

Clinical Decision Support System in Diagnosing Gynaecological Diseases

By

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Dissertation submitted in partial fulfilment of
the requirements for the
Bachelor of Technology (Hons)
Information System

JAN 2004

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8597
.N974
2004

1. Expert Systems (Computer science)
2. IT/IS -- Thesis

CERTIFICATION OF APPROVAL

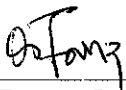
Clinical Decision Support System in Diagnosing Gynaecological Diseases

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A project dissertation submitted to the
Information System Programme
Universiti Teknologi PETRONAS
in partial fulfilment of the requirement for the
BACHELOR OF TECHNOLOGY(HONS)
(INFORMATION SYSTEM)

Approved by,



(Mrs Amy Foong Ooi Mean)

UNIVERSITI TEKNOLOGI PETRONAS

TRONOH, PERAK

January 2004

CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.

NURUL FADZLINA BT MOHAMAD NASIR

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ABSTRACT

The purpose of the report is to explain the Clinical Decision Support System in Diagnosing Gynaecological Diseases. Clinical Decision Support System (CDSS) in Diagnosing Gynaecological Diseases. This CDSS can assist the trainee doctors or medical in diagnosing types of gynaecological diseases and treatment prescription for the patients who got problems with gynaecology. The objective of the report is to give the overview about the background of the system, problem statement, objectives and scope of study, methodology of work and also the conclusion and recommendation.

As we know, throughout the evolution of medical technology the development of an efficient, useful and practical clinical information system becomes a significant focus in health industry today. The development of such system hopefully will help the intern to get the idea on gynaecological disease and also can practise computerized clinical management. Therefore, the clinical information system technology has become increasingly demand driven, in that the usage of the systems will only increase as long as there is an acceptance of the new technology within the environment..

Nowadays, the women health issues always highlighted because one of the major caused of death is related to gynaecological diseases such as ovarian cancer, breast cancer and so forth. As far as the health is concerned, the doctors or gynaecologist should play the main roles in educating the women harmful of gynaecological diseases to their health and giving good treatment for them. This Clinical Decision Support System in Diagnosing Gynaecological Diseases will become a 'personal assistant' for the student in order to help them to traced and diagnosed the diseases related to gynaecology. In other word, it helps to make better decision in diagnosing.

The implementation of such Decision Support System(DSS) in medical fields gives lots of advantages in order to manage the critical data and to get more information before making decision especially related to human life. The author adopts the DSS concept in accomplishment of this project. The output of the system perhaps can be a useful guide to the user to make judgement and evaluation especially in diagnostic of diseases.

ACKNOWLEDGEMENT

The author would like to gratefully acknowledge the contribution of several people who have helped to complete my final year project.

First and foremost to author's supervisor, Mrs Amy Foong Oi Mean ,Lecturer in IT/IS Department. Thank you for your encouragement, invaluable guidance and support to the author throughout completing the Final Year Project.

Deepest appreciation goes to Mrs Vivian, Final Year Project Coordinator for all the priceless inputs and information throughout the semester.

Grateful thanks to all lecturers and colleagues of IT/IS department for every suggestion and support handed out.

For everyone who has been involved either directly or indirectly especially Tengku Ahmad Nazri Tengku Ramli , software engineer of IRIS Corporation, Dr Zulkifli Mohd Sharif, family doctor from Pusat Rawatan Islam Ar-Ridzuan, Dr Roslina Yusof, gynaecologist from Pusat Rawatan Islam Ar-Ridzuan, my fiancée.Mr Muhammad Zafuan for all the mental support and encouragement and also to my friends who get along with me throughout this project. Thank you very much.

CHAPTER 1

INTRODUCTION

1.1 BACKGROUND OF STUDY

Nowadays, the implementation of automated technology for decision making and to manage the clinical database is not widely used in medical world. The importance of such system is obviously critical especially in managing the clinical data and also to make better decision in term of disease diagnosis. Clinical decision support system is computer programs designed to improve the process and outcome of clinical decision making. Clinical decision support system is a system consisting of a knowledge base and an inference engine that is able to use data to generate case specific advice. It is also act as a tool for Information Management for hospital information system, bibliographic-retrieval systems, focusing attention and so forth. Other examples are reminder systems, diagnostic support systems and so on.

After studying the potential and importance of the clinical decision support system in medical field, the author proceed to develop a clinical decision support system in diagnosing gynecological diseases that can be used to assist the medical student or intern to get familiar with clinic management system and diagnosis in gynecological diseases. Currently, there is no special software that can be used to assist this group in order for them to get the real experience before they become a practitioners or professional doctors. The clinical decision support system in diagnosing gynecological diseases is as a tool to guide and recommend the possible solution for them before they make final diagnosis. The first phase of diagnosis is called provisional diagnosis. So, the author only focuses the early part of diagnosis.

The author's project is basically combination patient record management and also provisional diagnosis for gynecological diseases. The system is used to guide and assist the intern or medical student to make better decision based on guidelines and recommendations that provided in the system.

1.2 PROBLEM STATEMENT

The adaptation of new technology within the health care sector is fairly slow; therefore, the clinical information system technology has become increasingly demand driven. Through the evolution of Information Technology (IT), the data organization will be systematic and also providing information support to the clinician or intern doctor to make better decision. There is also no specific software or system that can assist them to get familiar with the symptoms and signs that can lead to certain gynaecological diseases.

Nowadays, most of the medical institutions are using manual system to record all the patient database and management of the clinic. It is almost impossible to backup every record, when there are thousands of patient records. It requires a lot of space and it is time consuming. Secondly, using a manual system, there is no automatic update that can keep the database updated and easy-tracking. It happens, since nurse or medical assistant needs to retrieve and updated patient's record when they step-in to the clinic. It is important to update and secured keep as if it is confidential report.

Security and confidential also the important elements that need to be apply when developing a medical computerized system because usually the patient details and report is very confidential. Using a manual system, it is easy for unauthorized people to access the patient's private records. At the same time, the irresponsible person also can erase or change the records. For the certain cases, the medical history of the patient is easily review by unauthorized people. There is no privacy for the patient, since only certain people should know their private information.

It is different when focus on diagnosis part. Doctor is a normal human and no human is perfect and knows everything. That's why people need to continuously learn. Sometimes the doctors tend to forget certain procedures when handling certain diseases or cases. When this happens, they have to do some research and refer to any medical references to get the solutions. It is time consuming to the doctor. They have a lot of other responsibilities. It does not mean that it is wrong for the doctor to do research, however it is much simpler and better if all the information has been provided to them, instead of having to search again.

The electronic decision making system will allow for a source of information regarding patient history, previous encounter history, disease tracking, and other relevant information. Through effective data entry and use of the electronic medical record, the amount of deaths caused by lack of data or erroneous data entry will be significantly reduced.

1.3 OBJECTIVE AND SCOPE OF STUDY

The development of an effective Clinical Decision Support System (CDSS) becomes one of the alternatives solutions to provide high integrity and systematic data management. Through the creation of a standard electronic medical record, numerous users involved in the care delivery process can utilize the information stored on the record. Besides, the accessibility of the system gives option to the authorized person to update and extract information for their specific usage needs. The benefits of a clinical information system are evident in terms of the reduction of medical error, the knowledge sharing, cost control, quality control, and decision support.

Furthermore, the development of an effective clinical information system is providing ability to share information. Through the creation of a standard electronic medical record, numerous users involved in the care delivery process can utilize the information stored on the record. Clinical decision support system also offers the possibility to improve the quality and reduce the cost of care by influencing medical decisions at the time and place that these decisions are made

This clinical decision support system is intended to receive patient data and utilize that data to propose a series of possible diagnoses and a course of action. The advent of such a system will provide the intern or medical student with a guideline through which he/she can model their decision. Furthermore, the diagnosis suggestion may allow for better standardization of care delivery and the care path followed. Standardization of care, successful and effective diagnosis, and correct care path choice will result from the system.

The development of the system also gives such benefits in term of women health. This is because the system is one of the alternatives to diagnose the disease and deliver a good treatment result for gynaecological diseases. So, the death caused by gynaecological problem should be reduced and women heath status might be increased. The development of this system will take about 3 months to complete. After considering the scope and feasibility of the project, hopefully it could be finish on time successfully.

CHAPTER 2

LITERATURE REVIEW AND THEORY

2.1 Clinical Decision Support System in Medical

The development of Clinical Decision Support System (CDSS) is increasingly demand. According to Modern Healthcare's 12th Annual Survey of Information Trends, health care executives of single-hospital and multiple-facility systems replied for the eighth consecutive year that improving decision support for clinicians was one of their top three Information Technology priorities. In a March 2000 survey of hospital and health care systems executives by Gartner, an information technology research and advisory firm, nearly half of respondents stated they intend to add a clinical decision-support system to their health care IT infrastructure within the next two years. So, we can see that the trend of using high technology system is very wide in term of improving the services and support the health care .The concept of computerised decision support for medicine is not new. As far back as 1959, a pioneering article in Science described how computers might assist in the process of diagnosis. The familiar miniature device used by DrMcCoy (1959) to make diagnoses in the StarTrek series evolved out of a similar dream. This section describes some of the various approaches employed to develop previous CDSS.

The impact of computer technology on an organization especially in medical field is increasing as a new technology evolved and expanding. Interaction and cooperation between human and machine are rapicly growing to cover more and more aspect. From traditional and manual record keeping, computerized system now penetrating complex decision making process. According to Caldwell(1995),says that Information technology is vital to every business operation and decision making. Actually ,to provide a good clinical decision support system, there should be a specific framework like introduced by Simon(1977) and Anthony(1965).The ideas is to classify the problem into structured and unstructured.So,from that we can know the complexity of the problems before proceed with design phase to make choice.The expected benefits of DSS and their determinants were studied by Udo and Guimaraes(1994) in 201 U.S Corporation.The perceived benefits discovered are higher decision quality, improved communication, cost reduction, increase productivity and satisfaction.

Different CDSS is used different approaches. In the MYCIN system used for the management of patients with infections, a set of “if-then” rules was used to generate advice for physicians. A combination of Bayesian and rule based approaches was used in the MEDITEL-PEDS diagnostic system for paediatrics. Besides, in the DXplain medical diagnostic aid, scores for diseases were based on disease probabilities and heuristic methods (“rules of thumb”). The development and use of such a system will allow for a significant decrease in medical errors. The National Academy of Sciences’ Institute of Medicine estimates that the deaths caused by medical mistakes are greater than deaths caused by AIDS, breast cancer or car accidents. The number of deaths caused by medical error has been estimated to be 98,000 individuals per year. So, we can see that manual system give some drawbacks that lead to death. So, the development of computerized system is one of the best solutions to reduce medical error and also give more benefits in term of managing critical database and become more efficient.

An effective and possible provision diagnosis could save numerous patient lives, since an information system may be better able to synthesize vast amounts of information. Furthermore, the diagnosis suggestion may allow for better standardization of care delivery and the care path followed. Ever since computers were first coming into use, it was believed that computers could model the clinical problem solving techniques used by physicians. As early as 1970, William Schwartz of Tufts University School of Medicine wrote: “Computing science will probably exert its major effects by augmenting and, in some cases, largely replacing the intellectual functions of the physician”. In 1994 Berner *At AI* , published the results of a study in which four commercially available medical diagnostic systems were challenged to diagnose a series of 105 patients each of whom had been referred to a consultant and in which of whom a diagnosis had been established. The programs studied included Dxplain, Iliad, Meditel and QMR.

