Medical Expert System Focusing on Diagnosis of Liver Cancer

by

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CERTIFICATION OF APPROVAL

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A project dissertation submitted to the
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Approved by,

_____
(Foong Oi Mean)

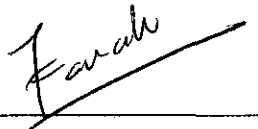
UNIVERSITI TEKNOLOGI PETRONAS

TRONOH, PERAK

JANUARY 2006

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.



FARAH WAHIDA BINTI YA'ACOB

ABSTRACT

This final year project is to develop Medical Expert System Focusing on Diagnosis of Liver Cancer that can help doctors to diagnose type of liver cancer in early stage. This project is targeted for doctors to help them in diagnosing early stage of liver cancer. The main objective of developing this project is to develop medical expert systems that can help doctor to early diagnose a specific type of cancer focusing on liver cancer. The scope of the project will focus on diagnose cancer based on Physical exam analysis, Health history analysis, and Blood tests result analysis. Based on the research, although a doctor and laboratory work may be essential to confirm a diagnosis, but there were some problems and disadvantage of that way of diagnosis. The major problem to diagnose cancer is to get the surest way to know whether the problem is cancer or not as there are some problems encountered in diagnosing blood diseases. The methodology basically involves overlapping Planning, Collection of data, Analysis, Design, and Implementation phase. Expert System development design process involved conceptual, gathering data, and physical design stages. This project is really helping the doctors in early diagnosing liver cancer. From the result, this Medical Expert System have an accurate result compared to expert's result. That is means this system is a good system to help doctor in diagnosis liver cancer.

ACKNOWLEDGEMENTS

IN THE NAME OF Allah most gracious, most merciful, Author would like to thanks to Allah SWT for the guidance and wisdom to fulfill my Final Year Project. Hereby, I would like to take this opportunity to convey my greatest appreciation to all people who have been very cooperative and supportive during the accomplishment of this Final Year Project.

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TABLE OF CONTENT

LIST OF FIGURES

LIST OF TABLES

ABBREVIATION AND NOMENCLATURES

MEDLICA	:	Medical Expert System Focusing on Diagnosis of Liver Cancer
DNA	:	Nucleic acid
AFP	:	Alpha-fetoprotein
hCG	:	Human chorionic gonadotropin
LDH	:	Lactate dehydrogenase
T	:	PRIMARY TUMOR
N	:	REGIONAL LYMPH NODES
M	:	DISTANT METASTASIS

CHAPTER 1

INTRODUCTION

1. INTRODUCTION

This chapter features the basic information of the project, which includes the background of the project, problem statement, the objectives and scope of the study.

1.1 Background of study

The number of new cases of cancer in the world is increasing each year. Cancer develops gradually as a result of a complex mix of factors related to environment, lifestyle, and heredity. The increase of cancer cases number has made a vital research to diagnose and treat the cancer. Nowadays, scientists have identified many ways to diagnosis cancer.

In the clinical term, Cancer is an uncontrolled replication of damaged cells. This condition usually produces a mass called a tumor. Cancer is the direct result of either a mutation of the cellular DNA or some sort of damage to the cellular DNA. For the cancerous cell to actually develop into a tumor, it must be able to grow and to replicate itself. A cancerous cell that cannot grow or make a copy of itself will die or lie dormant for an extended period.

There are many types of cancer that can be found in this world. One of the famous cancers is liver cancer. The liver is one of the largest organs in the body, filling the upper right side of the abdomen, inside the rib cage. The liver has two parts, a right lobe and a smaller left lobe. The liver has many important functions, including filtering

harmful substances from the blood so they can be passed from the body in stools and urine, Making bile to help digest fats from food, and storing glycogen (sugar), which the body uses for energy.

Frequently, patients with liver tumors are asymptomatic (have no symptoms) [2]. The diagnosis is made during an examination as part of a routine follow-up after cancer treatment. If a patient with colon cancer is going to develop metastatic disease in the liver, this will occur most likely within two years. Occasionally patients with liver tumors will develop symptoms such as pain, abdominal fullness, fever, or jaundice.

When the primary care physician finds a reason to suspect cancer in the liver, they will be advised to undergo a series of diagnostic tests. Some of these tests are noninvasive and require a brief visit to a clinic or lab. Others are more involved and may require an overnight stay in a hospital.

When scheduling the testing, consider scheduling the more difficult tests on separate days. While it may be less convenient, some tests may tire people and require a day or so of recovery. Consider scheduling the tests on days when a friend or family member can accompany the patient. Not only can this person provide support, but he or she can also assist technicians and medical personnel with patient's health history as well as help them keep you comfortable. The diagnostic testing can become quite stressful. Allow people as much time as possible to learn about the test and to recover from the testing experience. [1]

After diagnosis, doctor will find out the best treatment for the patients.

1.2 Problem statement

Nowadays, number of people that get a cancer has increase. Basically, there are about 200 different types of cancer affecting the different body tissues. What affects one body tissue may not affect another. For example, tobacco smoke that you breathe in may help to cause lung cancer. Over exposing your skin to the sun could give you a melanoma on your leg. But the sun won't give you lung cancer and smoking won't give you melanoma. [3]

Apart from infectious diseases, most illnesses are 'multi-factorial'. And cancer is no exception. Multi-factorial means that there are many factors involved. In other words, there is no single cause for any one cancer. Multi-factoral causes are such as Carcinogens, age, genetic make up, immune system, diet , day-to-day environment , and also Viruses.

If someone have a sign or symptom that might mean they have cancer, the doctor will do a physical exam and ask about your medical history. For time being, no single test can diagnose cancer, but laboratory tests of such things as blood and urine give doctors important information. The major problem to diagnose cancer is to get the surest way to know whether the problem is cancer. [4]

Typically, a physician will conduct various tests and exams. They may include imaging procedures, which produce pictures inside the body, or usage of various scopes, which allows the doctor to look directly inside certain organs; and laboratory tests.

In most cases, the doctor also orders a biopsy, a procedure in which a sample of tissue is removed. A pathologist examines the tissue under a microscope to check for cancer cells.

Although a doctor and laboratory work may be essential to confirm a diagnosis, but there were some problems and disadvantage of that way of diagnosis. The major problem to diagnose cancer is to know whether the problem is cancer or not. Usually, if the patient just only see the doctor, that doctor maybe not know the exact result from

the diagnose testing. Some doctors tent to think within his or her specialty, and may be biased by preconceptions, stereotyping, emotions or personal interests. As a human, doctor sometimes make a wrong conclusion about the diagnosis.[5]

1.3 Objective and scope of study

1.3.1 Objectives

i. To develop medical expert systems that can help doctor to early diagnose a specific type of cancer focusing on liver cancer.
ii. To understand the concept and development of rule-based expert systems.
iii. To develop medical expert systems that integrates knowledge of many doctors and researchers.
iv. To develop medical expert systems that is available at any time and anywhere.
v. To develop medical expert system that offers completes anonymity (if desired).

1.3.2 Scope of Study

This project focuses on the expert system services and features available in the application.

The main features of this project would be:

i. Help the Doctors to detect in early stage of liver cancer.
ii. Describe the stage of liver cancer.

The scopes of this project are focusing on this area:

i. Physical exam analysis

Physical exam analysis is an analysis of an examination of the body to check general signs of health, including checking for signs of disease, such as lumps or anything else that seems unusual. The testicles may be checked for lumps, swelling, or pain.

ii. Health history analysis

A history of the patient's health habits and past illnesses and treatments will also be taken. Scientists have found that people with certain risk factors are more likely than others to develop liver cancer. A risk factor is anything that increases a person's chance of developing a disease.

Studies have shown the example of risk factors are Chronic liver infection (hepatitis) B or (hepatitis) C, Cirrhosis, Aflatoxin, Family history (People who have family members with liver cancer may be more likely to get the disease).

iii. Blood tests result analysis

Many blood tests may be used to check for liver problems. One blood test detects alpha-fetoprotein (AFP). High AFP levels could be a sign of liver cancer.

CHAPTER 2

LITERATURE REVIEW / THEORY

2. LITERATURE REVIEW / THEORY

This chapter provides the background information of Medical Expert System and liver cancer diagnosis. This chapter also contains related findings on this field, consisting of relevant theories, hypotheses, facts and data, which are relevant to the objectives and findings of the project.

2.1 Definition of cancer

Cancer is any malignant growth or tumor caused by abnormal and uncontrolled cell division; it may spread to other parts of the body through the lymphatic system or the blood stream (astrology) a person who is born while the sun is in Cancer. a small zodiacal constellation in the northern hemisphere, between Leo and Gemini the fourth sign of the zodiac; the sun is in this sign from about June 21 to July 22 type genus of the family Cancridae.[26]

In other hand, cancer is defined as a class of diseases characterized by uncontrolled cell division and the ability of these cells to invade other tissues, either by direct growth into adjacent tissue (invasion) or by migration of cells to distant sites (metastasis). This unregulated growth is caused by a series of acquired or inherited mutations to DNA within cells, damaging genetic information that define the cell functions and removing normal control of cell division. [25]

2.2 Staging of liver cancer

The most important step before diagnosis of cancer is to accurately determine the stage of cancer. Stage describes how far the cancer has spread. Each stage of cancer may be treated differently. [6]

Staging is part of the diagnostic process and consists of gathering detailed information about the tumor to determine its *stage* of development. Staging is critical in determining if your cancer is advanced. The exact stage of the cancer will determine the treatment options. To determine the stage of disease, the physician uses a variety of diagnostic procedures to determine the type of tumor, size and location, and whether the tumor has metastasized or spread to another region of the body.

