficiency Virus (HIV). Hence, they require the patient's dialysis centre to fax or mail their medical

information to the particular dialysis centre that the patient wanted to visit and this is time consuming.

Heeks, R. (1999) explained that through the centralization of the data, it helps in sharing resources. A well-planned centralised system holds data used across the community or across the organization allowing all the people involved to access it. This helps to improve the efficiency and effectiveness of the dialysis centres. Other than that, it also avoids duplication of the data and records. It helps to maintain single version of any particular information system for the whole community or the organization and to store data once and only once. Hence, there is no waste of effort, storage capacity and inconsistency of data.

By the centralization of the data of the patients, the patients are able to get their latest information easily wherever they go. Besides that, it also helps to avoid any not updated information or inconsistent medical information of the patient as the latest medical information of the dialysis patients are important for every dialysis centres.

2.6 Related Work

Due to the population of the dialysis patients in Malaysia is small and less attention is given to these patients, hence, there is no dialysis centre or research on gathering the dialysis patients' data in order to ease the patients in Malaysia. However, some systems that gather and manage the data are available in the market. This section will describe on the available systems and their functions.

2.6.1 Gambro Dialysis Data Management Tool

Figure 6 : Gambro Dialysis Data Management Tool

(Source : Gambro, 2011*)*

This system helps the dialysis centres to manage their dialysis facilities and improve their overall performance. Gambro Dialysis Data Management Tool will automatically collect the treatment data of the patient and it also allows real time access to treatment data and real time report of alarms and events.

Other than that, Gambro Dialysis Data Management Tool will automatically help the dialysis centres to do preparation and print out treatment forms and treatment run-sheets. This system also helps to optimise the patient care before, during and after the treatment.

Before the treatment, it provides the centres an intelligent tool to help the nurse to define the optimal dose for the dialysis patient. During the treatment, the system will provide pre-dialysis measurement for example, patient weight and blood pressure. Besides, it also helps to monitor patient's condition continuously and records the every single event. At the end of the treatment, treatment analysis will be conducted by the system to calculate the exact dose to be delivered to the patient.

This system can be conducted via online, offline or remote. If the system is used offline, the data is transmitted via patient card. If the system is online, the data can be transmitted via local area network. If the system is remote, the data can be transmitted over the phone or internet (Gambro, 2011).

2.6.2 GJI iCentral

Figure 7 : GJI Pty Ltd

(Source : GJI Pty Ltd, 2013)

GJI Pty Ltd provides data centralisation systems to the customers called iCentral. This system is able to consolidate multiple data sources into a centralised system that is easy to manage and provides customer with a customized dashboard to allow them to access their data easily.

Figure 8 : Data centralised system by GJI Pty Ltd

(Source : GJI Pty Ltd, 2011)

CHAPTER 3

METHODOLOGY

3.1 Project Description

This project is designed to solve the problem that stated in the problem statement. The objective of the project is to ease the dialysis patients, dialysis centres and doctors to get the patient information and data.

This project contains 2 modules. The first module is where the dialysis patients view their information and track their records. Besides, the dialysis patients also can send their information to the doctor or dialysis centres through this section. The system does not allow the patients to change any of their information, they only have the right to send and view their information. In the module 2, the dialysis centres are able to view and update the patient's visiting records. The system gives the dialysis centres the authority to insert new records to the patient's visiting records but not editing the previous data. Besides that, the dialysis centres are also having the rights to enter the patient blood test result. Some patients who are having Hepatitis B, Hepatitis C or Human Immuno-deficiency Virus (HIV), they are required to have blood test for every 3 months according to Ministry of Health Malaysia (2012). Hence the system will send the notification to the patients, dialysis centres as well as the blood test centres.

All their data will be stored in the server where this server could be managed by The Malaysian Red Crescent Society, one of the NGO. By using this system, all

the health information and data are all on the hand of the patient and this information can be retrieved just with one click. Besides that, the system is designed to be simple and easy to use in order to suit for every user.

3.2 System Architect

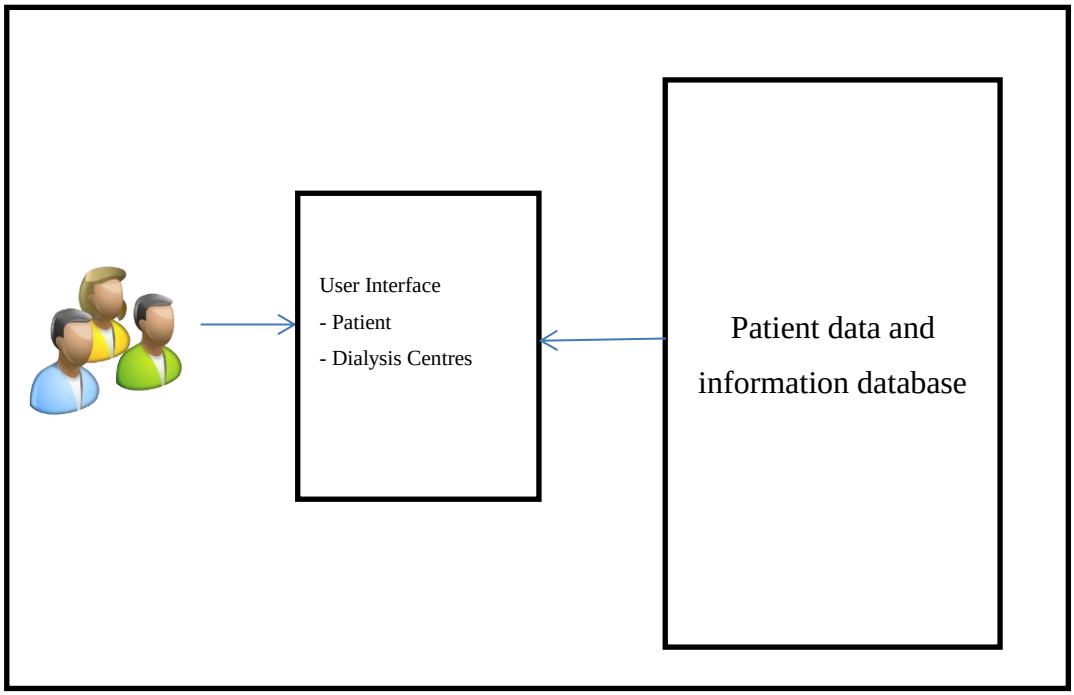


Figure 9 : Centralised data for dialysis patient system architect

3.3 Software Development Life Cycle

3.3.1 Introduction

There are varieties of development approaches designed to be used or deployed for the development process of software. The purpose for every model is to ensure success in the process of software development. Rouse, M. (2009) explained that the software development life cycle is a conceptual model that being used in project management that describes all the stages involved in the information system development project from the initial feasibility study through maintenance of the completed system. There are various software development life cycle methodologies have been developed for instance, waterfall model, rapid application development, spiral model and agile method.

3.3.2 Waterfall Model

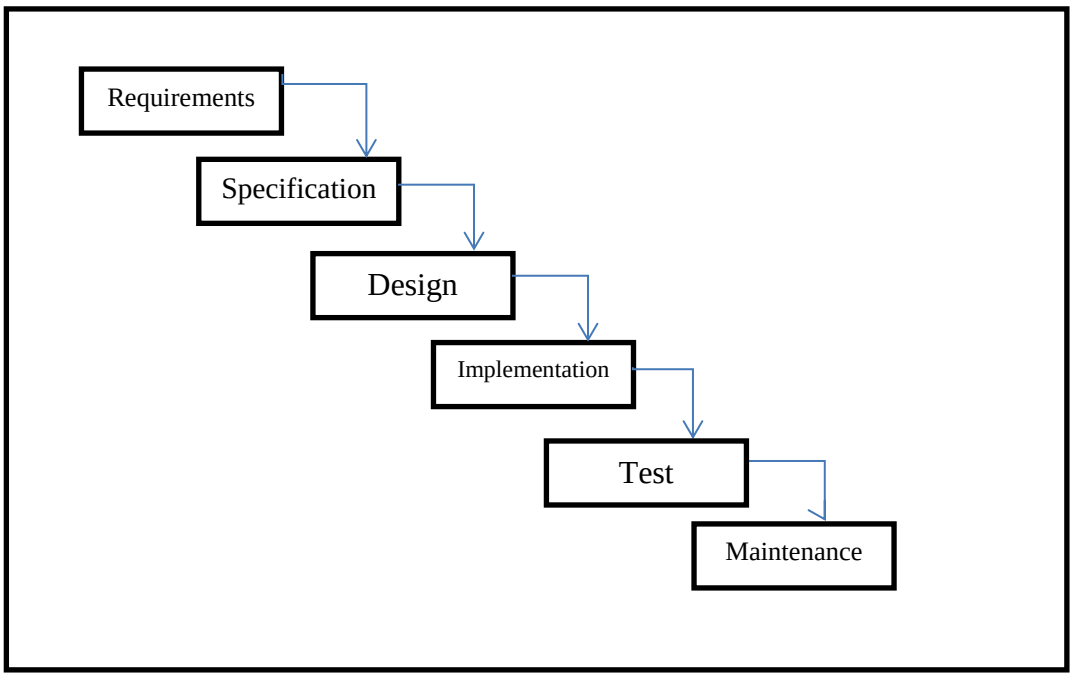


Figure 10 : Waterfall Model

According to Vishnu Sharma (n.d.), waterfall model is popular in 1970s. The waterfall model is fall from top to the bottom which shows the development process from the top to the bottom in steps. It emphasizes on completing a phase before proceeding to the next phase. This type of model is suitable for system which does not require frequently change on the requirement specification. The minor changes can be done through a maintenance process or through the small design changes.

Disadvantages of Waterfall Model are every phase is isolated from the other stage in the waterfall model and every phase is needed to be completed before move on to the next stage. According to Sommerville, I. (2004), waterfall model does not cope well with changes, generating rework and may cause unpredictable software qualities due to delay testing. To develop a system, the clients often not clear on their own requirements. Hence the requirement specification is always changing. Any changes made by the clients may cause confusion. Besides, the customers are unable to review the final product until the last stage of the waterfall model. This might causes the final products do not fulfil the requirement of the customers.

3.3.3 Spiral Model

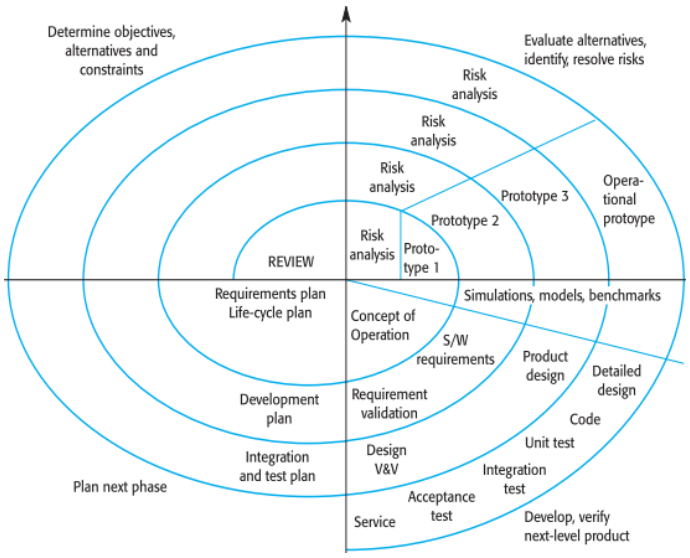


Figure 11 : Spiral Model

(Source : Sommerville, I. ,2004)

Spiral model is an evolution from the waterfall model but this model is more emphases on the risk analysis. Govardhan, A. and Nabil Mohammed Ali Munassar (2010) explained that the spiral model will lead the software project repeatedly passes planning, risk analysis, engineering and evaluation. Hence through this model, the software product can be produced early in the software life cycle and the clients are able to make evaluation on the output before the project continues to next spiral.

According to Vishnu Sharma (n.d.), the spiral size of the model is corresponds to the system size while the distance between the coils of the spiral will shows the resources used. If the distance between the coils does not change, this means that the amount of resources being used is not changing.

However, the cost for this model is high. Hence, it is tough to meet the budgetary and scheduling requirements by using this model.

3.3.4 Agile Model

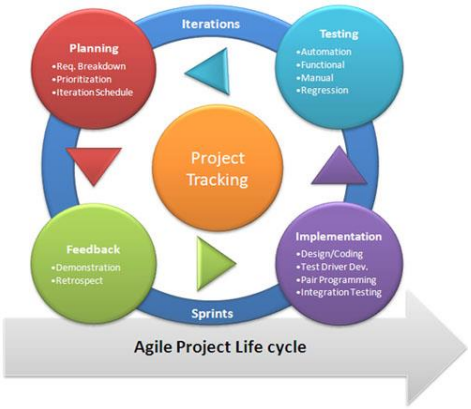


Figure 12 : Agile Model

(Source : Hughes Systique, n.d.)

Sheetal Sharma, Darothi Sarkar and Divya Gupta (2012) explained that agile model is an iterative and incremental based model. In this model, the requirements are changeable based on the client needs. Hence, it helps in adaptive planning, iterative development and time boxing. In the agile process, it requires the client to have direct involvement in evaluating the software to increase the satisfaction by the client. Agile process has a high ability to adapt the changing environment, this is because there are several iterations in the model and each iteration is characterized by analysis, design, and implementation and testing. After each iteration, it will be tested and getting feedback from the clients. This will help to decrease the risk of the development as the incremented mini software is delivered to the clients and feedback is taken from the clients.

Sheetal Sharma, Darothi Sarkar and Divya Gupta (2012) also explained that this agile model requires high involvement of the client and the entire project is developed based on the client requirements. If the client is not clear on the software features, this might cause the project to be delayed or out of track.

3.3.5 Rapid Application Development (RAD)

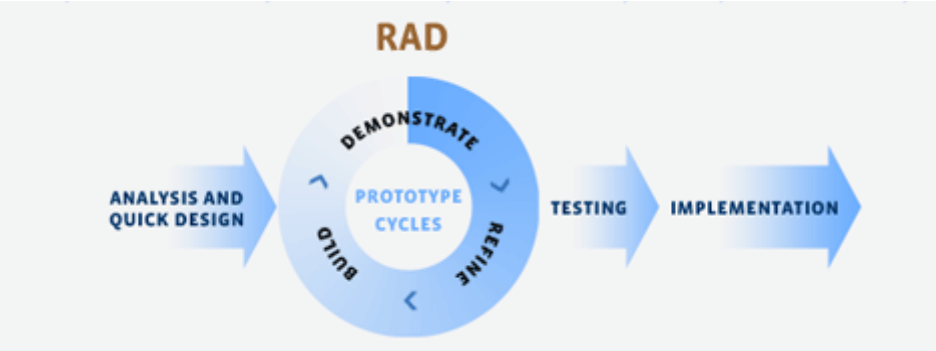


Figure 13 : Rapid Application Development (RAD)

(Source : Vikash, 2012)

According to Martin, J. (1991), rapid application development is a model that designed to provide a faster development but with higher quality result if compare to those traditional life cycles. This model is designed to take maximum advantage of powerful development software that has evolved at that time.

NC DENR System Development Life Cycle Methodology (1999) wrote that Rapid application development model integrated project management techniques, development techniques, users and tools to build quality application system. Rapid development combines focused teams working in a high structured environment.

This model enables fast delivery. Rapid application development increased development speed and decreased time to delivery. This model has some tools which help to focus on converting requirements to code as fast as possible, it enables the developers to re-use previously generated code. Besides that, the quality can also be assured by using this model. The quality of the system can be enhanced by meeting the requirement of the clients. On the other hand, this model reduces scalability and features. Due to the time boxing, some features are pushed off to later versions in

order to deliver the system in a short time frame. Besides, this model is mainly focuses on development of a prototype that is iteratively developed into a full system. Hence, the delivered solution may lack of scalability of a solution according to Core Partners Inc (n.d.).

3.4 Method Selected

Based on the researches and comparison among the model that available, the most suitable software development methodology model to be used to develop this project is Rapid Application Development (RAD).

Rapid Application Development (RAD) is selected because of:-

- Development time is shorter

  The timeframe given by university to develop final project system is less than 4 months. Besides that, RAD model encourage to develop the main core of the system before adding addition features to the system in order to decrease the development time. This is suitable for the current system where the centralise the patient is the main core of the system while the security or the dialysis centres locator feature will be added after the completion of the main core of the system.

- Flexible and adaptive to change

  RAD model increase the flexibility of the system. During the development, the clients always change their requirements. Hence, by using RAD model, it will not affect the entire project.

  In this project, the features can be added into the system during the development easily if the time is allowed. Besides that, RAD also provides an updated “look and feel” of the evolving product to make sure that the system is always on the right track.

- Better project management

  The main purpose of project management is to ensure a quality system can be done in time and within the budget given. Since the time frame for this project is short therefore the project management is very important. RAD is suitable for this project. RAD model is having active participation of the stockholders. Hence, less error or misunderstanding of the requirements will happen, which may lead to prolong the development time.

During the analysis phase of RAD, the objective, target audience, mode of delivery and the target audience requirements are need to be gathered. All the information that are required for the development of the Dialysis Data Management System is collected from the dialysis centers as well as the dialysis patients. The database is first designed based on the information gathered. Besides that, a constant update of the system with the dialysis centres is required to ensure that the system is on track and is developed based on their requirement. Other than that, related projects and related documents are studied in order to get more information about the system which is going to be developed and to ensure that there is no duplication of similar system exists.

The next phase of the RAD is prototype cycle which is the design phase. In this phase, it consists of builds, demonstrate and refine. During this phase, the progress of the system is constantly updated and demonstrated to the users. This is to ensure that the system is always on track and within the scope of the users. If there is any correction or out of the users' scope, the system can be rectified easily and be corrected in shorter time. On the other hand, if the system is found not fulfilling the user requirements after the system is done, it will take more time to correct the system. Hence, build and demonstrate at same time is more time saving and more secure when the project has to be developed within a limited time.

Next will be the testing. Unit testing, integration testing, functional testing and acceptance testing are being done during this phase. This is to ensure that the system is work correctly and the data is passing correctly between the interfaces as

well as the database. Besides that, the acceptance test which is done by the users is tested after the system is completely done. This acceptance test is to prove that the system is done based on their requirement and test on their satisfaction on the system.

Lastly will be the implementation. During this phase, the system is delivered to the users and evaluation will be taken. This Dialysis Data Management System will be implemented in the actual environment. Some of the actual patient data is keyed into the system. This system required a web based as well as database is required. Hence, the system is required to be deployed into the World Wide Web by using the hosting services.

3.5 Development Tool

1. PHP

   PHP is known as hypertext pre-processor. This PHP is widely used for web development and it can be embedded into HTML. The code of PHP is executed in the server and it generates html then send to the client. This enables the client to view the result but do not know what the underlying code was. Besides that, PHP is working well with MySQL as well as cloud services. PHP also offers a lot of the security mechanisms to avoid from the PHP file in the server being changed. One of the technologies is Encoding PHP files where the editable plain text files is changed to binary format.

2. MySQL

   MySQL is a relational database management system that uses Structured Query Language. It is used to adding, accessing and managing (add, access and manage) content in a database. MySQL is developed,

distributed and supported by Oracle Corporation. All the data will be stored in the database and MySQL is used to manage the data in database and plays a role in computing, as standalone utilities.

3.6 Project Plan

This project contains 3 phases:

- Literature Review Phase
  During this phase, information related to project is gathered through the surveys, journals, and case studies.
  Duration: January 2013 to April 2013
- Methodology Phase
  During this phase, different methodologies are compared to determine the best methodology to be used for the project.
  Duration: January 2013 to April 2013
- Development Phase
  During this phase, the system starts to develop for the database, user interface and test cases to make sure that the system satisfies the needs.
  Duration: May 2013 to August 2013

Gantt chart that shown in **APPENDIX A** shows the estimated time to complete the development of the system.

Due to the system is developed by using PHP and MySQL, both are open source hence less cost is needed for this project.

CHAPTER 4

DESIGN

4.1 Introduction

In the design phase, a systematic process of designing the front-end and the back-end of the system are determined and planned. During this stage, the storyboards, user interface and the databases are designed. Besides that, the architecture design and system flow chart are also illustrated. Below are the components that will be considered during this phase:

- Use case
- Flow Chart
- System architecture Design
- Story board design
- Database design

4.2 Use Case

According to Rouse, M. (2007), use case is a methodology used in system analysis to identify, clarify, and organize system requirements. The use case is made of a set of possible sequences of interaction between the users and the systems in the Dialysis

Data Management System environment. Diagrams below show the use case for the dialysis centres as well as for the patients.

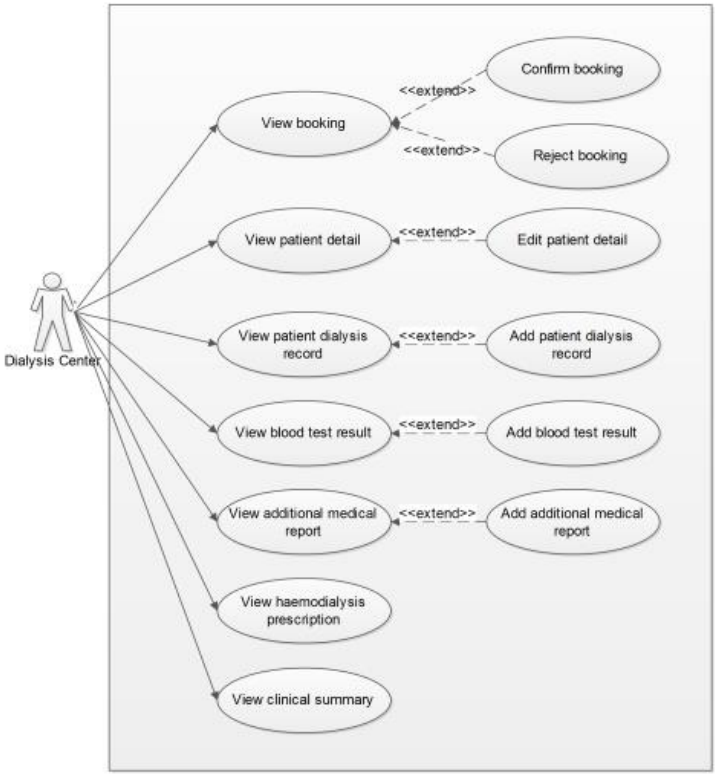


Figure 14 : Dialysis Centre's Use Case Diagram

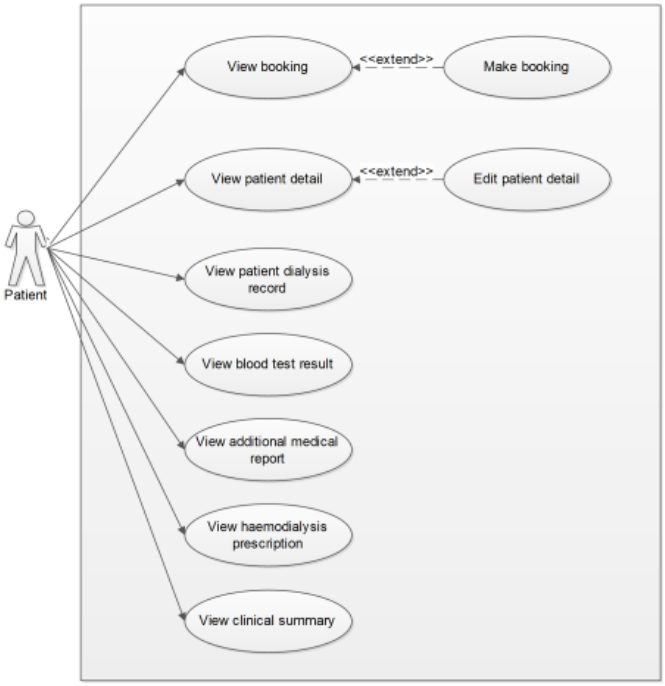


Figure 15 : Dialysis Patient's Use Case Diagram

4.3 Flow Chart

Edraw, a professional diagram solution company (2004) explained that a flow chart is visually presenting the flow of data through an information process system.. Diagrams below show the flow chart for the dialysis centers and the dialysis patients.