Women health is one of the issues arise in developed country. The numbers of death caused by gynaecological diseases such as ovarian cancer, breast cancer, and cervix cancer and so on is very high. So the development such as this system might be one of the way to help the patient to detect the gynaecological diseases in a quick time. Based on the research done by Samuel S. Epstein, and Quentin D. Young from National Cancer Institute (NCI) and the world's wealthiest

non-profit, the American Cancer Society (ACS), they said that "Cancer mortality rates have remained virtually unchanged (199/100,000) from 1975 to 2000. These rates are based on NCI's statistics, which are adjusted to compensate for the aging population. Over the same period, overall cancer incidence rates have escalated by 18 percent, now striking about 1.3 million annually. Today, nearly one in two men and more than one in three women develop cancer in their lifetimes caused of breast and ovarian cancer". Looking at this statistic, we can say that the women are exposed to gynaecological diseases.

CHAPTER 3

METHODOLOGY AND PROJECT WORK

3.1 METHODOLOGY

Project approach towards Clinical Decision Support System in Diagnosing Gynaecological System is based on the project development scheduled set by Final Year Project (FYP) Committee. The duration of the project work is about four month, starting from January 2004 until April 2004. Expected deliverables within the given time frame is ensured to guarantee the project continuity and accomplishment.

The author used to choose Waterfall Model as the development methodology and guidelines. Waterfall model is a linear system development life cycle consists of planning, analyzing, designing and development. The rationale of adopting this model for the system is because it is a well structured model, easy to follow and suitable for the project, specifically in term of project scope and time constraint.

The phases of the model are:

1. Project definition and planning
2. System analysis and design
3. System development
4. System Testing

3.1.1 Project Definition and Planning

In the early stage of system development life cycle, the author has to define the scope of projects, the process and system specification and also the interfaces that allow user to interact with. A proper plan should be done to conform the requirement of the Final Year Project (FYP) standard and benchmarking. The author choose medical area as research field and recommend a prototype that implementing the usage of clinical decision support in diagnosing gynaecological disease .As a start ,the author has to get information about clinical decision support system throughout journal ,books and also website. All the information gathered can be guideline to proceed with next stage. The author also defines the scope of the

system that is focussing on gynaecological diseases. The author also prepared Gantt Chart as the project milestones to make sure that deliverable output can be accomplished on the time given. Please refer to *Appendix 1*, which provide Gantt Chart that shows the workflow of the project based on the time given.

3.2.2 System Analysis and design

3.2.2.1 System Analysis

Essentially, the purpose of analysis phase is to identify the data, process and interface requirement for the user of a new system. In order to meet the analysis phase, the author has to collect and analyse the information through interviews, questionnaires and discussion with the doctors, software engineers and also clinic staffs. After analysing the information, the author comes out with system requirement. During the interview conduct and discussion with doctors, the author can gain so much knowledge especially in term of workflow, scope, procedure and practise that implemented in medical .So, that the author gained idea on how to implement such system based on the procedures stated. Besides, the author also seeks the information and data through internet.

There is so many useful websites, journals and articles in the internet that can be used as a reference in developing Clinical Decision Support System in Diagnosing Gynaecological Disease. Please refer to Appendix 2-Sample of Interview Questions that the author get from doctors during interview and discussion session. The author also gets the overview about the procedures on medical practising to make sure that the system is meeting the standard. Please refer to Appendix-3 for the standard procedure in diagnosing disease. Due to time and expertise constraints, the author decided to choose only 20 common gynaecological diseases to work. Please refer to Appendix 4 -Sample of gynaecological disease from a website that the author take as reference to develop the system.

Results from on the author's research, the development of the system also based on decision making concept. According to Simon (1977), the decision making process can be through these three phases:

- 1) **Intelligence**
- 2) **Design**

3) Choice

4) Implementation

During intelligence phase, where the reality is examined and problem is identified and defined. So, the author follows these three steps as an analysis to model the decision making concept in the system.

- **Identification of the problems and analysis**

In decision making process, there should be a methodology or approach to develop such model to obtain a good decision making. One important aspect that we must focus is environmental scanning and analysis that includes monitoring, scanning and interpretation of collected information. Same goes with the system that needs to be predicts the output produced in the end. The problem must be identified and understanding before proceed with modelling the results that should produced. Let's say, we choose one type of gynaecological disease that is Endometriosis. So, we should analyse the components or symptoms that lead to Endometriosis.

- **Variable Identification**

Identification of the model variables (decision, result, uncontrollable and others) is critical, as their relationships. A general form of diagram such as cognitive map can guide to help. For this Clinical Decision Support System in Diagnosing Gynaecological Disease, the author listed the symptoms that can possibly lead to Endometriosis. Let's say ten symptoms exist that possibly lead to Endometriosis.

- **Forecasting**

Based on the symptoms or problem that exists, the author forecast the results that possible based on information that she get. The technique or model that the author used to manipulate the decision or final output is by using *Heuristics*. The heuristics technique is to find good enough using rules.

As an example, the author must understand and study one type of disease, Endometriosis. So, the problem is what the elements or symptoms that can cause Endometriosis. So, the author must list down the symptoms and elements of Endometriosis.

Generally, the decision support system can provide the steps to solve problem or assist people to make better decision. Please refer to Appendix 5-shows the workflow of decision support system. For the structure of the system, the author used the Decision-Making/Modelling Process as the guideline to produce a good system.

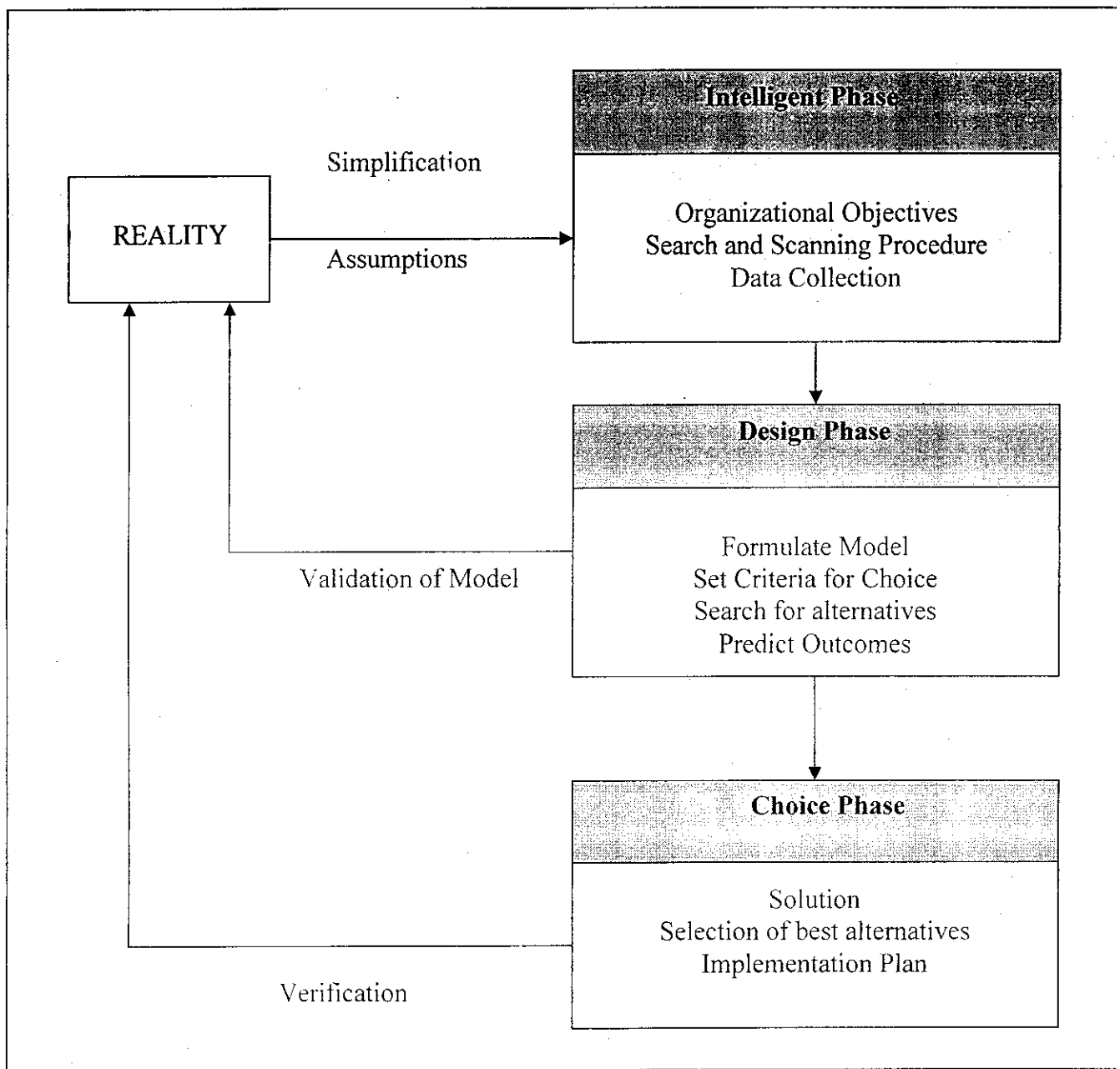


Figure 3.2.1 Schematic View on Decision Support Modelling Process

3.2.2 System Design

In this stage also, the author had to design the flow of the system and the interface. A good understanding of the proposed system is needed in order to proceed with the working. A conceptual model used to find and analyzing possible cause of an actions based on the symptoms or problem that identified in the early stage. The author used to choose *heuristics programming methodology* to produce the possible outcomes. Although it is not fully implemented, but the author applying the concept to model her system to produced the solution. Basically, the heuristics is not guaranteed to obtain optimal solution, but it can provide satisfactory output to be considered. Heuristics programming is the approach to arrive at feasible and “good enough” solutions to some problems. The author used Visual Basic 6.0 to develop the system. In order to come out with good system to represent the concept of decision making, the author has to develop a simulation that represents diagnostic simulation in gynaecological diseases. Although it is not fully used for commercialization, but it is just a simulation to show the implementation of decision support in disease diagnostic. Please refer to Appendix 6-Relationship table for Clinical Decision Support System in Diagnosing Gynaecological Disease. Based on the database relationships, the author design the interface of the system based on specification and requirement. The process flow diagram of Clinical Decision Support System in Diagnosing Clinical Decision Support System can be shown in Figure 3.2.2

Based on the decision making concept and approach, the author design the system workflow as per shown in the figure 3.2.3

3.2.4 System Development

The development tool for Clinical Decision Support System in Diagnosing Gynaecological Diseases is using Microsoft Visual Basic 6.0. The author also used Microsoft Access to develop database of the system. In this stage, the author more focuses on linking the forms of the system using Visual Basic code. It is to bring it all together to form a system. Development not only involves building the system, but also to test and verify that it works. Basically, the author stores the information in the database as an 'inference engine'. So, the coding part is much easier because all the data just called from the database storage. The author spent much time on developing database and linking them to form a system. It takes about 2 ½ month to cope with database and programming part. Please refer to Appendix 7- The source code of the system using Microsoft Visual Basic 6.0.

