City University of Hong Kong
Department of Computer Science

BSCCS Final Year Project 2014-2015
Interim Report I

(14CS079)

Chinese Medicine Clinic Management System

(Volume 1 of 1)

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1. Introduction

1.1. Background Information

Healthcare services is one of the essential elements of our life in modern society. Healthcare services are not only including those treating our diseases and repairing our body, they also include those keeping our body in a healthy status and maintaining the systems in our bodies work well. The majority of Hongkongers may have a concept that Western Medicine relieves symptoms for short-term or immediate effect while Traditional Chinese Medicine (TCM) restores the harmony of different parts of our body and keep us healthy in the long run.

Nowadays, staying healthy is one of the hot topics in the city. In addition to the aging problem in Hong Kong, more and more concerns about diseases associated with old age and weakened systems in bodies are being emphasized on. It is claimed in one of the World Health Organization's Commission on Intellectual Property Rights, Innovation and Public Health Studies that spreading TCM to all the places on the Earth is beneficial for people's health (Jia, n.d.). From this, we can see the status of TCM keep rising all over the world. Thus, the attentions on TCM and the needs of TCM are increasing.

1.2. Existing Problems

In Hong Kong, no matter what kind of healthcare services settings, TCM or Modern Western Medicine, it is all about consultation, medication, treatments and procedures. These activities are followed by two common tasks, which are record generation and documentation. As the population in Hong Kong keeps growing (Census and Statistics Department, 2014), the number of attendance of healthcare services will greatly increases. As the amount of patient increases, the number of records produced will also increase exponentially. Unfortunately, for clinics, these records are in written form, which means all these records are in hardcopies. When their businesses just

start up, it might be still able to keep and manage few hundreds piles of health records. When their clinics run for years, as more patients have been cured, it may be difficult for clinics to find and manage thousands decks of patient profiles. It may also be a problem for storing such huge amount of hardcopy paper records in a clinic as the size for clinics is usually small and rental fee is high.

In this situation, information technology can help. For Modern Western Medicine, there are plenty of solutions for clinical management and the majority of clinics and hospitals have adopt these solutions. For government Western Medicine clinics and hospitals, they all use the Hospital Authority (HA) in-house developed Clinical Management System (Hospital Authority, 2014). For private clinics, they adopted some popular solutions like The Hong Kong Medical Association's CMS 3.0 (Food and Health Bureau, 2014). For Hospital Authority running TCM clinics, most of them are using the in-house developed system, Chinese Medicine Information System (Health, Welfare and Food Bureau, & Hospital Authority, 2007; Hospital Authority, 2011). However, for private Traditional Chinese Medicine clinics, they seem to be not following the trend to have a commonly adopted solution. There are less than a half of practitioners in Hong Kong are using IT facilities for their work and only a half of them are satisfied with the current system (eHealth Consortium Limited, 2010).

1.3. Motivation

There are some major reasons behind that TCM practitioners do not adopt Information Technology solutions.

First, there may not have enough systems, which can be chosen, in the market (eHealth Consortium Limited, 2009). This may increase the difficulties to find the best solution. For example, considering a clinic which only provide consultation services, but not dispensary and sales services and only clinical and sales integrated systems are available in the market. It may not fit the

business of the clinic. Thus, the clinic would probably refuses to adopt the solutions.

Second, the solution cost is expensive or cost ineffective (eHealth Consortium Limited, 2010). Like the case mentioned above, the sale management part is not necessary for the clinic. The solution is actually charging the clinic for some unwanted elements. The clinic may consider that the software is not cost effective. What is more, if the cost of the system outweighs the profit or even the benefits they get, this would makes the TCM practitioners hesitate those solutions.

Third, there is no standard being widely used in the industry for the terminologies used at this moment (Food and Health Bureau, 2014) and practices for different doctors may vary (eHealth Consortium Limited, 2010). This would causes inconvenience to users for changing their daily routines and mindset if the system being used does not provide flexibility to do a certain degree of customization.

