CHAPTER 2

REVIEW OF LITERATURE

"One of the greatest joys known to man is to take a flight into ignorance in search of knowledge"

Robert Lynd

2.0 Review of Literature

2.1 Introduction

Review of literature is carried out with the intent to give the reader the background information regarding the research. It demonstrates the familiarity with research in the undertaken field whereby it shows how the work contributes one more piece in the puzzle of expanding the knowledge base in the respected field [Reed. 1998]. The literature review also demonstrates the understanding of the relevant works of others and the ability to summarize this information for the conveniences of the readers.

This chapter is divided into few sections. First, the definitions that apply to this study are given and followed by the general review on medical expertise. An example of a primary health care model is given, too. Reviews on the existing systems and the tools proposed for the development are also discussed. Finally, this chapter concludes with a sketch of a proposed system that will be developed for this project.

2.2 Definition of Terms

In this section, a number of definitions are introduced. These terms are directly related to this study. Therefore, it is necessary to clearly define the terms, first.

The Little Oxford Dictionary [Swannell, 1983] defines an **expertise** as follows:

> "Expert opinion or skill or knowledge".

And, the term **expert** is defined as:

> "Trained by practice, well-informed, skillful - a person having special skill or knowledge".

The term **specialist** is defined as:

> "A person who devotes himself to particular branch of profession etc. esp. medicine, or gives special attention to a thing".

And, the term **specialty** is defined as:

> "Special feature or characteristic; special pursuit, product, etc.; thing in which a person or place specializes."

The *Dorland's Pocket Medical Dictionary* [Saunders, 1989] defines a **specialist** as follows:

> "Specialist is a physician whose practice is limited to a particular branch of medicine or surgery, especially one who, by virtue of advanced training, is certified by a specialty board as being qualified to so limit his practice".

And, the term **specialty** is defined as :

> "Specialty is the field of practice of a specialist".

In this report, the terms medical expertise and specialist will be used interchangeably.

2.3 General Review on Medical Expertise

2.3.1 Roles of Medical Expertise

Some of the roles of medical expertise in Malaysia are listed in table 2.1. The meaning for all of these medical expertise were retrieved from the on-line medical dictionary [On-line Medical Dictionary, 1998].

Specialist	*Definition*
Cardiologist	A medically qualified specialist in internal medicine who has sub specialized in the diseases of the heart and blood vessels.
Dermatologist	A specialist expert in the treatment of disorders of the skin.
General Practitioner	A medically qualified doctor who practices general medicine as a family practitioner.
Neurologist	A physician who diagnoses and treats disorders of the nervous system.
Ophthalmologist	A physician specialist expert in the treatment of diseases of the eyeball and retina.
Orthopedic Surgeon	One who prevents, cures, or remedies deformities, esp. in children.
Pediatrician	A medical doctor who treats children and infants.
Pathologist	A doctor who specializes in identifying diseases by studying cells and tissues under a microscope.
Plastic Surgeon	A surgeon who specializes in reducing scarring or disfigurement that may occur as a result of accidents, birth defects, or treatment for diseases (such as melanoma).
Psychiatrist	A physician who specializes in the diagnosis and treatment of behavioural abnormalities and mental diseases.
Radiologist	A medically qualified doctor who specializes in the use of imaging techniques (X-rays, Ultrasound, CT, MR, fine needle

	biopsy etc) for diagnosis (diagnostic radiologist) or one who specializes in the use of imaging techniques in assisting treatment, for example in inserting catheters into blood vessels, in choking the blood supply of a tumour by injection of a type of glue etc. (interventional radiologist).

Table 2.1 : Partial List of the Roles of Medical Expertise

With some of the medical expertise listed above, it is best hoped that a clearer picture of the different roles of medical expertise is achieved.

2.3.2 Facts on Medical Expertise

A literature on the current number of medical expertise for each specialty could not be obtained. Attempts were also made to get the ratios of medical expertise from the organizations concerned, but to no avail. Moreover, information about individual medical expertise is normally not published by medical centres. However, various bodies have stated that the proportion of medical expertise in Malaysia physician workforce is far too low and have recommended significant increases in the production of new physicians in the primary care specialties.

2.3.3 Primary Health Care Model

The practice of medicine has been based on interaction of the patient and health care resource in the same place and at the same time. A typical scenario of the medical practice concerning the primary health care of patients is described below [Briggs and Bradley, 1997]:

A patient's first point of contact is usually his/her general practitioner (GP). Often the GP is able to treat the patient but sometimes the GP decides to refer the patient to another doctor who specializes in the illness affecting the patient. These specialist doctors usually work in hospitals and are known as "expertise" or "specialist". The GP might ask the expertise for advice about the patient, or ask the expertise to take over management of the patient's condition.