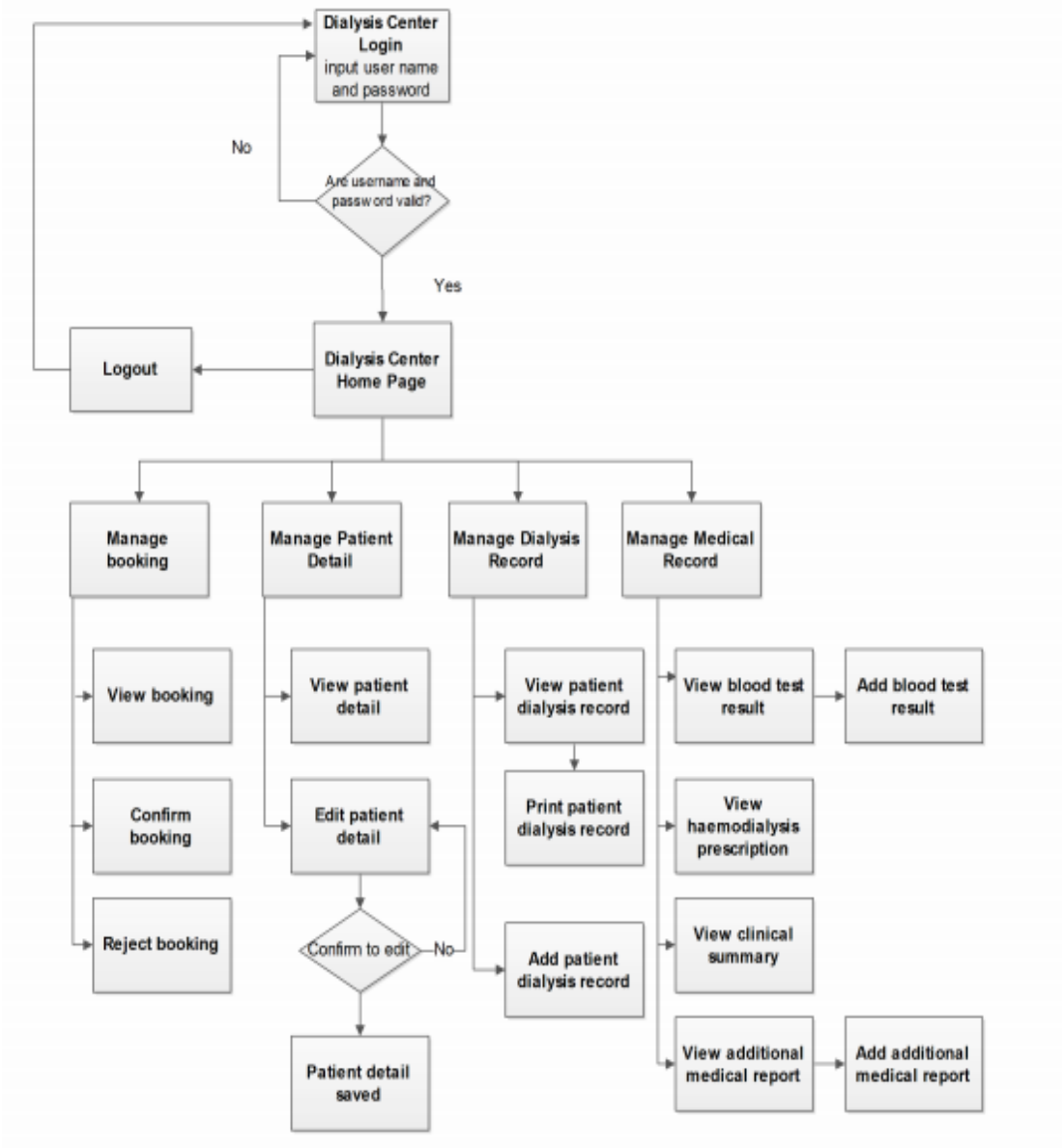


Figure 16 : Dialysis Centre's Flow Chart

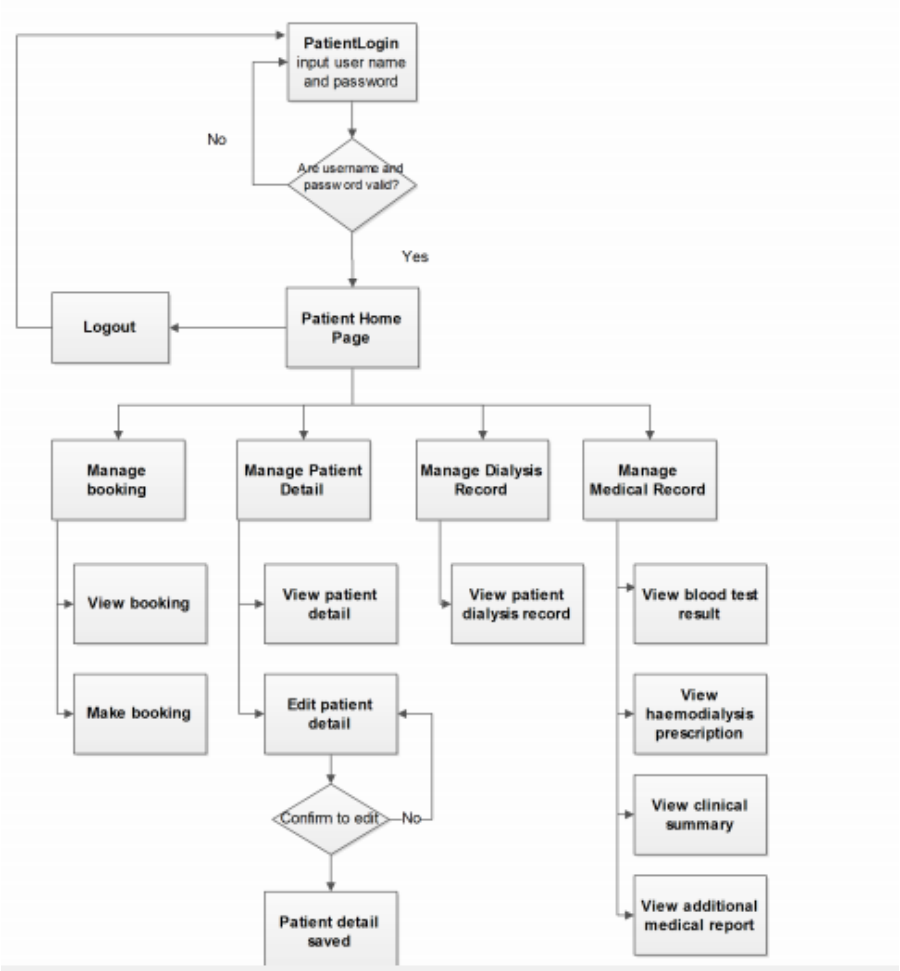


Figure 17 : Dialysis Patient's Flow Chart

4.4 System Architecture Design

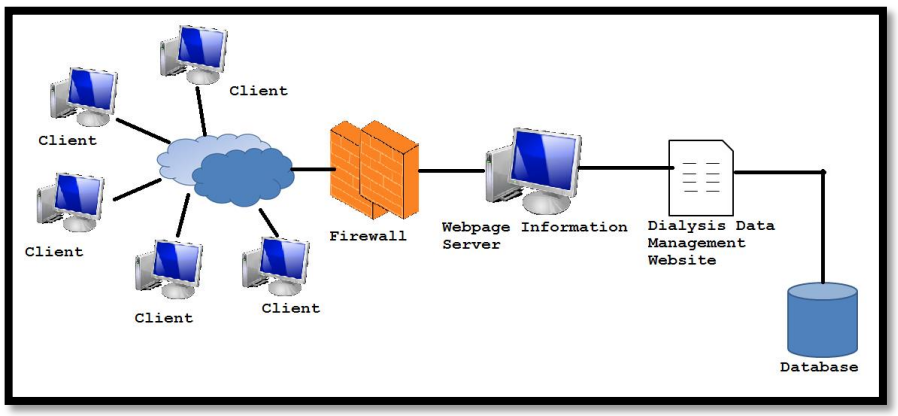


Figure 18 : Dialysis Data Management System Architecture Design

Dialysis Data Management website will be installed in the Dialysis Centre's web server. A client of the website can be the dialysis centre or the dialysis patient that has an internet connection. The client will access the web server through the firewall. The request will sent to the firewall and the firewall will get the access to the web server where the system will be stored. The Dialysis Data Management Website will be connected to the database where all the information that is needed will be added and stored.

In conclusion, when the clients send request to the firewall, the firewall will contacts the firewall where the website is stored and access to all information which stored in the database.

4.5 Storyboard Design

Storyboard is an illustration of the entire scenario from the beginning to end including every screen that the user will go through. The storyboard samples for this project are shown as below:

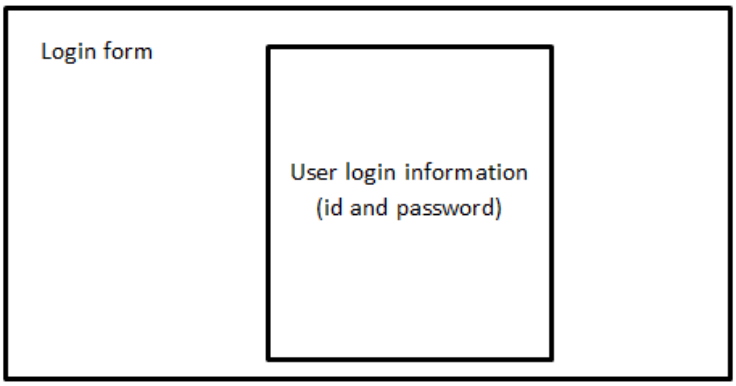


Figure 19 : Storyboard of DDMS Login Page

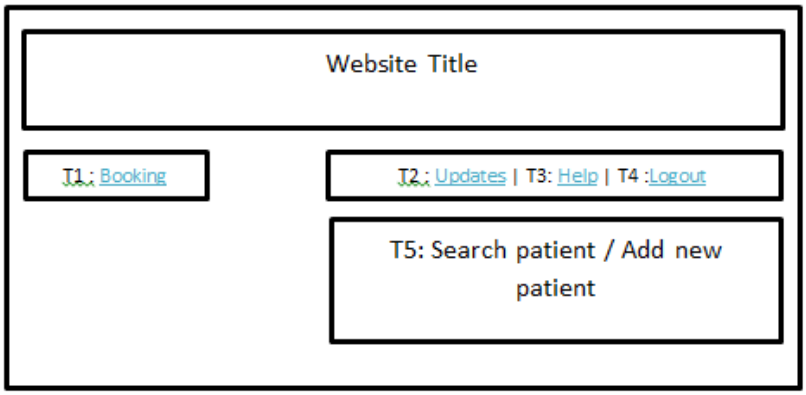


Figure 20 : Storyboard of DDMS dialysis centre's main page

Graphical Instruction Text (T)	Description
T1 : Booking	Click on T1 to go to booking screen. To view for patients' booking.
T2 : Updates	Click on T2 to go to updates screen. To update dialysis information and password.
T3: Help	Click on T3 to go to help screen. To get tutorial on how the website work.
T4: Logout	Click on T4 to go Logout from the user.
T5 : Search patient / Add new patient	Search on particular patient or add new patients.

Table 2 : Description of dialysis centre's main page in detail.

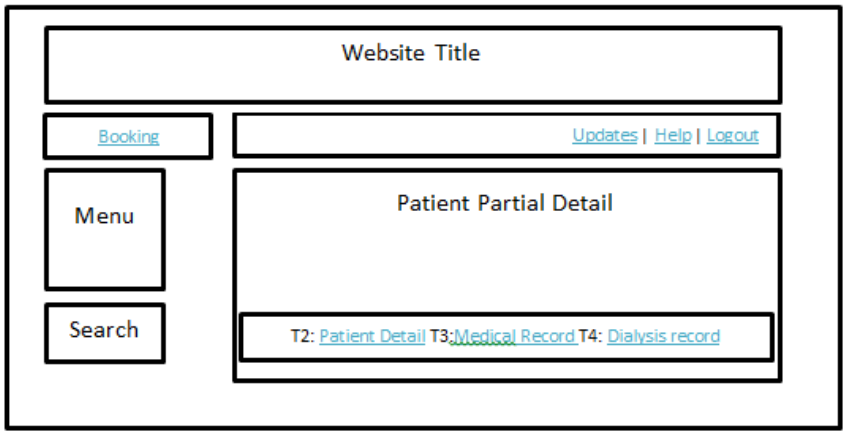


Figure 21 : Storyboard of DDMS dialysis centre's view of patient detail

Graphical Instruction Text (T)	Description
Search	Search for another patient.
T2 : Patient Detail	Click on T2 to view more detail of the patient information.
T3: Medical Record	Click on T3 to view the patient's medical record.
T4: Dialysis Record	Click on T4 to view the patient's dialysis record.
Menu	Side menu to access for patient's detail, medical record and dialysis record.

Table 3 : Description of dialysis centre patient's detail page in detail.

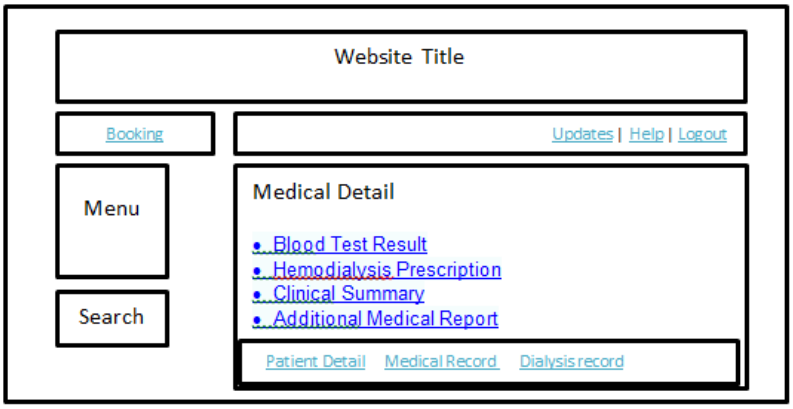


Figure 22 : Storyboard of DDMS dialysis centre's view on patient's medical detail.

Graphical Instruction Text (T)	Description
Blood test result	Click to view patient's blood test result
Hemodialysis Prescription	Click to view patient's hemodialysis prescription.
Clinical Summary	Click to view patient's clinical summary.
Additional Medical Report	Click to view patient additional medical report.

Table 4 : Description of dialysis centre's patient medical detail page in detail.

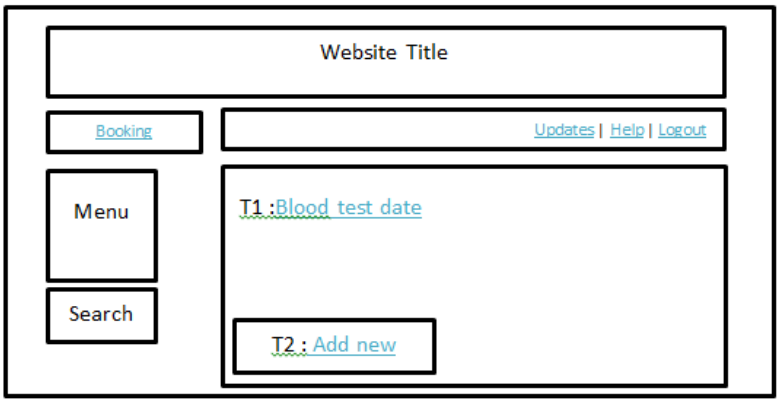


Figure 23 : Storyboard of DDMS dialysis centre's view on patient blood test report.

Graphical Instruction Text (T)	Description
T1 :Blood test date T2 : Add new record	Display the date of the report according and click on for the report detail. Add new blood test report.

Table 5 : Description of dialysis centre's patient blood test report page in detail.

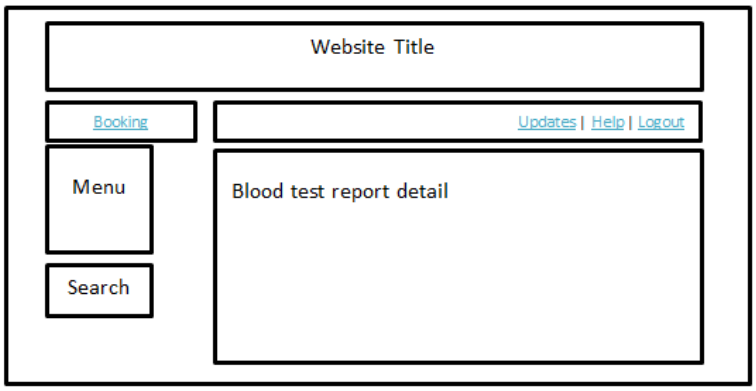


Figure 24 : Storyboard of DDMS dialysis centre's view on patient blood test report detail.

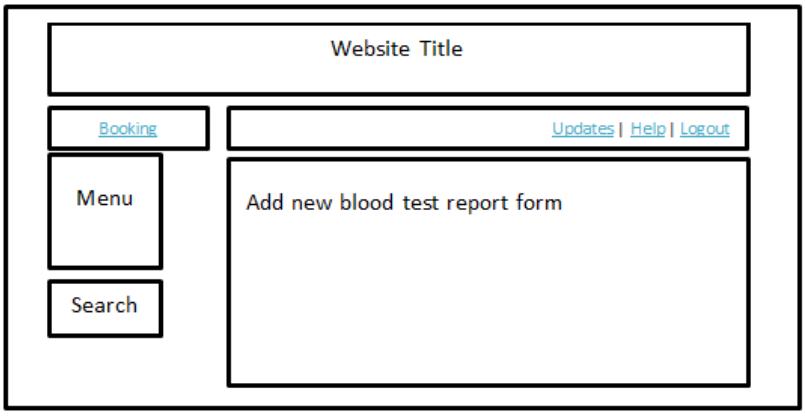


Figure 25 : Storyboard of DDMS dialysis centre's view on add new patient blood test report form.

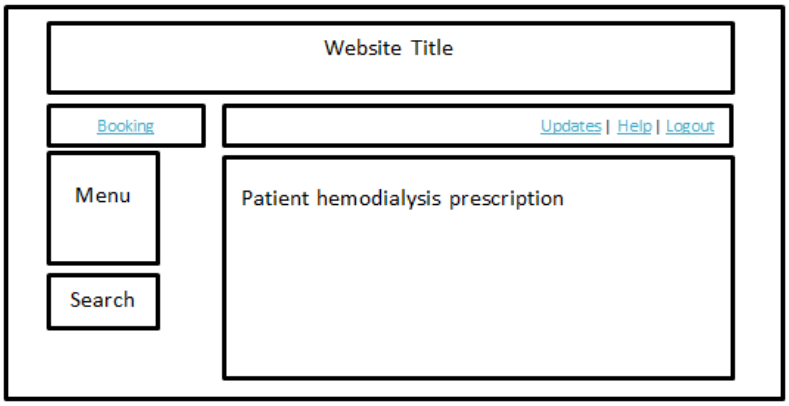


Figure 26 : Storyboard of DDMS dialysis centre's view on patient haemodialysis prescription.

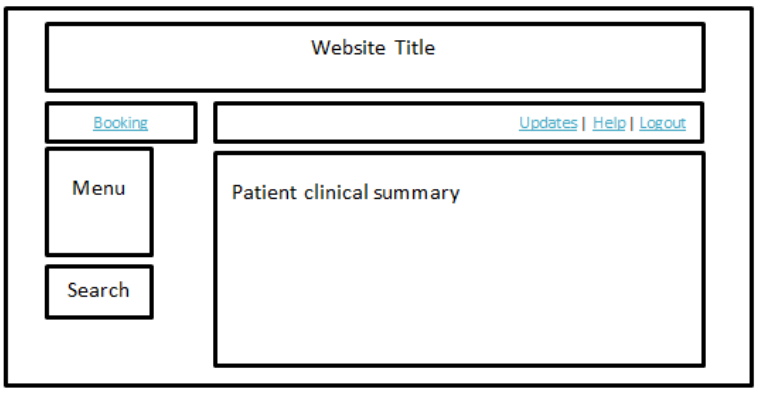


Figure 27 : Storyboard of DDMS dialysis centre's view on patient clinical summary.

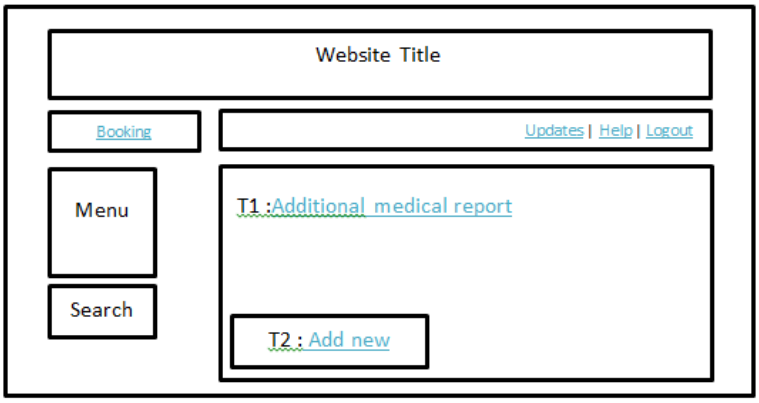


Figure 28 : Storyboard of DDMS dialysis centre's view on patient additional medical report.

Graphical Instruction Text (T)	Description
T1 :Additional medical report T2 : Add new record	Display the date of the report according and click on for the report detail. Add new medical report.

Table 6 : Description of dialysis centre's patient additional medical report page in detail.

Figure 29 : Storyboard of DDMS dialysis centre's view on adding new patient medical report form.

Figure 30 : Storyboard of DDMS dialysis centre's view on patient visitation record.

Graphical Instruction Text (T)	Description
T1 :Visitation record T2 : Add new record	Display the date of the report according and click on for the report detail. Add new visitation record.

Table 7 : Description of dialysis centre's patient visitation record page in detail.

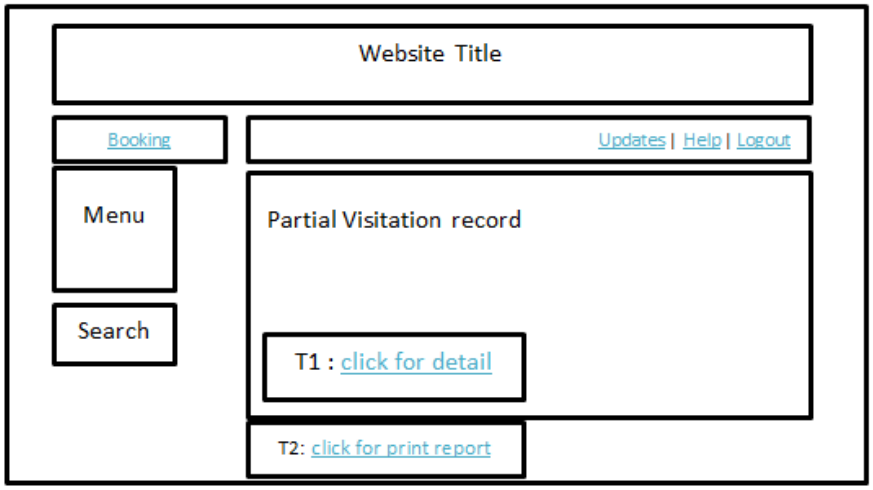


Figure 31 : Storyboard of DDMS dialysis centre's view on patient clinical summary.

Graphical Instruction Text (T)	Description
T1 :Click for detail	Click T1 to view for the patient's dialysis record detail.
T2 : Click for print report	Click T2 to print the record.