3.2.5 System Testing

Any system designed must be well tested, in order to detect any errors during the development phase. The purpose of software testing is to uncover errors. Software testing is a critical element of software quality assurance and represents the ultimate review of specification, design, and code generation. Testing is a set of activities that can be planned in advance and conducted systematically. The author had implemented 2 types of testing that are Unit Testing and System Testing:

- ***Unit Testing***

Unit Testing focuses on the verification effort on the smallest unit of software design – the software component or module.

- ***System Testing***

This is actually a series of different tests whose primary purpose is to fully exercise the system.

Previously, the system will be tested on its 'individual' functionality. When successfully completed, only then all forms are tested as a whole system. It involves the navigation part (whether the button links to the correct form), the links to database and application part and whether the system fulfils the requirements.

3.2 TOOLS

The tools and equipment used throughout the development of the system are as follows:

I. Managerial purposes

- Microsoft Project
 - The purpose is to plan and schedule the tasks involve along the development process, in order to meet the due date.
- Microsoft Word and Excel
 - This software useful to prepare reports, user manual, creating tables and diagrams.
- Microsoft Power Point
 - The purpose is to prepare presentation slides.

II. Development tools

- Visual Basic 6.0
 - This software is the main tool to develop the system. VB is the best approach to develop this system since it is object oriented and can be integrated with a lot of other applications, such as Microsoft Access (database).
- Adobe Photoshop 6.0
 - This software is useful in editing pictures and images.

III. Database management system

- Microsoft Access
 - This software is the common application used to manage database.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 System Output

Clinical Decision Support System in Diagnosing Gynaecological Diseases (GDSS) is a clinical decision support system to diagnose gynaecological diseases based on symptoms and signs shown by patients. Basically, the target user for the system is the intern or trainee doctor. The usage of the system is to provide guideline and assist them to make better decision on diagnosing gynaecological diseases. GDSS is consisting of two part:

- *Record Management*-to cater all the patient record such as computerization of patient database
- *Diagnostic* –to predict the possible diseases based on the symptoms and signs told by the patient. Then, the system assists the user by recommending diagnosis test and treatment.

The system is very useful for these groups of medical student or intern to forecast and get familiar with the disease diagnosis especially in gynaecological diseases. Based on the research done by the author, the stage of medical practitioners is as shown in the diagram. Please refer to Appendix 8-Stages of Medical Practitioners in Malaysia.

The author gets all the information and data from by conducting interviews with doctors and specialists to get overview and details about the procedure on disease diagnosis process. The process of diagnosing a disease is as in Figure 4.1.

The GDSS is more effective in provisional diagnosis. Due to time limitation and expertise, the author has to focus on certain aspect only. The Clinical Decision Support System in Diagnosing Gynaecological Diseases is consists of two part:

4.2 Patient Record Management

It consists of fulfilling the patients details and save into the database. The user also can edit or delete the database if necessary. The searching function also provided as an easy tool to retrieve patient database easily and quickly.

- **System Login**

Before enter the system, the user should provide password as an authorization tool for security. The user launches GDSS from their workstation. A login screen will be appearing. Please refer to the figure 4.1.1 is the login window for the user to log into the system.

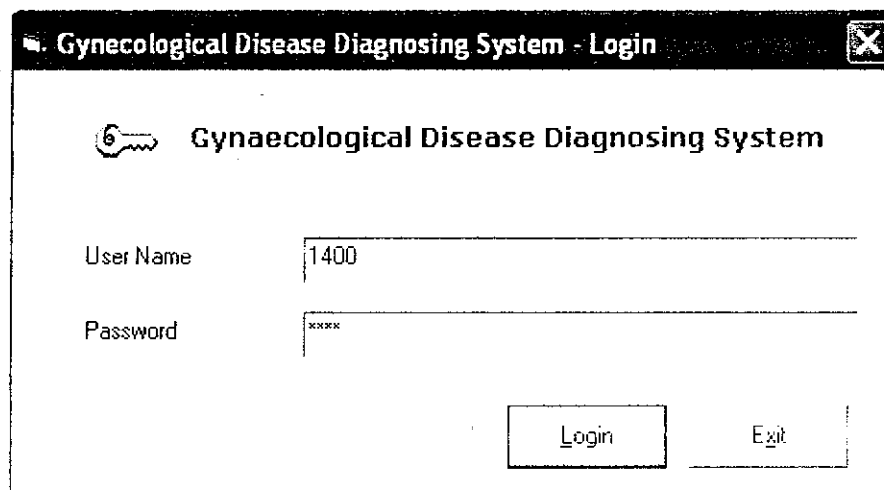


Figure 4.1.1 -GDSS Login Screen

Besides, the log on function is important for security purpose. It is to ensure only the authorized users are able to use the system. The only identified authorized users are able to use the system. So, the medical record of the patients can be kept confidentially.

- **Main Menu**

After successfully login to the system, the user will arrive at the main page or main menu. From this menu, the user can choose the steps that they want. If they want to add new patient in the database, the just click to that menu.

Add new patient record

Select existing patient database

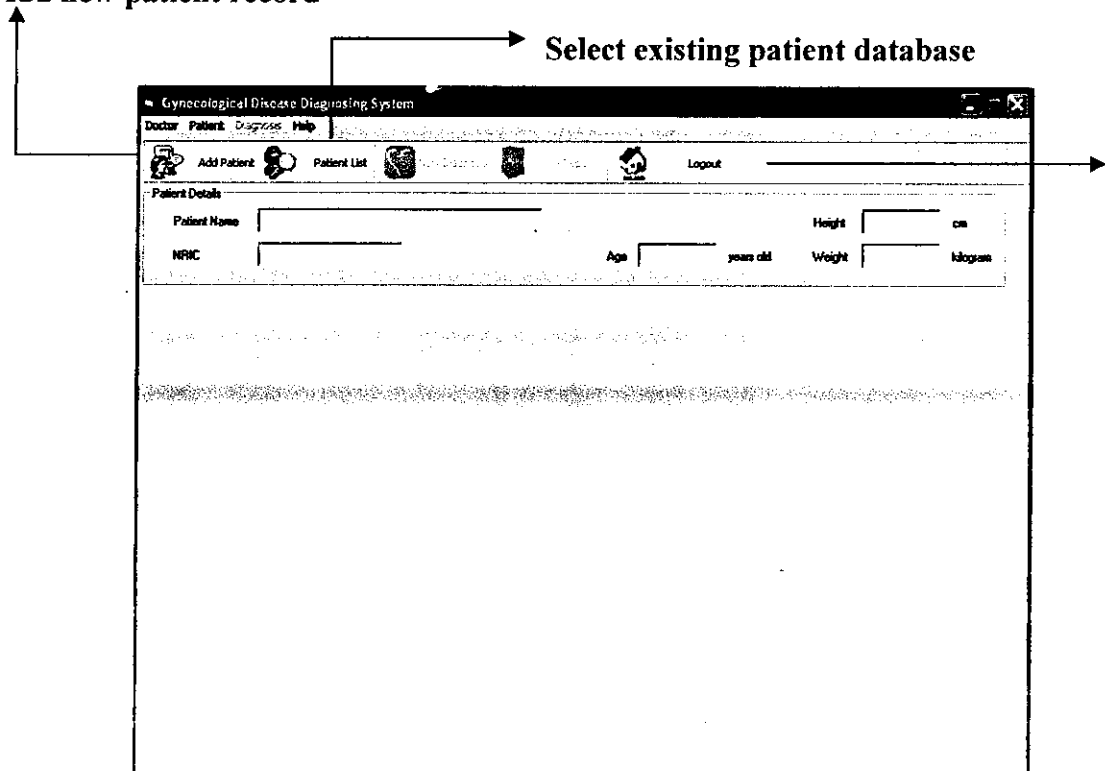


Figure 4.1.2 Main Menu

Let's say the user select existing patient from the list. So, the system is captured the database and provide Diagnose button to proceed on medical history of selected patient. Please refer to figure 4.1.3 for details.

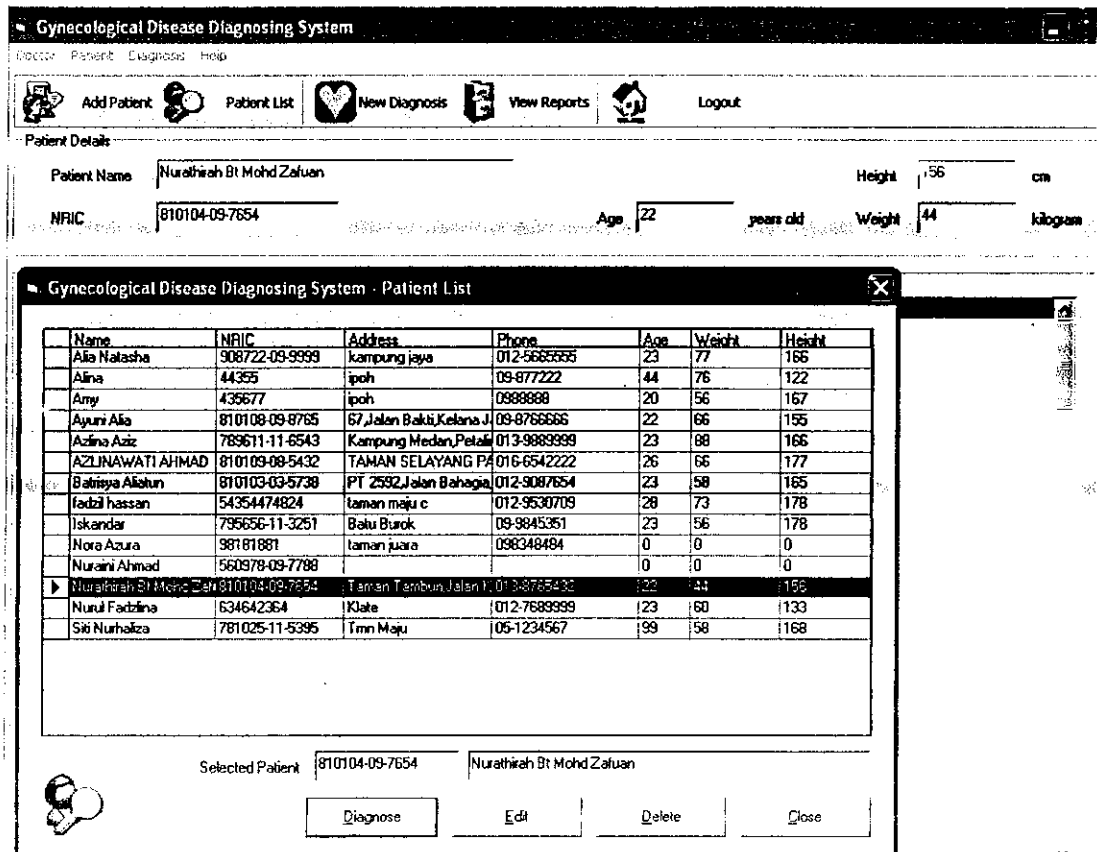


Figure 4.1.3 A patient data from existing database selected

4.3 Diagnostic

In diagnostic part, the selected patient from the database will be diagnosed based on the symptoms and signs told by the patient. In my database storage, there is about 100 symptoms to be ticked by the user. Please refer to figure 4.1.4 for list of symptoms provided.