As can be noted in the last two lines (italicized text), patients do not have a choice but seek treatment from the referred expertise. They listen to whatever the expertise has to say and take that as the final verdict. But, as it was emphasized by Datuk Mohd. Farid Ariffin, "*Our advice to people is not to take the first opinion as the last opinion, but they should seek second and third opinions*" [Paying Attention to the Little Things, 2000]. This is due to the fact that many of them do not have the proper information about other medical specialists that are available. That was a typical scenario some time ago.

In our lives, we compare items of purchase on a daily basis. This means that we have analyzed our needs, searched for stores that carry the item and most of all, determine who has the best warranty and service after purchase. It is no denial that we are a society of information that demands quality and service. Determining the best doctor or medical expertise is not any different and it should be determined by us.

Therefore, anyone who experiences the often perplexing signs and symptoms of most diseases may find that the road to diagnosis and appropriate treatment is

often frustrating without proper information. That is why, it is important to find the right doctor with the qualifications and experience to recognize what may cause such symptoms and proceed effectively through a differential diagnosis and long-term treatment.

Presently, the scenario of health care has had changes. As the general population is more informed and literate, they choose the "best expertise" in the medical field despite being referred to by their GP. Most of them seek information from the Internet to get the best medical expertise that they are comfortable with.

Despite the advent of information technology, there was still a lack of system for patients in Malaysia to get the extra information in this area. There is yet a hospital or clinic that provides computer systems for searching of information on medical expertise, here in Malaysia. In view of that, a system that keeps track of medical expertise is very much needed. It will not only serve the public but also the medical community by having a system that integrates a number of functions.

2.4 Medical Organizations

A number of web pages on medical organizations were reviewed. Only two web pages are discussed here. They are MMA and AMA.

2.4.1 Malaysian Medical Association (MMA)

Malaysian Medical Association, the National Association for Medical Doctors was formed in 1959, with 509 founder members [MMA, 1998]. There are no links to find a physician in Malaysia at this site. But, however, there is a link at this

site to all of the medical centres comprising of a list of government and private hospitals and clinics in Malaysia. A visit was made to MMA, Kuala Lumpur in December to get more information pertaining to the project. However, much information could not be provided due to confidentiality of data.

2.4.2 American Medical Association (AMA)

The AMA is a professional association of physicians and medical students dedicated to the health of America. AMA was founded in 1847. This site maintains data on all US physicians and medical students. Furthermore, it contains a link, Doctor Finder, whereby one can select a doctor from a list of more than 650,000 doctors of medicine (MD) and doctors of osteopathy or osteopathic medicine (DO) [AMA, 2000]. The Doctor Finder site will be reviewed in the following section.

2.5 Reviews on Existing Systems

Reviews on the existing systems were carried out. The section that follows gives a brief description on each of the system.

2.5.1 AMA Physician Select - On-Line Doctor Finder

AMA Physician Select is compiled and published by the AMA as a reference source of demographic and professional information on individual physicians in the United States. AMA Physician Select provides a public service for individuals who wish to locate a physician [AMA Physician Select, 2000]. It is intended for use by

the general public to allow them quick access to information on physicians. However, the database of physician information does not contain sufficient information with which to verify physician credentials. Therefore, for further information about the services available, general users need to specifically verify physician credentials by referring to AMA.

The AMA Physician Select provides two search functions. These include search by physician specialty and name. A brief description is given below on the AMA Physician Select system.

i) Search by Physician Specialty

This search function performs a search by medical specialty. A user needs to select a medical specialty from the list of medical specialties and enter as much information as possible in the provided text box. The search by specialty option is based on a physician designated practice specialty. A 'sounds-like' search can be performed if a user is unsure of the exact spelling of a city, or if the search did not return the desired results. Fig. 2.1 shows a sample screen of search by specialty.

ii) Search by Physician Name

Meanwhile, the search by physician name allows a user to search a physician by name. A user can either enter the first name or the first letter of the first name, with the * sign (wild card), to help narrow the search. The physician's last name and state are required, too. Similarly, a 'sounds-like' search can be performed, if the user

is unsure of the exact spelling of the name or city, or if the search did not return the desired results. A sample screen of search by name is shown in fig. 2.2.