Table 8 : Description of dialysis centre's patient clinical summary in detail.

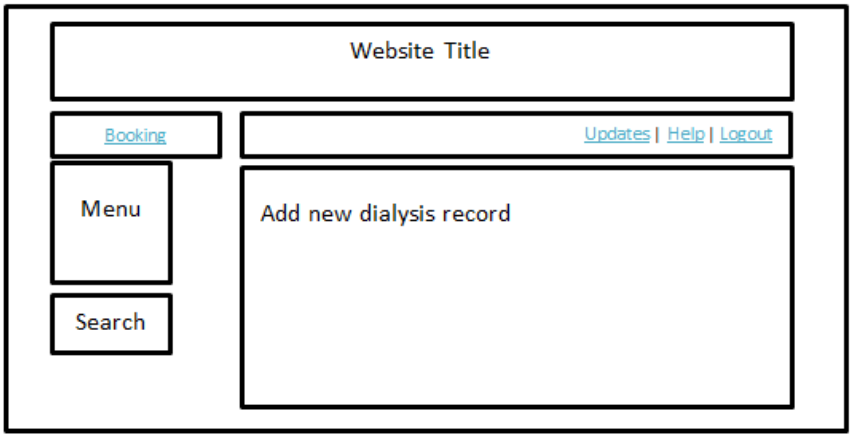


Figure 32 : Storyboard of DDMS dialysis centre's view on adding new patient dialysis record.

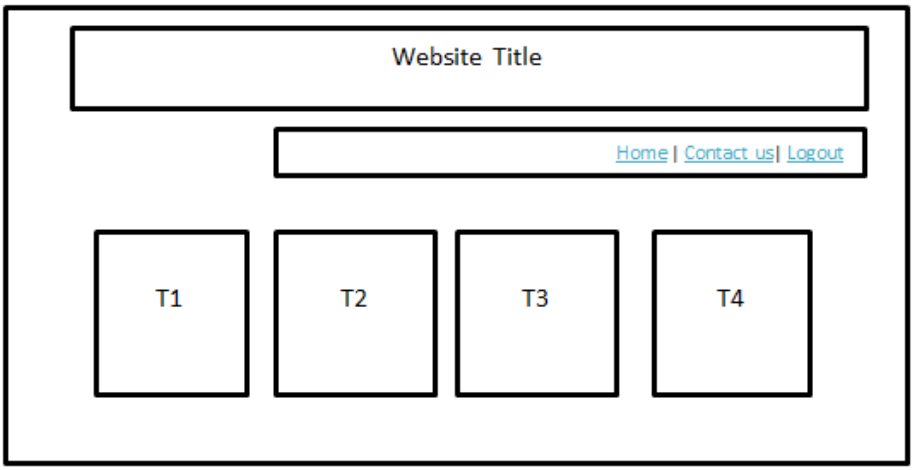


Figure 33 : Storyboard of DDMS patient's main page.

Graphical Instruction Text (T)	Description
T1 :Personal information	Click T1 to view for the patient's personal information.
T2 : Medical record	Click T2 to view for the patient's medical record.
T3 :Dialysis record	Click T3 to view for the patient's dialysis record
T4 :Booking	Click T4 for booking and view booking status.

Table 9 : Description of dialysis centre's patient main page.

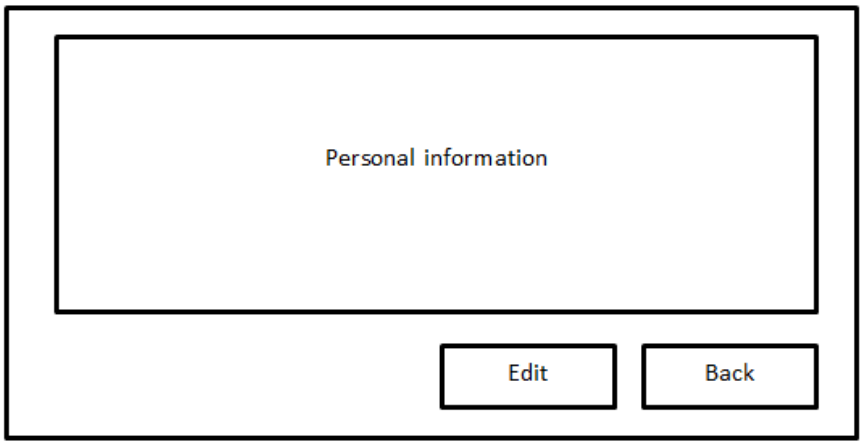


Figure 34 : Storyboard of DDMS patient's personal information.

Graphical Instruction Text (T)	Description
Edit Back	The patient edits his own personal information. Click back to go for the previous page.

Table 10 : Description of patient's personal main page in detail.

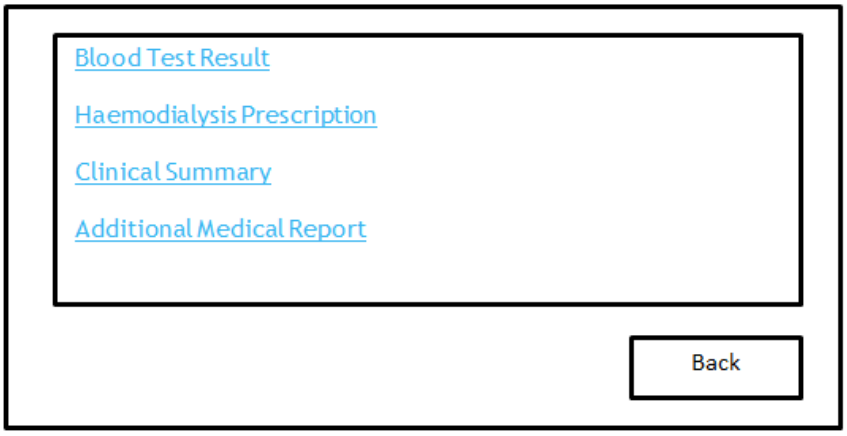


Figure 35 : Storyboard of DDMS patient's medical record page.

Graphical Instruction Text (T)	Description
Blood test result	Click to view patient's blood test result
Hemodialysis Prescription	Click to view patient's hemodialysis prescription.
Clinical Summary	Click to view patient's clinical summary.
Additional Medical Report	Click to view patient's additional medical report.

Table 11 : Description of patient's medical record page in detail.

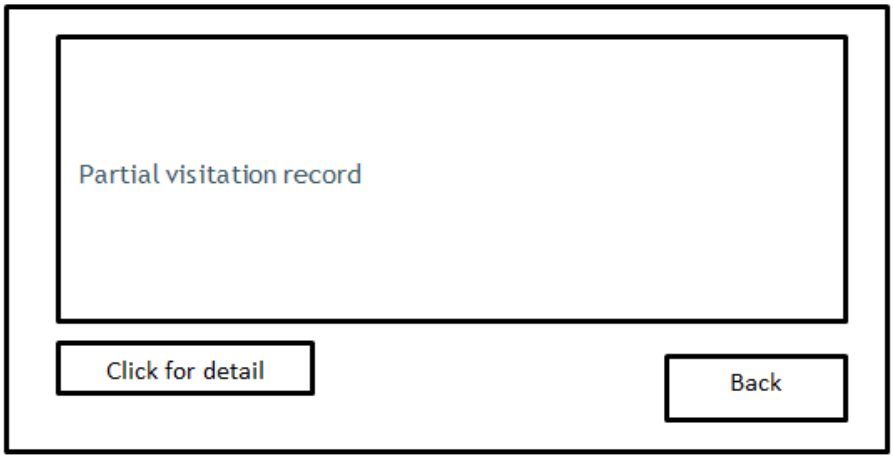


Figure 36 : Storyboard of DDMS patient's partial visitation record page.

Graphical Instruction Text (T)	Description
Click for detail	Click to view for the patient's dialysis visitation record detail.

Table 12 : Description of patient's partial visitation record page in detail.

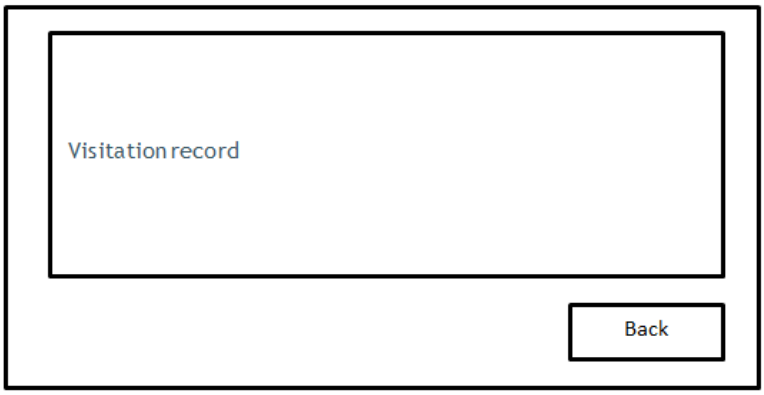


Figure 37 : Storyboard of DDMS patient's visitation record page.

Graphical Instruction Text (T)	Description
Visitation record	Display the date of the report according and click on for the report detail.

Table 13 : Description of patient's visitation record page in detail.

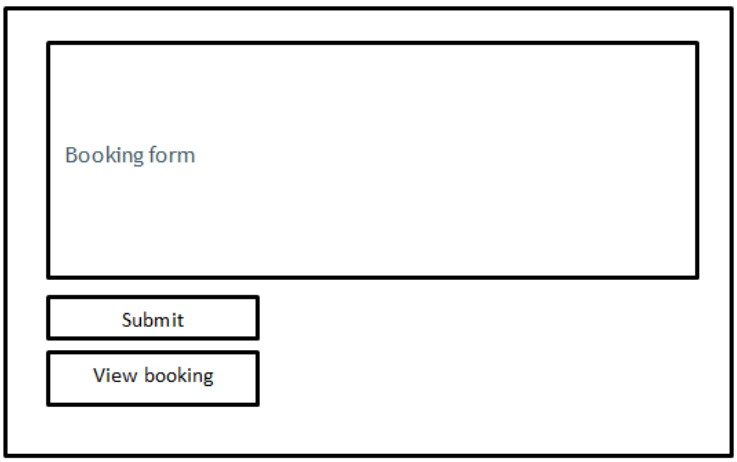


Figure 38 : Storyboard of DDMS patient's booking page.

Graphical Instruction Text (T)	Description
Submit	Click to submit the booking
View booking	Click to view the status of booking

Table 14 : Description of patient's booking page in detail.

4.6 Database Design

4.6.1 Introduction

According to Connolly, T. and Begg, C. (2010), database design is one of the stages on system development life cycle. In the database design, it consists of conceptual database design and logical database design. Conceptual database design is to build a conceptual representation of the database, which includes identification of the important entities, relationships and attributes. This part will describe on the conceptual design.

4.6.2 Entity Relationship diagram (ER- Diagram)

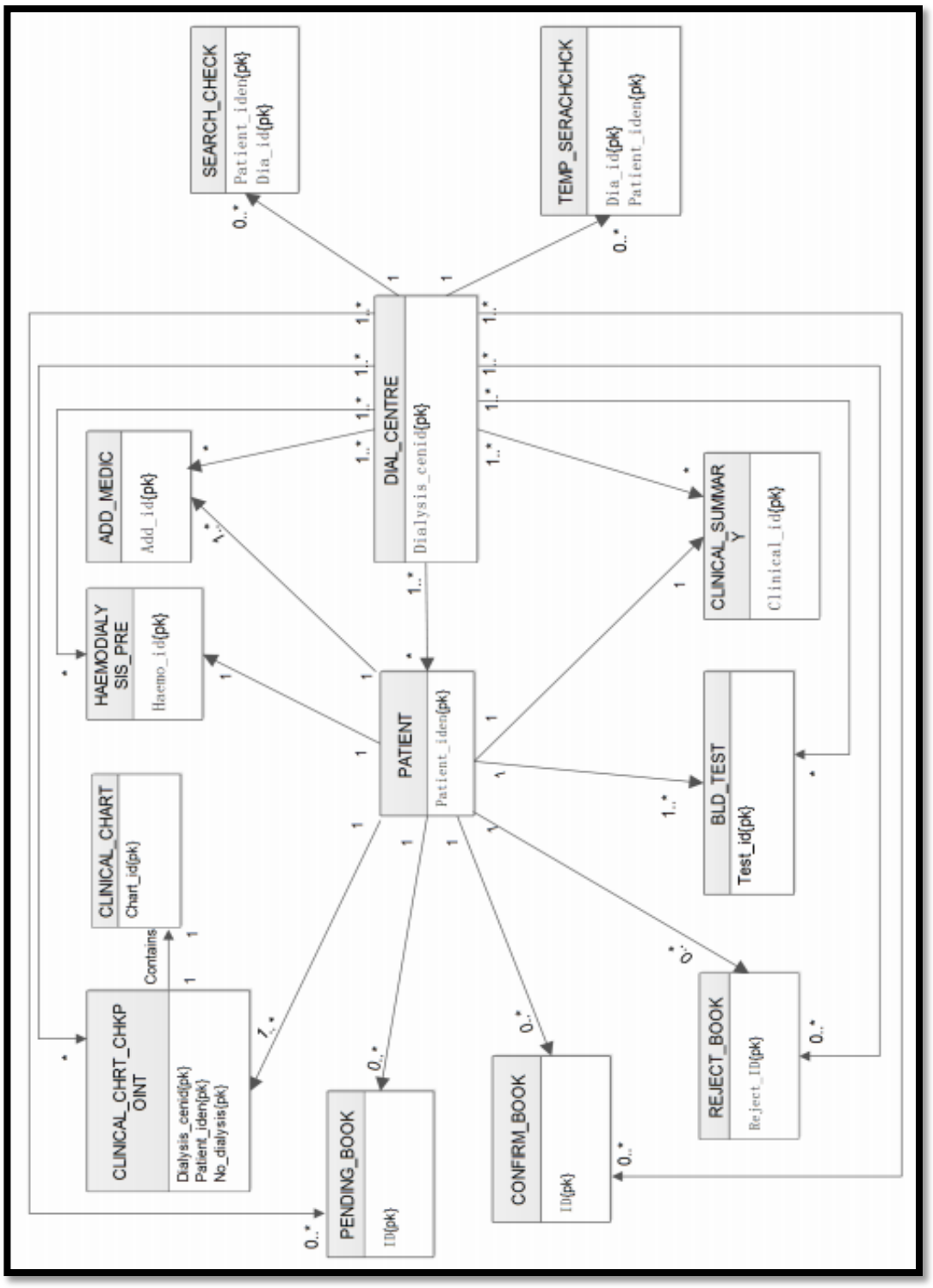


Figure 39 : ER Diagram

Entity Name	Attributes	Description
PATIENT	patient_iden{pk}	Unique patient's identity card number or passport number
	patient_name	Patient's name
	gender	Patient's gender (M or F)
	contact_home	Patient's house phone number
	contact_hp	Patient's mobile contact number
	ref_person	Patient's reference person
	ref_contact	Patient's reference person contact number
	addr	Address
	city	
	state	
	postcode	
	email	
	dob	Date of birth
	password	For login verification purpose
DIAL_CENTRE	dialysis_cenid{pk}	Unique dialysis centre's identity
	dialysis_name	Dialysis centre's name
	dialysis_add	Dialysis centre's address
	dialysis_city	
	dialysis_state	
	dialysis_postcode	
	dialysis_ph	Dialysis centre's phone number
	dialysis_fax	Dialysis centre's fax number
	password	For dialysis login verification purpose
CLINICAL_CHART	Chart_id{pk}	Unique clinical chart identity
	Patient_iden	
	Visit_date	Date that the patient visit dialysis centre in the format of YY-MM-DD
	Visit_time	Time that the patient's visit dialysis centre in the format of HH:MM:SS

	Dialysis_cenid	Dialysis centre identity
	No_dialysis	Number of patient visit the particular dialysis centre
	Mac_name	The name of the dialysis machine being used by the patient
	Duration_dia	Duration of the haemodialysis take place
	Vas_acc_type	Type of vascular access
	Uf_target	Target of ultrafiltration rates
	Temp_pre	Patient's initial temperature
	Temp_post	Patient's final temperature
	Bp_pre	Patient's initial blood pressure
	Pulse_pre	Patient's initial pulse reading
	200bld_flw	Blood flow minutes 200 ml per minutes
	Weight_pre	Patient's initial weight
	Weight_post	Patient's final weight
	Bp_post	Patient's final blood pressure
	Pulse_post	Patient's final pulse reading
	Dialyser_typ	Type of dialyzer being used by the patient
	Dialyser_usage	Dialyser usage
	Remarks	
	Ktv	
	Initial	Number used to quantify haemodialysis and peritoneal dialysis treatment adequacy
		Nurse in-charge
CLINICAL_CHRT _CHKPOINT	Dialysis_cenid{pk}	
	Patient_iden{pk}	
	No_dialysis{pk}	
	Time_frst	The time that the information being taken from the patient
	Bp_frst	Blood pressure that being taken for

		the particular time
	Pulse_rte_frst	Pulse rate that being taken for the particular time
	Vp_frst	Vp that being taken for the particular time
	Tmp_frst	Temperature that being taken for the particular time
	Rmk_frst	Remarks
	Time_scnd	
	Bp_frst	
	Pulse_rte_scnd	
	Vp_scnd	
	Tmp_scnd	
	Rmk_scnd	
	Time_thrd	
	Bp_thrd	
	Pulse_rte_thrd	
	Vp_thrd	
	Tmp_thrd	
	Rmk_thrd	
	Time_frth	
	Bp_frth	
	Pulse_rte_frth	
	Vp_frth	
	Tmp_frth	
	Rmk_frth	
BLD_TEST	Test_id{pk}	Unique blood test identity
	Patient_iden	
	Doc_detail	Doctor in-charge
	Date_collected	Date collected the report
	Date_ref	Date of reference
	Pat_ref	Patient reference
	Lab_no	Number of lab that the test take place

	Test_req	Test that being requested by the patient
	Hiv_state	The HIV status of the patient
	Hiv_det	The HIV detail of the patient
	Serology_state	The serology status of the patient
	Serology_det	The serology detail of the patient
	Hep_state	The hepatitis status of the patient
	Hepb_antigen	The status of hepatitis b antigen by the patient
	Hepb_antibdy	The status of the hepatitis b antibody by the patient
	Hepc_antibdy	The status of the hepatitis c antibody by the patient
	Hep_det	The hepatitis detail of the patient
CLINICAL_ SUMMARY	Clinical_id{pk}	Unique clinical summary identity
	Patient_iden	
	Doc_inchar	
	Clinical_name	
	Clinical_add	
	Rep_date	
	Med_pro	Medical problem
	Rpt_his	Renal replace therapy history
	Diaacc_his	Dialysis access history
	Pres	Prescription
	Clinical_note	Clinical notes
	Plan_no	
	Bill_no	
HAEMODIALYSIS _PRE	Haemo_id{pk}	Unique haemodialysis prescription identity
	Patient_iden	
	Dry_weight	
	Idwg_frm	Inter-dialytic weight gain (from)

	Idwg_to	Inter-dialytic weight gain (to)
	Avr_prebp	average of the initial blood pressure of the patient
	Avr_pstbp	average of the final blood pressure of the patient
	Freq	frequency(times per week)
	Duration	
	Arterial_ndl	The arterial needle that being used by the patient
	Venous_ndl	the venous needle that being used by the patient
	Bolus_hepdos	Bolus heparin dosage
	Cont_hepdos	Continuous heparin dosage
	Con_a	Concentrate a that being used by the patient (e.g. Low calcium)
	Con_b	Concentrate b that being used by the patient (e.g. Bicarbonate)
	Bldflw_frm	Blood flow rate (from)
	Bldflw_to	Blood flow rate (to)
	Dialysate_flw	Dialysate flow
	Venpres_frm	Venous Pressure(from)
	Venpres_to	Venous Pressure (to)
	Drug_allrgy	Drug allergy
ADD_MEDIC	Add_id{pk}	Unique additional medic identity
	Patient_iden	
	Doc_inchar	
	Clinic_name	
	Clinica_add	
	Rep_date	
	Patient_ref	
	Lab_no	
	Report_title	Report title
	Rep_detail	Report detail

SEARCH_CHECK	Patient_iden{pk} Dia_id{pk} Check	Check if the dialysis centre is been checked
TEMP_ SEARCHCHCK	Dia_id{pk} Patient_iden{pk} Confirm_code	Code that send to the patient through email for verification purpose
PENDING_BOOK	ID{pk} Patient_iden Diacen_id Date Reason	Unique pending book identity
CONFIRM_BOOK	ID{pk} Patient_iden Diacen_id Date Time_frm Time_to Duration Remark	Unique confirm book identity
REJECT_BOOK	Reject_ID{pk} Patient_iden Diacen_id Date Reason	Unique reject book identity

Table 15 : Data dictionary of DIALYSISCEN, showing a description of attributes.

CHAPTER 5

IMPLEMENTATION

5.1 Introduction

According to IEEE Standard Glossary of Software Engineering Terminology (1990), implementation is the process of translating a design into hardware components, software components or both. Implementation also concerns about the result of the process of translation the design.

This chapter will discuss about the implementation of the system where the technology and tools that are used for the implementation. Besides that, this chapter will also discuss on the implementation flow and decisions and the development process of the project in detail.

5.2 Technology Comparison

There are many technologies that can be used to develop this Dialysis Data Management system. Every technology has different advantages and disadvantages. During this section, different technology is compared and discussed and further explanation on their functionality, advantages and disadvantages.

5.2.1 Active Server Pages (ASP)

Figure 40 : Active Server Pages

(Source: ASP.NET, 2013)

Microsoft Developer Network (n.d) explains that active server pages is a server-side scripting environment that the developer can use to create and run dynamic, interactive Web server application. It can combine HTML pages, script commands and COM components in order to create interactive web pages and web-based application.

Below are the advantages of the ASP:

- ASP is maintained by Microsoft. The technology is constantly updated. Hence, it is more reliable and has higher levels of security.
- According to Debray, T. (2012), ASP use less execution time. This is because ASP is compiled hence it does not need to set up the connection and query the databases that cause most of the page rendering time arises.
- Microsoft provides IDE to facilitate the development of the active server pages. Hence, it eases the development of ASP as well as reduces the time of development.

Below are the disadvantages of the ASP:

- ASP has limited control on HTML. ASP uses server to control render themselves as HTML. The problem is that ASP causes the HTML output difficult to comply with the web standard. Besides that, it also causes the JavaScript difficult to be accessed due to complex ID values generated by the server.

- ASP will cause frustration to the users due to it requires times and increase the bandwidth demands of the server for the first time users.

5.2.2 Java Server Pages (JSP)

Figure 41 : Java Server Pages

(Source: Java, 2013)

According to Chien-Hung Liu (2004), Java Server Pages is another technology that is used to handle the server-side scripts which used to manage the HTTP request, to generate dynamic contents as well as used to interact with other components. Java Server Pages is a server side script which use Java technology.

Below are the advantages of the JSP:

- Java Server Pages support reusable components. The dynamic part of the Java Server Pages is written in Java hence it is suitable for the complex application that requires reusable components.
- Java Server Pages is free and open source. Hence less costing is required.

Below are the disadvantages of the JSP:

- JSP pages require more disk place to store the page. This is because of the JSP pages are needed to be translated into class files and the server is required to store the resultant class files with the JSP pages. Hence, JSP need more disk place to store the page.

- Same as ASP. JSP page is compiled. It required to be compiled on the server during the user first accessed. Hence, it requires times and increases the bandwidth demands of the server for the first time users.

5.2.3 Hypertext Preprocessor (PHP)

Figure 42 : Hypertext Pre-processor

(Source: PHP, 2013)

Php.net (n.d.) explained that PHP is a widely used general purpose scripting language that is suitable for the web development and can be embedded into HTML and the PHP scripts can be executed on the server.