Primary liver cancer (or hepatocellular cancer), intrahepatic bile duct cancer (cholangiocarcinoma), are diseases that occur when the tumor originates in the liver and did not spread from another organ. In Asia and Africa, hepatocellular cancer is the most common type of malignancy and frequently develops in patients who have liver cirrhosis.

Each type of cancer has specific staging criteria. In general the different stages can be summarized as follows:

Stage I: Localized and Resectable

Tumor is found in one location of the liver and could be treated surgically.

Stage II: Localized and Possibly Resectable

Primary tumor is found in one or more locations in the liver and may be treated surgically. The decision to surgically treat the disease will depend upon the experience of the physician.

Stage III: Advanced

Cancer has spread to more than one location in the liver and/or to other parts of the body. Frequently requires multiple treatment modalities for maximum benefit. Often, surgical resection does not provide benefit to the patient.

Stage IV: Disseminated

Cancer involves multiple sites throughout the body. Frequently, surgery is not indicated and chemotherapy is the best option.

2.3 Cancer diagnosis

There are differences between Diagnosis and detection. Cancer may be detected when symptoms or abnormalities, such as a lump or growth, are recognized by a patient or doctor. After a cancer is detected, it still must be carefully diagnosed. The diagnosis is made during an examination as part of a routine follow-up after cancer treatment

A diagnosis is an identification of a particular type of cancer. When making a diagnosis, the initial signs and symptoms are investigated through a variety of tests in order to identify whether cancer is causing them and, if so, what type of cancer it is. For example, breast cancer may be detected when a patient notices a lump, but it must be carefully evaluated with a number of tests in order to determine an accurate diagnosis. The diagnosis describes what type of breast cancer it is (i.e. "ductal" if it started in the ducts of the breast or "lobular" if it started in the lobes) and how advanced it is.[9]

Diagnosis of primary liver cancer is generally made using blood tests, diagnostic imaging, surgical biopsy or laparoscopy, or a combination of the above. The alpha-fetoprotein blood test and ultrasound imaging of the liver are also used to screen high-risk populations (including those with hepatitis B and hepatitis C infections) for the disease. Since the risk of liver cancer is relatively low for healthy individuals, these tests are not used to screen the general population diagnosis of primary liver cancer is

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2.4 Physical examination

Physical exam is an important part of the early cancer diagnosis.The physical appearance will give the physician a sense of the overall health of the liver. Yellowing of the skin and/or eyes is called jaundice, a condition that occurs when there is a build up of bile in the bloodstream caused by a malfunctioning liver, bile duct or gall bladder. This may also cause dark colored urine and clay colored bowel movements.

The liver will be examined by feeling the right upper quadrant of the abdomen. This examination is usually done while patient are lying on their back and relaxed. The physician begins in the lower region moving in an upward position feeling for the overall shape and firmness of your liver. The size of the liver can be estimated by percussion (placing one finger on patient's rib cage and tapping it with another finger), which uses sound as a determinate. Patient will also be examined for the presence of ascites (fluid that accumulates in the abdomen).

The exam will also include an assessment of the axillary (armpit) and supraclavicular (above the collarbone) lymph nodes to determine if they are enlarged, which could indicate involvement with cancer.

2.5 Health History

A history of the patient's health habits and past illnesses and treatments will also be taken to help for early diagnosis. A thorough history would contribute to the final diagnosis and development of a treatment strategy.

If you have had cancer previously, the primary site (i.e. colon, rectum, breast) of the cancer will be evaluated to determine if the disease has recurred.

Scientists have found that people with certain risk factors with specific health habits are more likely than others to develop liver cancer. A risk factor is anything that increases person's chance of developing a disease.
Studies have shown the following risk factors:

2.5.1 Chronic liver infection (hepatitis)

Certain viruses can infect the liver. The infection may be chronic. (It may not go away.) The most important risk factor for liver cancer is a chronic infection with the hepatitis B virus or the hepatitis C virus. These viruses can be passed from person to person through blood (such as by sharing needles) or sexual contact. An infant may catch these viruses from an infected mother. Liver cancer can develop after many years of infection with the virus. These infections may not cause symptoms, but blood tests can show whether either virus is present. If so, the doctor may suggest treatment. Also, the doctor may discuss ways of avoiding infecting other people.
In people who are not already infected with hepatitis B virus, hepatitis B vaccine can prevent chronic hepatitis B infection and can protect against liver cancer. Researchers are now working to develop a vaccine to prevent hepatitis C infection.

2.5.2 Cirrhosis

Cirrhosis is a disease that develops when liver cells are damaged and replaced with scar tissue. Alcohol abuse, certain drugs and other chemicals, and certain viruses or parasites may cause cirrhosis. About 5 percent of people with cirrhosis develop liver cancer.

2.5.3 Aflatoxin

Liver cancer can be caused by aflatoxin, a harmful substance made by certain types of mold. Aflatoxin can form on peanuts, corn, and other nuts and grains. In Asia and Africa, aflatoxin contamination is a problem.

2.5.4 Being male

Men are twice as likely as women to get liver cancer.

2.5.5 Family history

People who have family members with liver cancer may be more likely to get the disease.

2.5.6 Age

Liver cancer occurs more often in people over age 60 than in younger people. The more risk factors a person has, the greater the chance that liver cancer will develop. However, many people with known risk factors for liver cancer do not develop the disease. People who think they may be at risk for liver cancer should discuss this concern with their doctor. The doctor may plan a schedule for checkups.

2.6 Blood Test

A procedure in which a sample of blood is examined to measure the amounts of certain substances released into the blood by organs, tissues, or tumor cells in the body. Certain substances are linked to specific types of cancer when found in increased levels in the blood. These are called tumor markers. Many blood tests may be used to check for liver problems. One blood test detects *alpha-fetoprotein* (AFP).

2.6.1 Alpha-fetoprotein (AFP)

Alpha-fetoprotein (AFP) is a protein that is normally present in high concentrations in the blood of fetuses but disappears shortly after birth. If it is found in the blood of adults it suggests they may have liver cancer.

Tests for AFP are used to look for early tumors in people at high risk for liver cancer.

In areas where hepatocellular cancer is very common, use of the AFP blood test for hepatocellular cancer screening has resulted in the detection of many tumors at an earlier stage.

Alpha-fetoprotein (AFP) is most useful in following the response to treatment for *liver cancer* (hepatocellular carcinoma). Normal levels of AFP are usually less than 20 nanograms per milliliter (ng/mL). A nanogram is one-billionth of a gram. AFP levels are higher than normal in 2 out of 3 patients with liver cancer. The level increases with the size of the tumor. In most patients with liver cancer, the level is more than 500 ng/mL, while in very small tumors the levels may be less than 20 ng/mL. AFP is also elevated in acute and chronic hepatitis, but is seldom above 100 ng/mL in these diseases.

AFP is also higher in certain testicular cancers (embryonal cell and endodermal sinus types) and is used for follow-up of these cancers. Elevated AFP levels are also seen in a

certain rare types of ovarian and testicular cancer called yolk sac tumor or mixed germ cell cancer. For conclusion, high AFP levels could be a sign of liver cancer.

2.7 Expert system

An expert system is a computer application that solves complicated problems that would otherwise require extensive human expertise. In the other hand, an expert system is a program, which attempts to mimic human expertise by applying inference methods to a specific body of knowledge called the domain. Knowledge is different from data or information in that data is passive. Knowledge on the other hand is active in that it can be used to infer new information from what is already known about a problem. [8]

To do so, it simulates the human reasoning process by applying specific knowledge and interfaces. Expert systems also use human knowledge to solve problems that normally would require human intelligence. These expert systems represent the expertise knowledge as data or rules within the computer. These rules and data can be called upon when needed to solve problems. Books and manual guides have a tremendous amount of knowledge but a human has to read and interpret the knowledge for it to be used. It is also called as a system that uses human knowledge captured in a computer to solve problems that ordinarily require human expertise
An intelligent computer program that uses knowledge and inference procedures to solve problems that was difficult enough to acquire significant human expertise for their solutions (Feigenbaum).

Expert systems typically have a number of several components. The knowledge base is the component that contains the knowledge obtained from the domain expert. Normally the way of representing knowledge is using rules. The inference engine is the component that manipulates the knowledge found in the knowledge base as needed to arrive at a result or solution. The user interface is the component that allows the user to query the system and receive the results of those queries. Many ES's also have an

explanation facility which explains why a question was asked or how a result or solution was obtained.

There are several major application areas of expert system such as agriculture, education, environment, law manufacturing, medicine power systems etc. In this article we will review about agriculture, education, environment and medicine expert system. These four applications widely use among the practitioners due to the maturity of the field by revealing the acceptance of the technology by the commercial sectors.