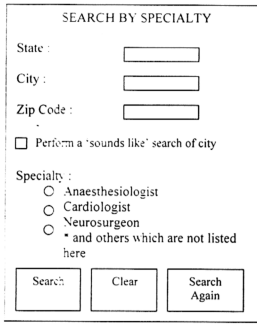


Fig. 2.1 : A Sample Screen of Search By Specialty

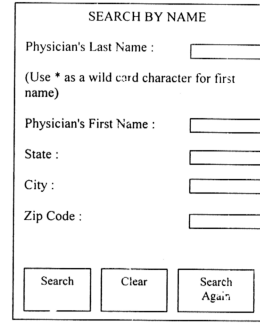


Fig. 2.2 : A Sample Screen of Search By Name

2.5.2 Find A PM&R Physician

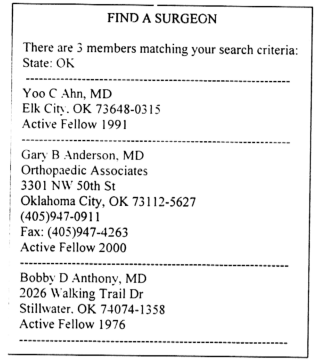
The Find a PM&R (Physical Medicine & Rehabilitation) Physician is a searchable database that allows a user to locate a PM&R physician in one's area particularly in the US. A search by state can be performed by clicking on the map to locate the desired medical expertise [AAPM&R, 2000]. If the alternate search method is chosen, the search for physicians in countries other than the United States can be performed by entering the last name, city, area code, zip code or country. A user can also type partial information in the fields to get a broader listing of the expertise.

2.5.3 Doctors On Call

Doctors On Call (DOC) is the largest medical professional directory on the Web. A right medical professional from the list of 400,000 doctors (and the list is growing daily) in the US can be searched. All of the specialists' names, locations, and phone numbers of nearly every physician in the US can be found here [Find A Doctor, 1998]. Users will be able to search their desired specialist by entering the required data in the provided text boxes.

2.5.4 Find A Surgeon

American Association of Orthopedic Surgeons (AAOS) does not track its members by specialty. This page allows a user to search for a member by last name and optionally first name, city, state, zip code, and country. A user, too, can search by a combination of fields. The percent sign, '%', can be used as a wildcard character in the search. As an example, 'ka%i' in the last name would return last names beginning with 'ka' and containing an 'i' in any other place in the last name. A user must either enter a last name, city, state, zip code, or country to perform the search [Find A Surgeon, 2000]. Fig. 2.3 shows a sample screen for the search results of Find A Surgeon.


FIND A SURGEON

There are 3 members matching your search criteria:
State: OK

Yoo C Ahn, MD
Elk City, OK 73648-0315
Active Fellow 1991

Gary B Anderson, MD
Orthopaedic Associates
3301 NW 50th St
Oklahoma City, OK 73112-5627
(405)947-0911
Fax: (405)947-4263
Active Fellow 2000

Bobby D Anthony, MD
2026 Walking Trail Dr
Stillwater, OK 74074-1358
Active Fellow 1976

Fig. 2.3 : Search Results for Find A Surgeon

2.5.5 Find An Ophthalmologist

The American Academy of Ophthalmology (AAO) has listed out the entire ophthalmologist in this page. The Find an Ophthalmologist can be performed by entering city, state and specialty of the desired ophthalmologist. Both the city and state are required to perform the search [AAO, 2000]. The figure below shows a sample screen for the search results of Find an Ophthalmologist.

Search Results for:
Lastname: john

Found 2 Records

Maurice E John , MD ,	Jeffersonville IN 47130	(812) 288-9011
Second Office	: Louisville KY 40207	(502) 894-8668
Practice Focus	: Refractive Surgery and Cataract/IOL	
Current Professional Activity	: Private Practice Group	
Hospital Privileges	: Clark Memorial Hosp	
Education	: MD, 1969, Univ Iowa	
Residency	: Univ Louisville, 1970-1974	
Teaching Position	: Clin Fac , Univ Louisville	
Certification.	: ABO-1975	

Thomas John , MD ,	Tinley Park IL 60477	(708) 429-2223
Practice Focus	: Cornea/External Disease and Cataract/IOL	
Current Professional Activity	: Private Practice Solo	
Hospital Privileges	: Little Company Mary	
Education	: MD, 1977, St Johns Med College	
Residency	: Univ Pennsylvania, 1981-1984, Harvard Med School, 1985-1987	
Fellowship	: Cornea/External Disease, Univ Rochester, 1984-1985, Anterior Segment	
Teaching Position	: Asst Prof , Loyola Univ Medical Center	
Certification	: ABO-1987	

Fig. 2.4 : Search Results for Find An Opthalmologist

2.5.6 Summary of Findings

A number of web pages on the Internet on medical associations were reviewed. It can be concluded that only the AMA has a link to search medical expertise throughout US. The others, such as MMA, BMA, AuMA and SMA web pages provide general information about their associations.