Fourth, as told by some existing system users, functions and business rules implemented in existing systems may not be useful or may even hinder their work. For example, if the doctor prescribes an herb with dosage larger than the suggested dosage stated in the system, the system will block the doctor from exercising their professional judgment for prescribing the recipe. This would lead to change of treatment and use a suboptimal recipe for the patient.

Fifth, some senior doctors may not be able to type Chinese characters in an acceptable speed or even cannot type Chinese. If the system requires users to type a lot for making prescription and entering history, this would discourage the doctors to use the solution.

Therefore, a system which incorporates more knowledge of the business domain and can be run under acceptable cost is needed.

1.4. Project Objectives and Scope

In Hong Kong, there are different scales of business regarding TCM clinics, from single doctor clinic for consultations only to clinics run by healthcare corporate with multiple doctors on duty at a time and dispensary with self-owned supply chain. In order to fit as much types of business as the system can, the system will only handle clinical and medication records part. For sales and dispensary part, it will be the deliverable of AU-YEUNG Wing Shing's final year project (Project Code: 14CS078). When combining the two systems together, it can form an integrated clinic information system.

In this project, a system that can help users with their daily jobs will be developed. The system should be possesses with some basic functions including patient administration, medical record management and documents generation functions. In order to keep the system can be run at low cost, the tools chosen would be freeware. In order to solve the problem raised by no widely adopted standard for terminology used in the industry, the system should allow a certain degree of customization to fit different users. Furthermore, this system would not stop the user for exercising professional decision. Once suspected decision errors and abnormal situations happens, the system will remind or warn the user instead of stops the action like the case mentioned in Section 1.3 point four. Concerning the Chinese typing ability of users, this system would minimize the chance of using word-typing input.

In the development process, opinions and suggestions from potential users will be received so ad to optimize the system for practical use.

Concerns of Internet security will not be addressed in this project and adoption of basic existing measure remain, i.e. anti-virus and firewall software.

2. Literature Review

In Hong Kong, information technology solutions has been used for daily operation in healthcare sector for a period of time. Just take the example of Hospital Authority, they use their in-house developed Clinical Management Systems since 1995 (Hospital Authority, 2014). It has been run for nearly 20 years. There may be some features or design that can be learnt for this project. In the market, there are also some solutions for Traditional Chinese Medicine practitioners. However, it is not popular among the industry. From them, we can know what is unfavorable by the users. Thus, a solution that can be applied to various situations can be developed. The following are some related solutions that have been studied.

2.1. HA Clinical Management System

Hospital Authority's Clinical Management System (HA CMS) is an important system in the HA. It is used by nearly all the HA clinicians providing healthcare services (Hospital Authority, 2011). It is provides a system for clinicians to access and create patient records within or outside itself (Solomon, 2008).

HA CMS in phase III development to enhance its function and features providing in the existing system in order to help the HA to provide services with high quality, less errors and high efficiency (Hospital Authority, 2011). In this sophisticated system, it provides drug allergy checking function (Hospital Authority, 2013) and this might also be useful in Chinese Medicine setting. However, some clinicians may find that the system's user interface keep changing frequently and they cannot adapt to the updated system easily. Thus, it may lead to errors due to clicking the wrong buttons.

2.2. HA Chinese Medicine Information

System

Hospital Authority's Chinese Medicine Information System (CMIS) is the information technology solution adopted by Chinese Medicine Centers for Training and Research (CMCTRs) (Hospital Authority, 2011). According to Leung et al. (2012), it is an integrated system in-house developed by HA for helping clinicians with their daily tasks and sharing data among clinics. Furthermore, it also serves for data collection for researches and studies.