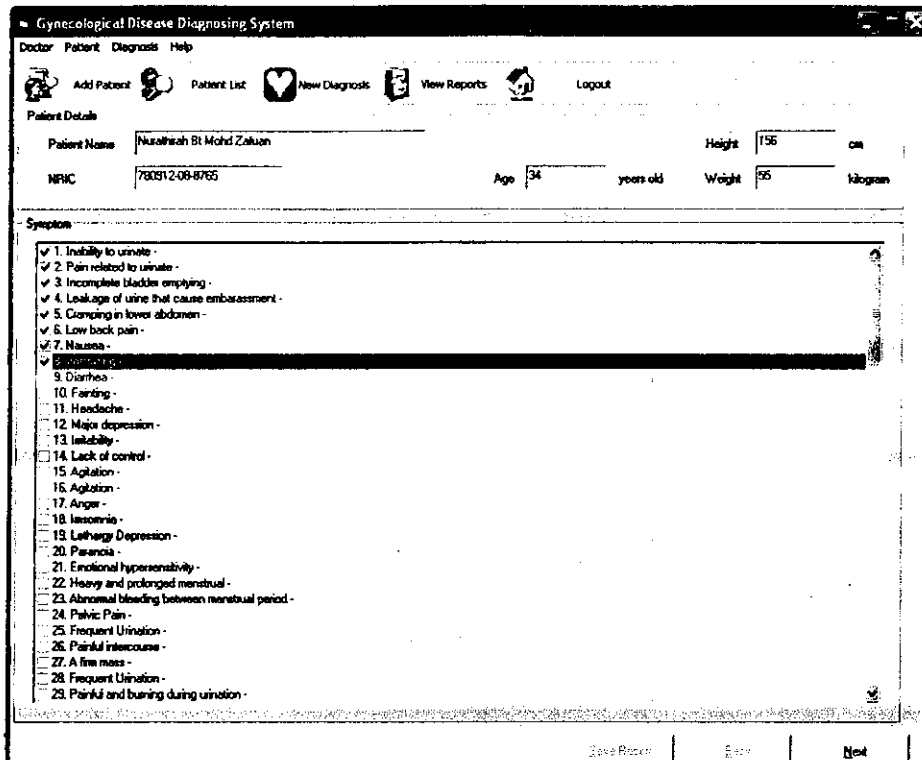


Figure 4.1.2 List of symptoms

Based on these symptoms ticked in Figure 4.1.2, the system will process the information and poses a few possible diseases. Please refer to Figure 4.1.3 for next screen. The process is based on the database that the author's has stored in the database. The relationship on how the inference engine finds the match of data is by listing all the symptoms and malady in one table like shown. Please refer to figure 4.1.3

MaladySymptom - Table			
	Malady	Symptom	Remarks
		1	1
		2	1
		1	2
		1	3
		1	4
		2	5
	Dysmenorrhia		6
3	Pre-menstrual Dys		6
4	Urinary Tract Infec		7
5	Uterine Fibroids		8
6	Endometriosis		9
7	Amenorrhea		10
8	Menorrhagia		11
9	Pelvic Inflammatory		12
		3	13
		3	14
		17	15
		3	17

Figure 4.1.3 Link Table of Symptoms and Malady

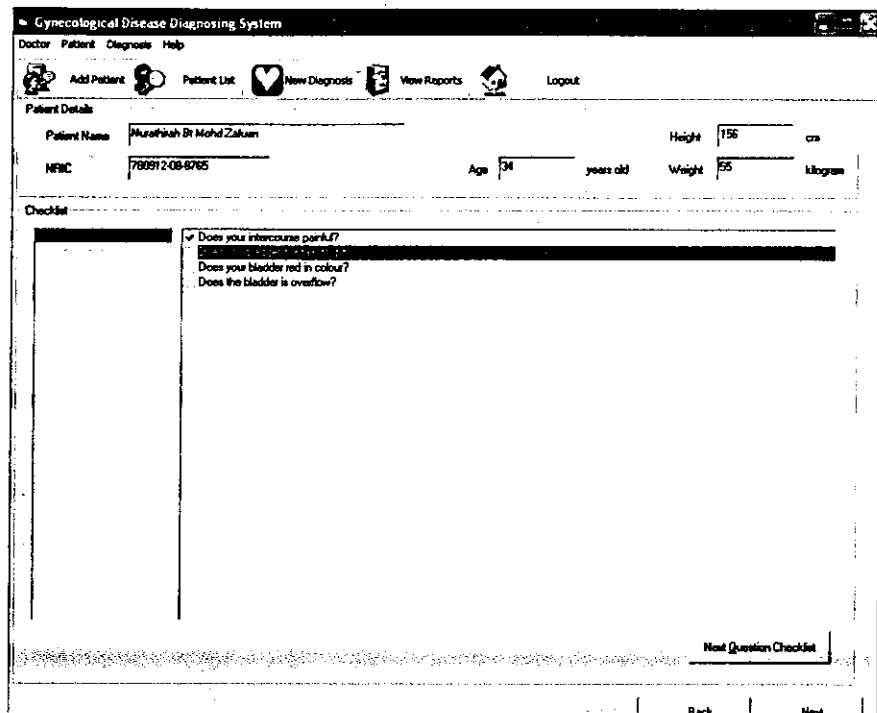


Figure 4.1.4 Checklist section show the possible diseases

From the symptoms ticked by the user, the system displayed two possible diseases that the patient suffers from. In order to determine either one of the disease, a few questions will be asked to confirm the disease. In the user finish to answer the checklist by ticking it up. Then, the diagnosis screen will appear to recommend the type of clinical diagnosis or physical examination to be performed by the doctor. Please refer to figure 4.1.5 to see the types of radiological and physical examination recommended to diagnosing the two possible diseases. While Figure 4.1.6 shows the recommended treatment to cure those diseases.

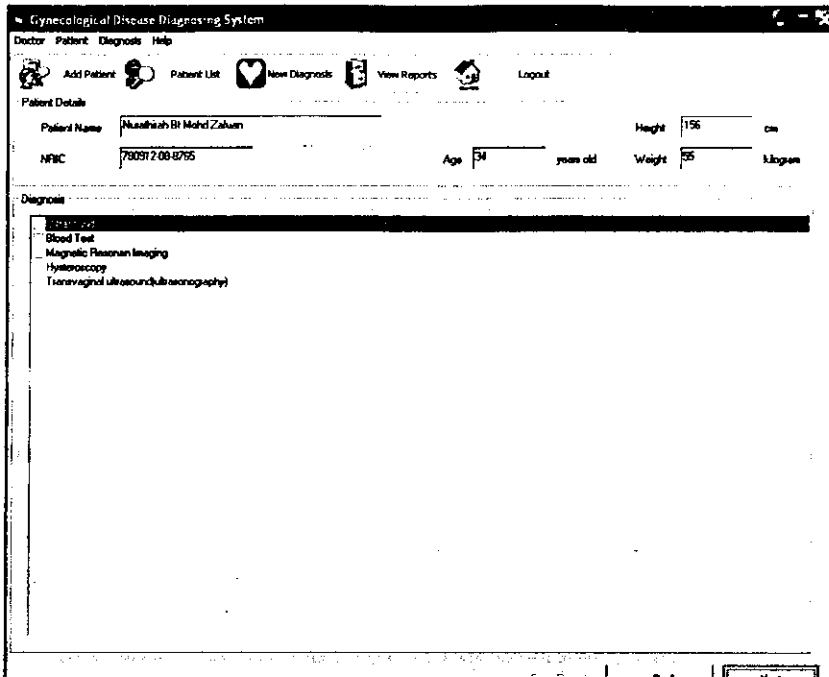


Figure 4.1.5 Recommended Clinical Diagnosis

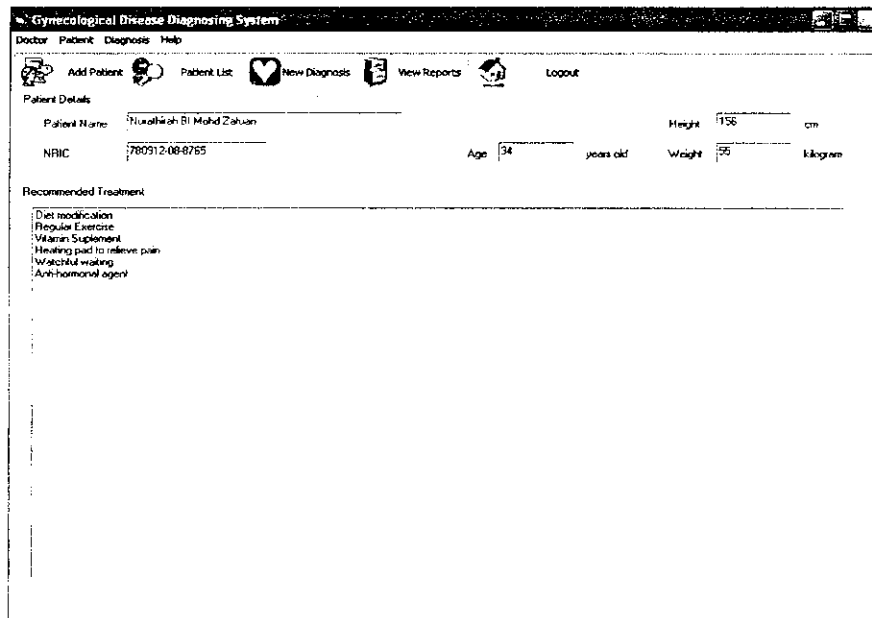


Figure 4.1.6 Recommended Treatment

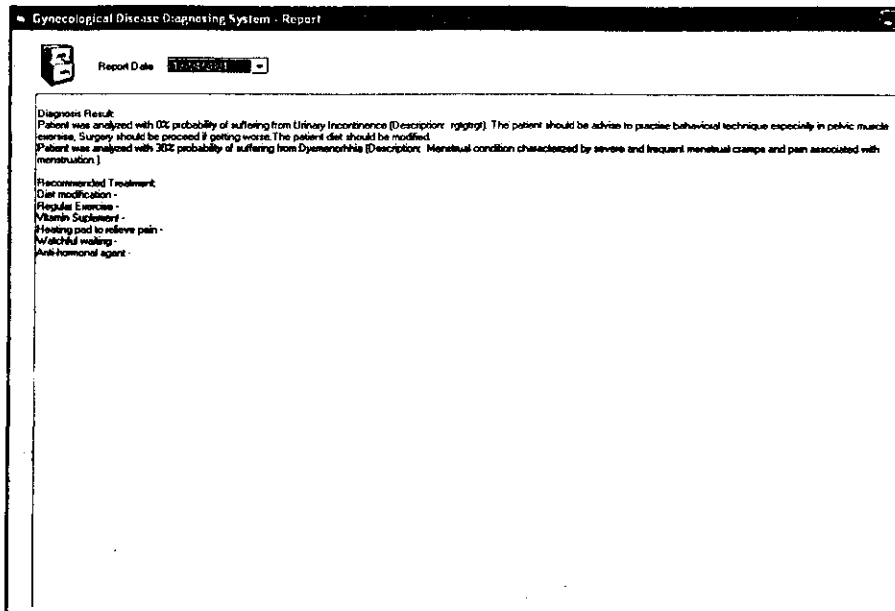


Figure 4.1.7 Report Generated to give the possible disease and medical report

Generally, the interaction between user and the system is the user interface. The term 'user interface' covers all aspects of communication between user and system. Based on the interface provided, the author feels that the effective user-interface is important component because the power, flexibility and ease-of use characteristics of the system. The author used Human Computer Interaction (HCI) concept to produce the interfaces.