The Find a PM&R Physician site is a unique page as it is the only page that allows a user to click on the map of US to seek for the desired medical expertise in a state. The other sites are more or less the same, as the users are required to enter

information in the provided text boxes to perform a search. The features and limitations of the reviewed existing systems are as described below:

➔ *Features :* The search function of specialists for the AMA Physician Select, Find a PM&R Physician, DOC, Find a Surgeon and Find an Ophthalmologist can be performed by entering the specialty, state, city, zip code, physician's last or first name. A user, too, can perform a 'sounds like' search by using the wild card sign (*) or the percent sign (%) to help narrow the search. This enables a user to perform his/her search without worrying about the spelling of the words. The Find a PM&R Physician is the only system that has a distinctive feature whereby a user can perform a search by clicking on the map of US to locate the desired specialist in a particular state. Furthermore, the screens for all of the reviewed existing systems have been designed to be easy to use for the general users. Immediate retrieval of information of the medical expertise with access to the full details can be obtained by entering the required data in the text boxes provided.

➔ *Limitations :* A user needs to enter the state, city and zip code as well as select a specialty to perform a search in the Search by Physician Specialty at the AMA Physician Select system. If a user does not enter any one of the above (state, city, zip code and specialty), the search will not be performed. This limits a general user to perform a search, as he/she needs to enter the required data in order to get the desired results. Similarly, in the Find a Surgeon system, a user must enter a last name, city, state, zip code and country to perform the search. If those data are not entered, then the desired results will not be obtained. Meanwhile, the Find an Ophthalmologist system requires the city and state in order to perform a search.

In short, the AMA Physician Select – On Line Doctor Finder, Find a PM&R Physician, Doctors on Call, Find a Surgeon, Find an Ophthalmologist and a number of other sites are useful to the general public as it can be accessed at anywhere and any time. However, these sites mostly cater the need of the US population.

2.6 Proposed Tools for Development

A study was also carried out to determine the system development tools for this project. As the system to be developed needs a database implementation, report generation and statistical package, the following tools were decided. The section that follows gives a brief description on each of the tool.

2.6.1 Microsoft Visual Basic 6.0 Professional Edition

Microsoft Visual Basic 6.0 (henceforth referred to as VB) will be used for the program coding for the proposed system. It is the most productive tool for creating high-performance enterprise and Web-based applications. Moreover, more than 50 percent of all professional developers use the Visual Basic language. Integrated Visual Database Tools and a RAD environment promote productivity while native code compilation provides fast applications [McKelvy et al., 1997].

While developing VB 6.0, Microsoft addressed these important needs by focusing on the following data productivity objectives [Microsoft Visual Basic, 2000]:

- to provide a faster and more comprehensive data access. And also, to ensure that data access is fast and efficient through improved database drivers and data access components.
- to provide a comprehensive data connectivity to take advantage of existing data regardless of its form or location.
- to provide an integrated set of database design and programming tools. It means, to integrate the necessary tools for all phases of client/server programming, including database design and diagramming, query and stored procedure creation and debugging, and the creation of data-access components.
- to simplify the creation of data-centric applications for the mobile user.
- to provide support for the latest database management technology using ActiveX Data Objects (ADO) and OLE DB. Apart from that, it supports the latest relational and non-relational database technologies, including ODBC and OLE DB, with native SQL Server and Oracle OLE DB support. Version 6.0 also introduces ADO as the powerful new standard for data access in VB, while still supporting existing DAO and RDO data access interfaces.
- to provide an easier access to more data types by the creation of reusable data sources that can be shared across projects and developers. In addition, to provide an easy access to legacy or proprietary data.

VB 6.0 has many distinctive features. Among them are:

- access to all of one's enterprise data sources through ODBC, OLE DB, and Microsoft ActiveX® Data Objects (ADO). VB 6.0 introduces ADO as the powerful new standard for data access. They include OLE DB drivers such as SQL Server™ 6.5+, Oracle 7.3.3+, Microsoft Access, ODBC, and SNA Server.