2.8 The advantages of the expert system

There are few advantages that the expert system being use in the agriculture field. First, it has the ability to imitate human thought and reasoning. Second, the expert system makes modification of knowledge very convenient. Third, it has the ability of interpretation makes interaction more user friendly. Fourth, with the machine learning technique knowledge can be acquired automatically and directly from experimental data and real time examples and helps to provide the right information which is timely and actionable. Sixth, it can provide expert level recommendations understandable to users. And lastly, it has the ability to handle uncertain information.

2.9 Exsys Corvid

EXSYS provides interactive expert system software and services that capture, automate and distribute problem-solving knowledge on the Web, and throughout organizations. For over two decades, EXSYS knowledge automation expert systems have been used by thousands of businesses worldwide providing significant costsavings and R.O.I., new revenue streams and a unique competitive edge.

Exsys CORVID is easy to learn and use. It is also a very powerful expert system development tool capable of handling a wide range of problems. Consequently, it has many options and controls that are used for advanced systems and special situations. Many of these advanced features are not typically needed for most systems. This guide will introduce to the common controls that are all users need to build most systems and help users get started building your first system. Selecting an Appropriate Problem Exsys CORVID is designed to help users describe the logical steps in a decisionmaking process in a way that allows the knowledge to be delivered to others as if they were interacting with a human expert. This is actually very similar to the way users would explain how to solve a problem to a person.

CHAPTER 3

METHODOLOGY / PROJECT WORK

3. METHODOLOGY AND PROJECT WORK

This chapter contains the details description of the methodologies and procedures used to complete and achieve the objectives of this project.

3.1 Project approach.

3.1.1 Problem Selection
3.1.2 Knowledge Acquisition
3.1.3 Knowledge Representation
3.1.4 Development
3.1.5 Testing, Verification, Validation, Evaluation

3.1.1 Problem Selection

Problem Selection was choosing according to problems statements below;

i. Human Error during diagnosing cancer.
ii. Number of people that get a cancer has increase
iii. Doctor do not know the surest way to diagnose cancer
iv. Lack of Expertise

3.1.2 Knowledge Acquisition

Gather knowledge to be used in expert system is most important task to be done. The data and information gathered are acquired from the various sources such as the online journals and articles. The knowledge basically gathered from document and expert. All the data would be collected from the interview between the experts, research, lab test, and others.

The methodology adopted to design the expert system is illustrated in this flow chart:

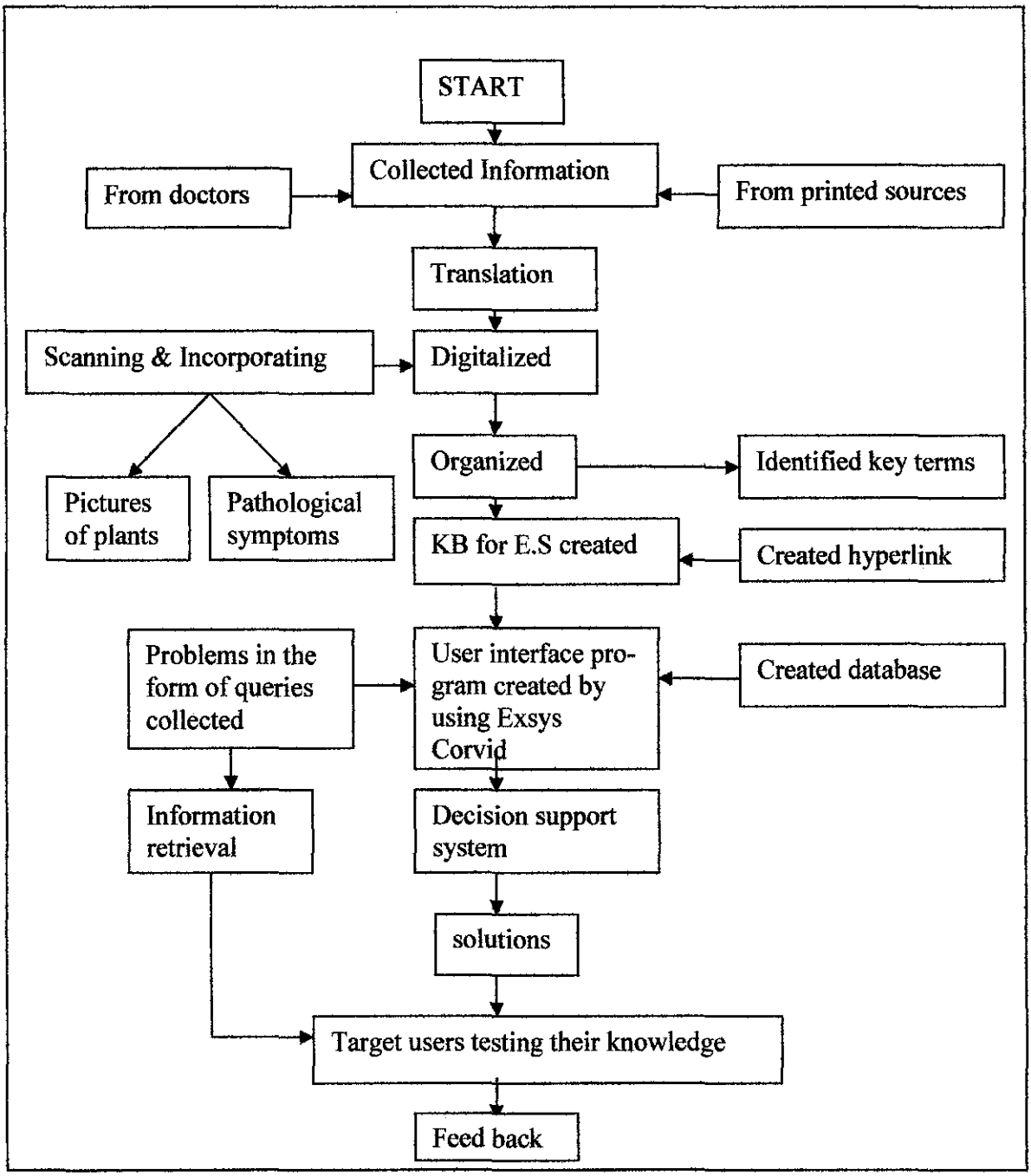


Figure 3.1: The methodology adopted to design the expert system

3.1.3 Knowledge Representation

After acquired the knowledge from various sources, the next step to be completed is to translate it into softcopy based form, and represent all the knowledge in the rules based.

Table 3.1: Cancer diagnose staging important information

STAGES	LIST OF TESTING TEST	High Risk	Low Risk
Medical history test	i. Chronic liver infection (hepatitis)	Yes	No
	ii. Cirrhosis	Yes, liver cells are damaged and replaced with scar tissue	No
	iii. Aflatoxin	Yes, a harmful substance made by certain types of mold	No
	iv. Family history	Other family members have liver cancer before	No, no family members have liver cancer before
	v. Being male	Man	Woman
	vi. Age	>60	<60
	vii. Alcohol abuse	Yes	No
	vii. Exposure to certain chemicals and toxins	Yes	No

Physical examination	i. Upper right abdomen pain	Always	Not have
	ii. Swelling in upper right abdomen	Yes	No
	iii. Abdominal pain extends to back and shoulder	Yes	No
	iv. Enlarged liver	Yes	No
	v. Weight loss	A big amount of weight loss in a short period of time	Normal weight
	vi. Malaise	Always	No
	vii. Loss of appetite	Always loss of appetite	No
	viii. Feeling of fullness	Always	No
	ix. Weakness	Always	No
	x. Fatigue	Always, although do a small work	No
	xi. Nausea	Always	No
	xii. Vomiting	Always, especially after eat something	No
	xiii. Fever	Always fell not well	No
	xiv. Jaundice a. Yellow	Yes	No

	skin b. Yellow eyes c. Darker urine		
Blood Test	Alpha-fetoprotein (AFP) level analysis	Level is more than 500 ng/mL	Less than 20 nanograms per milliliter (ng/mL)

3.1.4 Development

The project was developed using expert system programming, using EXSYS CORVID. EXSYS CORVID allow for easy development of rule based expert system.

Figure 3.2 shows the most important modules that make up a rule-based expert system. The user interacts with the system through a *user interface* which may use menus, natural language or any other style of interaction). Then an *inference engine* is used to reason with both the *expert knowledge* (extracted from our friendly expert) and data specific to the particular problem being solved. The expert knowledge will typically be in the form of a set of IF-THEN rules. The *case specific data* includes both data provided by the user and partial conclusions (along with certainty measures) based on this data. In a simple forward chaining rule-based system the case specific data will be the elements in *working memory*. Knowledge base contains facts and an inference procedure to utilize the knowledge, which is called as inference engine. An 'user interface' program has also been incorporated in the expert system, which enables an user to interact with the system.