Below are the advantages of the PHP:

- PHP is compatible with most of the operating systems and web servers. This enables it to deploy across different platforms easily.
- PHP provides a lot of libraries and extensions besides its core functionalities.
- PHP supports structural programming and object oriented programming. It is simple and easy to learn.
- PHP has good connective abilities. PHP has a modular system of extensions to interface with number of libraries. Besides that, it also able to extend PHP by writing a new extensions or write own executable and load it using PHP's dynamic loading mechanism.

Below are the disadvantages of the PHP:

- PHP is not very modular. Hence it is not suitable for a large application.
- Source code can be easily viewed. This is because the PHP codes are not compiled and can be accessed easily as a plain text files. This causes some security issues.

5.2.4 Technology Selected

The technology that has been selected for the Dialysis Data Management System is PHP. This main purpose of the system is the usability. Hence, the system needs to be simple, easy, fast and efficient to be used. ASP and JSP also required to be compiled on the server during the user first accessed and it takes times and increases the bandwidth demands of the server for the first time users. Besides that, JSP took more disk place to store the page compared to other technology. In addition, Dialysis Data Management System manages many patient's data and this will cause more disk place is required if JSP technology is used.

PHP is not considered the perfect technology to be used but it is the most suitable for the Dialysis Data Management System. This is because PHP is suitable and easier to manage the SQL database. It does not need to take so many times or disk places like what JSP and ASP required. In addition, PHP and MySQL are open source and there are many community and developers involved. Many additional functions are available and facilitate most tasks.

5.3 Development Tools and Technologies

This section will discuss on the technologies and the tools that are required to develop the Dialysis Data Management System. The technologies and tools that will be used for the system are:

i) Hyper Text Markup Language (HTML)
ii) Cascading Style Shits (CSS)
iii) Hypertext Preprocessor (PHP)
iv) MySQL
v) Java Script
vi) Apache
vii) XAMPP

5.3.1 Hyper Text Markup Language (HTML)

Rouse, M (2005) defined that Hyper Text Markup Language (HTML) is a set of markup symbols or codes that written in order to display on a World Wide Web browser page. The markup will inform the browser how to display a web page's words and images for the people who view the information.

This Dialysis Data Management System is mainly developed by Hyper Text Markup Language (HTML). For example, Hyper Text Markup Language (HTML) is used to create the form to display the information to the patients and dialysis centres as well as a form to retrieve the inputs from the users.

Figure 43 : Contact us page in DDMS

```
<nav class="art-nav clearfix">
    <ul class="art-hmenu"><li><a href="home.html">Home</a></li><li><a href="contact-us.html"
    class="active">Contact Us</a></li><li><a href="http://localhost/main.php">Logout
    </a></li></ul>
    </nav>


</header>
<div class="art-sheet clearfix">
            <div class="art-layout-wrapper clearfix">
                <div class="art-content-layout">
                    <div class="art-content-layout-row">
                        <div class="art-layout-cell art-content clearfix"><article class=
                        "art-post art-article">
                                <h2 class="art-postheader">Contact Us</h2>

                <div class="art-postcontent art-postcontent-0 clearfix"><div class=
                "art-content-layout">
    <div class="art-content-layout-row">
    <div class="art-layout-cell layout-item-0" style="width: 100%" >

        <h3>Our Address</h3>

        <p>UTAR Complex<br />
           Jalan Genting Kelang<br />
           53300 Setapak<br />
           Kuala Lumpur</p>
```

Figure 44 : HTML Code that used to generate "Contact-Us" page

The diagram above shows a browser that containing images and information. All these images and information is generated by the Hyper Text Markup Language (HTML) in order to be viewed by the users at the internet browser.

Figure 45 : Form that allow the user input

```
<div id="Page">
Search Patient
<br/><br/>
  <?php echo "<form action= 'http://localhost/dia/first_check.php?dia_id=$dia_id'
  method='post'>";?>
      <div><label for="pat_id">Patient Identity Number</label> : <input type="text"
      name="pat_id" value="" id="pat_id" /></div><br/>
      <?php echo"<a href='http://localhost/dia/add_new_pat.php?dia_id=".$dia_id."'>
      Add new patient</a><br/><br/>";?>
      <div id="login-button">
          <input type="image" name="submit" src="img/button.png" />
      </div>
  </form>

</div>
```

Figure 46 : HTML Code that generates the input form.

The diagram above shows a browser that containing a form that retrieves the input from the users. The form that displayed in the Dialysis Data Management system is also created by the Hyper Text Markup Language (HTML).

5.3.2 Cascading Style Shits (CSS)

W3Schools (n.d.) explains that the Cascading Style Shits (CSS) is a simple mechanism that is used to add style to the fonts, colors or spacing to the elements that are displayed on web browser. Cascading Style Shits (CSS) defines styles to display HTML elements.

For this Dialysis Data Management System, Cascading Style Shits (CSS) is used to style the fonts, set the position of the HTML elements and color. Cascading Style Shits (CSS) is stored in CSS files as external style sheets so that other HTML elements from other html pages are able to share style by referring to the external style sheet.

```
body

{
    background-color: white;
    font-family: arial;
    font-size: 12px;
}

#Inner
{
    margin-top: 15px;
}

#Container
{
    width: 900px;
    margin: 0px auto;
}

.cleaner
{
    clear: both;
}
```

Figure 47 : Cascading Style Sheet used in DDMS

Diagram above shows part of the external style sheet that is shared among the dialysis center's view of the system.

5.3.3 Hypertext Preprocessor (PHP)

As mentioned in the previous part, Hypertext Preprocessor (PHP) is used for this Dialysis Data Management System. PHP is the scripting that is used to make the dynamic web pages as well as retrieving the data from the database.

```
<?php
  function patient_det($pat_id){ //function for patient personal detail.


    $con=mysqli_connect('localhost','root','bear123','dialysiscen');

    if (mysqli_connect_errno())
    {
        echo "Failed to connect to MySQL: " . mysqli_connect_error();
    }

    $result = mysqli_query($con,"SELECT * FROM patient where patient_iden='$pat_id'");

    return $result;

  }
```

Figure 48 : PHP Code used in DDMS (Function Code)

Diagram above shows part of PHP code that is used to connect to the database and retrieve the information that is required by the system.

```
<div id="Menu_content"> <?php echo"<a class='menu_item' href='
http://localhost/dia/patient_det.php?pat_id=$pat_id&dia_id=$dia_id'><span>Patient
Detail</span></a><br/>
  <a class='menu_item' href='http://localhost/dia/medi_rec.php?pat_id=$pat_id
  &dia_id=$dia_id'><span>Medical Record</span></a><br/>
  <a class='menu_item2' href='http://localhost/dia/pat_bloodtst.php?pat_id=$pat_id
  &dia_id=$dia_id'><span>Blood Test Result</span></a><br/>
  <a class='menu_item2' href='http://localhost/dia/pat_hemopres.php?pat_id=$pat_id
  &dia_id=$dia_id'><span>Hemodialysis Prescription</span></a><br/>
  <a class='menu_item2' href='http://localhost/dia/pat_clinicalsum.php?pat_id=
  $pat_id&dia_id=$dia_id'><span>Clinical Summary</span></a><br/>
  <a class='menu_item2' href='http://localhost/dia/add_medrep.php?pat_id=$pat_id
  &dia_id=$dia_id'><span>Additional Medical Report</span></a><br/>
  <a class='menu_item' href='http://localhost/dia/pat_dialrec.php?pat_id=$pat_id
  &dia_id=$dia_id'><span>Dialysis Record</span></a><br/> "?>
```

Figure 49 : PHP Code used in DDMS (Data Passing)

Diagram above shows part of PHP code that is used to pass the information that is required by the location called.

5.3.4 MySQL

MySQL is a relational database management system (RDMS) based on Structured Query Language (SQL). Christopher Heng (2010) explained that database programs have different ways in storing, retrieving and organizing the stored data. One of the ways to access the data is by using a computer language known as sequel (SQL) and it is specially designed for database access. MySQL is a database that supports SQL to access the data stored.

For this Dialysis Data Management System, the data of the system is stored in MySQL and PHP is used to connect to MySQL and manipulate the database.

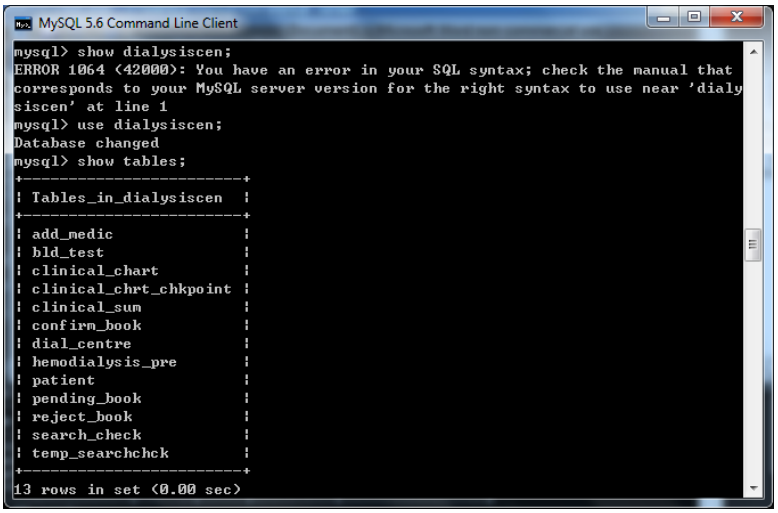


Figure 50 : Entities of DIALYSISCEN Database

Diagram above shows all the tables that involved in the Dialysis Data Management System.

5.3.5 JavaScript

JavaScript is a scripting language that is used for client side scripting, explained by Rouse, M (2005). This programming language is designed by Sun Microsystems and it is based on the Java syntax. This scripting language is mainly used to create dynamic and interactive web pages.

In this Dialysis Data Management System, JavaScript is used to create the calendar to allow the patient to input the booking date. Besides that, JavaScript is also used to create a pop out box to provide a better interface when the patients are retrieving the information.

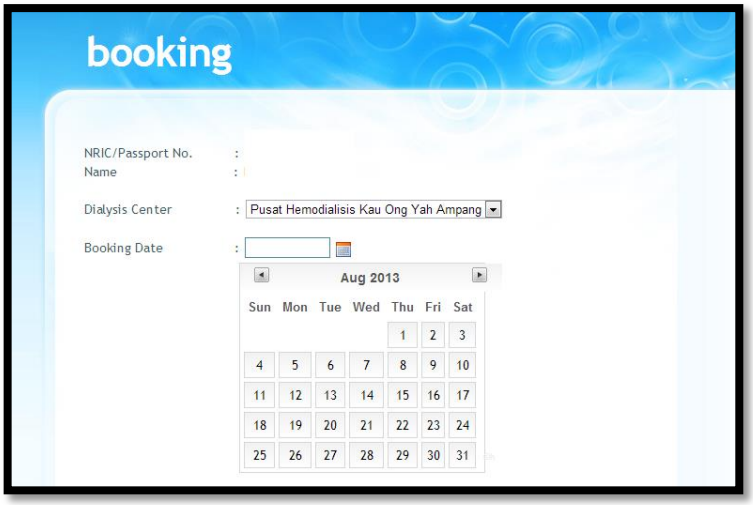


Figure 51 : Booking Calendar in DDMS

```
<script type='text/javascript'>
    var getDatee = new Date();
    var monthe = getDatee.getMonth();
    var yeare = getDatee.getFullYear();
    var day = getDatee.getDate();
    function isEmpty(val){
       return (val === undefined || val == null || val.length <= 0) ? true : false;
    }

    function prev()
    {
        monthe = monthe-1;
        if(monthe < 0)
    {
        yeare = yeare-1;
            monthe = 11;
        }
        dispCal(monthe, yeare);
        return false;
    }

    function next()
    {
        monthe = monthe+1;
        if(monthe > 11)
    {
```

Figure 52 : Code used to generate Calendar

Diagram above shows part of the JavaScript that is used to generate calendar in order to allow the patient to input the booking date.

5.3.6 Apache

Apache is recognized as Web server or HTTP server. Bradley Mitchell(n.d.) explained that Apache Web Server provides a full range of web server features, including CGI, SSL and virtual domains.

In this Dialysis Data Management System, Apache server is used to establish connection to the MySQL server and manage the information from the database. Besides that, Apache server is also used to interpret the PHP code and generate html markups in this Dialysis Data Management System.

5.4 Implementation Flow

The first step during the implementation of the system is to gather all the information that is required to be stored into the database. This process is done by conducting survey and site visit to the dialysis centers in order to collect all the necessary data. After the data gathering process, the database is created together with the entities and attributes.

After the database is implemented, the database is reviewed and tested to ensure that all the entities and attributes are created correctly. After the database is tested, the interface of the system is created. Firstly the interface of the dialysis center is created then only the interface of the patient is created. This is to ensure that the access to some links will be restricted for the users based on their user type.

After the interface of the system was created, the functionality of the system is implemented. After the functionality of the system is implemented, all the parts are integrated together to create a complete version of Data Dialysis Management System.

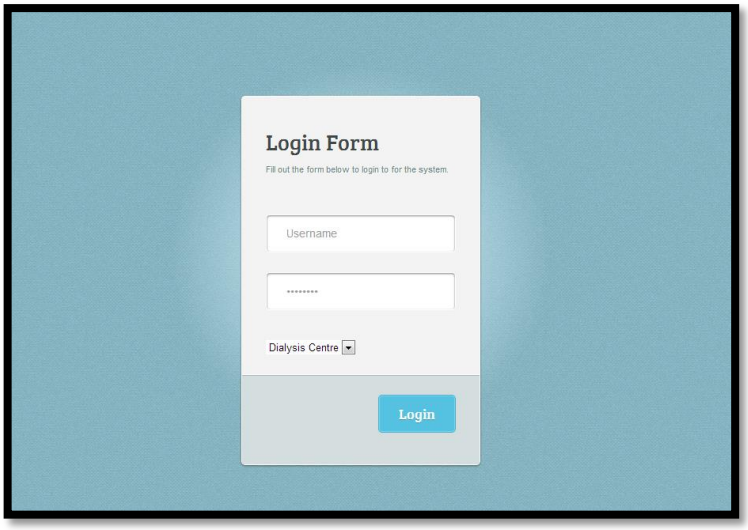


Figure 53 : Login Page of DDMS

5.5 Essential code and implementation justification

During this section, the essential functionalities, programming logics and codes will be discussed in detail. In addition, there will be only some codes presented in this section so that there will be a better understanding to the logic of the system this is because many of the codes are having the same flow and applied the same way.

5.5.1 Connect to Database

```
function patient_det($pat_id){ //function for patient personal detail.


  $con=mysqli_connect('localhost','root','bear123','dialysiscen');

  if (mysqli_connect_errno())
  {
      echo "Failed to connect to MySQL: " . mysqli_connect_error();
  }

  $result = mysqli_query($con,"SELECT * FROM patient where patient_iden='$pat_id'");

  return $result;

}
```

Figure 54 : PHP Code used to Connect to Database

All the database connection and query is located at the database page. This database page is used to establish a connection to the server as well as select the database where the data of the Dialysis Data Management System is stored. The connection to the server is started using the PHP built in function which is mysqli_connect() with the parameter of location of the server, username, password and the database name. After the database is established, the query to the database is made to retrieve or update data that is required.

5.5.2 Login

```php
// username and password sent from form
$myusername=$_POST['id'];
$mypassword=$_POST['password'];
$mytype=$_POST['usertype'];

if ($mytype=='patient'){

    $sql="SELECT * FROM patient WHERE patient_iden='$myusername' and password='$mypassword'";
    $result=mysql_query($sql);
    $count=mysql_num_rows($result);
}else
{
    $sql="SELECT * FROM dial_centre WHERE dialysis_cenid='$myusername' and password='$mypassword
    '";
    $result=mysql_query($sql);
    $count=mysql_num_rows($result);
}

if($count==1){
    session_start();
    $_SESSION['myusername'] = $myusername;
    $_SESSION['mypassword'] = $mypassword;
    $_SESSION['login'] = "1";


    header("location:http://localhost/login_success.php?id=$myusername&type=$mytype");
}
else {
echo "Wrong Username or Password";
}
```

Figure 55 : Part of the code in login.php page.

The login.php is the place where the users are login into the system so that the users are able to use the functionalities of the system. First, the username, password and the user type of the users are retrieved from the main page. During this page, the patient and the dialysis center is checked whether their data is exist in the database based on their user type they inputted. If the input is not tally with the data in the databases, ‘wrong username and password’ will be displayed. If the user is exists, the id and the password of the user will be saved until the user is log out. The $_SESSION[] function is used to save the user id and password. In order to save the

user id and password, the value is set to the $_SESSION[] function. On the other hand, $_SESSION[‘login’] is used to show that the user is successfully log in to the system.

```php
if(isset($_SESSION['login'])){
    if($mytype=='patient')
    {
        header("location:http://localhost/169_html/home.php?id=$myusername");
    }
    else
    {
        header("location:http://localhost/dia/dia_main.php?id=$myusername");
    }
```

Figure 56 : PHP Code used to determine type of users
(login.php)

After the user is logged in to the system, the user is redirected based on their user type. Different users have different interface and functionality. For example, dialysis centres are able to update the patient’s medical record but the patients are only to view the medical records.

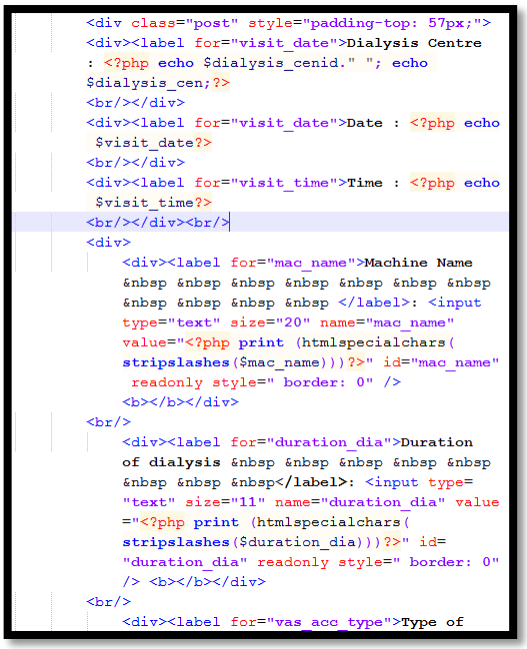
5.5.3 View Patient’s Dialysis Record (SELECT)

```php
$result = mysqli_query($con,"SELECT * FROM
clinical_chart where patient_iden= '$id' and
visit_date='$visit_date' ");

$row = mysqli_fetch_array($result);

$visit_date = $row['visit_date'];
$visit_time = $row['visit_time'];
$no_dialysis = $row['no_dialysis'];
$mac_name = $row['mac_name'];
$duration_dia =$row['duration_dia'];
$vas_acc_type =$row['vas_acc_type'];
$uf_target = $row['uf_target'];
$temp_pre = $row['temp_pre'];
$temp_post = $row['temp_post'];
$bp_pre = $row['bp_pre'];
$pulse_pre = $row['pulse_pre'];
$bld_flw = $row['200bld_flw'];
$weight_pre = $row['weight_pre'];
$weight_post = $row['weight_post'];
$bp_post =$row['bp_post'];
$pulse_post =$row['pulse_post'];
$dialyzer_typ = $row['dialyzer_typ'];
$dialyzer_usage = $row['dialyzer_usage'];
$ktv = $row['ktv'];
$remarks = $row['remarks'];
$initial = $row['initial'];
$dialysis_cen = $row['dialysis_cen'];
$dialysis_cenid = $row['dialysis_cenid'];
$inter_weight_gain = $weight_pre - $weight_post;
```

Figure 57 : Some of the Select Statement used in DDMS
(clinical_chart.php)

The clinical_chart.php is used by the patients where the patients are able to view their dialysis record after their visit to the haemodialysis treatment. In order to get the exact data of the dialysis record, the visitation date and the patient's id is required. When the date and the patient's id is retrieved, the following query is passed to the database "SELECT * FROM clinical_chart where patient_iden = patient identity AND visit_date = visitation date" and this query will selected all the data from the clinical chart table where the patient_iden attribute is equal to the patient's identity and the visit_date is equal to the visitation date.

After all the data is selected then the data will be displayed to the users.



```
<div class="post" style="padding-top: 57px;">
<div><label for="visit_date">Dialysis Centre
: <?php echo $dialysis_cenid." "; echo
$dialysis_cen;?>
<br/></div>
<div><label for="visit_date">Date : <?php echo
 $visit_date?>
<br/></div>
<div><label for="visit_time">Time : <?php echo
 $visit_time?>
<br/></div><br/>
<div>
    <div><label for="mac_name">Machine Name
                 
            </label>: <input
    type="text" size="20" name="mac_name"
    value="<?php print (htmlspecialchars(
    stripslashes($mac_name)))?>" id="mac_name"
     readonly style=" border: 0" />
    <b></b></div>
<br/>
    <div><label for="duration_dia">Duration
    of dialysis          
         </label>: <input type=
    "text" size="11" name="duration_dia" value
    ="<?php print (htmlspecialchars(
    stripslashes($duration_dia)))?>" id=
    "duration_dia" readonly style=" border: 0"
    /> <b></b></div>
<br/>
    <div><label for="vas_acc_type">Type of
```

Figure 58 : Part of the code that used to display data retrieved from database.

5.5.4Update Patient's Information (UPDATE)

```
    $type = $_GET['type'];
    $dia_id = $_GET['dia_id'];
    $pat_name = $_POST['patient_name'];
    $pat_iden = $_POST['patient_iden'];
    $pat_gen = $_POST['gender'];
    $pat_hmcon = $_POST['contact_home'];
    $pat_hpcon = $_POST['contact_hp'];
    $pat_ref = $_POST['ref_person'];
    $pat_refcon = $_POST['ref_contact'];
    $pat_addr = $_POST['addr'];
    $pat_city = $_POST['city'];
    $pat_state = $_POST['state'];
    $pat_postcode = $_POST['postcode'];
    $pat_email = $_POST['email'];
    $pat_dob = $_POST['dob'];

    $con=mysqli_connect("localhost","root","bear123","dialysiscen");
// Check connection
    if (mysqli_connect_errno())
    {
        echo "Failed to connect to MySQL: " . mysqli_connect_error();
    }

    mysqli_query($con,"UPDATE patient SET patient_name='$pat_name',dob='
    $pat_dob',gender='$pat_gen',email='$pat_email',contact_home='$pat_hmcon
    ',contact_hp='$pat_hpcon',ref_person='$pat_ref',ref_contact='$pat_refcon
    ',addr='$pat_addr', city='$pat_city',state='$pat_state',postcode='
    $pat_postcode' WHERE patient_iden='$pat_iden'  ");
```

Figure 59 : Some of the Update Statement used in DDMS (Update_personaldb.php)

Update_personaldb.php is used to update or modify the patient information by the patients themselves or the dialysis centres. All the required information is retrieved from the previous page through the $_GET and $_POST functions that provide by php. Through this page, the user can change the patient's information that are found at the input field and submit to the system. The system will update the patient where the patient_iden is equal to the patient's identity which was found in the patient entity.