CMIS has implemented functions facilitate all aspects in the daily workflow. For instance, herb-herb interaction and dosage checking functions have been implemented in order to increase the quality and safety of services provided by reducing human errors due to carelessness. What is more, CMIS seems to be the first system developed for Hong Kong TCM industry enforcing a terminology standard. Besides, advanced functions like monitoring the suspected outbreak of infectious diseases also provided in the system which can help in administration-level staff's work. In order to keep the services quality improving, Key Performance Indicators also implemented in CMIS. As this system is centralized, it can launch policies or standards like International Classification of Diseases 11th Revision (ICD-11) which is going to be release by 2017 (World Health Organization, 2014) with ease. It may be the most comprehensive and useful system that suits corporate level healthcare services providers.

However, there is quite a few number of clinics are in such a large scale. Most of TCM clinics are small to medium enterprise level. Those surveillance and performance monitoring function may not be useful to those common clinics and these functions may requires a large amount of resources, thus increase the cost. From a LegCo document, over five million of Hong Kong dollars were used for the implementation of CMIS in five CMCTRs (Health, Welfare and Food Bureau, & Hospital Authority, 2007), i.e. over one million per clinic. This huge amount of budget seems not affordable by those common clinics.

2.3. KT Chinese Medical Integration System

KT Chinese Medical Integration System (in Chinese: 國泰中醫整合系統) is a system developed in Taiwan. This system is being used by some clinics in Hong Kong. According to the website (國泰電腦有限公司, &國圓科技股份有限公司, n.d.), it is an all-in-one system which can support a whole workflow in clinics, including consultation, drug dispense, point-of-sales and clinicians roster scheduling. It supports varies well-known database systems with different performance, from MySQL to Oracle and Informix. This system can also connect with peripheral systems like queue number calling system which can make the clinic looks modern and give their client more confidence on their service.

This system may be suitable to some large clinic in Hong Kong as it possesses with a queuing system and also have the ability to cooperate with other peripheral systems. However, as this system is developed based on Taiwan's TCM industry, some of the functions implemented in the system may not be useful in Hong Kong or even tailor-made for Taiwanese.

2.4. Clinic Management System by ONE-POS

The TCM clinic management system developed by ONE-POS is called 中醫診所管理系統. It is a Hong Kong local developed system. It provides users with patient administration, health record management and point-of-sales functions (IT Force (Hong Kong) Limited, 2014). Based on the functions provided, the system might fit a lot of clinics in Hong Kong. However, from the screen capture provided in the website (IT Force (Hong Kong) Ltd., 2014), it seems mixed the domain of sales and TCM clinics. The functions buttons of the two

domains mixed in one panel and this would make the user confused. From the user interface captured, it seems requires a lot of word typing for entering the diagnosis and health records. Since doctors, especially those experienced, may not familiar with word typing and thus cannot use the system.

2.5. Summary

In the systems developed by Hospital Authority, both of them possess with a common type feature, which is drug checking. This drug checking function include the checking of drug compatibility and patient allergy history. The HA implement this kind of function in both systems, which may indicate that the function could probably reduce prescription faults due to carelessness. Therefore, this function can be considered to implement in this project.

For the problem of frequently changing user interfaces, this problem may be able to solve by changes on-demands. The layout or order of permissible options will only be changed when the user wants to change the order.

Consider the business domain mixing problems, this would be solve by separating the domains by two systems, like the system to be develop in this project only focus on clinical part and the one to be develop by AU-YEUNG's will be focusing on pharmacy and sale part.

3. Technology and Tools Reviews

3.1. Application Type

In business setting, most commonly used devices should be personal computers. Most of these computers are using Windows as their operating systems (Net Application.com, 2014). Thus, applications used on these computers mainly three types, Windows applications, Java applications and web applications. However, Java applications run on Java Virtual Machine which requires more resources and may not be able to run on slow or old computers. Therefore, in this project, only Windows application or web application will be considered as type of the application.

3.1.1. Windows Application

Windows application for this system will mainly consist of two parts, client application and server. The server is the connected database. For Windows application, developers can use .NET framework for the development. With the frameworks, useful libraries provided allow programmers to develop the system with nice graphical user interface easily. However, Windows applications can only be run of Windows, thus limited the user scope on Windows users.