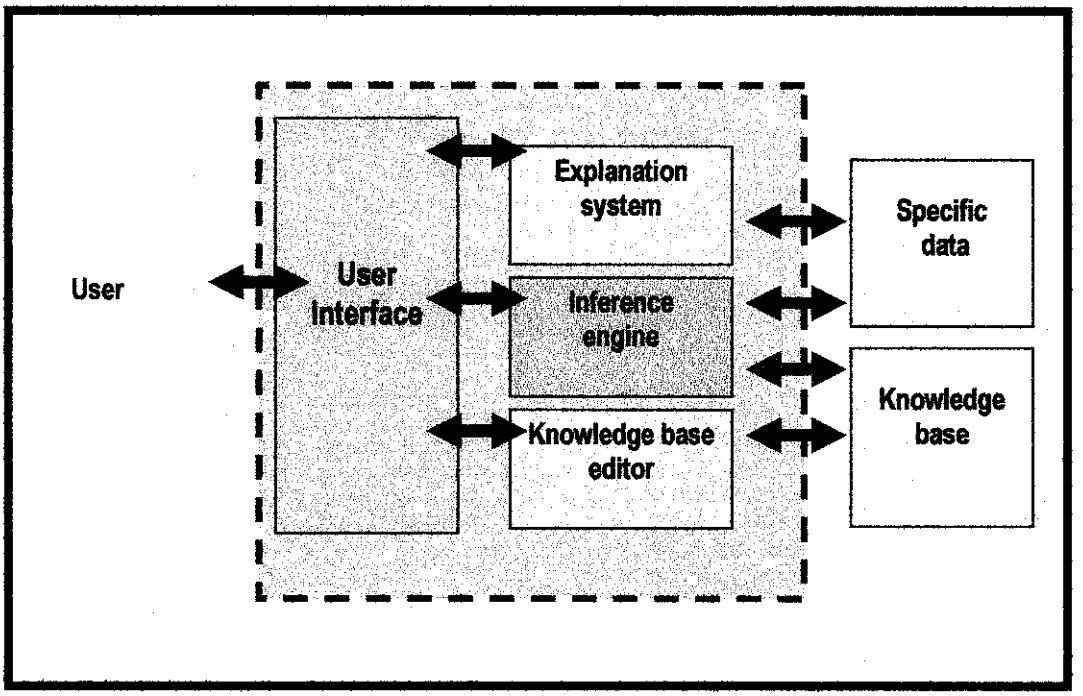


Figure 3.2: Expert System architecture [37]

Expert System Components

i. User Interface - tool used by the end-user to communicate with the expert system
ii. Knowledge Base - Storage of production rules
iii. Explanation facility - tool to describe to the end user reasoning scheme
iv. Working Memory - global database of facts used by the rules
v. Inference Engine - from the facts presented, determines which rules to use and executes the ones with the highest priority
vi. Stack - Inference engine created prioritized list of rules, whose patterns are satisfied by facts or objects in working memory
vii. Knowledge Acquisition Facility- tool to feed knowledge to the system

Image maps

Most of the questions and results are presented using image maps. These are JPG or GIF images with various regions marked as "hot spots". They either provide answers to questions or link to another HTML page. Image maps are a very flexible interface format since any graphics, text or images can be used. In this system, clicking on the various components in the wiring diagram will display more information on the item.

Frames

CORVID provides the option to display the information in a new browser window or in a named frame on the same page. In this system, named frames on a single page are used. As each question is asked, the lower frames are used to automatically display graphics, photos or information that might be needed. In addition, clicking on the tabs along the left side will display other links in these same frames. When desired, clicking on the "Images" tab will display a larger and more complex page in a new browser window for closer inspection.

Running the system

This system puts a lot of information on the screen in 3 frames. Because of this it is better to run it in a fairly large browser window. It is also best to have a video mode of at least 1024x768. Resize the browser window so that the entire Java applet in the top frame is visible. Since image maps are used extensively, and a GIF image is loaded for each question, you may see a slight delay between questions on slow Internet connections.