Overall, the Clinical Decision Support System in Diagnosing Gynaecological Diseases is such a prototype to show the decision making concept in medical field. Actually, the author only focuses only about 20 types of gynaecological diseases. Please refer to the Appendix -8 for lists of diseases can be diagnosed using this system. All decision support system use data, information and/or knowledge. These three terms are sometimes used interchangeably and may have several definitions. A common manner of looking at them is as follows:

- *Data*-Including data items about things, events and activities. In this system, the symptoms and patient details are considered as data.

- *Information*- Data that have been organized so that they have meaning to the system. The diagram or relationship table is the information to produce results.
- *Knowledge*-Data items or information organized and processed to convey understanding, experience and accumulated learning. Knowledge is used as information in making decision

From the research done, the author found that the decision support system capable in term of:

Support for decision makers/users mainly in semi-structured situation by bringing them together human judgement and also computerized information.

DSS also support all phases of the decision making process: intelligent, design, choice and implementation

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 CONCLUSION

The necessity for development of innovative and dependable clinical information systems with decision support capabilities is crucial. Increasing systems' acceptance depends on the culture of the hospital as well as the involvement of physicians itself. The involvement of all health care professionals especially physicians in the selection and implementation of the system from the outset is essential

Secondly, it is essential to consider in advance the new system's effects on the culture, practices, and attitudes of the people in the organization. Explicitly identifying how people and groups in the organization will benefit specifically will lend support for its implementation. The use of information systems by medical students or interns will be a good thing especially in getting familiar with diagnosing the gynaecological disease. Nowadays, the health conscious among Malaysian women is so good. So, by having this kind of system, a new innovation of medical information can be practising before these young doctors enter into the real practising in hospital.

Healthcare organizations and also practitioners must anticipate and be prepared to handle a diverse array of changes that will occur during the implementation process itself. The use of such Clinical Decision Support System in Diagnosing Gynaecological Diseases is not substituting the function of doctors but it assists them in order to make better decision in term of diagnosing the illness. GDSS is only the basic idea for further enhancement. This is a good approach of DSS application in real life. Computer technology continuous fast-paced evolution, so the capabilities are increasing dramatically. DSS application nowadays can really help people to make their work more effective and efficient.

The author had tried to make sure GDSS fulfils the DSS requirements. GDSS is a simple system that represents DSS application in real life. It supports these young doctors to make provisonal diagnosis from the given symptoms. The procedures involves are Input,

Process and Output. Perhaps, GDSS if implemented in real life can help doctors and the clinic management to manage the patient records. By using this system, every personal data and clinical data (medicine and treatment taken, also diagnosis report) can be kept in a single application. The clinic's management does not need to keep a variety of forms for many patients anymore. They just need to login into the system, and check the available records. At the same time, it provides the guidelines to diagnose and treat the patient. Of course it is useful to the clinical people, as they just only need to refer to the system if they ever forgot some of the procedures in diagnosing the patient. GDSS can provide the most recent diseases that are classified under gynaecological disease fields.

Even if the standard of care does not require the use of such systems, there are some legal and ethical issues that have not yet been well addressed. One interesting legal case that has been mentioned in relation to the use of technology in healthcare is the Hooper decision. This case involved two tugboats (the T.J. Hooper and its sister ship) that were pulling barges in the 1930s when radio (receiving sets) was available, but not widely used on tugboats. Because the boats did not have a radio, they missed storm warnings and their cargo sank. The barge owners sued the tugboat company; even though the tugboat captains were highly skilled and did the best they could under the circumstances to salvage their cargo. They were found liable for not having the radio, even though it was still not commonplace.

Besides, the author also hopes that this system will really help the interns to make better provisional diagnosis by using the system. Although, it is just a simple decision support system, but it is good to assist them to make better decision. Hopefully, the idea of this system will be accepted by clinics or medical institution for their training usage. GDSS is interesting, informative and helpful to the user. The system also is easy to use for the first timer. The author is really interested to work with any medical people and computer project to develop the real DSS application in medical.

5.2 RECOMMENDATION

The DSS application or expert systems give lots of benefits and really assist human in judging and making decision in any field. The Clinical Decision Support System in Diagnosing Gynaecological Diseases is one of the samples that is good to be used as a guideline for the interns. The author feels that some future enhancements should be recommended in order to come out with a good and effective system. This is a complex system and needs thorough studies. It same goes for the author where GDSS is only a basic idea to show how a DSS application in medical may be used. Below are some recommendations or future enhancement for the system.

Firstly, the author may use more complex model, so it can make the better recommendation. Exact methods can be employed instead of heuristics. The author has been using heuristics searching process in order to come out with the output or results. The results produced are come from the matching process between the system and the database. It is almost impossible for the author to come out with the true Expert System application, given this time frame and lack of knowledge. In a real DSS application, the methods used can vary whether it is Rule-Based, Model-Based or Case-Based. At the same time, mathematical techniques can also be implemented in DSS system such as Bayesian and Dempster-Shafer. Both of the techniques are examples of an algebra supporting probabilities in reasoning. All of these examples are typically used for complex system. For this system, the author only used simple heuristics method in decision making process.

Secondly, the contents of the system complexity can be expanded: also the accuracy of the results can be enhanced. In the system, the scope of database and list of gynaecological diseases is limited. It is only about 20 types of gynaecological diseases, due to lack of expertise and database limitation. For the future, may be the author can expand the system for further diagnosis and can be used for doctors or practitioners in real hospital and also providing investigation and patient management. Further research

and steps should be done in order to get more knowledge and can come out with a new innovation of DSS technology.

The interface of the system should enhance and improved to be more users friendly by putting such instruction to lead the user. A good command is essential to make sure that the user is in correct path to use the system. Besides, the exception error handling also should be included in the system to make sure that the user enters the right character or data. This is important to avoid data error.