3.1.2. Web Application

Web application for this system will mainly make up of three parts, web browser, web server and database. This type of application can provide a cross platform feature. However, the user interface is rendered by the web browser and different browser or even different version of browser may have different behavior on the same coding. This may trigger some abnormal behavior of objects on the user interface and increase the degree of difficulty on development.

3.1.3. Conclusion

Windows application would be chosen for this system. The system should be stable enough for users to use. It should not depends on third-party software too much as defects in those software will let the errors propagates to the system to be developed, thus decrease the confidence of using the system. Web application depends on web browser while Windows application not. Furthermore, Web application rely on two remote components, web server and database while Windows application only depends on one, which is database. The system to be developed is target for small to middle size clinics and they usually do not have much budget to have back-up or stand-by server for them. Thus, one of this component fails will lead to the system collapse. Also, the network condition may affect the performance in data transfer. More remote components, higher the chance of data transfer. Relying on more remote component may decrease the reliability of the system. Therefore, Windows application in client server model may be more suitable for this project.

3.2. Reporting tools

In the system going to be developed, it possesses with document generation and reporting functions. A reporting tool can help doing these job well with ease. In this project, JasperReports and Crystal Reports will be considered as the writer is more familiar with.

3.2.1. JasperReports

According to Jaspersoft Community (TIBCO Software, Inc., 2014), JasperReport is one of the popular open source reporting engines. It is written in Java and able to use different kinds of data source. The generated documents can be print or exported to different format including PDF.

3.2.2. Crystal Reports for Visual Studio

Crystal Report is a well-known commercial tool for reporting. According to its

official webpage (SAP, n.d.), it provides a developer version for Visual Studio development environment for free with some restriction on profit making. Developers can design the report layout under the Visual Studio environment and deploy and sell the product without putting extra charges on the client. However, the reports or documents generated requires a freeware, Crystal Reports Viewer, to view and print the reports.

3.2.3. Conclusion

Crystal Reports for Visual Studio will be chosen as the client application will be a Windows application and will use Visual Studio as the integrated development environment. Also, the application will not use Java as the programming language, if JasperReports is chosen, extra container and engine will be needed and which the setup is tedious. Therefore, Crystal Reports for Visual Studio would be better for this project.

4. Preliminary System and Design

4.1. System Overview

The clinic management system will consist of two client applications and a supporting database. The two client applications are used by doctors and patients respectively. The one for doctor will provide all the functions stated in the next section, System Function and Features, while the one for patient will only provide patient registration, queuing, and changing personal information functions. The system will still function with or without the client application for patient.

4.2. System Function and Features

The main functions of the system are as follows.

Basic functions:

- Patient registration / queuing
- Consultation Booking
- Input medical records
- Make prescription
- View patient medical history
- Document generation
  - Prescription
  - sick leave certificate
  - medical history report
- Administration
  - add/delete users
  - add/delete drug items
  - change user information
  - change drug data

Advanced functions:

- Suspected overdose alert
- Drug allergy alert
- Incompatible drug alert

- Customization
  - Each user can customize their own display name of drug on the drug list
  - Each user can order the items on the drug list and diagnosis list according to the using frequencies
  - Each user can customize the list of diagnosis description, i.e. add their own item on the list
- Analysis and Reporting
  - Analysis on drug using within a designated period of time
  - Analysis on episode diagnosis within a designated period of time
  - Report on no. of cases followed by each within a designated period of time

Value-added function (co-operate with AU-YEUNG's project):

- Drug reservation
- Drug availability checking

4.3. Use Case Diagram

The following is the use case diagram for this system which can provides a preliminary understanding and a better overview of functions that the system intended to provide.