- creation of custom data consumers and providers
- mobile computing support – e.g. write client/server applications that work with databases whether or not a connection exists with a LAN or the Web.
- high-performance, scalable application and component creation.
- increased data application development productivity and control.
- greater server application development support.
- a robust extensibility model for third-party support and availability of components and add-in technology.
- supports GUI, event handling and structured programming.

Therefore, VB 6.0 was chosen as the development tool for the program coding as it addresses many significant features.

2.6.2 Microsoft Access 97

Microsoft Access 97 for the Windows® 95 and Windows NT® operating systems (OS) provides relational database power that gives the information to make better decisions. It integrates data from spreadsheets and other databases and is the easy way to find answers and to share information. It offers greatly enhanced 32-bit performance with better data manipulation technology. Furthermore, databases created using Access can be manipulated through VB with a very high speed if compared to other DBMS.

VB for Applications, the programming language shared across all Microsoft Office 97 applications, provides sophisticated programming, interface, and debugging tools. ActiveX makes it a breeze to automate database functions, link to

other applications and objects, and deploy custom solutions with rapid, automated controls. New Access database projects allow Access users to create true client/server applications using the familiar Access interface [Microsoft Access, 2000]. The data can be retrieved from the database in a client/server-based system by using the ODBC driver for Access.

2.6.3 Seagate Crystal Reports 6.0

Reports are management tools. Their purpose is to help individuals quickly grasp the essential elements and relationships found in raw data so they can make effective decisions. For a report to be effective, it has to present the right data in a logical way. If it presents the wrong data or if it presents the right data in a haphazard manner, the report may slow the decision making process or even encourage incorrect decisions.

Seagate Crystal Reports 6.0 was chosen for the proposed system as it contains innovative features that continue to make it the premier choice for developers who need to integrate sophisticated reporting into their database applications [Crystal Reports, 1999]. It has many extensive capabilities and is designed to provide the greatest possible flexibility in designing reports. It has a wide variety of report types such as sub reports, conditional reports, summary reports, cross-tabs, form reports, drill-down, Top N, multiple detail reports, mailing labels, and others. Among the features of the Crystal Reports are as follows:

- fastest report processing
- presentation-quality reports can be created based on the end users demand

- report from virtually any data
- quick and easy report integration into web applications
- build a scalable web reporting solution

The custom reports done in Crystal Reports can be seamlessly integrated into a VB application. New databases can be designed and created in SQL Server or Access, or new programming can be done in VB to work with the existing SQL Server, Access, or ODBC / OLEDB / ADO compatible databases.

VB can be used to extend the power of Crystal Reports through the use of user-defined functions. Using VB, programming can be done to create additional functions in a .DLL that Crystal Reports will recognize. These custom functions then appear right along with the list of built-in functions when designing formulas in the Crystal Reports Designer [Crystal Reports, 1999].

2.6.4 Intercooled Stata 6.0

Intercooled Stata 6.0 (henceforth referred to as Stata) is a comprehensive package for data management and statistics with strong graphical facilities. It is available for virtually all personal computers (Windows, Macintosh, etc.) and mainframe (UNIX) platforms [StataCorp, 1999].

Stata incorporates the basic capabilities of spreadsheet programs, database managers, statistical packages, and graphics packages in an interactive environment, hence it is not a collection of separate modules. Statistical procedures available in Stata include general descriptive data analysis, analysis of variance, regression, survival analysis, probit and logit analysis, and nonparametric data analysis. Basic

statistics such as summaries, cross-tabulations, correlations, t tests, equality of variance tests, tests of proportions, and others are also available.

Stata has two modes for use: interactive and batch. In interactive mode, sessions are run interactively from the command line. It is useful for exploring data and relationships. In practice, the command line procedure is very fast. The analysis itself is incredibly fast as Stata keeps the data in memory and there is online help for all commands [StataCorp, 1999]. In batch mode, analyses are run from scripts (.DO files). Most users run a log file for their session. This is in ASCII format and can be edited in a word processing programs or text editor. The list of review commands can be saved into a .DO file for editing and subsequent use in batch processing. Therefore, Stata is fully programmable whereby users can create their own routines. A major feature is the simplicity and ease of use, and the program's speed, which is primarily due to the fact that all data are stored in memory while being analyzed. In short. Stata is flexible and easy to use.