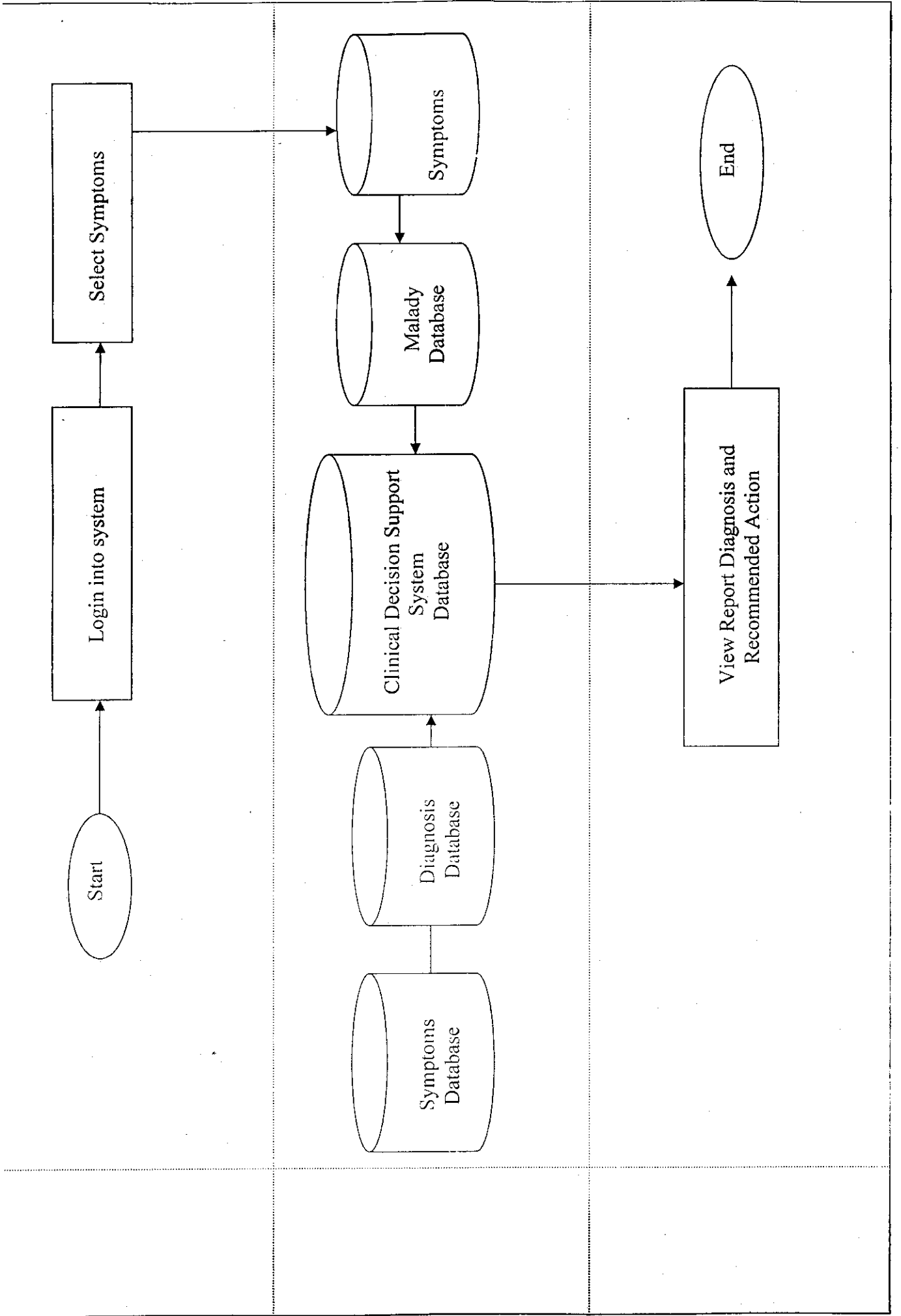
REFERENCES

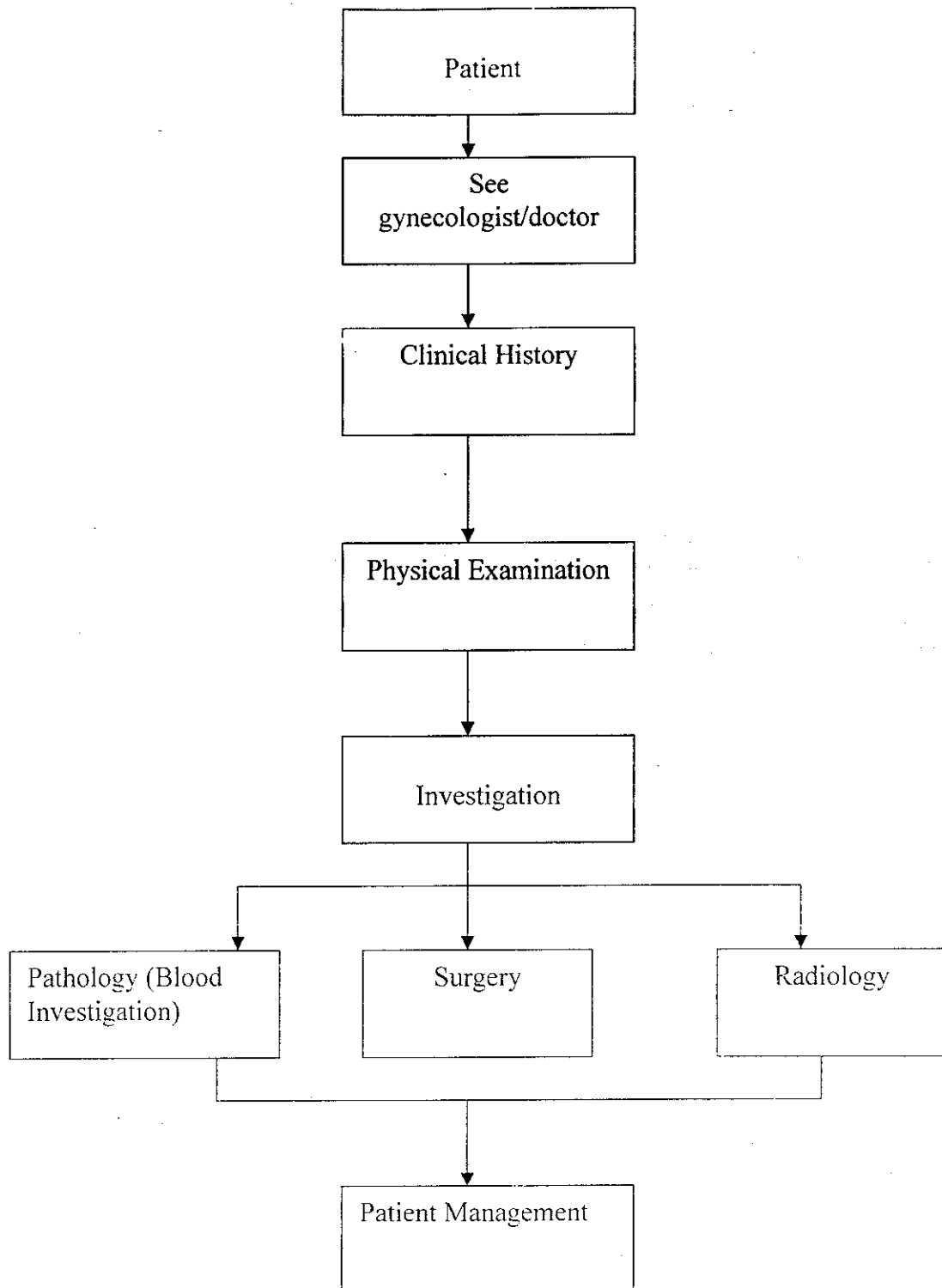
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Questions

1. Define the scope and procedure to diagnose the gynecological diseases?
2. Discuss the probability of getting such diseases based on symptoms observed?
3. Discuss the suitable diagnosis/clinical test to diagnose such diseases?
4. Discuss the recommendation treatment to cure the disease?
5. Get the sample format of gynecological diagnosis report.
6. Get any additional information on gynecological diseases/medical journal if any.
7. Get advice about 20 gynecological cancer:
8. Ovarian Cancer
9. Demo system for review.





Appendix 4-Gynaecological Disease Diagnosis Procedure

What is endometriosis?

The name comes from the word "endometrium", which is the tissue that lines the uterus. During a woman's regular menstrual cycle, this tissue builds up and is shed if she does not become pregnant. Women with endometriosis develop tissue that looks and acts like endometrial tissue outside the uterus, usually on other reproductive organs inside the pelvis or in the abdominal cavity. Each month, this misplaced tissue responds to the hormonal changes of the menstrual cycle by building up and breaking down just as the endometrium does, resulting in internal bleeding.

Unlike menstrual fluid from the uterus which is shed by the body, blood from the misplaced tissue has nowhere to go, resulting in the tissues surrounding the endometriosis becoming inflamed or swollen. This process can produce scar tissue around the area which may develop into lesions or growths. In some cases, particularly when an ovary is involved, the blood can become embedded in the tissue where it is located, forming blood blisters that may become surrounded by a fibrous cyst.

What are the different stages of endometriosis?

A staging system has been developed by the American Society of Reproductive Medicine (formerly the American Fertility Society). The stages are classified according to the following:

Stage	Level of Severity
Stage I	minimal
Stage II	mild
Stage III	moderate
Stage IV	severe

What are the symptoms of endometriosis?

The following are the most common symptoms for endometriosis, however, each individual may experience symptoms differently.

Symptoms of endometriosis may include:

pain, especially excessive menstrual cramps which may be felt in the abdomen or lower back

pain during intercourse

abnormal or heavy menstrual flow

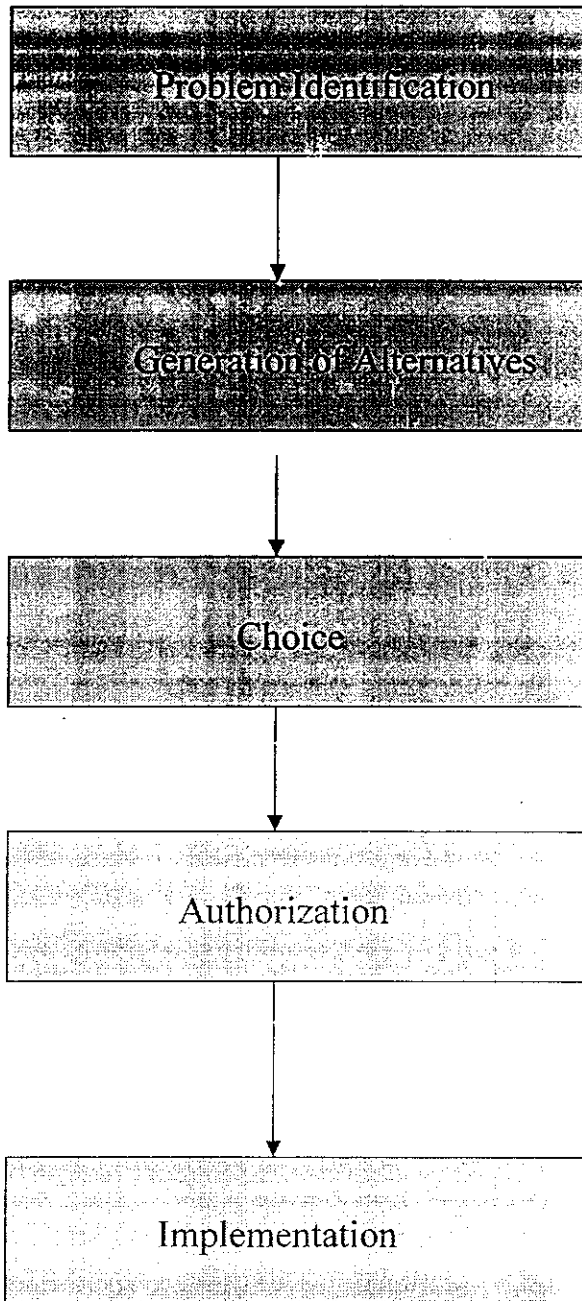
infertility

fatigue

painful urination during menstrual periods

painful bowel movements during menstrual periods

other gastrointestinal problems (i.e., diarrhea, constipation, and/or nausea)



Appendix 6-Workflow of decision making concept by Van den Hoven (1996)

Appendix 6-Source Code of the Program

```
Option Explicit
Private Sub cmdCancel_Click()
    Unload Me
End Sub
Private Sub cmdSave_Click()
    If Not txtOldPassword.Text = "" And Not txtNewPassword1.Text = "" Then
        If txtNewPassword1.Text = txtNewPassword2.Text Then
            If ChangePassword(CurrentDoctorID, txtOldPassword.Text, txtNewPassword1.Text) Then
                MsgBox "Password has been changed successfully.", vbInformation
                Unload Me
            Else
                MsgBox "Password changed was unsuccessful.", vbCritical
            End If
        Else
            MsgBox "New password field verification failed. New passwords mismatch.", vbExclamation
        End If
    Else
        MsgBox "Please fill in all fields.", vbExclamation
    End If
End Sub
Private Sub Form_Load()
    Me.Caption = "Change Login Password"
End Sub
Private Function ChangePassword(ByVal UserName As String, ByVal OldPassword As String, ByVal
NewPassword As String) As Boolean
    Dim SQL As String
    ChangePassword = False 'false by default
    Set MyRecordset = New ADODB.Recordset
    SQL = "select * from doctor where username='" & UserName & "' and password='" & OldPassword
& "'"
    With MyRecordset
        .Open SQL, MyConnection, , adLockOptimistic
        If .RecordCount = 1 Then 'found
            !Password = NewPassword
            .Update
            ChangePassword = True
        End If
    .Close
    End With
    Set MyRecordset = Nothing
End Function
Option Explicit
Private Sub cmdExit_Click()
    Unload Me
End Sub
Private Sub cmdLogin_Click()
    If DoLogin(txtUserName.Text, txtPassword.Text) Then
        CurrentDoctorID = txtUserName.Text
        frmMain.Show
        txtPassword.Text = "" 'clear current password
        Me.Hide
    Else
        MsgBox "Invalid username/password.", vbExclamation
    End If
End Sub
```

```

End Sub
Private Sub Form_Load()
    Me.Caption = App.Title & " - Login"
End Sub
Private Sub Form_Unload(Cancel As Integer)
    CleanUp
End Sub
Option Explicit
Option Base 0
Private SymptomList As String
Private ChecklistList As String
Private DiagnosisList As String
Private ChecklistFactor() As Single 'to store checklist factor calculation result for each malady
Private DiagnosisReport As String 'to store diagnosis report
Private Sub cmdBack_Click()
    cmdSaveReport.Enabled = False
    cmdNext.Enabled = True
    DiagnosisStep = DiagnosisStep - 1
    If DiagnosisStep <= MinStep Then
        DiagnosisStep = MinStep
        cmdBack.Enabled = False
        cmdSaveReport.Enabled = False
    End If
    ManageDiagnosisStep DiagnosisStep
End Sub
Private Sub cmdChecklist_Click()
    On Error GoTo Hell
    With lstMalady
        .ListIndex = .ListIndex + 1
        If .ListIndex = .ListCount - 1 Then cmdChecklist.Enabled = False
    End With

    Exit Sub

```

Hell:

```

If Err.Number = 380 Then 'invalid property value
    Err.Clear
    MsgBox "The list is empty.", vbExclamation
End If

```

End Sub

Private Function CalculateChecklistFactor() As Single

```

    On Error GoTo Hell

```

```

    Dim Counter As Integer
    Dim TotalFactor As Single

```

```

    With lstChecklist

```

```

        For Counter = 0 To .ListCount - 1

```

```

            If .Selected(Counter) Then TotalFactor = TotalFactor + .ItemData(Counter)