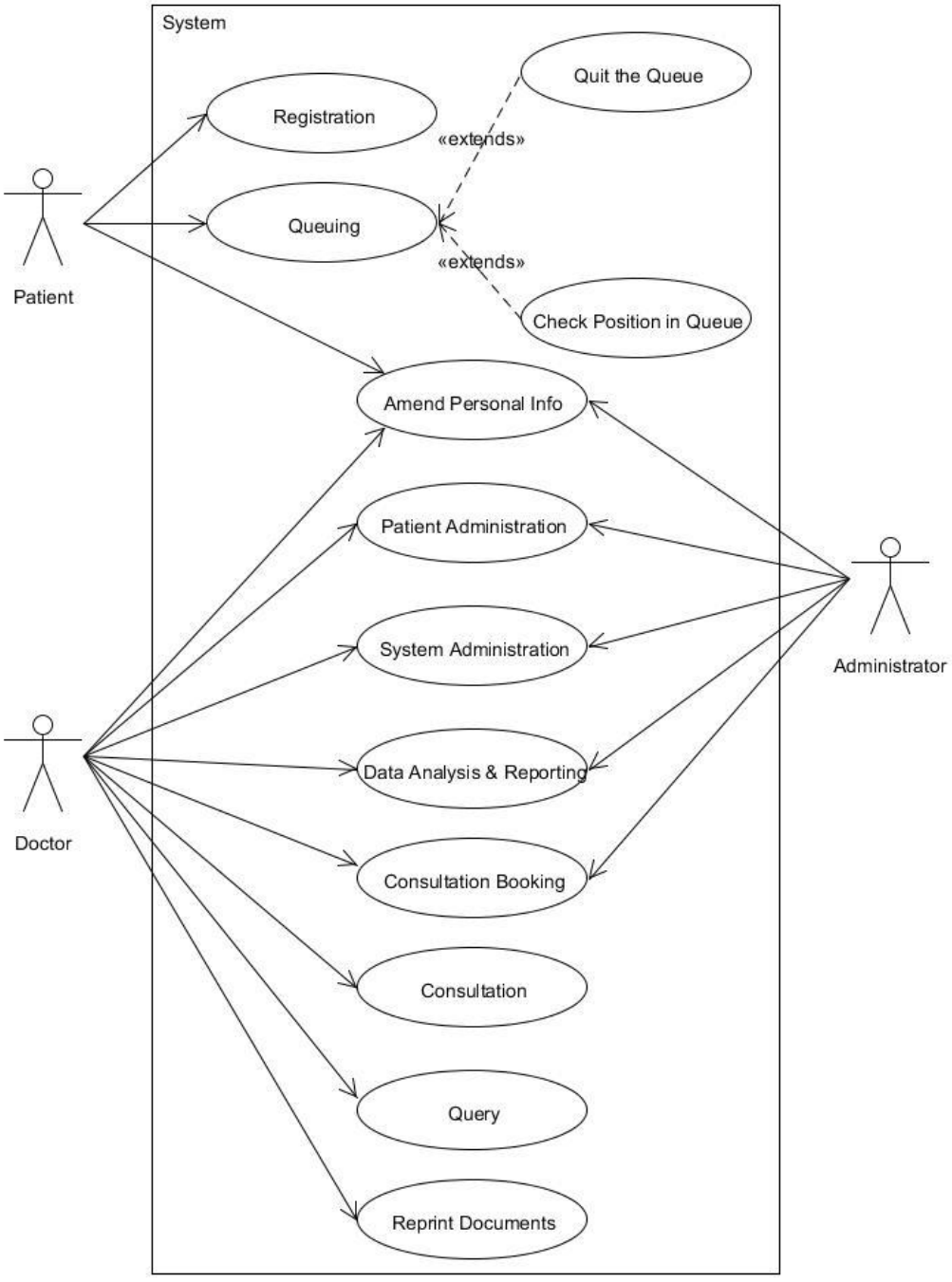

Fig 4.1 Preliminary Use Case Diagram

4.4. Functional Requirement

4.4.1. Registration

This function allows new patient to register a patient record for receiving services. It allows patients to enter their personal particulars such as name, gender, birthday, Hong Kong Identity Card (HKID) or Passport number, contact phone number and account password. If the patient have known drug allergy or have special genetic condition like Glucose-6-phosphate dehydrogenase deficiency (G6PD, in Chinese layman term: 蠶豆症) and need to avoid using certain drugs, the information also can be specified within this function. Personal particulars will be validated before recorded in the database. If the record is created successfully, Patient ID generated from the system will be shown on the screen.