Screen Shot

Figure 3.3: Front Page of MEDLICA

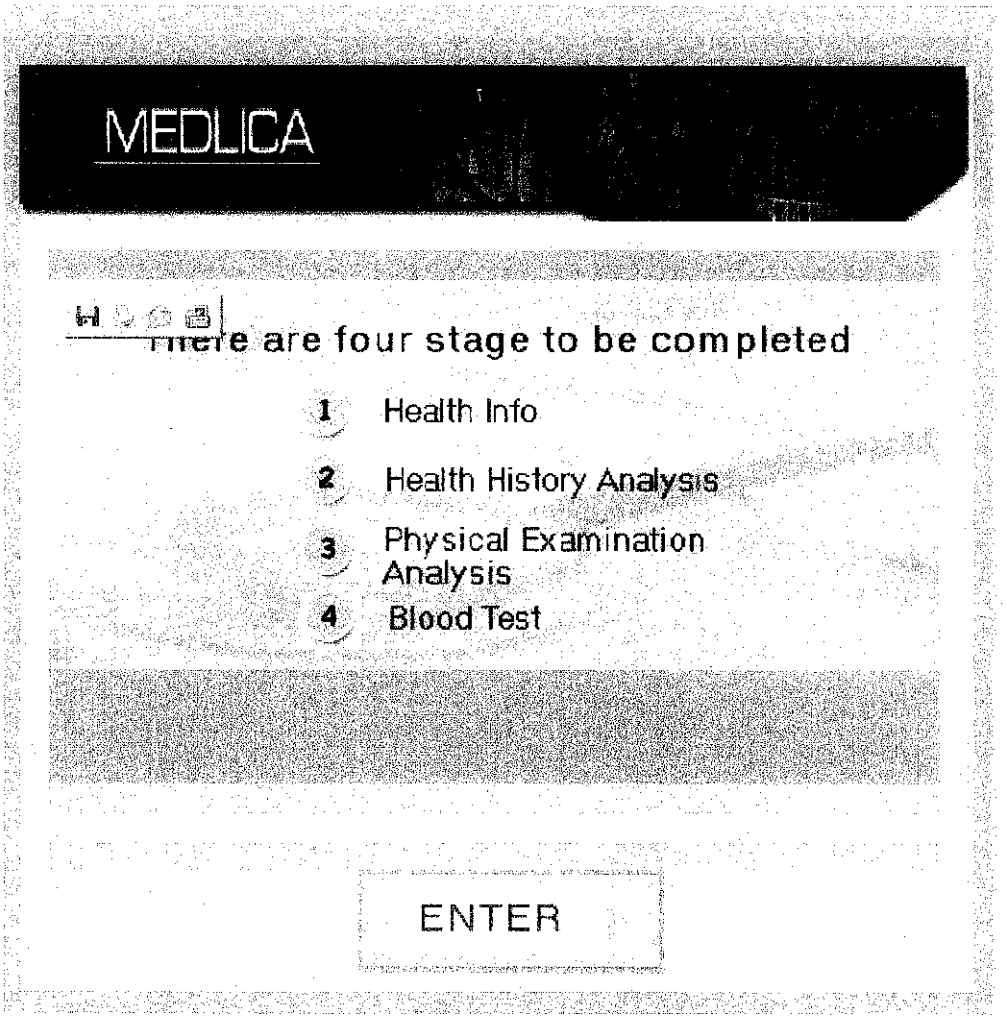


Figure 3.4: Four Stages to be completed

Figure 3.5: Questions stages for Heath Info

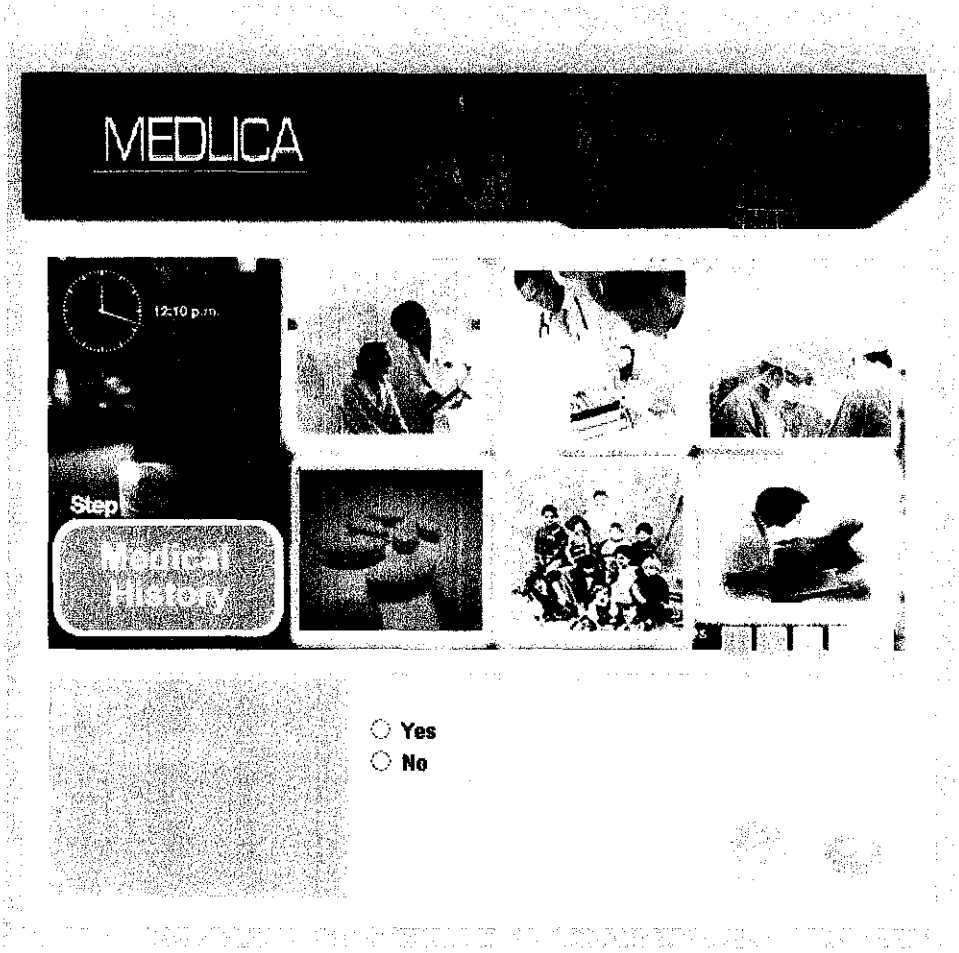


Figure 3.6: Questions stages for Medical History

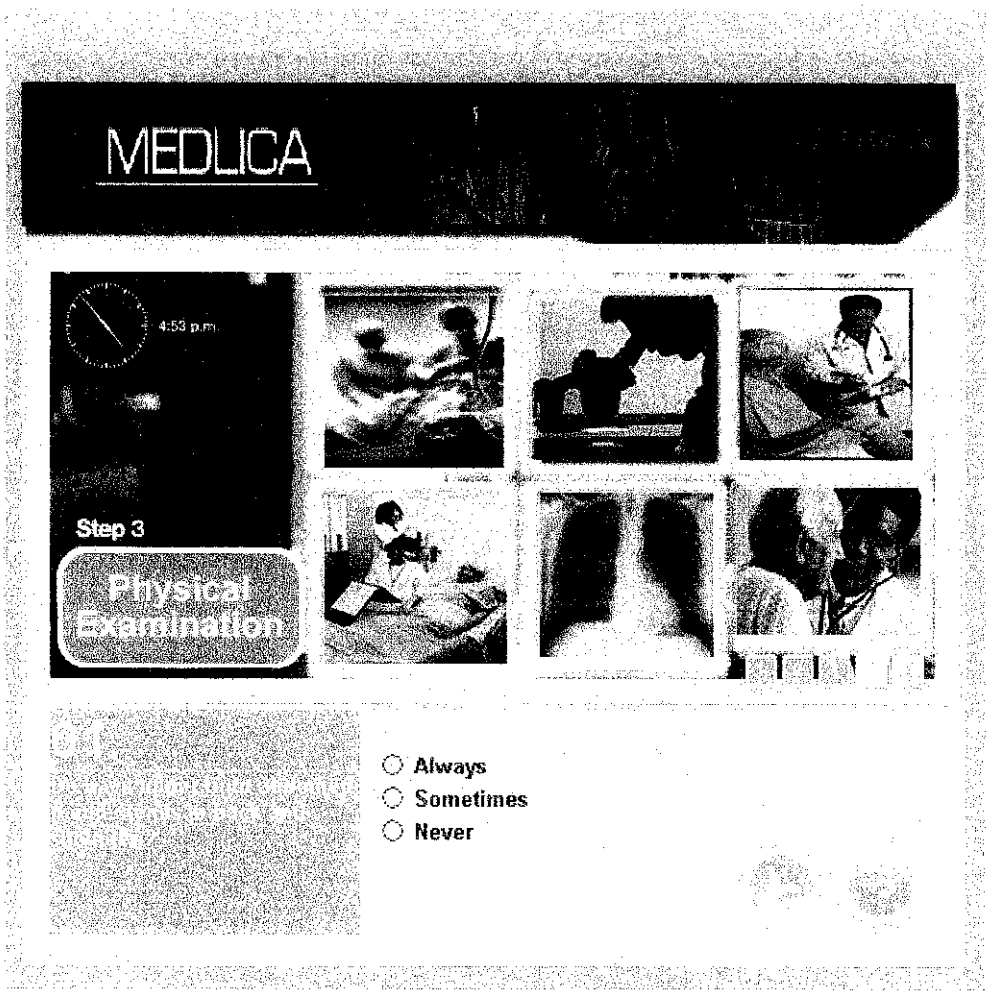


Figure 3.7: Questions stages for Physical Examination

Figure 3.8: Questions stages for Blood Test

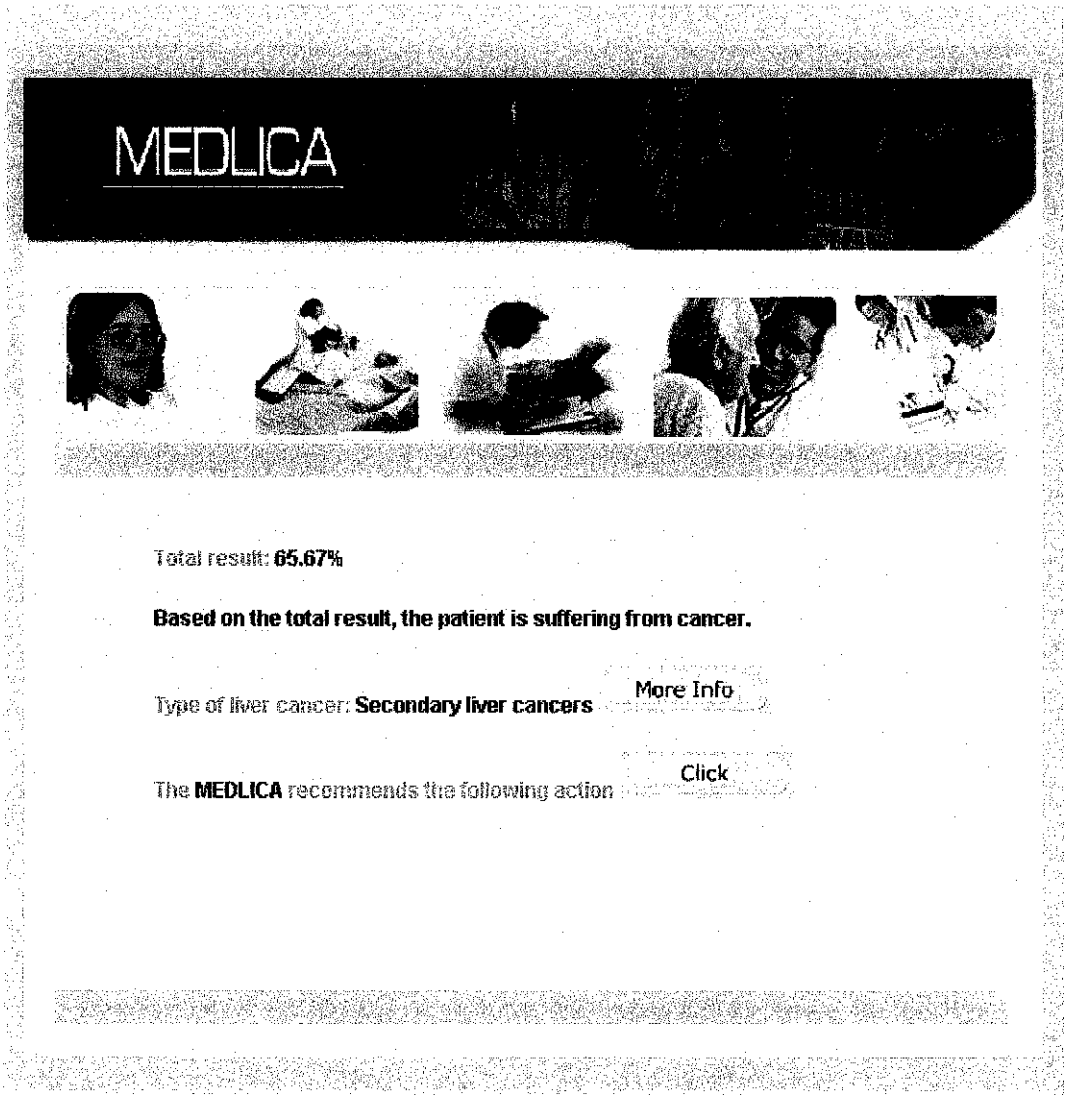


Figure 3.9: Result

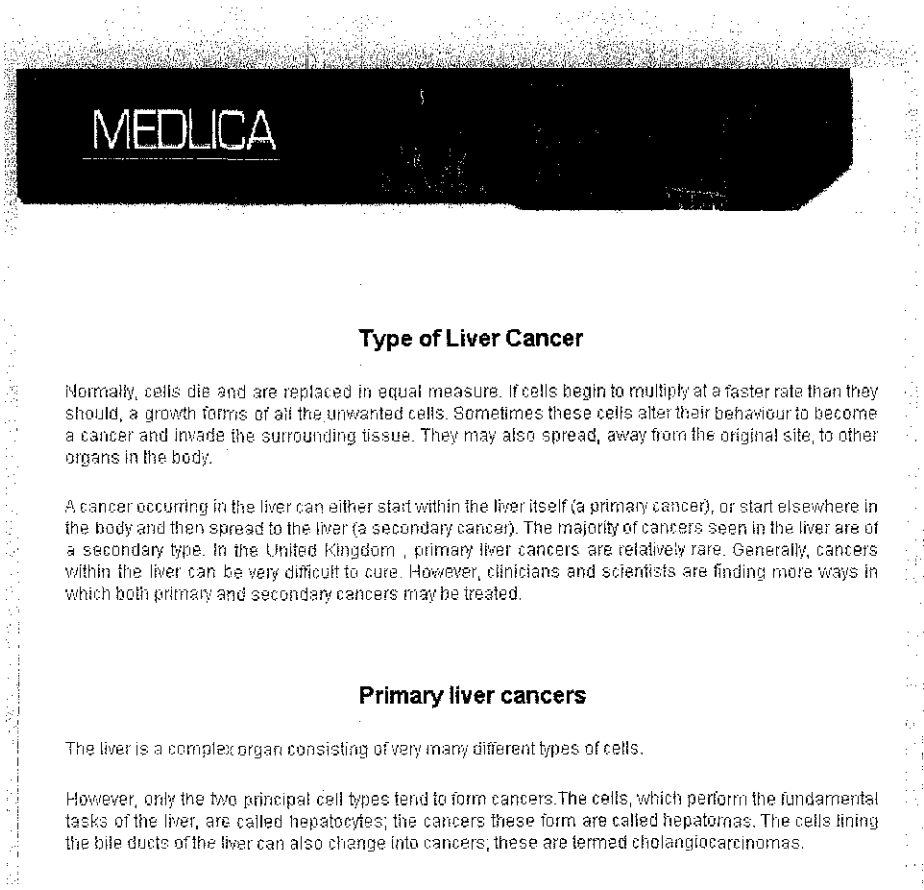


Figure 3.10: Information about the cancer that provided by the system.

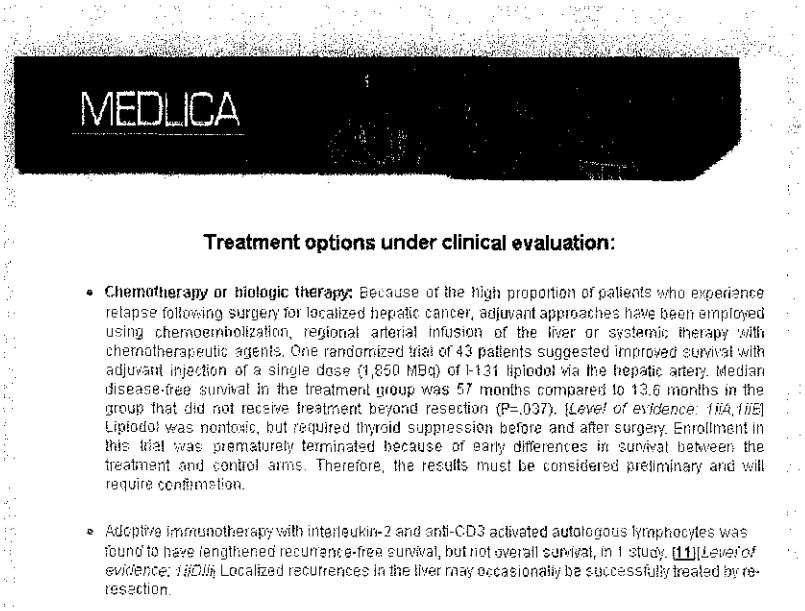


Figure 3.11: Information about the cancer that provided by the system.

3.1.5 Testing, Verification, Validation, Evaluation

Testing, Verification, Validation, and Evaluation are the final phase of the project development. This system will be tested and evaluated after the development processes are accomplished. If any problems or error found, a necessary action will be taken in order to repair it. The testing process will be done following to a Test Plan.

3.1 Tools Required

Software: EXSYS CORVID

CHAPTER 4

RESULTS AND DISCUSSION

4. RESULT AND DISCUSSION

The survey was conducted by distributed the questionnaire with 10 close-ended questions to a group of staff in Hospital Besar Ipoh. The questionnaire was distributed to gather the information about their opinion towards 'Medical Expert System to diagnose liver cancer', Level of acceptance of the 'Medical Expert System to diagnose liver cancer', and their level of knowledge of Medical Expert System.

4.1 Opinion towards 'Medical Expert System to diagnose liver cancer'