5.5.5 Insert New Patient (INSERT)

```
$pat_name = $_POST['patient_name'];
$pat_iden = $_POST['patient_iden'];
$pat_gen = $_POST['gender'];
$pat_hmcon = $_POST['contact_home'];
$pat_hpcon = $_POST['contact_hp'];
$pat_ref = $_POST['ref_person'];
$pat_refcon = $_POST['ref_contact'];
$pat_addr = $_POST['addr'];
$pat_city = $_POST['city'];
$pat_state = $_POST['state'];
$pat_postcode = $_POST['postcode'];
$pat_email = $_POST['email'];
$pat_dob = $_POST['dob'];
$pat_password = '1234';

$con=mysqli_connect("localhost","root","bear123","dialysiscen");
Check connection
if (mysqli_connect_errno())
{
    echo "Failed to connect to MySQL: " . mysqli_connect_error();
}
#mysqli_query($con,"UPDATE patient SET email='$pat_email' WHERE
patient_iden='$pat_iden' AND patient_name='$pat_name' ");
mysqli_query($con,"INSERT INTO patient
(patient_iden,patient_name,gender,contact_home,contact_hp,ref_person,
ref_contact,addr,city,state,postcode,email,dob,password) VALUES ('
$pat_iden','$pat_name','$pat_gen','$pat_hmcon','$pat_hpcon','
$pat_ref','$pat_refcon','$pat_addr','$pat_city','$pat_state','
$pat_postcode','$pat_email','$pat_dob','$pat_password')");
```

Figure 60 : Part of the Insert Statement code used in DDMS (add_newpersonaldb.php)

The add_newpersonaldb.php is used to add new patient to the patient table. This is done by the dialysis centres. The system will receive all the required information from the previous page based on the user input by using the $_POST[] function. All the information gathered will create and insert into the patient entity. The add_newclinicalsum, addnewpatclicnicdb, add_newrejectbookdb, insert_addmed functionality is based on the same principle.

5.5.6 Remove Pending Book (Delete)

```
$affected = mysqli_affected_rows($con);
//echo $affected ;


mysqli_query($con,"DELETE FROM pending_book WHERE id=".$pending_id."");


mysqli_close($con);
```

Figure 61 : Part of the Delete Statement code used in DDMS (add_confirmbookdb.php)

This happens in add_confirmbookdb.php. When the dialysis centre has made the decision on the pending bookings either the booking is being rejected or successful, the pending booking data must be deleted based on the pending id. This is used to avoid from duplication of the booking data happens. When the pending_ id is retrieved, the following query is passed to the database "DELETE FROMpending_book where id = pending_id". This query will delete all the data in the pending_book table where the id is equal to the pending_id that passed in.

5.5.7 Send Notification Email

```
$result = mysqli_query($con,"Select * from patient where
patient_iden='$patient_iden' ");
$row = mysqli_fetch_array($result);
$email = $row['email'];
// Random confirmation code
$random_hash = md5(uniqid(rand(), true));

echo $random_hash ;

// Insert data into database
mysqli_query($con,"INSERT INTO
temp_searchchck(confirm_code,patient_iden,dia_id) VALUES ('
$random_hash','$patient_iden',$dia_id)");


if($result){
// send e-mail to ...
$to=$email;
// Your subject
$subject="Your confirmation link here";
// From
$header="from: Dialysis Centre";
// Your message
$message="Your Comfirmation link \r\n";
$message.="Click on this link to activate your account \r\n";
$message.="http://localhost/dia/confirmation.php?passkey=
$random_hash";

// send email

$sentmail = mail($to,$subject,$message,$header);

}
```

Figure 62 : Code used to send notification email in DDMS (confimac.php)

This confirmac.php is used to send notification email to the patient that the dialysis centre is first time requires to access the patient information. This PHP page will generate a group of random number. This random number is then send to the patient with the email for the verification purpose.

In this PHP file, it consists of mail() function that provide by PHP and this mail() has 4 parameters : recipient email address, subject, message, and possibly header. The system will look for the patient email with the patient's identity then the system will send patient the notification email.

5.5.8 Print document

```
$pdf = new FPDF();
$pdf->AddPage();
$pdf->SetFont('Arial');
$pdf->Image('../images/logo.jpg',20,10,30,0,'');
$pdf->SetXY(10,100);
$pdf->image('../images/logowatermark2.jpg');

$pdf->SetY(10);
$pdf->ln(20);
$pdf->Cell(0,10,'Patient Detail' ,1 ,2 ,'C');
$pdf->Cell(0,10,'' ,0 ,2 );
$pdf->Cell(0,0,'Name                                    : '.$pat_name ,0 ,0 ,'L');
$pdf->Ln();
$pdf->Cell(0,10,'' ,0 ,2 );
$pdf->Cell(0,0,'NRIC/Passport No.          : '.$pat_iden ,0 ,0 ,'L');
$pdf->Ln();
$pdf->Cell(0,10,'' ,0 ,2 );
$pdf->Cell(0,0,'Gender                                  : '.$pat_gen ,0 ,0 ,'L');
$pdf->Ln();
$pdf->Cell(0,10,'' ,0 ,2 );
$pdf->Cell(0,0,'Date of Birth                     : '.$pat_dob ,0 ,0 ,'L');
$pdf->Ln();
$pdf->Cell(0,10,'' ,0 ,2 );
$pdf->Cell(0,0,'Email of Birth                  : '.$pat_email ,0 ,0 ,'L');
$pdf->Ln();
$pdf->Cell(0,10,'' ,0 ,2 );
$pdf->Cell(0,0,'Contact Number(Home) : '.$pat_hmcon ,0 ,0 ,'L');
$pdf->Ln();
$pdf->Cell(0,10,'' ,0 ,2 );
$pdf->Cell(0,0,'Contact Number(H/p)     : '.$pat_hpcon ,0 ,0 ,'L');
```

Figure 63 : Part of the code used to convert data into PDF format (printdoc.php)

This printdoc.php is used to convert the document into the PDF format and for the purpose of printing. PHP provide a FPDF() format to allow the user to convert their information into PDF format. The functionality that provided by PHP, it allows to set the font size and type, pages, position of the wording and images in the PDF file. In the *cell* that shown in above diagram is consisting of height, width, border and text

parameter. On the other hand, the image parameter consists of image file name, the x and y coordinates of the image and width and height of the images.

5.6 Site Map

According to Rouse, M (2005), site map is defined as a visual or textually organized model of a web site's content that allows the users to navigate through the site to find the information. The site map for this Dialysis Data Management System is shown as below:

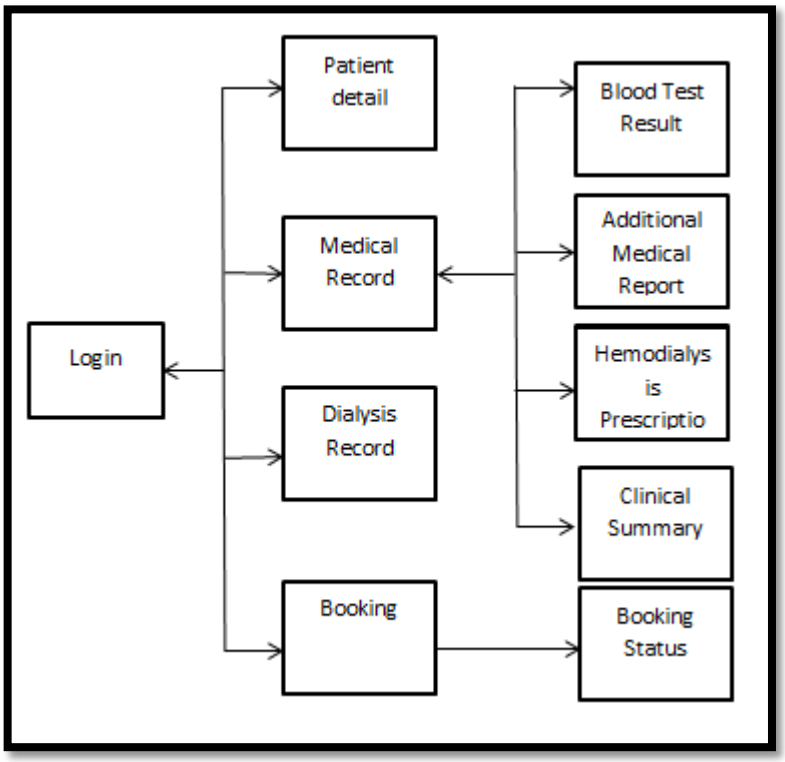


Figure 64 : Patient Site Map

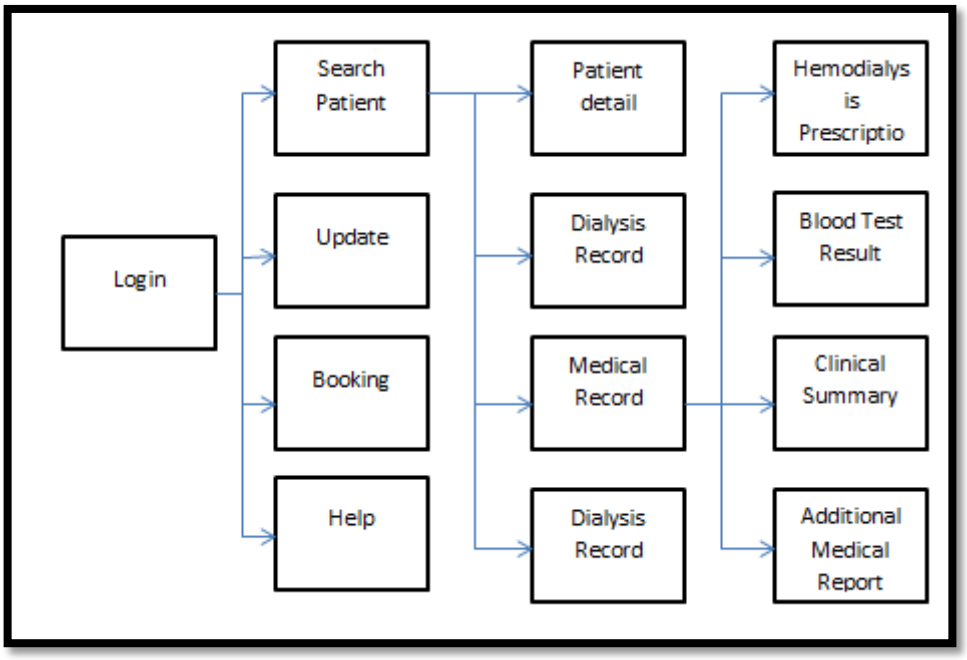


Figure 65 : Dialysis Centre Site Map

CHAPTER 6

TESTING

6.1 Introduction

Software reliability means the probability of the operation of a system that is free of failure. Testing is one of the effective ways to measure software reliability. Software testing is used to analyze and detect the differences between existing and required condition and evaluate the features of the application. Black box testing and white box testing techniques are used to test the application. Black box testing is often used for validation while white box testing is used for verification. Black box testing ignores the internal coding and internal logic of the program and focus solely on the output that generated in response to selected inputs and execution conditions. On the other hand, the white box testing takes into account the internal coding and internal logic of a system or component according to IEEE Standard Glossary of Software Engineering Terminology (1990).

During the testing phase for this Dialysis Data Management system, unit testing, integration testing techniques, functional testing and acceptance testing are used to ensure the system is fulfilling the requirement and is of expected quality. Different testing is conducted by different group of people. Basically, programmer are involved in the unit testing, integration testing techniques and functional testing during the development and also after completion while the users are involved in the acceptance testing for this Dialysis Data Management system after the system is done and ready for deploy.

6.2 Unit Testing

According to IEEE Standard Glossary of Software Engineering Terminology (1990), unit testing is test on the individual hardware, software unit or group of related units. Based on Narendra Kumar and Rama Mohan Reddy (2011), unit testing is used to ensure that the code is in accordance with the design specification. Unit testing is more effective when the construct is more specific to be tested instead of testing the entire code. Small part of the application is taken out to be tested independently of the entire application to ensure that the individual parts of the system are working correctly.

White box testing is used for the test. To ensure the code does what it is intended to do at a low structure level, test case is used to determine that the code will provide the desire result. In this system, it is involving of many database query and 'if else' statement. Hence, test case is used to ensure that query to the database is successful. If there is an 'if else' statement, a second test case is used to go down the path that not executed by the first test case. Besides that, the structure of the code is examined by reading the code itself to find the error that might exist in the system without knowing. Below is some part of the codes that are tested by unit testing.

```
$mytype=$_GET['type'];
if(isset($_SESSION['login'])){
    if($mytype=='patient')
    {
        header("location:http://localhost/169_html/home.php?id=$myusername");
    }
    else
    {
        header("location:http://localhost/dia/dia_main.php?id=$myusername");
    }
}
```

Figure 66 : Part of code used Unit Testing

During the unit testing of this part of code, the user is required to select user type. If the type is patient, the page will login the user to the patient home page base on the user id. On the other hand, the page will login the user to the dialysis home page if the user type is not patient.

Besides that, unit testing is also used to test for the connection to the database.

```
$con=mysqli_connect('localhost','root','bear123','dialysiscen');
// Check connection
if (mysqli_connect_errno())
{
    echo "Failed to connect to MySQL: " . mysqli_connect_error();
}
```

Figure 67 : Part of code used to test Database Connectivity.

If the database is failed to connect, the website will display that the SQL is failed to connect with the error messages.

In order to ensure database queries are correct, unit testing is also used to check on the database query. Below is one of the parts that used unit testing to test for the database query.

```
$rep_result = mysqli_query($con,"SELECT * FROM clinical_chrt_chkpoint where
dialysis_cenid= '$dialysis_cenid' AND patient_iden= '$id' AND no_dialysis= '
$no_dialysis'");
```

Figure 68 : Part of the Select Statement used in Unit Testing

The result of the unit testing was satisfied. With the testing of each possible path of each individual unit, it was assured that the functionality of the system is working fine and perfectly. Bugs that encountered are identified and fixed immediately during the testing.

6.3 Integration Testing

According to IEEE Standard Glossary of Software Engineering Terminology (1990), integration testing is combining the software components and hardware components together and tested to evaluate the interaction between them. Integration testing is being done after the unit testing. Technique that used for this testing is black box and white box testing.

The main objective of this integration test is to ensure that the units of the system are able to work together when they are integrated with larger code base. During this test, the data is examined to ensure that the data and messages are pass correctly across and interface and also make sure that the interface are implemented as specified. Besides that, the predetermined inputs were also passed into the system and the output that received is compared to ensure that the result is correct. For this system, there is consisting of insert, update and delete from the database as well as passing the information across different pages. Hence, the data are checked to ensure that these data are passing or updated correctly into the database.

Below is some part of the system that is tested by integration testing:

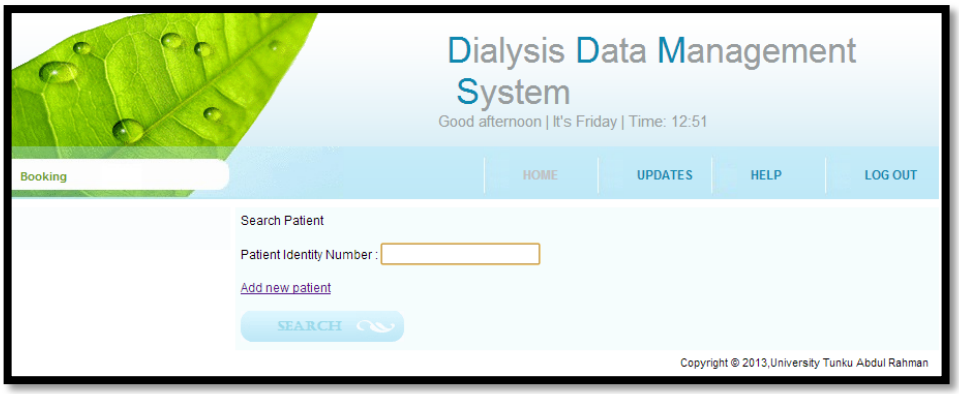


Figure 69 : Screenshot of the form where the dialysis centre enters the patient's identity number.

Figure 70 : Screen shot of request permission screen

During the integration testing, the patient's identity number is required whether it is exist in the database. After checking for the patient's identity in the patient database, the system is required to check whether the dialysis centre has the rights to access the patient information. If the dialysis center does not have the right to access the patient information, the system will send the patient an email to get the acknowledgement from the patient and get the approval from the patient. During this integration testing, the data passing and the database query is integrated in order to run the test.

```
<?php echo "<form action= 'http://localhost/dia/first_check.php?dia_id=$dia_id'
method='post'>";?>
    <div><label for="pat_id">Patient Identity Number</label> : <input type="text"
    name="pat_id" value="" id="pat_id" /></div><br/>
    <?php echo"<a href='http://localhost/dia/add_new_pat.php?dia_id=".$dia_id."'>
    Add new patient</a><br/><br/>";?>
    <div id="login-button">
        <input type="image" name="submit" src="img/button.png" />
    </div>
</form>
```

Figure 71 : Part of code that sends the identity number to check for the access permission.

```php
// send e-mail to ...
$to=$email;

// Your subject
$subject="Your confirmation link here";

// From
$header="from: Dialysis Centre";

// Your message
$message="Your Comfirmation link \r\n";
$message.="Click on this link to activate your account \r\n";
$message.="http://localhost/dia/confirmation.php?passkey=$random_hash";

// send email

$sentmail = mail($to,$subject,$message,$header);
```

Figure 72 : Part of the code used to send notification email to patient.

Besides that, here is another example that used integration testing.

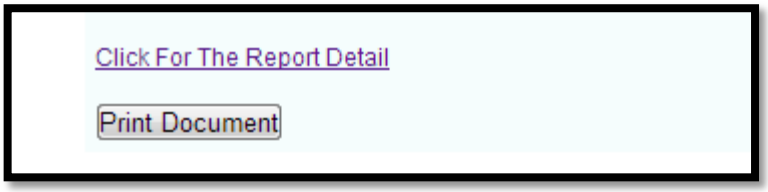


Figure 73 : Screen shot of the button click to convert data into PDF format

```php
<?php
require('../pdf/fpdf.php');


$dia_id=$_GET['diacen_id'];
$pat_id=$_GET['id'];
$visit_date=$_GET['date'];
$visit_count = $_GET['nodia'];
```

Figure 74 : PHP function that enables to convert data into PDF format

During the integration testing, print PDF function, database query function and the data passing is integrated into the system. When the dialysis center clicked on the print document button, the data that required is passed in order to print out the information that required. Hence, the information that printed out is checked to determine whether the data is passed correctly and fulfilled the customer's requirement.

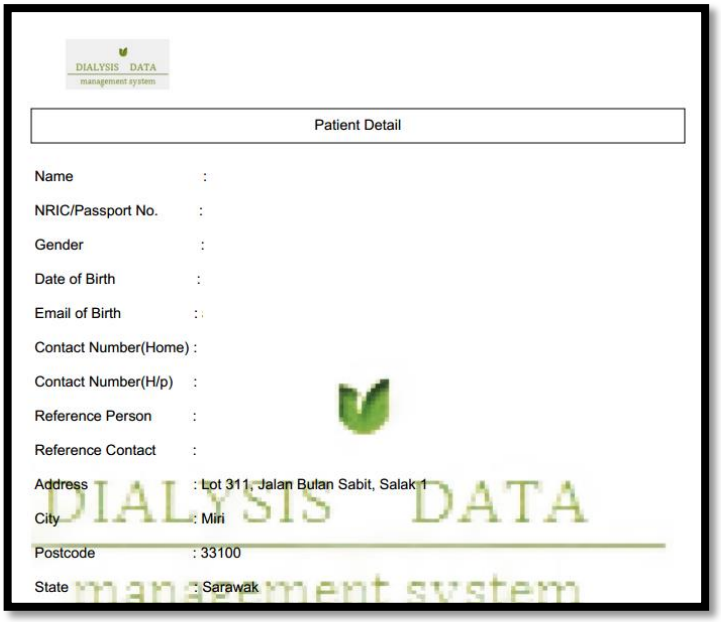


Figure 75 : Screen shot of the PDF document generated.

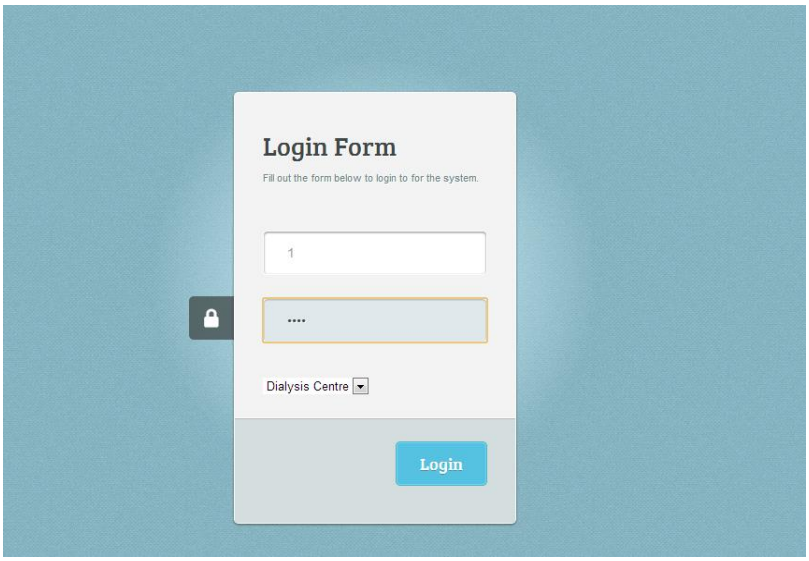
The bugs that encountered are identified during the integration testing and have been fixed once using the Integration testing.

6.4 Functional Testing

IEEE Standard Glossary of Software Engineering Terminology (1990) explained that functional testing ignores the internal mechanism of a system or component and focuses on the output of the system with the selected inputs and execution conditions

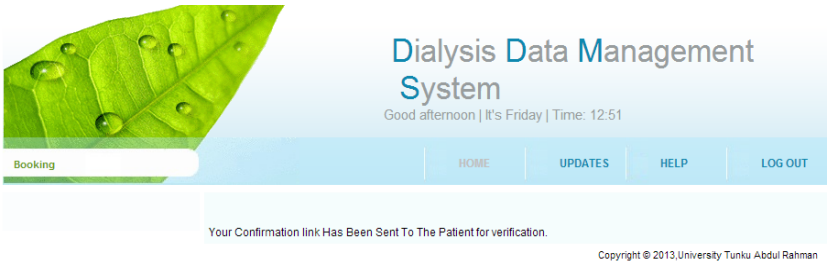
Functional testing is done on the whole system. It ensures that the system fulfill the functionality specified in the requirement specification work.

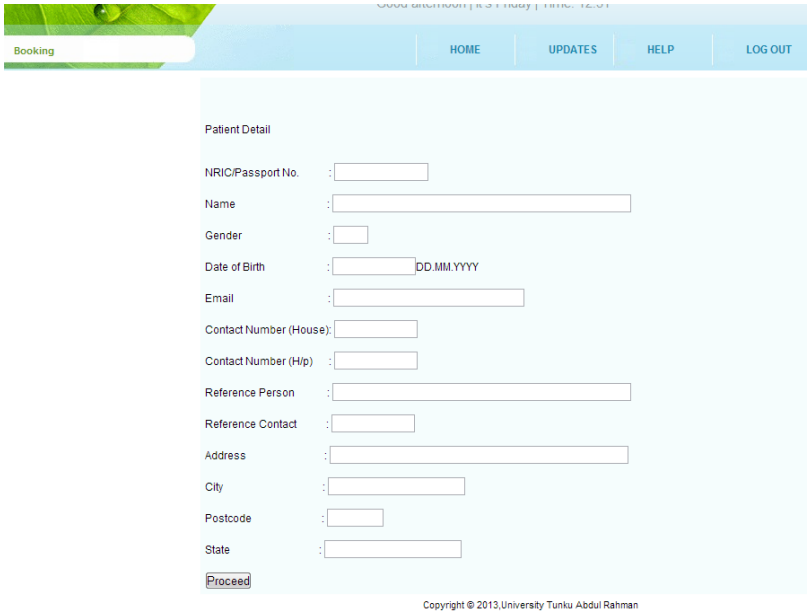
Test case	To access a dialysis patient's personal data that has been visited the dialysis centre by the nurse of a dialysis centre.