4.4.2. Queuing

For using this function, the user must be an existing patient in the system, i.e. have a patient record created by using the registration or created by doctor user or administrator. Patient can find their record by using Patient ID, contact phone number and/or HKID/Passport number. If more than one records found, the program will ask the patient to choose the correct record. For clinic with more than one doctors on duty, the system will allow the patient to choose at least one doctor he/she would like to see. Then, the system will request the patient to enter the password for identity confirmation. Once confirmed, the patient will be in the queue.

4.4.3. Quit the Queue

For using this function, the patient should be in the queue. If the patient do not want to see doctor suddenly when queuing, he/she can look up the queuing record by patient ID, contact phone number and/or HKID/Passport number and enter password to confirm and leave the queue.

4.4.4. Check Position in Queue

For using this function, the patient should be in the queue. Patients can use his/her patient ID, contact phone number and/or HKID/Passport number to query their position in the queue.

4.4.5. Amend Personal Information

For all users, they can change their own personal particulars and password in this function.

4.4.6. Patient Administration

This function is for doctors and administrators only. This function allow users to create patient records, change patient information, add patient to the waiting queue and schedule a consultation booking.

4.4.7. System Administration

This function is for doctors and administrators only.

Doctors can customize drug display name, diagnosis display name and drug list and diagnosis list item display order according using frequency under this function. They also can add diagnosis item to the list using this function.

Administrators can create doctor user under this function. They also can change system variables like clinic name and number of missed call before putting the patient to the end of the queue. They also can amend the drug and diagnosis information globally which the changes can be accessed by all authorized users, i.e. doctors and administrators.

4.4.8. Data Analysis and Reporting

This function is for doctors and administrators only.

They can get the report on drug dispensing frequency, diagnosis and number of cases attended within a given period of time. Data scope for doctor user is his/her-self while for administrator is whole clinic.

4.4.9. Consultation Booking

This function is for doctors and administrators as only doctors and administration can determine the duration for a consultation. The users can schedule consultation for patients in the coming 7 days. The duration is in 5-minute timeslot.

4.4.10. Consultation

Doctors can enter the diagnosis by choosing item from the diagnosis list or enter by free-text. They can make prescription by choosing standard formulae and drugs from drug list. If not using standard formulae, they can first enter the prescription using free-text and use check drug name function to match the drug items on the drug list. All drugs used should be on the drug list. The system will check the compatibility of the prescription with allergy history of the patient and the dosage limit. If it is suspected incompatible, the system will warn the doctor. If this system is use with the product made by AU-YEUNG's final year project, the system will also check the drug availability and reservation. If the drug is not available, the system will notify the doctor. Remarks can also be entered on the prescription using free-text input or standard phrase pre-defined in the system. They can print the prescription and issue certificates under this function.

4.4.11. Query

Doctor can using this function to see the drugs availability and pre-defined diagnosis list item in this function.

4.4.12. Reprint Document

Doctors can reprint certificate and documents. If the certificate is not yet

issued on the same day of consultation, the certificate cannot be issue afterwards with this function.

4.5. Preliminary Design

The following are the stereotype class diagram for the two applications.