```

```

        Next Counter

```

```

    End With

```

```

CalculateChecklistFactor = TotalFactor

Exit Function

Hell:

If Err.Number = 381 Then ' invalid array
    Err.Clear
    CalculateChecklistFactor = 0
    'Resume Next
End If

End Function

Private Sub cmdNext_Click()

    cmdBack.Enabled = True

    'make sure all checklists have been gone through
    If DiagnosisStep = Checklist And cmdChecklist.Enabled Then
        MsgBox "There are still diagnosis items to test. Click on the 'Next Question Checklist' button to
        proceed with the next diagnosis checklist.", vbExclamation
        Exit Sub
    End If

    DiagnosisStep = DiagnosisStep + 1
    If DiagnosisStep >= MaxStep Then
        DiagnosisStep = MaxStep
        cmdNext.Enabled = False
        cmdSaveReport.Enabled = True
    End If

    ManageDiagnosisStep DiagnosisStep

End Sub

Private Sub cmdSaveReport_Click()

    DoSaveReport

End Sub

Private Sub Form_Activate()

    'disable diagnosis function if currentpatientid has not been set
    If Not CurrentPatientID = "" Then
        SetDiagnosisControls True
    Else
        SetDiagnosisControls False
    End If

    'display current patient details if currentpatientid has been set
    With adoPatient
        .RecordSource = "select NRIC, Name, Age, Weight, Height from patient where NRIC="" &
        CurrentPatientID & """"
        .Refresh
    End With

```

```

End With

End Sub

Private Sub Form_Load()

    Me.Caption = App.Title

    'automatically set all ado controls' connection string
    Dim x As Control
    For Each x In Me.Controls
        If TypeOf x Is Adodc Then
            x.ConnectionString = ConnectionString
            x.CursorLocation = adUseClient
        End If
    Next x

    staMain.Panels("doctor").Text = CurrentDoctorID
    DiagnosisStep = Symptom 'set initial diagnosis step
    SetDiagnosisControls False
    SetAllDiagnosisFrames False 'initially hide all diagnosis frames

End Sub

Private Sub Form_Resize()

    'resize and reposition all diagnosis frames properly on the form
    'take fraSymptom's values as guide
    fraSymptom.Left = fraPatient.Left

    With fraSymptom
        fraChecklist.Left = .Left
        fraChecklist.Top = .Top
        fraChecklist.Height = .Height
        fraChecklist.Width = .Width

        fraDiagnosis.Left = .Left
        fraDiagnosis.Top = .Top
        fraDiagnosis.Height = .Height
        fraDiagnosis.Width = .Width

        fraTreatment.Left = .Left
        fraTreatment.Top = .Top
        fraTreatment.Height = .Height
        fraTreatment.Width = .Width
    End With

End Sub

Private Sub Form_Unload(Cancel As Integer)

    frmLogin.Show

End Sub

Private Sub lstChecklist_Click()

```

End Sub

Private Sub cmdEdit_Click()

```
    Load frmPatientDetails
    With frmPatientDetails
        .SetCurrentNRIC txtNRIC.Text
        .Show vbModal, Me
    End With
    adoPatient.Refresh
```

End Sub

Private Sub dbgPatient_Click()

```
    txtName.Text = adoPatient.Recordset!Name
    txtNRIC.Text = adoPatient.Recordset!NRIC
```

End Sub

Private Sub dbgPatient_RowColChange(LastRow As Variant, ByVal LastCol As Integer)

```
    txtName.Text = adoPatient.Recordset!Name
    txtNRIC.Text = adoPatient.Recordset!NRIC
```

End Sub

Private Sub Form_Load()

```
    Dim SQL As String

    Me.Caption = App.Title & " - Patient List"

    SQL = "select Name, NRIC, Address, Phone, Age, Weight, Height from patient order by name"

    With adoPatient
        .ConnectionString = ConnectionString
        .RecordSource = SQL
        .Refresh
    End With
```

End Sub

Private Sub txtNRIC_Change()

```
    If txtNRIC.Text = "" Then
        DisableButtons
    Else
        EnableButtons
    End If
```

End Sub

Private Sub DisableButtons()

```
    cmdDiagnose.Enabled = False
```

```

Dim CurrentMalady As Integer

CurrentMalady = lstMalady.ListIndex 'get the current selected malady and use it as an index for the
checklistfactor array
ChecklistFactor(CurrentMalady) = CalculateChecklistFactor
'Debug.Print "factor=" & ChecklistFactor(CurrentMalady)

End Sub

Private Sub lstMalady_Click()

    On Error GoTo ErrHandler

    adoChecklist.RecordSource = "select Factor, Question from checklist where malady = " &
lstMalady.ItemData(lstMalady.ListIndex)
    adoChecklist.Refresh

    lstChecklist.Clear
    With adoChecklist.Recordset
        .MoveFirst
        Do Until .EOF
            lstChecklist.AddItem !Question
            lstChecklist.ItemData(lstChecklist.NewIndex) = !Factor
            .MoveNext
        Loop
    End With

    ReDim ChecklistFactor(lstMalady.ListCount - 1) 'to store factor calculation of each malady

Exit Sub

ErrHandler:

If Err.Number = 3021 Then 'no current record
    Err.Clear
Else
    MsgBox Err.Description & Str(Err.Number), vbCritical
End If

End Sub

Private Sub mnuAbout_Click()

    frmAbout.Show vbModal, Me

End Sub

Private Sub mnuAddNewPatient_Click()

    Load frmPatientDetails
    frmPatientDetails.SetCurrentNRIC "" 'add new patient
    frmPatientDetails.Show vbModal, Me
    staMain.Panels("patient").Text = CurrentPatientID

End Sub

```



```
Private Sub mnuChangePassword_Click()
```

```
    frmPassword.Show vbModal, Me
```

```
End Sub
```

```
Private Sub mnuPatientList_Click()
```

```
    frmPatientList.Show vbModal, Me  
    staMain.Panels("patient").Text = CurrentPatientID
```

```
End Sub
```

```
Private Sub mnuLogout_Click()
```

```
    Unload Me
```

```
End Sub
```

```
Private Sub mnuDiagnose_Click()
```

```
    Dim Ans As VbMsgBoxResult
```

```
    If cmdBack.Enabled Then 'a diagnosis session is in progress
```

```
        Ans = MsgBox("A diagnosis session is in progress. Are you sure to discard this session and start a  
new diagnosis session?", vbQuestion + vbYesNo)
```

```
        If Ans = vbNo Then Exit Sub
```

```
    End If
```

```
    'prepare all controls to perform diagnosis beginning at 1st step (symptom)
```

```
    cmdBack.Enabled = False
```

```
    cmdNext.Enabled = True
```

```
    DiagnosisStep = Symptom 'begin with 1st step (symptom)
```

```
    ManageDiagnosisStep DiagnosisStep
```

```
End Sub
```

```
Private Sub mnuViewReport_Click()
```

```
    frmViewReport.Show vbModal, Me
```

```
End Sub
```

```
Private Sub tlbMain_ButtonClick(ByVal Button As MSComctlLib.Button)
```

```
    Select Case Button.Key
```

```
        Case "addpatient"
```

```
            mnuAddNewPatient_Click
```

```
        Case "patientlist"
```

```
            mnuPatientList_Click
```

```
        Case "diagnose"
```

```
            mnuDiagnose_Click
```

```
        Case "viewreport"
```

```
            mnuViewReport_Click
```

```
        Case "logout"
```

End Sub

Private Sub Form_Load()

Me.Caption = App.Title & " - Patient Details"

adoPatient.ConnectionString = ConnectionString
adoPatient.CursorLocation = adUseClient

End Sub

Public Sub SetCurrentNRIC(ByVal NRIC As String)

CurrentNRIC = NRIC
LoadPatientDetails

End Sub

Private Sub LoadPatientDetails()

Dim SQL As String

With adoPatient

'determine whether this form is used to add new patient details or to edit existing patient details

If CurrentNRIC = "" Then 'addnew

SQL = "select * from Patient"

.RecordSource = SQL

.Refresh

.Recordset.AddNew

Else 'edit

SQL = "select * from patient where nric=" & CurrentNRIC & ""

.RecordSource = SQL ' SQL, MyConnection, , adLockOptimistic

.Refresh

End If

End With

Dirty = False 'form field has not been changed

End Sub

Private Sub txtAddress_Change()

Dirty = True

End Sub

Private Sub txtAge_Change()

Dirty = True

End Sub

Private Sub txtHeight_Change()

Dirty = True

End Sub

Private Sub txtName_Change()

 Dirty = True

End Sub

Private Sub txtNRIC_Change()

 Dirty = True

End Sub

Private Sub txtPhone_Change()

 Dirty = True

End Sub

Private Sub txtWeight_Change()

 Dirty = True

End Sub

Option Explicit

Private Sub cmdClose_Click()

 Unload Me

End Sub

Private Sub cmdDelete_Click()

 Dim Ans As VbMsgBoxResult

 Ans = MsgBox("Delete a patient's record will automatically erase all medical records of that patient."
& vbNewLine & "Are you sure to delete record " & adoPatient.Recordset!NRIC & " (" &
adoPatient.Recordset!Name & ")?", vbYesNo + vbQuestion)

 If Ans = vbYes Then

 adoPatient.Recordset.Delete

 MsgBox "Record has been successfully deleted.", vbInformation

 End If

End Sub

Private Sub cmdDiagnose_Click()

 CurrentPatientID = txtNRIC.Text 'set current patient id

 DiagnosisStep = Symptom 'perform a new diagnosis

 Unload Me

 'frmSymptom.Show vbModal, frmMain

```

SQL = "select * from visitrecordtreatment"
With MyRecordset
    .Open SQL, MyConnection, , adLockOptimistic
    For Counter = 0 To lstTreatment.ListCount - 1
        .AddNew
        !VisitRecord = CurrentVisitRecord
        !Treatment = lstTreatment.ItemData(Counter)
        .Update
    Next Counter
    .Close
End With

'create entry into visitrecordmalady
SQL = "select * from visitrecordmalady"
With MyRecordset
    .Open SQL, MyConnection, , adLockOptimistic
    For Counter = 0 To lstMalady.ListCount - 1
        .AddNew
        !VisitRecord = CurrentVisitRecord
        !Malady = lstMalady.ItemData(Counter)
        !TestResultPercentage = ChecklistFactor(Counter)
        .Update
    Next Counter
    .Close
End With

MsgBox "Report has been successfully saved.", vbInformation
cmdSaveReport.Enabled = False

Set MyRecordset = Nothing

End Sub
Option Explicit

Private Dirty As Boolean 'track any changes
Private CurrentNRIC As String

Private Sub cmdCancel_Click()

    Dim Ans As VbMsgBoxResult

    If Dirty Then
        Ans = MsgBox("Discard changes?", vbYesNo + vbQuestion)
        If Ans = vbNo Then Exit Sub
    End If

    Unload Me

End Sub

Private Sub cmdSave_Click()

    adoPatient.Recordset.Update
    MsgBox "Patient record has been successfully updated.", vbInformation
    CurrentPatientID = txtNRIC.Text
    Unload Me

```

```

Dim SQL As String
Dim MaladyList As String
Dim Counter As Integer

'construct malady list
With lstMalady
    For Counter = 0 To .ListCount - 1
        If .Selected(Counter) Then MaladyList = MaladyList & .ItemData(Counter) & ", "
    Next Counter
    MaladyList = Left(MaladyList, Len(MaladyList) - 2) 'discard the last comma (,)
End With

'get treatment based on given malady list
SQL = "select ID, Name from treatment, maladytreatment where
maladytreatment.treatment=treatment.id and maladytreatment.malady in (" & MaladyList & ")"
Debug.Print SQL
With adoTreatment
    .RecordSource = SQL
    .Refresh
End With

'fill maladylist on the listbox
lstTreatment.Clear 'clear existing items lst
With adoTreatment.Recordset
    .MoveFirst
    Do While Not .EOF
        lstTreatment.AddItem !Name
        lstTreatment.ItemData(lstTreatment.NewIndex) = !ID
        .MoveNext
    Loop
End With

Exit Sub

Hell:

If Err.Number = 3021 Then 'no current record
    Err.Clear
Else
    MsgBox Err.Description & Str(Err.Number), vbCritical
End If

End Sub

Private Sub DoSaveReport()

    Dim SQL As String
    Dim Counter As Integer

    CurrentVisitRecord = CreateVisitRecord 'create a visit record and hold the reference no

    Set MyRecordset = New ADODB.Recordset

    'create entry into visitrecordtreatment