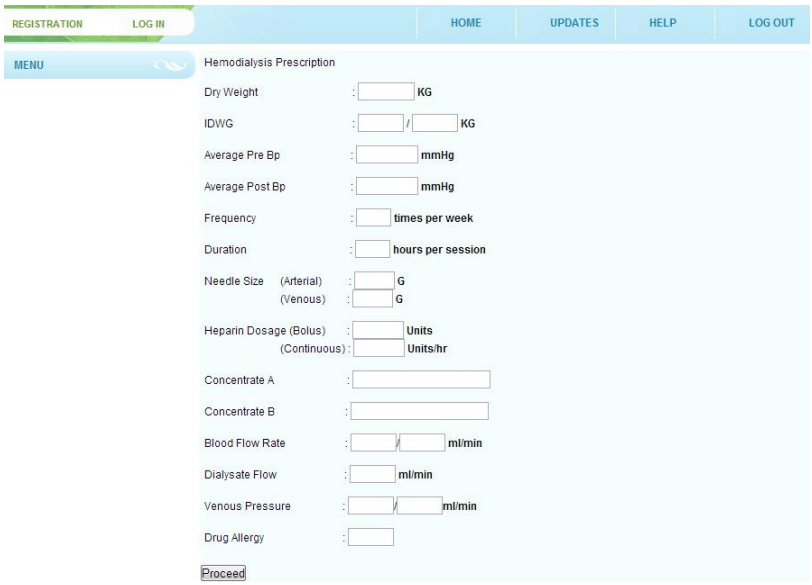
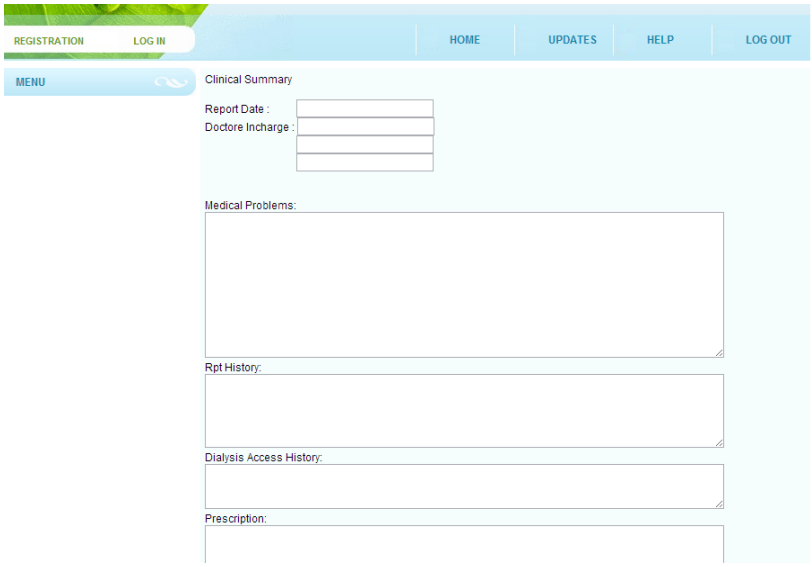
Test Performed	Steps: 1. Login to the system by using the dialysis centre's id and password  2. Search for the patient base on the patient's identity card number or passport. 

	3. Once the patient's identity card number or passport is entered, the detail of the patient will be displayed.  4. Return to the home page by clicking on the Home button or log out from the user by clicking log out button.
Expected Result	1. When the dialysis centre's nurse login into the system, it will appear the home page for dialysis centre where the nurse can enters the patient's identity card number or passport number. 2. After the nurse enters the patient's identity card number or passport number, the patient's detail is displayed. 3. The nurse clicks on the home button to go back to the Home page and log out the system by clicking on the log out button.
Actual Result	1. The dialysis centre's nurse login into the system and entered to the main page for the dialysis center. 2. The nurse entered the patient's identity card number or passport number and the patient's detail is displayed. 3. The nurse clicked to the Home button to go back the home page and clicked the logout button to log out from the system.
Pass/Fail	Pass

Test case	To access a dialysis patient's personal data who has not been visit the dialysis centre by the nurse of a dialysis centre.
Test Performed	Steps: 1. Login to the system by using the dialysis centre's id and password and search for the patient that has not been visited the dialysis centre before base on the patient's identity card number or passport.  2. The system will show that the dialysis centre does not have the right to access the patient's information. Email is required to send to notify the patient in order to access the data. 

	3. Click on the Get Approval button, the email will send to the user. 
Expected Result	1. When the dialysis centre's nurse login into the system, it will appear the home page for dialysis centre where the nurse can enter the patient's identity card number or passport number. 2. After the patient identity card number or passport number that has not been visited the dialysis centre is enter, a notification will display to show that the dialysis centre does not have the right to access the patient's information. An email is required to send to notify the patient in order for the nurse to access the data. 3. The nurse clicks Get Approval button, a notification email will send to the patient.
Actual Result	1. The dialysis centre's nurse login into the system and entered to the main page for the dialysis center. 2. The nurse entered the patient's identity card number or passport number that has not been visited the dialysis centre is enter. A notification was displayed to show that the dialysis centre does not have the right to access the patient's information. 3. The nurse clicked Get Approval button, a notification email was send to the patient.
Pass/Fail	Pass

Test case	To add a new patient by the nurse of a dialysis center
Test Performed	Steps: 1. Login to the system by using the dialysis centre's id and password and click on the Add New Patient link.  2. The system will show the patient's personal detail form. 

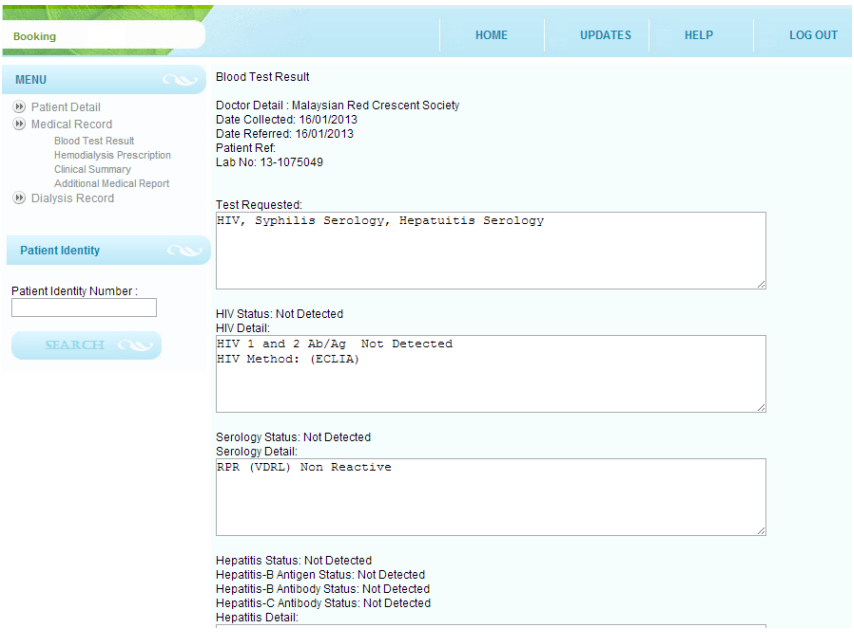
	3. Next, the system will show the patient's haemodialysis prescription form.  4. Next, the system will show the patient's Clinical Summary form.  5. Go back to home page and find the patient to ensure that the patient is successfully entered into the system.
Expected Result	1. After the nurse login to the system, the nurse clicks on the Add New Patient link. It will link to the patient's personal detail

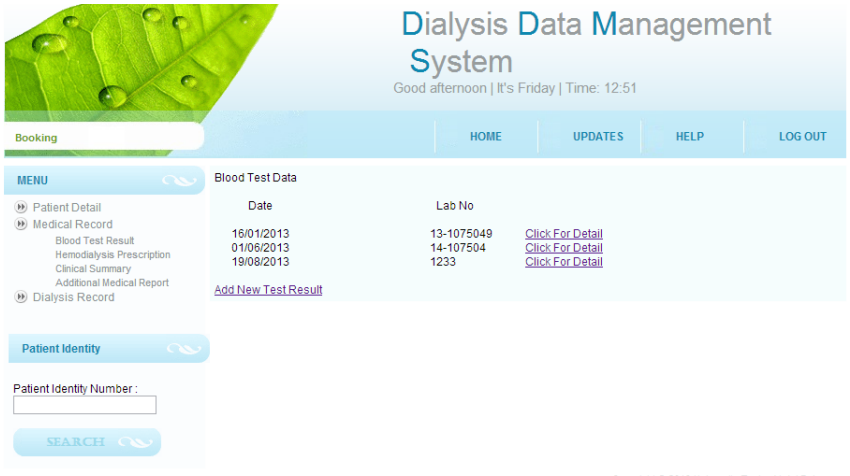
	form. 2. After the nurse enters all the patient's personal detail, the system will link to the patient's haemodialysis prescription form. 3. After the nurse enters all the patient's haemodialysis prescription, the system will link to the patient's Clinical Summary form. 4. After the nurse enters the patient's Clinical Summary, the system will go back to the home page. The nurse is required to search back the patient to ensure that the patient's detail is successfully entered into the system.
Actual Result	1. After the nurse login to the system, the nurse clicked on the Add New Patient link. The patient's personal detail form is displayed. 2. After the nurse entered all the patient's personal detail, patient haemodialysis prescription form is displayed. 3. After the nurse entered all the patient's haemodialysis prescription, patient's Clinical Summary form is displayed. 4. After the nurse enters the patient's Clinical Summary, the nurse searched back the patient and the patient was successfully entered into the system.
Pass/Fail	Pass

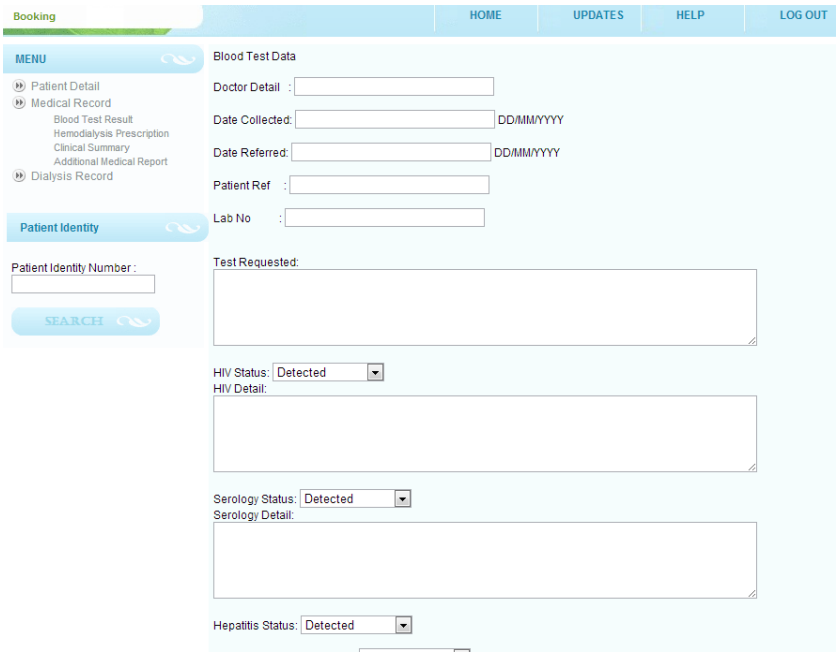
Test case	To access a dialysis patient's blood test result by the nurse of a dialysis centre
Test Performed	Steps: 1. Login to the system by using the dialysis centre's id and password and search for the particular patient.

2. Click on the Blood Test Result at the side menu or click on Blood Test Result link below the patient's detail.

3. Next, the system will show all the blood test report based on the date and lab number.

	4. Click on the Click for Detail link to have more detail on the particular report. 
Expected Result	1. After the nurse login to the system, the nurse enters a patient's identity card number or passport numbers. 2. After the nurse enters the patient's identity card number or passport number, click on the Blood Test Result at the side menu or click on Blood Test Result link below the patient's detail. 3. The nurse clicks on the "Click For Detail" link to view the detail of the patient's blood test result.
Actual Result	1. After the nurse login to the system, the nurse entered a patient's identity card number or passport numbers. 2. The nurse clicked on the Blood Test Result at the side menu on Blood Test Result link below the patient's detail to enter the Blood Test Result page. 3. The nurse clicked on the "Click For Detail" link to get the detail of the patient's blood test result.
Pass/Fail	Pass

Test case	To enter new blood test result for dialysis patient by the nurse of a dialysis centre
Test Performed	Steps: 1. Login to the system by using the dialysis centre's id and password and search for the particular patient. 2. Click on the Blood Test Result at the side menu or click on Blood Test Result link below the patient's detail.  3. Next, the system will show all the blood test report page and click on the Add New Test Result link. 

	4. Next, the system will show the patient Add New Blood Test form.  5. Go back to Blood Test Result page to ensure that the new Blood Test Report is successfully entered into the system.
Expected Result	1. After the nurse login to the system, the nurse enters a patient's identity card number or passport numbers. 2. After the nurse enters the patient's identity card number or passport number, click on the Blood Test Result at the side menu or click on Blood Test Result link below the patient's detail to view for the patient Haemodialysis Prescription detail. 3. The nurse clicks on the Add New Blood Test Result to enter the new blood test report into the system. 4. After the nurse enters the patient's new Blood Test Result into

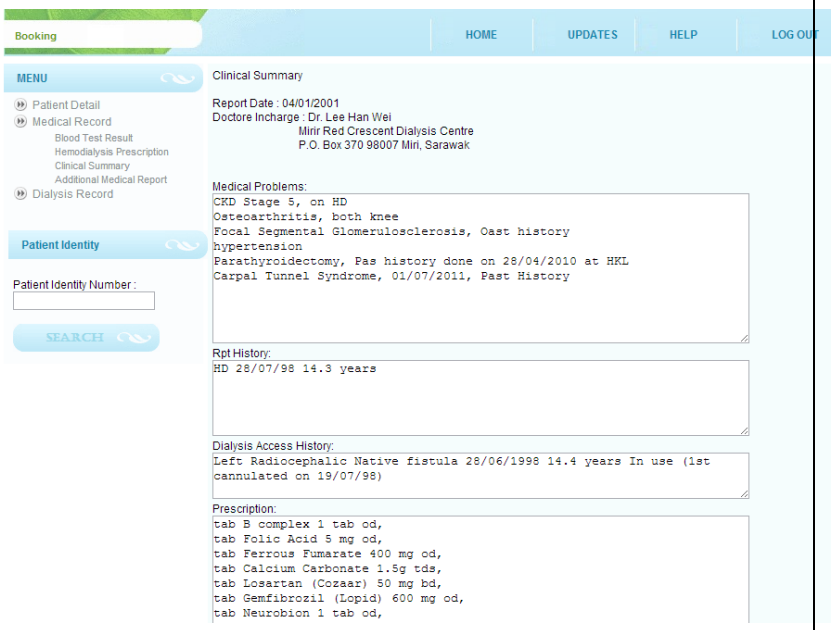
	the system. The nurse is required to go back to Blood Test Result page to ensure that the new Blood Test Report is successfully entered into the system.
Actual Result	1. After the nurse login to the system, the nurse entered a patient's identity card number or passport numbers. 2. The nurse clicked on the Blood Test Result at the side menu and Blood Test Result link below the patient's detail to enter the Blood Test Result page. 3. The nurse clicked the Add New Blood Test Result to enter the new blood test report into the system. 4. The nurse went back to back to Blood Test Result page to ensure that the new Blood Test Report is successfully entered into the system.
Pass/Fail	Pass

Test case	To access a dialysis patient's haemodialysis prescription by the nurse of a dialysis centre
Test Performed	Steps: 1. Login to the system by using the dialysis centre's id and password and search for the particular patient.

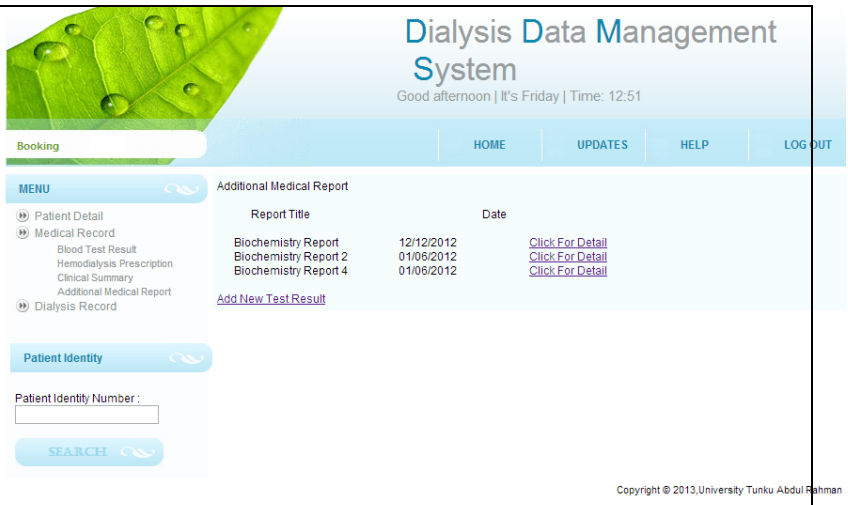
	2. Click on the Haemodialysis Prescription at the side menu or click on Haemodialysis Prescription link below the patient's detail.  3. Next, the system will show the patient's Haemodialysis Prescription report. 
Expected Result	1. After the nurse login to the system, the nurse enters a patient's identity card number or passport numbers. 2. After the nurse enters the patient's identity card number or

	passport number, click on the Haemodialysis Prescription at the side menu or click on Haemodialysis Prescription link below the patient's detail.
Actual Result	1. After the nurse login to the system, the nurse entered a patient's identity card number or passport numbers. 2. The nurse clicked on the Haemodialysis Prescription at the side menu and Haemodialysis Prescription link below the patient's detail to enter the the Haemodialysis Prescription page. 3. Patient's Haemodialysis Prescription is displayed.
Pass/Fail	Pass

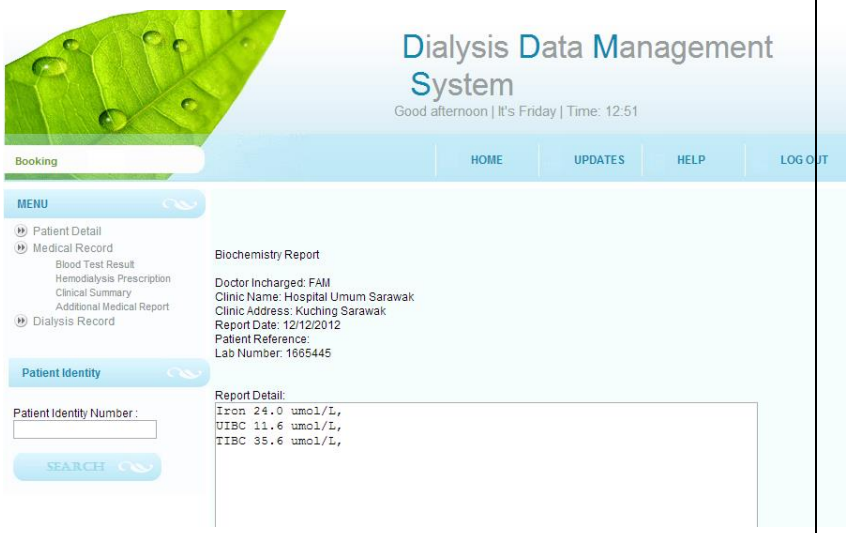
Test case	To access a dialysis patient's Clinical Summary by the nurse of a dialysis centre.
Test Performed	Steps: 1. Login to the system by using the dialysis centre's id and password and search for the particular patient. 2. Click on the Clinical Summary at the side menu or click on Clinical Summary link below the patient detail. 

	3. Next, the system will show the patient's Clinical Summary report. 
Expected Result	1. After the nurse login to the system, the nurse enters a patient's identity card number or passport numbers. 2. After the nurse enters the patient's identity card number or passport number, click on the Clinical Summary at the side menu or click on Clinical Summary link below the patient's detail.
Actual Result	1. After the nurse login to the system, the nurse entered a patient's identity card number or passport numbers. 2. The nurse clicked on the Clinical Summary at the side menu and Clinical Summary link below the patient's detail to enter the Clinical Summary page. 3. Patient Clinical Summary is displayed.
Pass/Fail	Pass

Test case	To access a dialysis patient's Additional Medical Report by the nurse of a dialysis centre.
Test Performed	Steps: 1. Login to the system by using the dialysis centre's id and password and search for the particular patient. 2. Click on the Additional Medical Report at the side menu link.  3. Next, the system will show all the Additional Medical Report based on the date and report title.

<table>
<tr>
<td></td>
<td>


4. Click on the Click for Detail link to have more detail on the particular report.

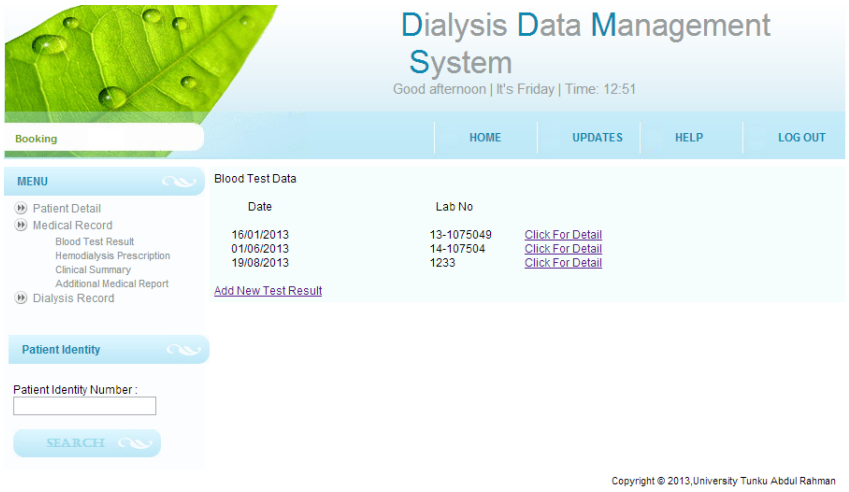


</td>
</tr>
<tr>
<td>Expected Result</td>
<td>
1. After the nurse login to the system, the nurse enters a patient’s identity card number or passport numbers.
2. After the nurse enters the patient’s identity card number or passport number, click on the Additional Medical Report at the side menu.
3. The nurse clicks on the “Click For Detail” link to view the detail of the patient’s additional medical report.
</td>
</tr>
</table>

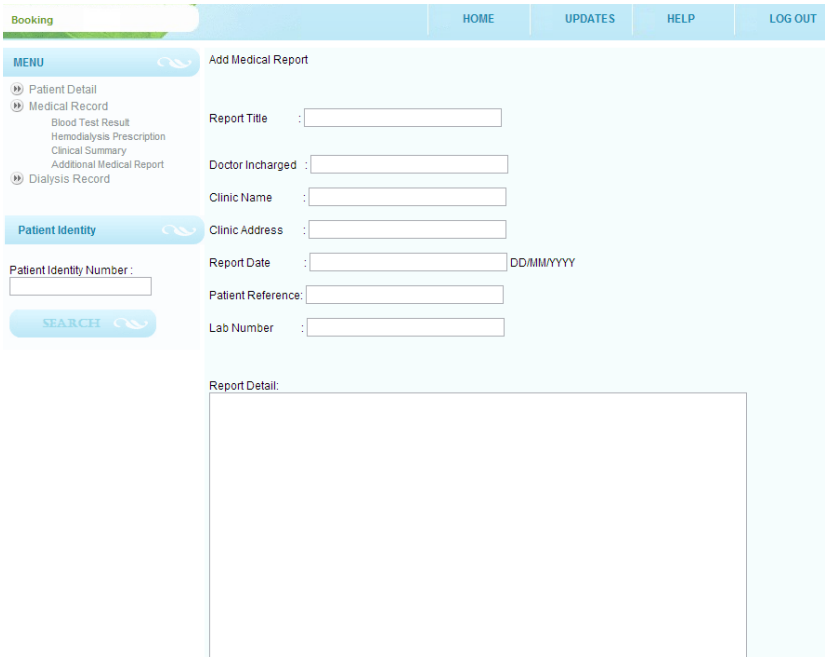
Actual Result	1. After the nurse login to the system, the nurse entered a patient's identity card number or passport numbers. 2. The nurse clicked on the Additional Medical Report at the side menu. 3. The nurse clicked on the "Click for Detail" link to get the detail of the patient's Additional Medical Report.
Pass/Fail	Pass

Test case	To enter new additional medical report for dialysis patient by the nurse of a dialysis centre.
Test Performed	Steps: 1. Login to the system by using the dialysis centre's id and password and search for the particular patient. 2. Click on the Additional Medical Report at the side. 