4.5.1. Analysis Stereotype for Patient's Application

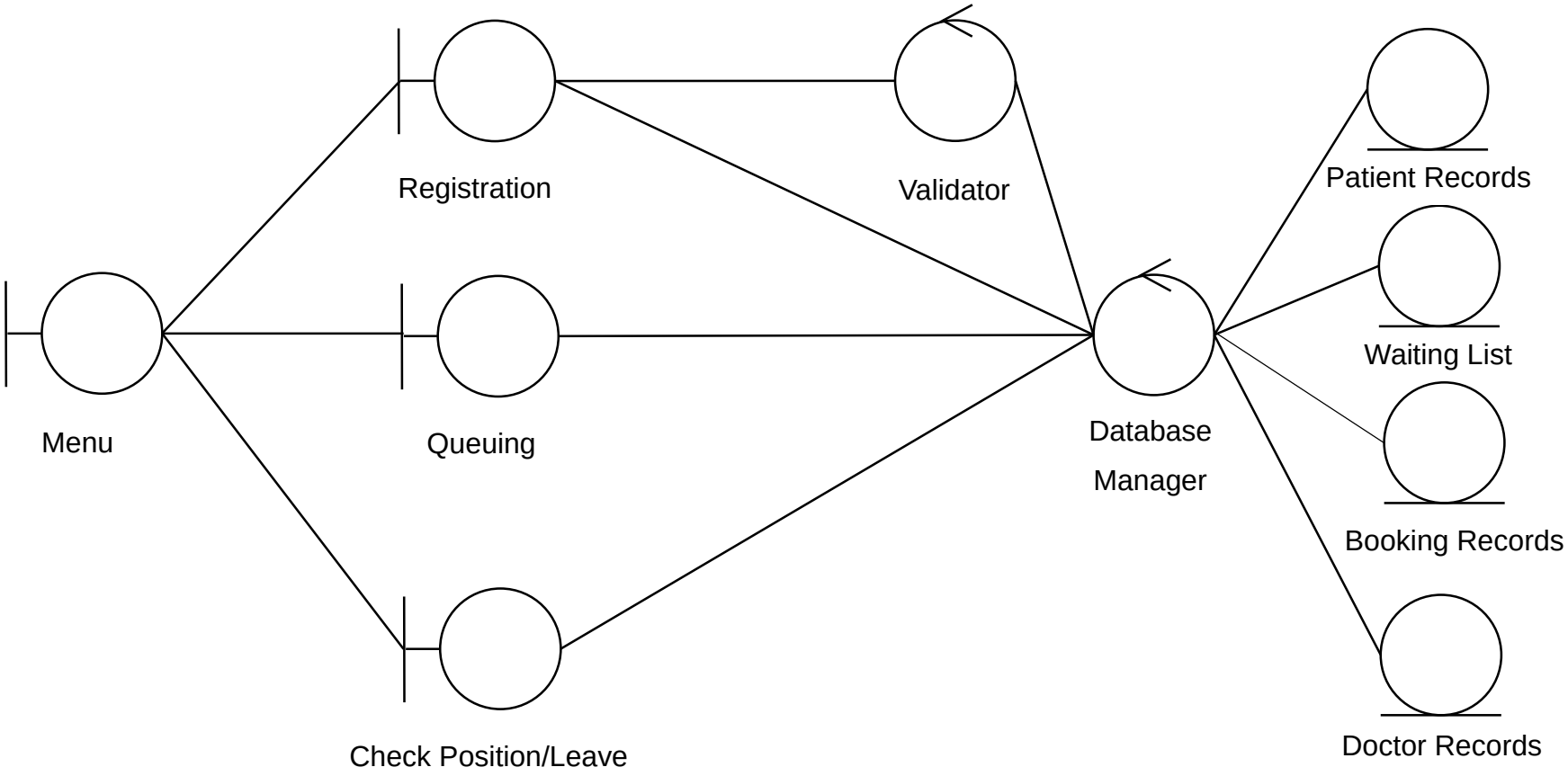

Fig 4.2 Stereotype Class Diagram for Patient's Application

4.5.2. Analysis Stereotype for Doctor and Administrator's Application

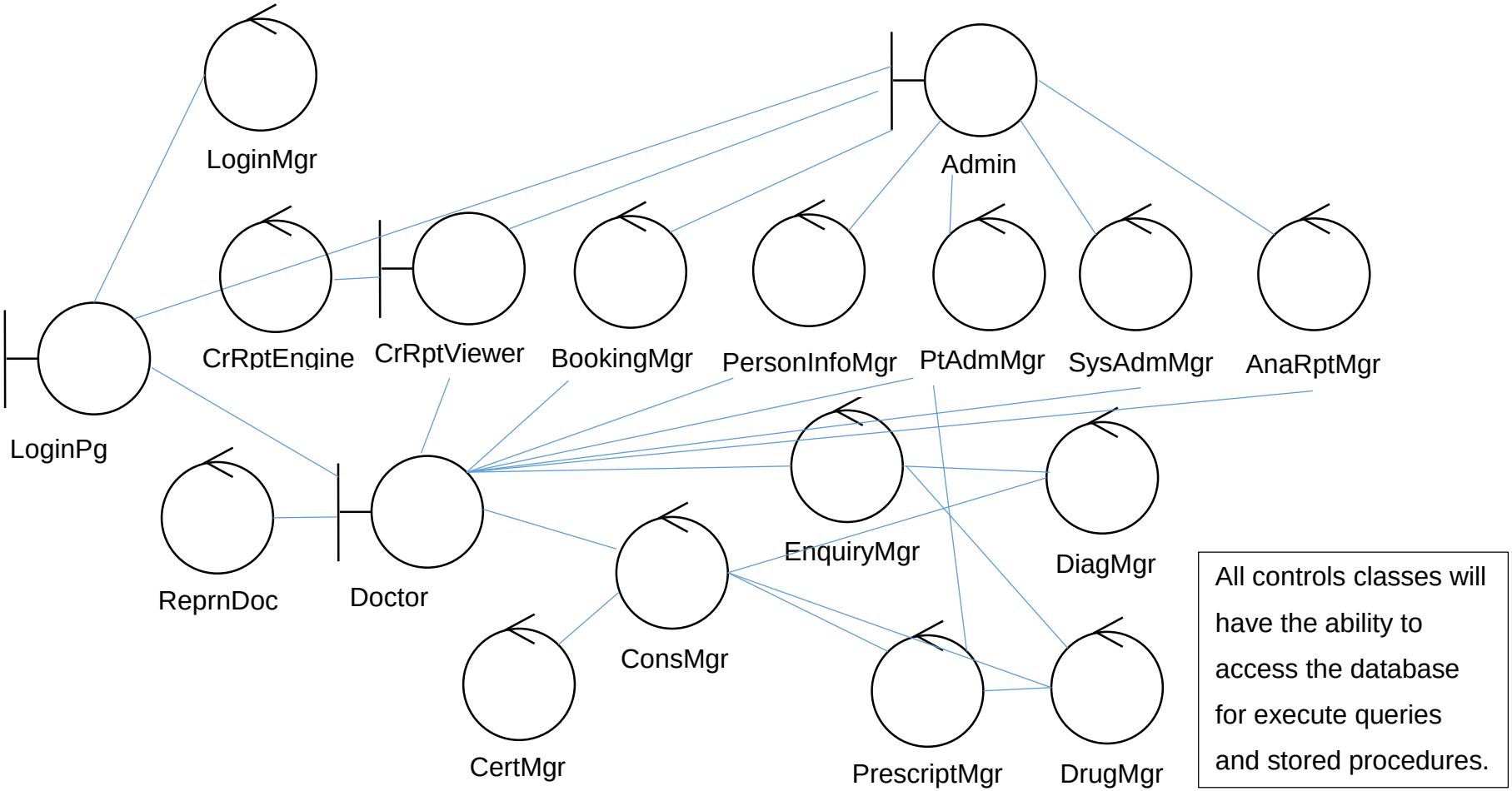

Fig 4.3 Stereotype Class Diagram for Doctor and Administrator's Application

5. Development Schedule

Date	Activity
7 November 2014	Submit of Interim Report I
Nov 2014 - End of 2014	Construct Patient's Application and testing
January 2015	Construct basic functions of Doctor & Administrator's Application and testing
1 – 9 February 2015	Prepare and submit Interim Report II
February 2015	Construct advanced and value added functions
March 2015	- System test - Prepare the Final Report
13 April 2015	Submit required documents

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