Stata was the preferred package for statistical computing for this project. It is due to:

- Stata is not expensive relative to other comprehensive programs (such as SPSS) on the market because:
  - the program includes all procedures: there are no extra modules to purchase.
  - there are no annual costs. The license that one receives is permanent.
  - updates (minor adjustments to the program) may be downloaded free from the Stata web site.
- Stata is a powerful package that can do almost any sensible statistical analysis
- very limited statistics can be performed in spreadsheet programs such as EXCEL

2.6.5 Macromedia Flash 3.0

Macromedia Flash (henceforth referred to as Flash) authoring software was first introduced in 1996 [Flash, 2000]. It is a vector graphics editor and an animation tool designed for creating the interface animations. It has become the standard for creating high-impact vector based Web sites that deliver sound, interactivity, graphics and animations and perform flawlessly across multiple browsers and platforms.

Pulsing musical tracks, sound effects, gorgeous animations, and innovative interfaces all converge in Flash. An array of dazzling effects can be created using the drawing tools in Flash or by importing artwork from favorite vector illustration tools, such as Macromedia FreeHand [Flash, 2000]. All graphics created in Flash appear smooth on screen (anti-aliased). Flash is easy to learn for developers of any skill level. Moreover, it does not sacrifice performance or increase the file size. Due to that, the Macromedia Flash 3.0 was chosen as the interface design tool for the introductory screen of the proposed system.

2.7 A Proposed System

From the reviews of the existing systems (section 2.5), the user section of the proposed system will have the search, view and printing capabilities. Meanwhile, the administration section of the proposed system will have integrated packages of reporting, statistical and database. The proposed system will specialize in integrating the details on medical expertise with information technology to empower decisions

in health care management and resource planning. The figure below shows a sketch of the proposed system.

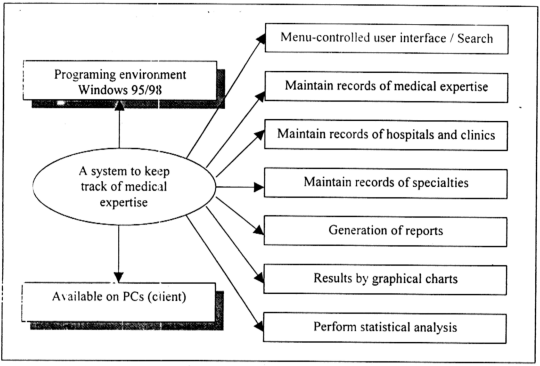


Fig 2.5 : A Sketch of the Proposed System

2.7.1 Client/Server Model

The proposed system will be a client/server-based system with a 3-tier architecture. Client-server architectural model is a distributed system model, which shows how data and processing is distributed across a range of processors. The major components of this model are [Sommerville, 1995]:

- a set of stand-alone servers which offer services to other sub-systems. Examples of servers are print servers, which offer printing services and database servers that offer data storage and processing.

- a set of clients that call on the services offered by servers. These are normally sub-systems in their own right. There may be several instances of a client program executing concurrently.
- a network which allows the clients to access these services.

One of the most important advantages of the client-server system model is that the distribution is straightforward. Effective use can be made of networked systems with many distributed processors [Sommerville, 1995]. Therefore, it is easy to add a new server and integrate it gradually with the rest of the system or to upgrade servers transparently without affecting other parts of the system.

2.7.2 Using Visual Basic in a 3-tier design

VB will be used to create the middle tier components of a 3-tier design. These middle tier components sit "between" the client programs (VB) and the database server (Access). Requests for data from the client programs are passed to the middle tier components, which retrieve the data and pass the results back to the client programs. The data can be retrieved from the database in a client/server-based system by using the ODBC driver for Access.

2.8 Summary

This chapter mainly discusses and makes an assessment of the literature pertaining to the existing systems and tools for the development. It begins by looking at the role of medical expertise and the typical primary health care model. Existing systems were also reviewed but all of these systems cater the need of the general

users. Some of the features of the reviewed systems were adopted in the proposed system for the user section. The features of the administration section for the proposed system are based on the need of the health care administrators, which will be discussed in the following chapter. From the literature review, a proposed system has been sketched and it will be the basis of the requirements gathering and the development of the system. All the proposed tools as discussed above will be integrated in VB. The integration of the tools is discussed in chapter five.

Finally, this chapter draws attention to the fact that, due to the rising perception of the need to produce improved health care management, appropriate tools should be developed. The medical community should be aware of these tools and their capabilities. At this point in time there are very few tools that directly address the issues of keeping track of the medical expertise. The proposed tool will be one of the first.