3. Next, the system will show all the additional medical report and click on the Add New Test Result link.



4. Next, the system will show the patient's Additional Medical Report form.



5. Go back to Additional Medical Report page to ensure that the new medical report is successfully entered into the system.

Expected Result	1. After the nurse login to the system, the nurse enters a patient's identity card number or passport numbers. 2. After the nurse enters the patient's identity card number or passport number, click on the Additional Medical Report at the side to view for the patient's Haemodialysis Prescription detail. 3. The nurse clicks on the Add New Test Result to enter the new medical report into the system. 4. After the nurse enters the patient's new medical report into the system. The nurse is required to go back to Additional Medical Report page to ensure that the new medical report is successfully entered into the system.
Actual Result	1. After the nurse login to the system, the nurse entered a patient's identity card number or passport numbers. 2. The nurse clicked on the Additional Medical Report at the side menu to enter the Additional Medical Report page. 3. The nurse clicked the Additional Medical Report to enter the new medical report into the system. 4. The nurse went back to back to Additional Medical Report page to ensure that the new medical report is successfully entered into the system.
Pass/Fail	Pass

Test case	To access and print a dialysis patient's Dialysis Record by the nurse of a dialysis centre.
Test Performed	Steps: 1. Login to the system by using the dialysis centre's id and password and search for the particular patient.

2. Click on the Dialysis Record at the side menu link or click on the dialysis record link below the patient's detail.

3. Next, the system will show all the Dialysis Record based on the date.

4. Click on the Click for Detail link to have more detail on the particular report.

<table>
<tr>
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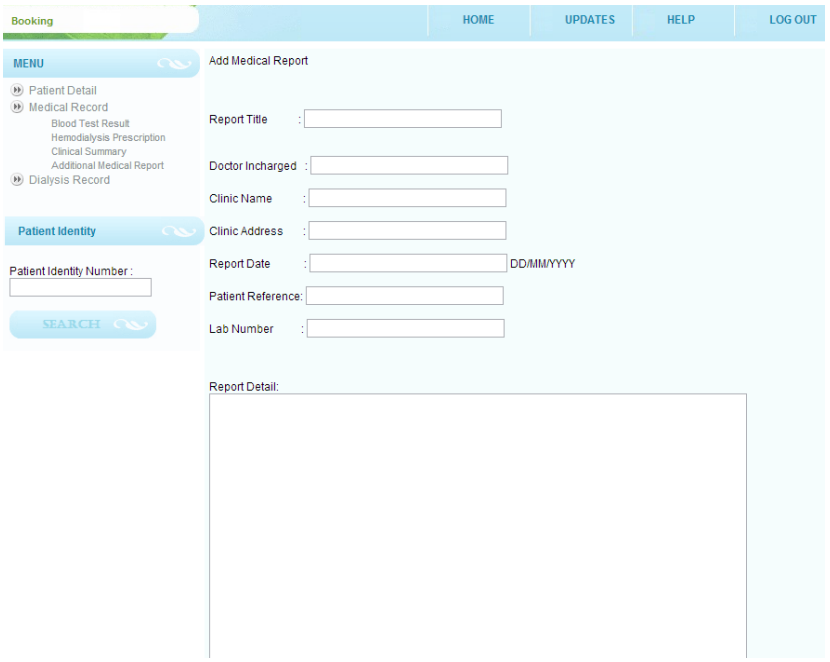
5. Click on the Print Document button to print the information.

</td>
</tr>
<tr>
<td>Expected Result</td>
<td>
1. After the nurse login to the system, the nurse enters a patient’s identity card number or passport numbers.
2. After the nurse enters the patient’s identity card number or passport number, click on the Dialysis Record at the side menu and the Dialysis Record link below the patient’s detail to enter the Dialysis Record page.
3. The nurse clicks on the “Click For Detail” link to view the detail of the patient’s dialysis record.
4. The nurse clicks on the “Print Document” button to print the patient’s dialysis record.
</td>
</tr>
<tr>
<td>Actual Result</td>
<td>
1. After the nurse login to the system, the nurse entered a patient’s identity card number or passport numbers.
</td>
</tr>
</table>

	2. The nurse clicked on the Additional Medical Report at the side menu and the Dialysis Record link below the patient detail to enter the Dialysis Record page. 3. The nurse clicked on the "Click for Detail" link to view the detail of the patient's dialysis record. 4. The nurse clicked on the "Print Document" button and the dialysis record is printed.
Pass/Fail	Pass

Test case	To enter new additional medical report for dialysis patient by the nurse of a dialysis centre.
Test Performed	Steps: 1. Login to the system by using the dialysis centre's id and password and search for the particular patient. 2. Click on the Additional Medical Report at the side.  3. Next, the system will show all the additional medical report and click on the Add New Test Result link.

4. Next, the system will show the patient's Additional Medical Report form.



5. Go back to Additional Medical Report page to ensure that the new medical report is successfully entered into the system.

Expected Result	1. After the nurse login to the system, the nurse enters a patient's identity card number or passport numbers. 2. After the nurse enters the patient's identity card number or

	passport number, click on the Additional Medical Report at the side to view for the patient Haemodialysis Prescription detail. 3. The nurse clicks on the Add New Test Result to enter the new medical report into the system. 4. After the nurse enters the patient's new medical report into the system. The nurse is required to go back to Additional Medical Report page to ensure that the new medical report is successfully entered into the system.
Actual Result	1. After the nurse login to the system, the nurse entered a patient's identity card number or passport numbers. 2. The nurse clicked on the Additional Medical Report at the side menu to enter the Additional Medical Report page. 3. The nurse clicked the Additional Medical Report to enter the new medical report into the system. 4. The nurse went back to back to Additional Medical Report page to ensure that the new medical report is successfully entered into the system.
Pass/Fail	Pass

Test case	To access and print a dialysis patient's Dialysis Record by the nurse of a dialysis centre.
Test Performed	Steps: 1. Login to the system by using the dialysis centre's id and password and search for the particular patient. 2. Click on the Dialysis Record at the side menu link or click on the dialysis record link below the patient's detail.

3. Next, the system will show all the Dialysis Record based on the date.

4. Click on the Click for Detail link to have more detail on the particular report.

<table>
<tr>
<td></td>
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5. Click on the Print Document button to print the information.

</td>
</tr>
<tr>
<td>Expected Result</td>
<td>
1. After the nurse login to the system, the nurse enters a patient's identity card number or passport numbers.
2. After the nurse enters the patient's identity card number or passport number, click on the Dialysis Record at the side menu and the Dialysis Record link below the patient's detail to enter the Dialysis Record page.
3. The nurse clicks on the "Click For Detail" link to view the detail of the patient's dialysis record.
4. The nurse clicks on the "Print Document" button to print the patient's dialysis record.
</td>
</tr>
<tr>
<td>Actual Result</td>
<td>
1. After the nurse login to the system, the nurse entered a patient's identity card number or passport numbers.
2. The nurse clicked on the Additional Medical Report at the side menu and the Dialysis Record link below the patient's detail to
</td>
</tr>
</table>

	enter the Dialysis Record page. 3. The nurse clicked on the "Click for Detail" link to view the detail of the patient's dialysis record. 4. The nurse clicked on the "Print Document" button and the dialysis record is printed.
Pass/Fail	Pass

Test case	To enter new dialysis record for dialysis patient by the nurse of a dialysis centre.
Test Performed	Steps: 1. Login to the system by using the dialysis centre's id and password and search for the particular patient. 2. Click on the Dialysis Record at the side menu link or click on the dialysis record link below the patient's detail.  3. Next, the system will show all the Dialysis Record based on the date and click on the Add New Record link.

<table>
<tr>
<td></td>
<td>


4. Next, the system will show the patient's Additional Medical Report form.

5. Go back to Dialysis Record page to ensure that the new dialysis record is successfully entered into the system.
</td>
</tr>
<tr>
<td>Expected Result</td>
<td>1. After the nurse login to the system, the nurse enters a patient's identity card number or passport numbers.</td>
</tr>
</table>

	2. After the nurse enters the patient's identity card number or passport number, click on the Dialysis Record at the side or click on the dialysis record link below the patient's detail to view for the patient Dialysis Record. 3. The nurse clicks on the Add New Record to enter the new dialysis record into the system. 4. After the nurse enters the patient's new dialysis record into the system. The nurse is required to go back to Dialysis Record page to ensure that the new dialysis record is successfully entered into the system.
Actual Result	1. After the nurse login to the system, the nurse entered a patient's identity card number or passport numbers. 2. The nurse clicked on the Dialysis Record Report at the side menu or click on the dialysis record link below the patient's detail to enter the Dialysis Record page. 3. The nurse clicked the Add New Record to enter the patient's new dialysis record into the system. 4. The nurse went back to back to Dialysis Record page to ensure that the new dialysis record is successfully entered into the system.
Pass/Fail	Pass

Test case	To view booking / Reject Booking / Confirm Booking.
Test Performed	Steps: 1. Login to the system by using the dialysis centre's id and password. 2. Click on the Booking link on the header menu to view all the pending booking.

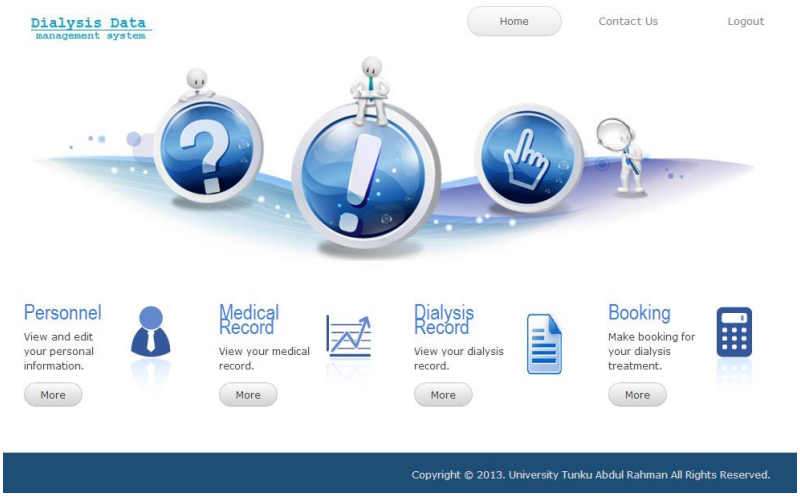
3. Next, click on the “Click to Reject” link to reject the patient.

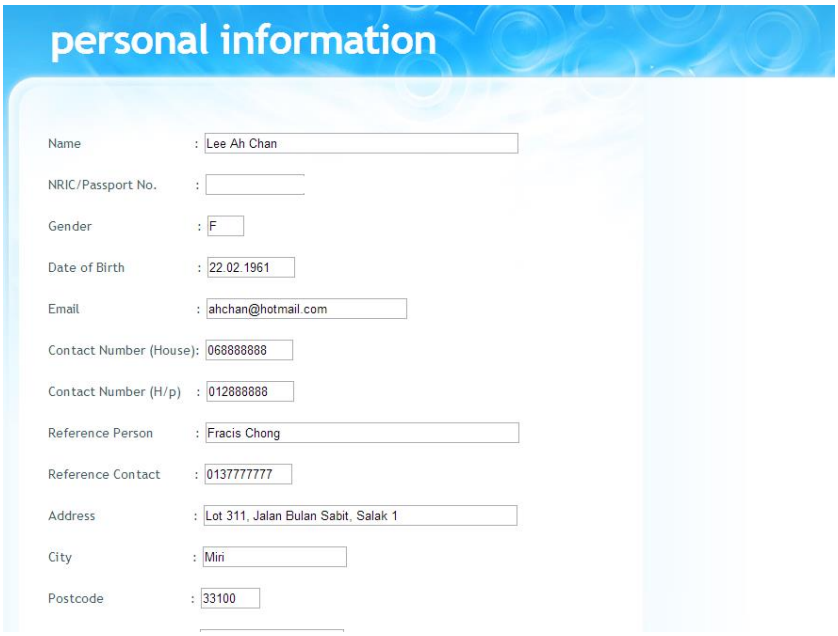
4. Click on the “Click to Confirm” link to confirm the patient’s booking.

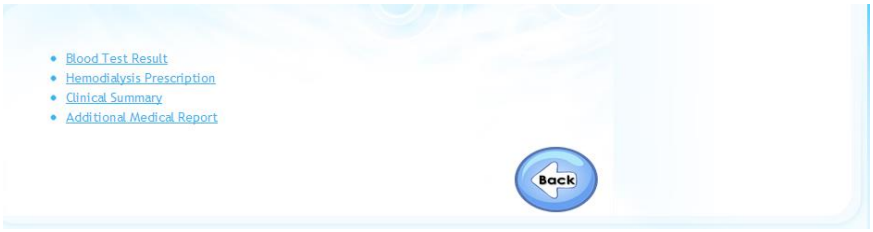
5. Click on the "View All Booking" link to view all the confirm booking.

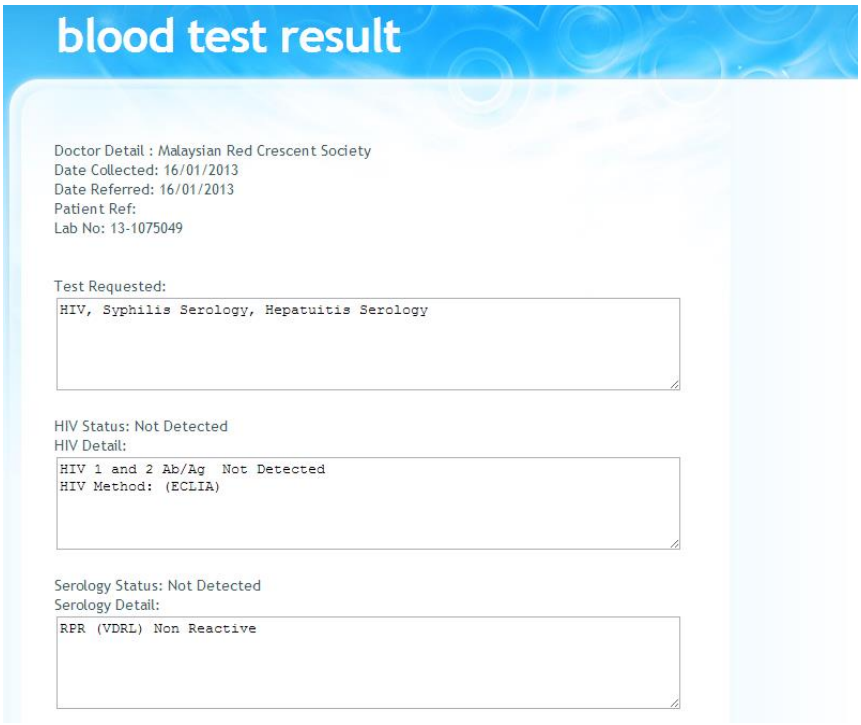
Expected Result	1. After the nurse login to the system, click on the booking link at the top menu to view all the pending booking. 2. The nurse clicks on the "Click to Reject" link to reject the patient with a reason.

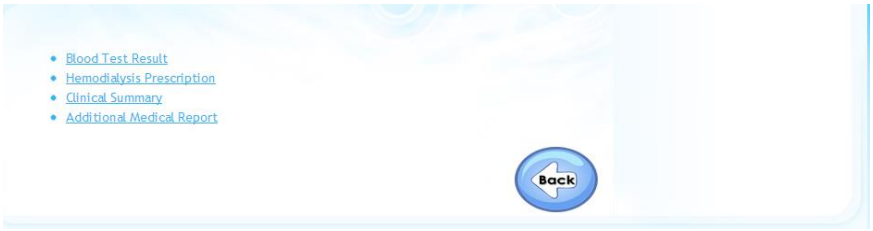
	3. The nurse clicks on the "Click to Confirm" link to confirm the patient's booking and also specify the time of the treatment. 4. The nurse clicks on the "View All Booking" link to view all the confirm booking for the dialysis centre.
Actual Result	1. After the nurse login to the system then clicked on the booking link to enter the booking page to view all the pending booking. 2. The nurse clicked on the "Click to Reject" link to reject the patient with a reason of fully booking. 3. The nurse clicked on the "Click to Confirm" to confirm the patient's booking and also specified the time of the treatment. 4. The nurse clicked on the "View All Booking" link to view all the confirm booking of the dialysis centre.
Pass/Fail	Pass

Test case	To access a patient's personal information by a dialysis patient.
Test Performed	Steps: 1. Login to the system by using the patient's id and password to enter the patient view main page. 

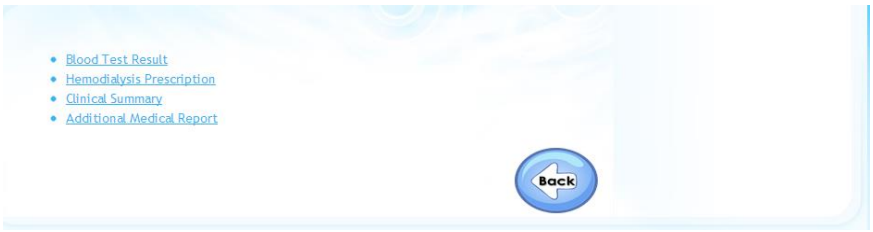
	2. Click on the "More" at the personal icon at the main page to view and edit their personal detail. 
Expected Result	1. When the dialysis patient login into the system, it will appear the home page for patient. The patient clicks on "More" at the personal icon to view and edit their personal detail 2. The patient edits their personal information and clicks save to save the edited information. 3. The patient goes back to Personal Information page to view the edited information to ensure the information is corrected.
Actual Result	1. The patient login into the system. The patient clicked on the "More" button at the personal icon to view for their information. 2. The patient edited their information and clicked "Saved" icon to save the edit information. 3. The patient went back to the Personal Information page to view the edited information to ensure the information is corrected.
Pass/Fail	Pass

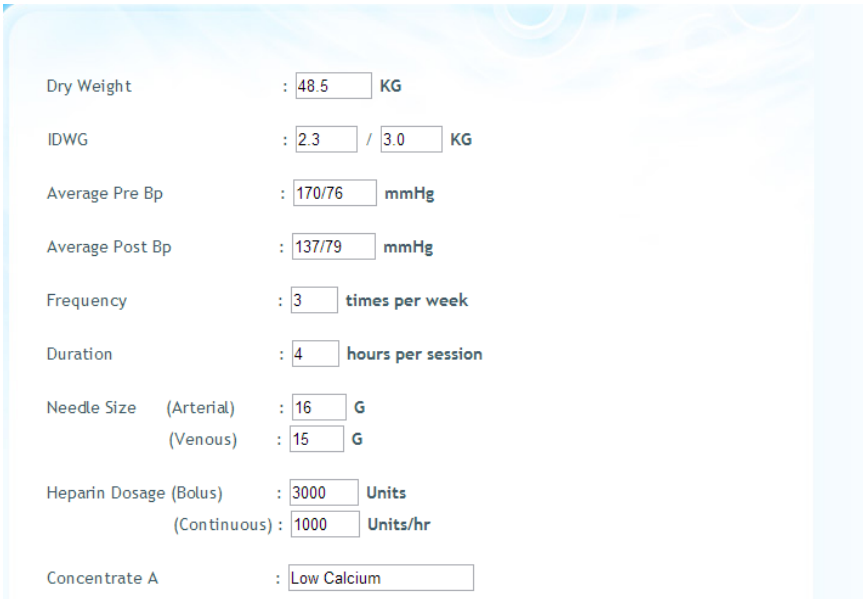
Test case	To view a patient's blood test result by a dialysis patient.
Test Performed	Steps: 1. Login to the system by using the patient's id and password to enter the patient view main page. 2. Click on the "More" at the Medical Record icon at the main page.  3. Click on Blood Test Result to view the patient's blood test result. The system will show all the blood test report based on the date and lab number. 

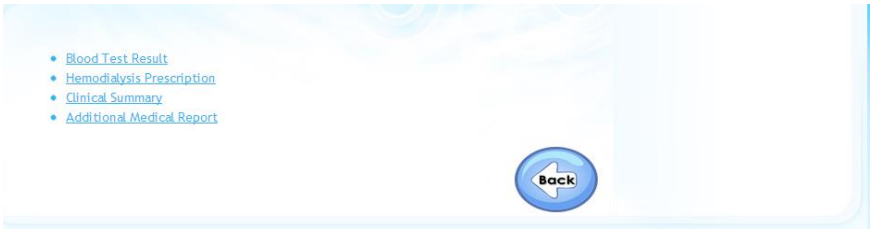
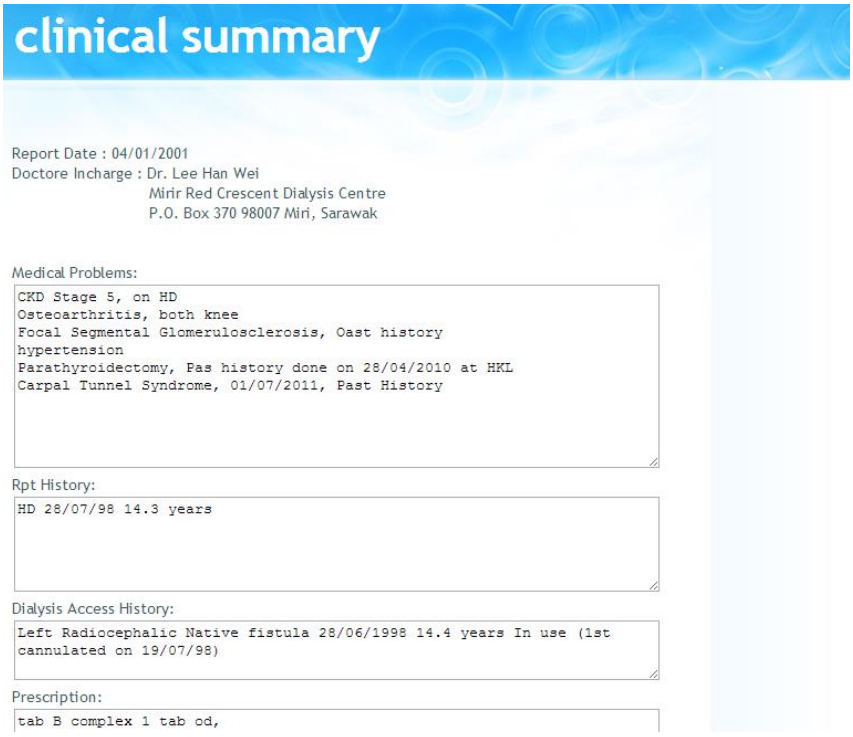
	4. Click on the Click for Detail link to have more detail on the particular report. 
Expected Result	1. When the dialysis patient login into the system, it will appear the home page for patient. The patient clicks on “More” at the Medical Record icon to enter the medical page. 2. The patient clicks on the Blood Test Result link to view all the blood test report based on the date and lab number. 3. The patient clicks on the Click for Detail link to have more detail on the particular report.
Actual Result	1. The patient login into the system. The patient clicked on the “More” button at the Medical Record icon to enter the medical page. 2. The patient clicked on the Blood Test Result link to view all the blood test report based on the date and lab number. 3. The patient clicked on the Click for Detail link to view the detail on the particular report.
Pass/Fail	Pass

Test case	To view a patient's Addition Medical Report by a dialysis patient.
Test Performed	Steps: 1. Login to the system by using the patient's id and password to enter the patient view main page. 2. Click on the "More" at the Medical Record icon at the main page.  3. Click on Additional Medical Report to view the patient's medical report. The system will show all the medical report based on the date and report title.  4. Click on the Click for Detail link to have more detail on the particular report. 