Based on the surveys, majority of the respondents have agreed that 'Medical Expert System' can help them to diagnose cancer. From the total survey, 70% of the respondents really agreed that 'Medical Expert System to diagnose liver cancer' can help to diagnose cancer. The second highest percentage denotes by the respondents who agree with 'Medical Expert System to diagnose liver cancer' that is 30% and 0% respondent neither agree nor disagree. The result of this survey can be evaluated and influence the respondents acceptance towards this research project.

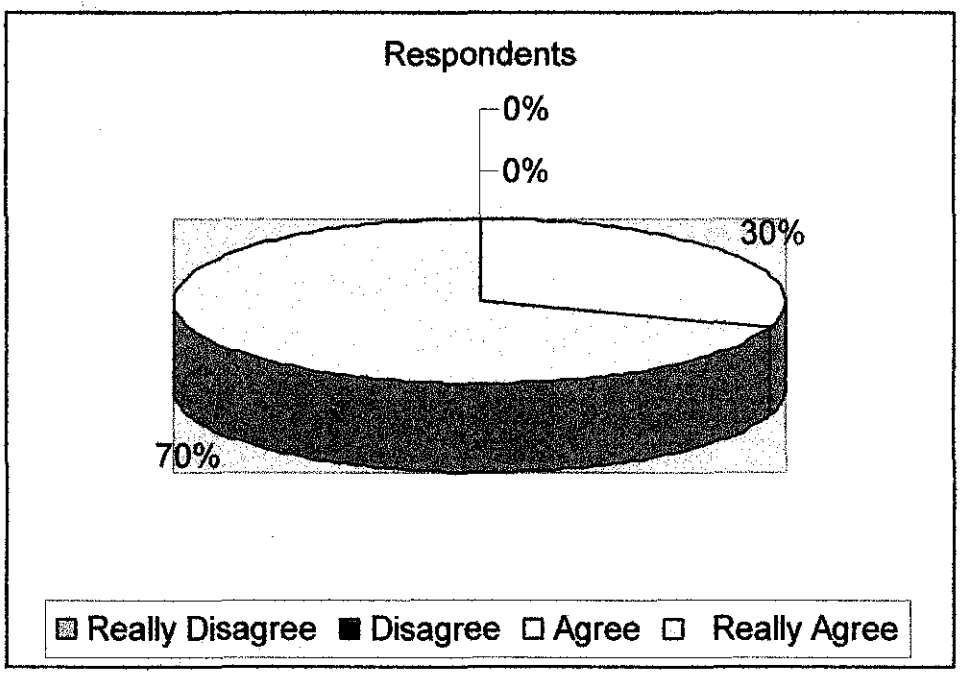


Figure 4.1: Opinion towards 'Medical Expert System to diagnose liver cancer'

4.2 Stage of acceptance towards 'Medical Expert System to diagnose liver cancer'

The survey also has been conducted to analyze the stage of acceptance of 'Medical Expert System to diagnose liver cancer'. From the survey's analysis, 30% of the total respondents strongly accept to implement 'Medical Expert System to diagnose liver cancer' in their hospital. 60% of the respondents accept to implement 'Medical Expert System to diagnose liver cancer'. The remaining of total number of respondent, 10% not accept on the system. 0% of the respondents strongly not accept.

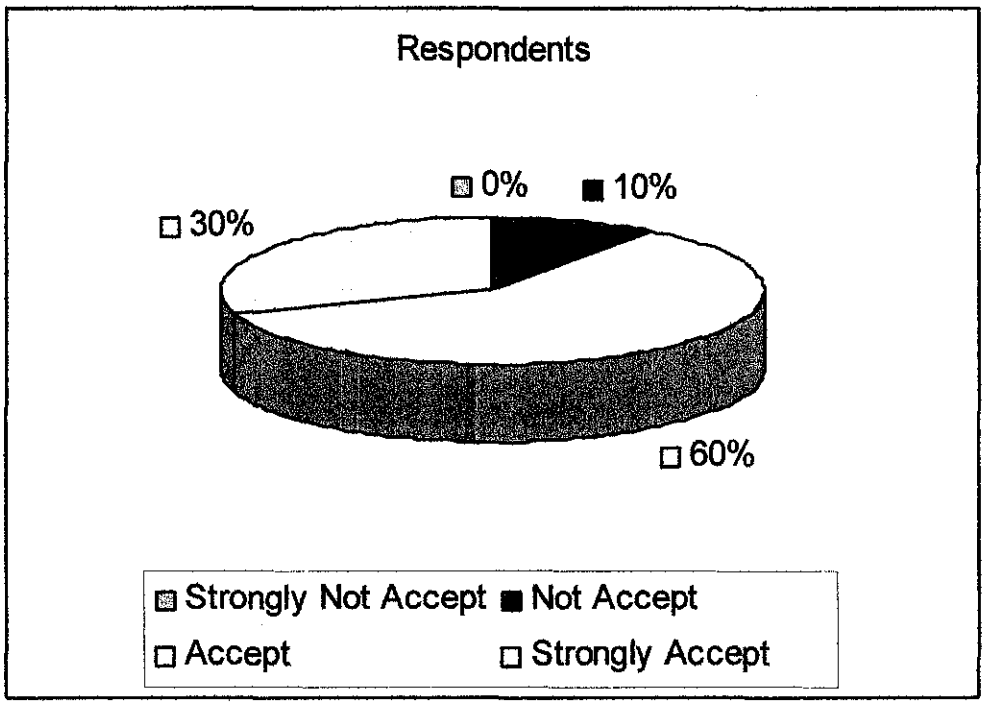


Figure 4.2: Stage of acceptance towards 'Medical Expert System to diagnose liver cancer'

4.3 Stage of staff's knowledge of Medical Expert System

Based on the surveys concerning the stage of staff's knowledge of Medical Expert System, 30% of staffs really expert in Medical Expert system, and 60% know how to use and handle Medical Expert System. About 10% of respondent do not know how to use Medical Expert System.