```

```
        mnuLogout_Click
    End Select
```

```
End Sub
```

```
Private Sub ManageDiagnosisStep(CurrentStep As enuDiagnosisSteps)
```

```
    'hide all diagnosis frames
    SetAllDiagnosisFrames False
```

```
    'show one frame based on current diagnosis step
```

```
    Select Case CurrentStep
        Case Symptom
            fraSymptom.Visible = True
            DoSymptom
        Case Checklist
            fraChecklist.Visible = True
            DoChecklist
        Case Diagnosis
            fraDiagnosis.Visible = True
            DoDiagnosis
        Case Treatment
            fraTreatment.Visible = True
            DoTreatment
    End Select
```

```
End Sub
```

```
Private Sub SetAllDiagnosisFrames(ByVal Status As Boolean)
```

```
    fraSymptom.Visible = Status
    fraChecklist.Visible = Status
    fraDiagnosis.Visible = Status
    fraTreatment.Visible = Status
```

```
End Sub
```

```
Private Sub SetDiagnosisControls(ByVal Status As Boolean)
```

```
    mnuDiagnosis.Enabled = Status
    cmdNext.Enabled = Status
    If DiagnosisStep = Symptom And Status Then cmdBack.Enabled = False
    tlbMain.Buttons("diagnose").Enabled = Status
    tlbMain.Buttons("viewreport").Enabled = Status
    'Debug.Print DiagnosisStep
    ManageDiagnosisStep DiagnosisStep
```

```
End Sub
```

```
Private Sub DoSymptom()
```

```
    Dim SQL As String
```

```
    'SQL = "select ID, Name & ' - ' & Description as Symptom from symptom order by Name"
    SQL = "select ID, ID & ' . ' & Name & ' - ' & Description as Symptom from symptom order by ID"
    'temporary
```

```

With adoSymptom
    .RecordSource = SQL
    .Refresh
End With

With adoSymptom.Recordset
    .MoveFirst
    Do While Not .EOF
        lstSymptom.AddItem !Symptom
        lstSymptom.ItemData(lstSymptom.NewIndex) = !ID
        .MoveNext
    Loop
End With

End Sub

Private Sub DoChecklist()

    Dim SQL As String
    Dim SymptomList As String
    Dim Counter As Integer

    'construct symptom list
    With lstSymptom
        For Counter = 0 To .ListCount - 1
            If .Selected(Counter) Then SymptomList = SymptomList & .ItemData(Counter) & ", "
        Next Counter
        If Len(SymptomList) > 0 Then
            SymptomList = Left(SymptomList, Len(SymptomList) - 2) 'discard the last comma (,)
        Else
            MsgBox "No symptom was selected.", vbExclamation
            Exit Sub
        End If
    End With

    'get malady based on given symptom list
    SQL = "Select distinct ID, Name from Malady, MaladySymptom where
maladysymptom.malady=malady.id and maladysymptom.symptom in (" & SymptomList & ")"

    With adoMaladyList
        .RecordSource = SQL
        .Refresh
    End With

    'fill maladylist on the listbox
    lstMalady.Clear 'clear existing items lst
    With adoMaladyList.Recordset
        .MoveFirst
        Do While Not .EOF
            lstMalady.AddItem !Name
            lstMalady.ItemData(lstMalady.NewIndex) = !ID
            .MoveNext
        Loop
    End With
    cmdChecklist.Enabled = True

```

```
cmdEdit.Enabled = False
cmdDelete.Enabled = False
```

```
End Sub
```

```
Private Sub EnableButtons()
```

```
cmdDiagnose.Enabled = True
cmdEdit.Enabled = True
cmdDelete.Enabled = True
```

```
End Sub
```

```
Option Explicit
```

```
Private Sub cmdClose_Click()
```

```
Unload Me
```

```
End Sub
```

```
Private Sub dbcVisitDate_Change()
```

```
Dim VisitRecord As Long
```

```
rtfReport.Text = "" 'clear current report
VisitRecord = dbcVisitDate.BoundText 'get the visitrecord reference no
DoReport VisitRecord 'print a specific report
```

```
End Sub
```

```
Private Sub Form_Load()
```

```
Dim SQL As String
```

```
Me.Caption = App.Title & " - Report"
```

```
'automatically set all ado controls' connection string
```

```
Dim x As Control
```

```
For Each x In Me.Controls
```

```
    If TypeOf x Is Adode Then
```

```
        x.ConnectionString = ConnectionString
```

```
        x.CursorLocation = adUseClient
```

```
    End If
```

```
Next x
```

```
If CurrentPatientID = "" Then
```

```
    MsgBox "Please select a patient first.", vbExclamation
```

```
Else
```

```
    SQL = "select * from visitrecord where patient='" & CurrentPatientID & "' order by visitdate, referenceno"
```

```
    adoVisitRecord.RecordSource = SQL
```

```
    adoVisitRecord.Refresh
```

```
End If
```

```
End Sub
```



```
Private Sub DoReport(ByVal VisitRecord As Long)
```

```
    Dim SQL As String  
    Dim ReportItem As String
```

```
    Set MyRecordset = New ADODB.Recordset
```

```
    'diagnosis report  
    WriteReport "", True 'linebreak  
    WriteReport "Diagnosis Result:", True  
    SQL = "select Malady.Name, Malady.Description, Malady.Consultation,  
    VisitRecordMalady.TestResultPercentage from malady, visitrecordmalady where  
    visitrecordmalady.visitrecord=" & VisitRecord & " and visitrecordmalady.malady=malady.id"  
    Debug.Print SQL  
    With MyRecordset  
        .Open SQL, MyConnection  
        '.MoveFirst  
        Do While Not .EOF  
            WriteReport "Patient was analyzed with " & (!TestResultPercentage / 100)% probability of  
suffering from " & !Name & " (Description: " & !Description & "). " & !Consultation, True  
            .MoveNext  
        Loop  
    .Close  
End With
```

```
    'treatment  
    WriteReport "", True 'linebreak  
    WriteReport "Recommended Treatment:", True  
    'WriteReport "Patient was recommended to undergo "  
    SQL = "select Name, Description from treatment, visitrecordtreatment where visitrecord=" &  
VisitRecord & " and visitrecordtreatment.treatment=treatment.id"  
    Debug.Print SQL  
    With MyRecordset  
        .Open SQL, MyConnection  
        '.MoveFirst  
        Do While Not .EOF  
            WriteReport !Name & " - " & !Description, True  
            .MoveNext  
        Loop  
    .Close  
End With
```

```
    Set MyRecordset = Nothing
```

```
End Sub
```

```
Private Sub WriteReport(ByVal ReportString As String, Optional ByVal LineBreak As Boolean = False)
```

```
    rtfReport.Text = rtfReport.Text & ReportString  
    If LineBreak Then rtfReport.Text = rtfReport.Text & vbNewLine
```

```
End Sub
```

```

cmdChecklist_Click 'select the 1st malady on list

End Sub

Private Sub DoDiagnosis()

    On Error GoTo Hell

    Dim SQL As String
    Dim MaladyList As String
    Dim Counter As Integer

    'construct malady list
    With lstMalady
        For Counter = 0 To .ListCount - 1
            'If .Selected(Counter) Then MaladyList = MaladyList & .ItemData(Counter) & ", "
            MaladyList = MaladyList & .ItemData(Counter) & ", "
        Next Counter
        MaladyList = Left(MaladyList, Len(MaladyList) - 2) 'discard the last comma (,)
    End With

    'get diagnosis based on given malady list
    SQL = "select distinct ID, Name from diagnosis, maladydiagnosis where
maladydiagnosis.diagnosis=diagnosis.id and maladydiagnosis.malady in (" & MaladyList & ")"
    'Debug.Print SQL
    With adoDiagnosis
        .RecordSource = SQL
        .Refresh
    End With

    'fill maladylist on the listbox
    lstDiagnosis.Clear 'clear existing items
    With adoDiagnosis.Recordset
        .MoveFirst
        Do While Not .EOF
            lstDiagnosis.AddItem !Name
            lstDiagnosis.ItemData(lstDiagnosis.NewIndex) = !ID
            .MoveNext
        Loop
    End With

    Exit Sub

Hell:

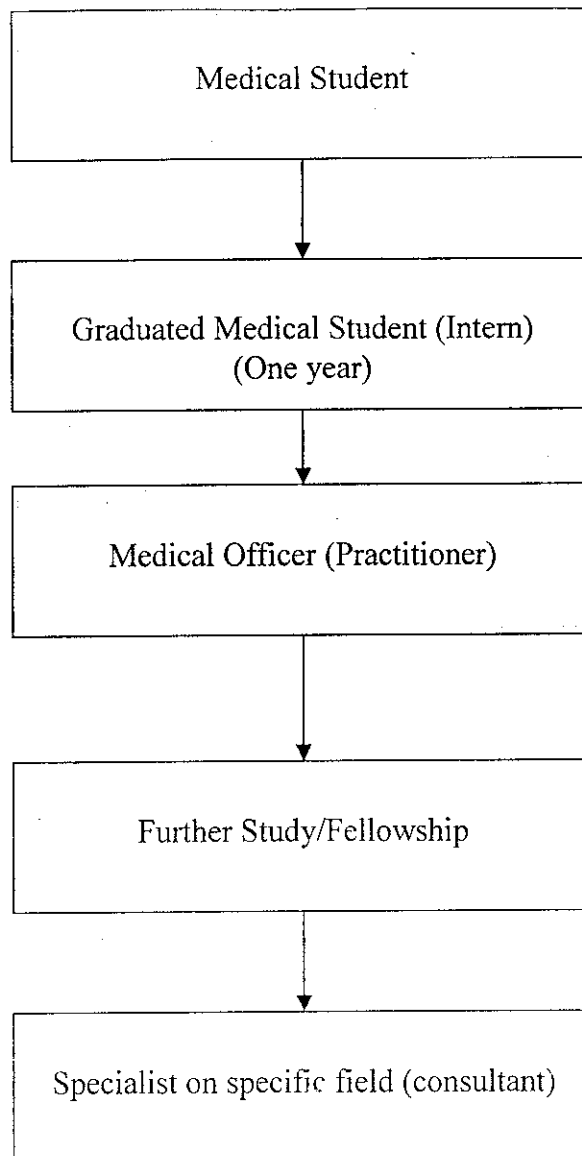
    If Err.Number = 3021 Then 'no current record
        Err.Clear
    Else
        MsgBox Err.Description & Str(Err.Number), vbCritical
    End If

End Sub

Private Sub DoTreatment()

    On Error GoTo Hell

```



Appendix 8-Stages of medical practitioners in Malaysia .Sources from MMC(Malaysian Medical Council)