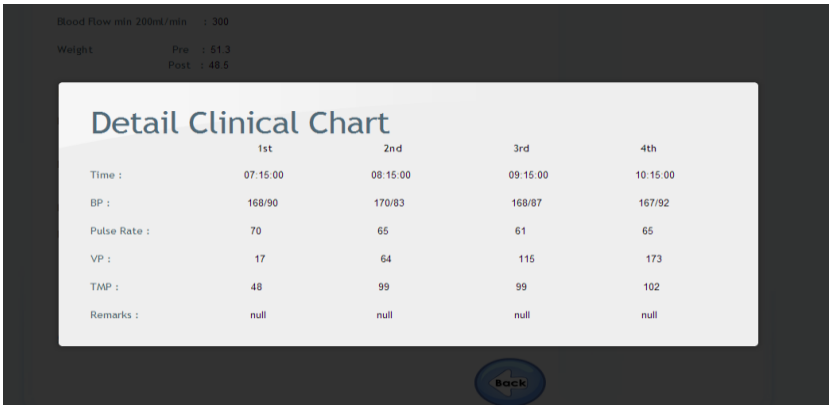
Expected Result	1. When the dialysis patient login into the system, it will appear the home page for patient. The patient clicks on “More” at the Medical Report icon to enter the medical page. 2. The patient clicks on the Additional Medical Report link to view all the Medical Records based on the date and report title. 3. The patient clicks on the Click for Detail link to have more detail on the particular report.
Actual Result	1. The patient login into the system. The patient clicked on the “More” button at the Medical Report icon to enter the medical page. 2. The patient clicked on the Additional Medical Report link to view all the medical report based on the date and report title. 3. The patient clicked on the Click for Detail link to view the detail on the particular report.
Pass/Fail	Pass

Test case	To view a patient’s Haemodialysis Prescription by a dialysis patient.
Test Performed	Steps: 1. Login to the system by using the patient’s id and password to enter the patient view main page. 2. Click on the “More” at the Medical Record icon at the main page. 

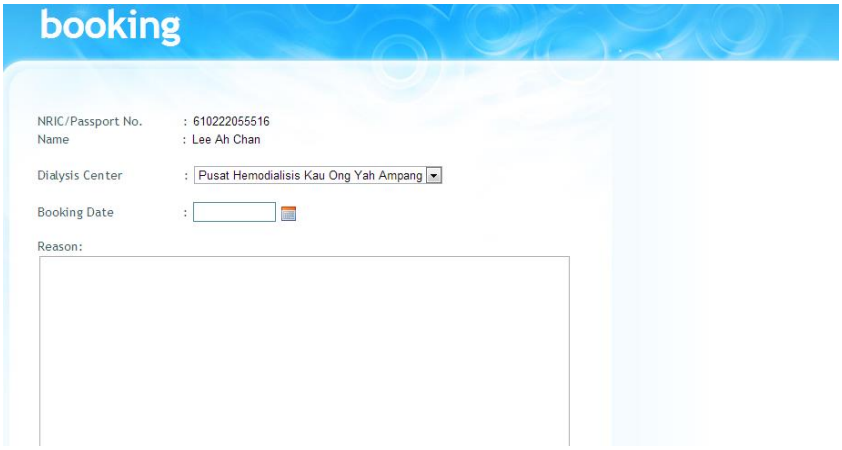
	3. Click on Haemodialysis Prescription to view the patient's haemodialysis prescription report. 
Expected Result	1. When the dialysis patient login into the system, it will appear the home page for patient. The patient clicks on "More" at the Medical Report icon to enter the medical page. 2. The patient clicks on the Haemodialysis Prescription link to view all the Haemodialysis Prescription report of the patient.
Actual Result	1. The patient login into the system. The patient clicked on the "More" button at the Medical Report icon to enter the medical page. 2. The patient clicked on the Haemodialysis Prescription link to view all the Haemodialysis Prescription of the patient.
Pass/Fail	Pass

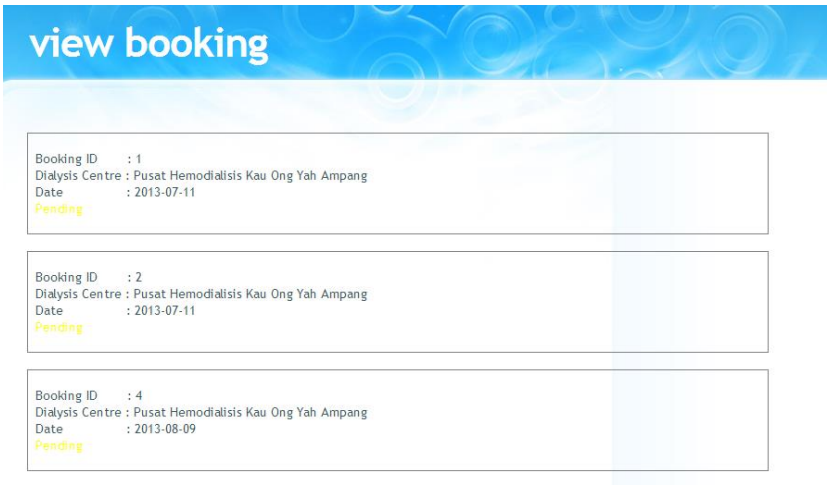
Test case	To view a patient's Haemodialysis Prescription by a dialysis patient.
Test Performed	Steps: 1. Login to the system by using the patient's id and password to enter the patient view main page. 2. Click on the "More" at the Medical Record icon at the main page.  3. Click on Clinical Summary to view the patient's Clinical Summary report. 
Expected Result	1. When the dialysis patient login into the system, it will appear the home page for patient. The patient clicks on "More" at the Medical Report icon to enter the medical page. 2. The patient clicks on the Clinical Summary link to view all the Clinical Summary report of the patient.

Actual Result	1. The patient login into the system. The patient clicked on the "More" button at the Medical Report icon to enter the medical page. 2. The patient clicked on the Clinical Summary link to view all the Clinical Summary of the patient.
Pass/Fail	Pass

Test case	To view a patient's Dialysis Record by a dialysis patient.
Test Performed	Steps: 1. Login to the system by using the patient's id and password to enter the patient view main page. 2. Click on the "More" at the Dialysis Record icon at the main page. The system will show all the dialysis record based on the date.  3. Click on the "Date" link to have more detail on the particular report. 

Expected Result	1. When the dialysis patient login into the system, it will appear the home page for patient. The patient clicks on "More" at the Dialysis Record icon to enter the dialysis record page. 2. The patient clicks on the date to have more detail on the particular report.
Actual Result	1. The patient login into the system. The patient clicked on the "More" button at the Dialysis Record icon to enter the dialysis record page. 2. The patient clicked on the date to have more detail on the particular report.
Pass/Fail	Pass

Test case	To view a booking status and make booking by a dialysis patient.
Test Performed	Steps: 1. Login to the system by using the patient's id and password to enter the patient view main page. 2. Click on the "More" at the Booking icon at the main page. Select the desire dialysis centre and date that the patient wants to visit as well as valid reason. 

	3. Click on view booking button to view all the booking status. 
Expected Result	1. When the dialysis patient login into the system, it will appear the home page for patient. The patient clicks on "More" at the Booking icon to enter the booking page. 2. The patient enters the desire dialysis centre and date with a valid reason. 3. The patient clicks the "View Booking" button to view all his booking status.
Actual Result	1. The patient login into the system. The patient clicked on the "More" button at the Booking icon to enter the booking page. 2. The patient entered the desire dialysis centre and date with a valid reason. 3. The patient clicked the "View Booking" button to view all his booking status.
Pass/Fail	Pass

Functional testing is being done after unit testing and integration testing. During the functional testing, the dialysis center page and the patient page are being tested in order to make sure that all the requirements are being fulfilled and are function well. The system is being tested and the system is confirmed that it fulfills the users' requirements and scopes.

6.5 Acceptance Testing

Acceptance testing is a formal testing that is conducted by the user or customer to determine whether the system satisfies its acceptance criteria and allow the customer to make decision whether to accept the system, explained by IEEE Standard Glossary of Software Engineering Terminology (1990).

During the acceptance testing, the system is delivered and tested by the customers. The customers of the system are the dialysis centre's staff and dialysis patient. These customers are not trained software tester and runs black box acceptance based on their expectation on the system. After the customers tested the system, a questionnaire is given to them to receive the feedback from the customers.

Based on the result of the questionnaire, customers are very satisfied with the system developed. They gave a very good and positive feedback to the system. This system has fulfilled their requirements as well as the main objectives of this system which is data searching, data storing, updating data and facilitate booking services. In term of ease to use of the system, most of the customers in a opinion that the system is easy to use but there is some customers have a perception that it is not easy due to this group of customers are lack of IT knowledge. They hope that this system can be further improved in order to provide more functionality to the dialysis centres as well as the patient.

The system is being tested and the system is satisfied by the users and is ready to be delivered to the users.

6.6 Conclusion

Testing Type	**Opacity**	**Person who do the testing**
Unit Testing	White box	Programmers
Integration Testing	White box and black box	Programmers
Functional Testing	Black box	Programmers
Acceptance Test	Black box	Users / Customers (dialysis center and dialysis patient)

Table 16 : Table of Testing

It is important to perform testing for the system before the system is delivered to the customers. This process is to ensure that the system is fulfilling the requirement and the satisfaction of the customers. Besides that, it is also a way to fix the bugs and errors of the system. Hence, this testing is to ensure that the system works as expected and satisfy the customers' needs and requirements. From the test result, it shown that the test for each module is passed and accepted.

CHAPTER 7

CONCLUSION AND RECOMMENDATION

7.1 Introduction

In the previous chapter, all the information regarding to the system has been discussed. The information about the objective, problem states, scope, related projects, design, implementation and testing are all explained in detail during the previous chapter. Hence, this chapter will give a brief discussion on the overall of the project.

This chapter will mainly discuss on the contribution of the projects, limitation and future implementation of this Dialysis Data Management System.

7.2 Contribution of the Projects

The main concern about this project is to facilitate the dialysis patients to manage their own dialysis data. Currently in Malaysia do not have any system to allow the dialysis patients to manage their own information together with the dialysis centres. Hence, wherever the dialysis patients are travel, they are required to request for the latest patient's documentation from the patient's dialysis centre to send their document through email or fax.

There is a true story that told by one of the customer during development of this project. There was a case that the dialysis patient at Selangor is required to travel to Johor for a month, so the patient requested the dialysis centre to send the latest patient's documentation to the dialysis centre at Johor. Hence, the dialysis centre that located at Selangor tried to fax and email to the dialysis centre at Johor but failed. Due to the time constraint, the dialysis centre had no choice but to courier the document to the dialysis centre at Johor branch. This is kind of troublesome for the dialysis centres as well as the patients.

This system also facilitates in booking services for the dialysis centres and the patients. They do not need to call for the dialysis centre to check for booking but they can make booking just by one click and wait the confirmation of booking from the dialysis centres.

Due to the advancement of the technology, many things can be simplified and easy with the use of technology. Besides that, this system not only decreases the dialysis centres' paper work and the use of papers but also make their life easier in managing the patients' data. On the other hand, in the patients' point of view, every data and information is in the patients' hand. They have their own data wherever they go. Besides that, the patients also able to make booking and send their information to the desire dialysis centre easily with the use of this system.

7.3 Limitation of the System

Due to time constraint, there are many parts of the system are needed to be improved in order to provide the dialysis centres and the patients a perfect system. The limitations of the system are:

- The security is not strong to protect the patients' information.
- Every dialysis centres need to have account in the system in order to fully utilizes the function of the system.

- Some information displayed need to be organized in a better way to provide a better view.

7.4 Future Implementation

For the future implementation, more functionality is needed to be included into the system in order to make the system as an all rounded system. Currently, the system only concern in managing the patients' data and booking. The dialysis centre was requested to make the system to be connected with the dialysis machine so that it can automatically update the system without the need of the user to key in the record manually. Besides that, the dialysis centres also requested the system to be able to include the billing system to manage the dialysis patients' bills.

Other than that, the security of the system can be improved by sending a notification SMS to the patient to provide an additional security in managing the patients' data. This system is managing of the patients' information. Hence, it is consisting of many privates and confidential information therefore the security is another main concern in this system.

Lastly, the organisation of the information displayed is needed to be improved in order to provide a better way to present the information to the users. Besides that, the system input is also need to be improved so that less input is required by the users.

7.5 Conclusion

Last but not least, the main objective of this system is to facilitate the dialysis centres and dialysis patients to managing their data. The main objective of the system is fulfilled and the system is getting a very good and positive feedback from the users in the way of managing the patient data, less paper work, and eco-friendly due to less paper is required by using the system. Hence, this system can have further improvement in order to make the system to be an all rounded system that can facilitate the users as much as possible.

REFERENCES

Baxter. (2013) Dialysis Options.*Baxter* [Online].Available at http://www.baxterhealthcare.com.au/patients_and_caregivers/areas_of_expertise/renal/treatment_options.html.Accessed on 4th April 2013, 4:15pm.

Berns, J.S. (2013) Patient information: Hemodialysis (Beyond the Basics). *Up To Date*. [Online].Available at http://www.uptodate.com/contents/hemodialysis-beyond-the-basics.Accessed on 4th April 2013, 3:10pm.

Bradley Mitchell(n.d.). Apache [Online].Available at http://compnetworking.about.com/cs/webservers/g/bldef_apache.htm.Accessed on 22nd Jun 2013, 12.30 pm.

Chien-Hung Liu (2004) Data flow analysis and testing of Java Server Pages.Computer Software and Applications Conference, 2004. Compsac 2004.Proceedings of the 28th Annual International.Vol.2 [Online].Available at http://ieeexplore.ieee.org.libezp.utar.edu.my/stamp/stamp.jsp?tp=&arnumber=1342689.Accessed on 21st Jun 2013, 1.00 p.m.

Christopher Heng (2010). What is MySQL? What is Database? What is SQL? [Online].Available at http://www.thesitewizard.com/faqs/what-is-mysql-database.shtml.Accessed on 22nd Jun 2013. 11.00a.m

Connolly, T. and Begg, C. (2010) Database Systems: A Practical Approach To Design, Implementation, and Management. Fifth Edition. Pearson.

Core Partners Inc (n.d.). Software Engineering and Professional Services [Online]. Available at http://www.corepartners.com/. Accessed on 18th May 2013. 11.30a.m..

Dalisay, .M (2013). Scalable and Rapid Application Developmet Using Grails [Online]. Available at http://www.codeofaninja.com/2013/07/scalable-and-rad-development-grails.html. Accessed on 22nd June 2013. 10.10a.m.

Debray, T. (2012). Php vs Asp.net [Online]. Available at http://www.researchgate.net/post/Php_vs_Aspnet. Accessed on 12 July 2013. 10.00am.

Edraw (2004) [Online]. Flow Chart. Available at http://www.edrawsoft.com/Flowchart-Definition.php.Accessed on 21st Jun 2013, 12.00 pm.

Fresenius Medical Care. (2012) Therapy Data Management System.*Fresenius Medical Care.*[Online].Available at http://russia.fmc-ag.com/files/Br_TDMS-09.09_GB_w.pdf.Accessed on 2nd April 2013, 12:45pm.

Fresenius Medical Care. (2012) Therapy Data Management System.*Fresenius Medical Care.*[Online].Available athttp://www.fmc-ag.se/files/TDMS_-_Therapy_Data_Management_System.pdf.Accessed on 14th April 2013, 8.30pm.

Gambro.(2011) Dialysis Data Management Tool.*Gambro.*[Online].Available at http://www.gambro.com/PageFiles/7447/HCEN1292_4_Exalis_%20Dialysis%20Data%20Management%20Tool.pdf?epslanguage=en.Accessed on 4th April 2013, 5:15pm.

GJI (2011). GJI Pty Ltd. Available at http://www.gji.com.au/news/article/get-control-of-your-data-with-icentral/ Accessed on 19nd Aug 2013. 11.00a.m.

GJI (2013). Data centralised system by GJI Pty Ltd. Available at http://www.gji.com.au/news/article/get-control-of-your-data-with-icentral/. Accessed on 20nd May 2013. 10.00a.m.

Govardhan, A. and Nabil Mohammed Ali Munassar. (2010) A Comparison Between Five Models of Software Engineering. *International Journal of Computer Science Issues, Vol. 7, Issue 5* [Online].Available at http://www.ijcsi.org/papers/7-5-94-101.pdf.Accessed on 7th April 2013, 10:30am.

Heeks, R. (1999) Centralised vs. Decentralised Management of Public Information Systems: A Core-Periphery Solution. *School of Environment and Development, The University of Manchester.*[Online].Available at http://www.sed.manchester.ac.uk/idpm/research/publications/wp/igovernment/documents/igov_wp07.pdf.Accessed on 3rd April 2013, 10:45am.

Hughes Systique (n.d.). Agile Model [Online]. Available at http://www.hsc.com/tabid/69/Default.aspx. Accessed on 20nd Aug 2013. 11.00a.m.

Java (2013). Java Server Pages [Online]. Available at http://www.java.com/en/. Accessed on 20nd Aug 2013. 10.10a.m.

Lim, T.O, Lee, D.G and Morad,Z. (2000) Provision of Dialysis in Malaysia. *Med J Malaysia 2000,* 55, pp.188-195 [Online]. Available at http://www.crc.gov.my/documents/Journal/ProvisionOfDialysis.pdf.Accessed on 5th April 2013, 11:25am.

Malaysian Society Nephrology (2011).19th Report of the Malaysian Dialysis and Transplant Registry 2011[Online]. Available at http://msn.org.my/fwbPagePublic.jsp?fwbPageId=pMdtr2011. Accessed on 21st June 2013 10.30a.m.

Malaysian Society of Nephrology.(2011) 19th Report of the Malaysian Dialysis and Transplant Registry 2011.*Malaysian Society of Nephrology.*[Online].Available at http://msn.org.my/fwbPagePublic.jsp?fwbPageId=pMdtr2011.Accessed on 2nd April 2013, 4:25pm.

Martin. J (1991). Rapid Application Development. Macmillan Coll Div.

Microsoft Developer Network (n.d.). Active Server Pages [Online].Available at http://msdn.microsoft.com/en-us/library/aa286483.aspx.Accessed on 21st Jun 2013. 1.30 pm.

Microsoft(2013).ASP.net [Online]. Available at http://www.asp.net. Accessed on 20nd Aug 2013. 10.00a.m.

Ministry of Health. (2001) Guidelines for private healthcare institutions providing renal Dialysis: - regulation 4 of the private hospitals and medical Clinics regulations. *Guidelines for Renal Dialysis Centres* [Online].Available at https://www.moh-ela.gov.sg/ela/content/sps_institutions_providing_renal_dialysis_guidelines.pdf.Accessed on 6th April 2013, 1:25pm.

Ministry of Health. (2012). Haemodialysis Quality And Standards: - Infection Control Measures. *Haemodialysis Quality And Standards* [Online]. Available at http://www.moh.gov.my/images/gallery/Garispanduan/Haemodialysis_Quality_Standards.pdf.Accessed on 6th April 2013, 2:45pm.

Narendra Kumar Rao.B. , Rama Mohan Reddy. A, Ravi.k (2011).Level Dependencies of Individual Entities in Random Unit Testing of Structured Code.IEEE Xplore [Online].Available at http://ieeexplore.ieee.org.libezp.utar.edu.my/stamp/stamp.jsp?tp=&arnumber=5942086&tag=1.Accessed on 24th Jun 2013. 12.00 pm.

National Kidney Foundation (2013). Diabetes and Kidney Disease [Online]. Available at http://www.kidney.org/atoz/content/diabetes.cfm. Accessed on 19th May 2013. 11.30a.m..

National Renal Registry(2003). 11th Report of The Malaysian Dialysis & Transparent Registry 2003 [Online]. Available at http://www.msn.org.my/Doc/PublicDoc_PB/Publication/nrr_report2003/NRR11report.pdf . Accessed on 20nd Aug 2013. 11.00a.m..

NC DENR System Development Life Cycle Methodology.(1999) Section 6 – Rapid Application Development Method [Online].Available at http://portal.ncdenr.org/c/document_library/get_file?uuid=60ae8525-cf9f-417c-83d9-90d45f726520&groupId=17979.Accessed on 7th April 2013, 11:30am.

Peterson, K., Wohlin, C. and Dejan Baca. (2009) The Waterfall Model in Large-Scale Development. *PROFES 2009*,LNBIP 32 pp.386 - 400 [Online]. Available at http://www.bth.se/fou/forskinfo.nsf/0/fc0d54aeea5cb8d7c12575c8005fc9d6/$file/00320386.pdf . Accessed on 7th April 2013, 10:00am.

Php.net (n.d.). What is PHP? [Online].Available at http://php.net/manual/en/intro-whatis.php.Accessed on 21st Jun 2013. 2.00p.m.

Php.net(2013). PHP [Online]. Available at http://www.php.net/. Accessed on 20nd Aug 2013. 10.20a.m.

Rouse, M. (2005). JavaScript [Online]. Available at http://searchsoa.techtarget.com/definition/JavaScript . Accessed on 22nd Jun 2013, 12.00 pm.

Rouse, M. (2005). Site map [Online]. Available at http://searchsoa.techtarget.com/definition/site-map. Accessed on 23th Jun 2013,10.00 am.

Rouse, M. (2005). HTML (HypertextMarkup Language) [Online]. Available at http://searchsoa.techtarget.com/definition/HTML .Accessed on 21st Jun 2013, 3.00 pm.

Rouse, M. (2005). Site map [Online]. Available at http://searchsoftwarequality.techtarget.com/definition/systems-development-life-cycle. Accessed on 23th Jun 2013,10.00 am.

Rouse, M. (2007). Use Case[Online]. Available at http://searchsoftwarequality.techtarget.com/definition/use-case.Accessed on 21st Jun 2013, 11.35am.

Sheetal Sharma, Darothi Sarkar and Divya Gupta. (2012) Agile Processes and Methodologies: A Conceptual Study. *International Journal of Computer Science Issues, Vol. 4, No.5* [Online].Available at http://www.enggjournals.com/ijcse/doc/IJCSE12-04-05-186.pdf.Accessed on 7th April 2013, 10:45am.

Sommerville, I. (2004). Software Engineering,7th edn. Person Education Ltd., London. Available at http://www.bth.se/fou/forskinfo.nsf/0/fc0d54aeea5cb8d7c12575c8005fc9d6/$file/00320386.pdf. Accessed on 20nd Aug 2013. 11.00a.m.

The Institute of Electrical and Electronics Engineers (1990). IEEE Standard Glosaary of Software Engineering Terminology.IEEEXplore[Online]. Available at http://ieeexplore.ieee.org.libezp.utar.edu.my/stamp/stamp.jsp?tp=&arnumber=159342 .Accessed on 10 August 2013 12.00pm.

The Star.(2013) 'Pushing for more dialysis clinics'. 20 February 2013, p. 14.

Vishnu Sharma. (n.d.) Waterfall Model and Spiral Model [Online].Available at http://examengineinfo.airinsoft.in/UploadTutorialFiles/MIS_waterfall%20and%20spiral%20model.pdf .Accessed on 7th April 2013, 10:15am.

W3Schools.com (n.d.). CSS Introduction [Online].Available at http://www.w3schools.com/css/css_intro.asp.Accessed on 22nd June 2013. 10.00a.m.