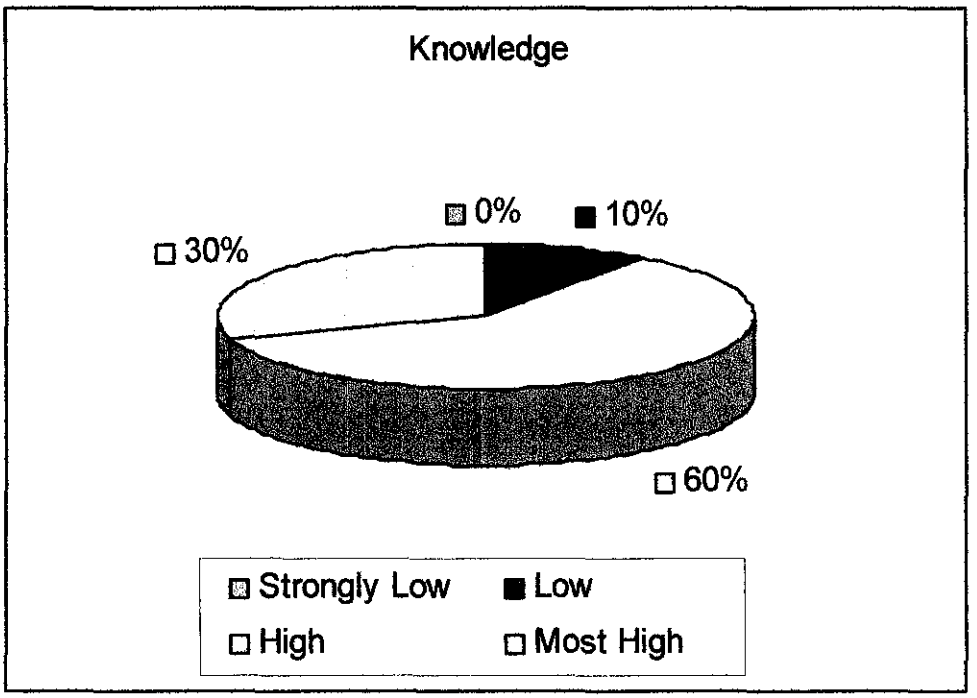


Figure 4.2: Stage of staff's knowledge of Medical Expert System

From the survey, majority of the respondents are satisfied and pleased with 'Medical Expert System to diagnose liver cancer'. This is directly shows that the system is acceptable among the staff in the hospital.

Majority of the respondents agree that 'Medical Expert System to diagnose liver cancer' would give a good impact in diagnosing liver cancer. Doctors in that hospital are expecting to have a better service in cancer diagnosing.

CHAPTER 5

CONCLUSION

This research is aimed to study on the expert system for liver cancer diagnosing. This expert system has proved to be a value – added and decision – aid information product in research library, which is the ultimate motive of designing this system. Such value-added, tailor made products will definitely attract more readers and motivate them to use the resources to the maximum extent.

Implementation of expert system in such fields is greatly influenced by techniques and methods from adaptive hypertext and hypermedia. Features of personalization, user modeling and ability of adaptive towards environment will become great challenges to settle. It can be used as a guideline to promote an expert system in various functions.

This paper has highlighted that Expert System is an innovative tool for managing knowledge in any domain.

REFERENCES

[1] General Hospital's, Liver Cancer Network Diagnosis,
<http://www.livercancer.com/diagnosis/staging.html,.htm
>, (Accessed in 3 Oct 2005).

[2] National Cancer Institute, Childhood Liver Cancer Treatment,
< http;\\\\National Cancer Institute ,
>, (Accessed in 5 Oct 2005).

[3] Cancer Research UK, What causes cancer,
< http://www.cancerhelp.org.uk,
>, (Accessed in 5 Oct 2005).

[4] Cancer Research Center, Diagnosis, screening and cancer detection,
< http://www.cancer.umn.edu/page/patients/diagnos.html,
>, (Accessed in 5 Oct 2005).

[5] Diagnose Me.com, Expert system\Diagnose-Me - Online Diagnosis - Diagnostic Tool,
< http://www.diagnose-me.com/index.html, >, (Accessed in 5 Oct 2005).

[6] Cancer Consultant, Introduction to Cancer Treatment_newly diagnosed,
< http://patient.cancerconsultants.com/diagnosed.aspx ,>,
(Accessed in 5 Oct 2005).

[7] Mayoclinik Diagnosis of Liver Cancer,
< (http://www.mayoclinic.org/livercancer-rst/diagnosis.html#ultrasound
,>,(Accessed in 5 Oct 2005).

[8] The Knowledge Based Systems Centre, Medical Expert Systems,
< http://www.computer.privateweb.at/judith/special_field3.htm#cancer ,>,
(Accessed in 5 Oct 2005).

[9] Cancer consultant, Disease of cancer,
<www.bio.hw.ac.uk/edintox/glossall.htm ,>,
(Accessed in Oct 2005).

[10] Doctor's Silent Partner, Medical Expert Systems,
< http://www.computer.privateweb.at/judith/special_field3.htm#antibiotics ,>,
(Accessed in Oct 2005).

[11] Expert System, Expert System in Real World Applications,
< http://www.generation5.org/content/2005/Expert_System.asp
,>,(Accessed in Oct 2005).

[12] Cancer, Cancer Help,
< http://www.cancerhelp.org.uk/help/menuforthistopic.asp?page=85
,>,(Accessed in Nov 2005).

[13] liverTumor, Liver Tumor,
<http://www.livertumor.org/about.asp
,>,(Accessed in Nov 2005).

[14] Mayoclinic, Liver Tumor,
<http://www.mayoclinic.org/livercancer-rst/diagnosis.html#ultrasound
,>,(Accessed in Nov 2005).

[15] cancer backup, Primary Liver Cancer,
<http://www.cancerbacup.org.uk/Cancertype/Liver/Primarylivercancer
,>,(Accessed in Nov 2005).

[16] liver Cancer, cancer,
<http://www.mskcc.org/mskcc/html/
,>,(Accessed in Nov 2005).

[17] Raysahelian, cancer,
<http://www.raysahelian.com/livercancer.html
,>,(Accessed in Nov 2005).

[18] Wrongdiagnosis, Liver cancer,
<http://www.wrongdiagnosis.com/sym/enlarged_liver.htm
,>,(Accessed in Nov 2005).

[19] Wrongdiagnosis, symptoms,
<http://www.wrongdiagnosis.com/l/liver_cancer/symptoms.htm
,>,(Accessed in Nov 2005).

[20] Cancerbacup, Cancer type,
<http://www.cancerbacup.org.uk/Cancertype/Liver/Primarylivercancer
,>,(Accessed in Nov 2005).

[21] Livercancer, Cancer Staging,
< http://www.livercancer.com/diagnosis/staging.html
,>,(Accessed in Nov 2005).

[22] Cancer Backup, Primary Liver Cancer,
< http://www.cancerbacup.org.uk/Cancertype/Liver/Primarylivercancer
,>,(Accessed in Nov 2005).

[23] Mayoclinic, Ultrasound,
< http://www.mayoclinic.org/livercancer-rst/diagnosis.html#ultrasound
,>,(Accessed in Nov 2005).

[24] Cancer Consultation, Liver cancer,
< http://www.cancerconsultants.com/index.php
,>,(Accessed in Nov 2005).

[25] Wikipedia, Definition of cancer,
< en.wikipedia.org/wiki/Cancer
,>,(Accessed in Nov 2005).

[26] Princeton, Definition,
< wordnet.princeton.edu/perl/webwn
,>,(Accessed in Nov 2005).

[27] Stanford Cancer Cennter, Diagnosis,
<http://cancer.stanfordhospital.com/healthInfo/cancerDiagnosis/diagnosticImaging/
,>,(Accessed in Nov 2005).

[28] American Cancer Society Cancer Diagnosis,
<http://www.cancer.org
,>,(Accessed in Nov 2005).

[29] AMC Cancer Research Center and Foundation , Cancer Diagnosis,
<http://www.amc.org
,>,(Accessed in Nov 2005).

[30] Cancer Information Service, Cancer ,
<http://cis.nci.nih.gov
,>,(Accessed in Nov 2005).

[31] CNM Health, Cancer Definition ,
<www.cnn.com/HEALTH/library/DG/00022.html
,>,(Accessed in Nov 2005).

[32] Bio. HW, Cancer Definition,
<www.bio.hw.ac.uk/edintox/glossall.htm
,>,(Accessed in Nov 2005).

[33] Expert system gebaseerd,
<http://projects.edte.utwente.nl/pi/Java/ExpSystems/Physician.html
,>,(Accessed in Nov 2005).

[34] Expert Systems in Computer Animation Production Environments,
<http://web.ukonline.co.uk/victor/published/CADE95/CADE95.html
,>,(Accessed in Nov 2005).

[35] Oncolink, Types of Cancer,

< http://www.oncolink.upenn.edu/types/article.cfm?c=5&s=15&ss=113&id=9495,
>,(Accessed in Nov 2005).

[36] Medline Plus, Liver Cancer,

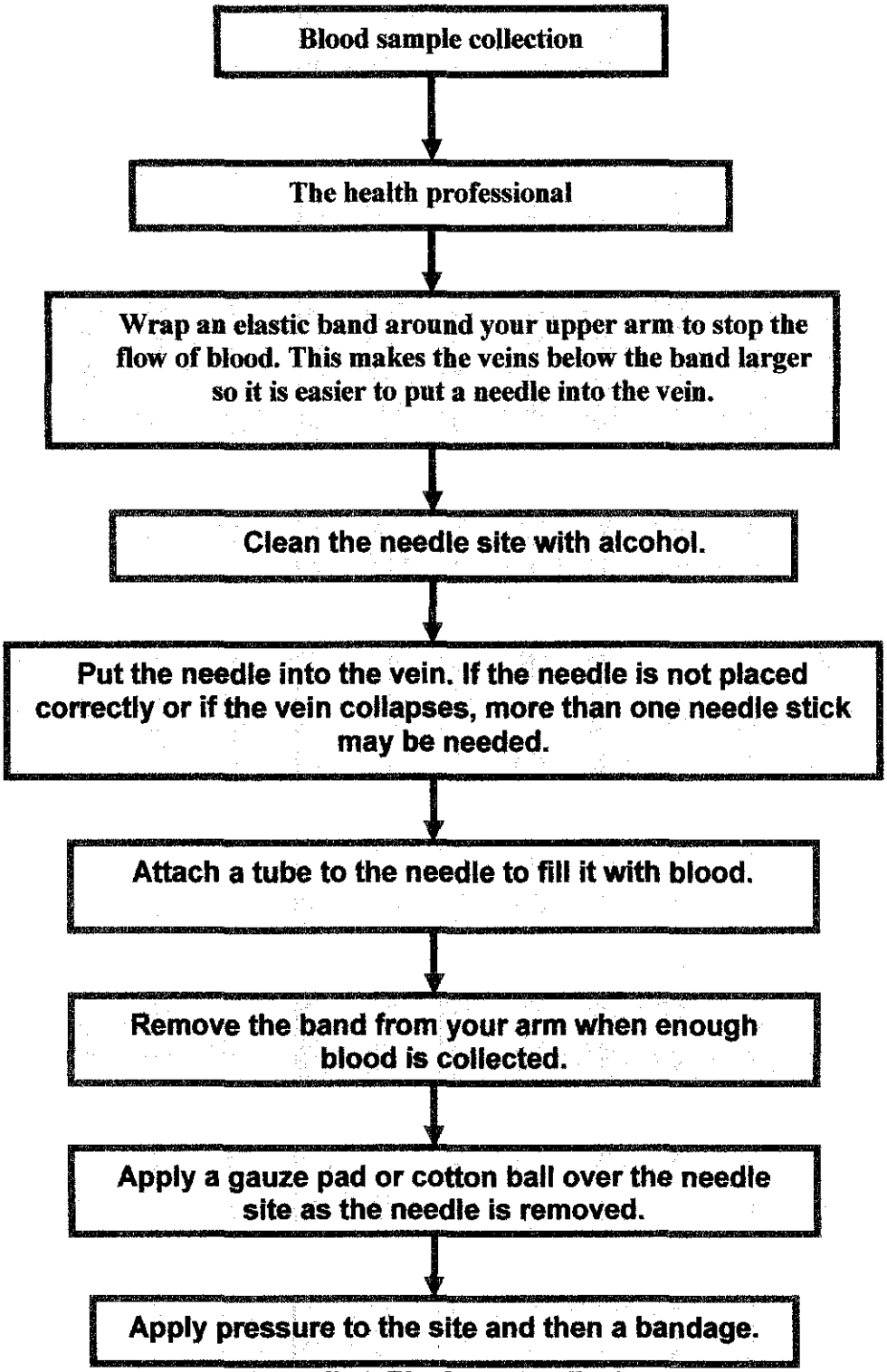
< httpwww.nlm.nih.gov ,

>,(Accessed in Nov 2005).

[37] Expert System Architecture

<http://www.macs.hw.ac.uk/~alison/ai3notes/subsection2_5_2_1.html,

>,(Accessed in May 2006).

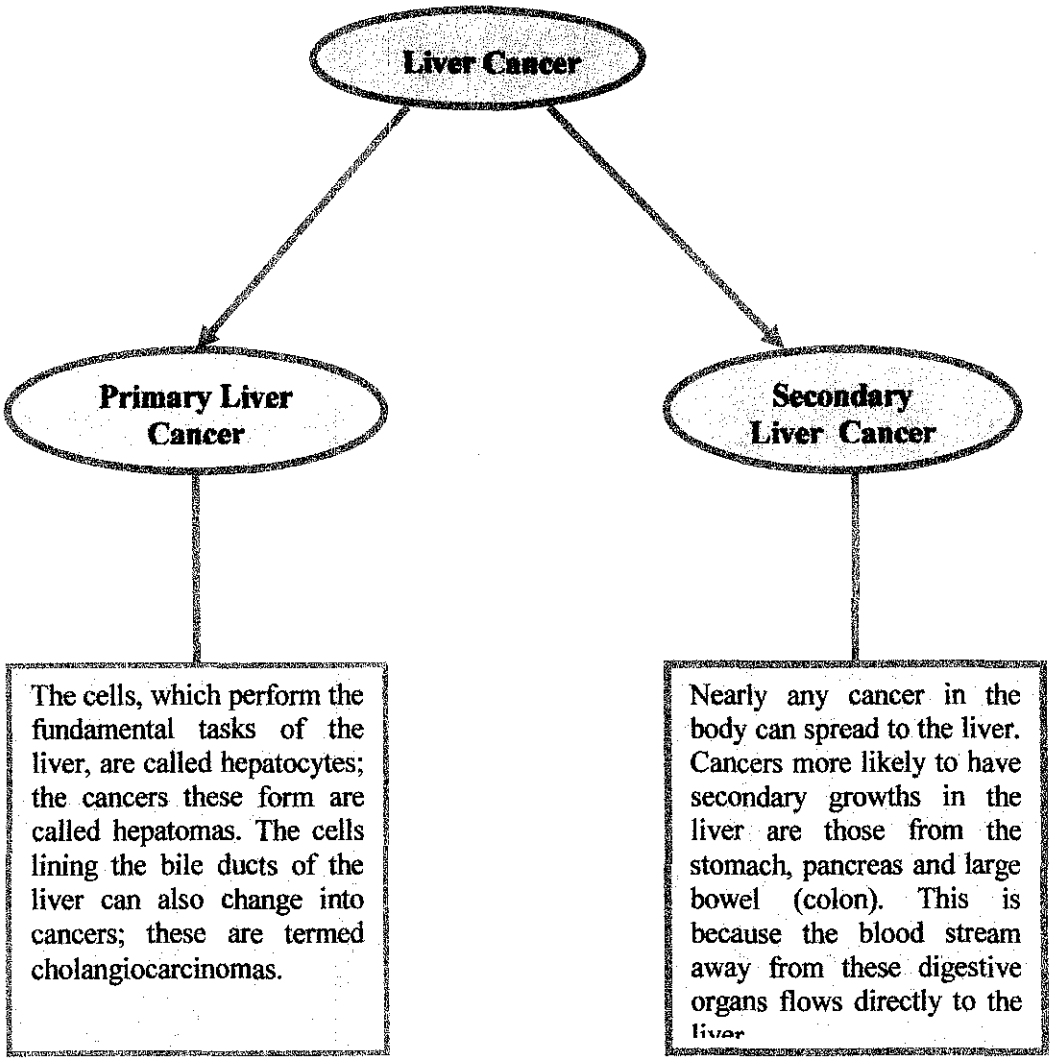


Appendix 1: Blood sample collection

Human chorionic gonadotropin (hCG) levels in blood

Men and nonpregnant women:		Less than 5 international units per liter (IU/L)
Pregnant women:	About 24 to 28 days after the last menstrual period (LMP):	5–100 IU/L
	4 to 5 weeks after the LMP:	50–500 IU/L
	5 to 6 weeks after the LMP:	100–10,000 IU/L
	Peak, 14 to 16 weeks after the LMP:	12,000–270,000 IU/L

Appendix 2 : Normal values for Human chorionic gonadotropin (hCG) levels in blood



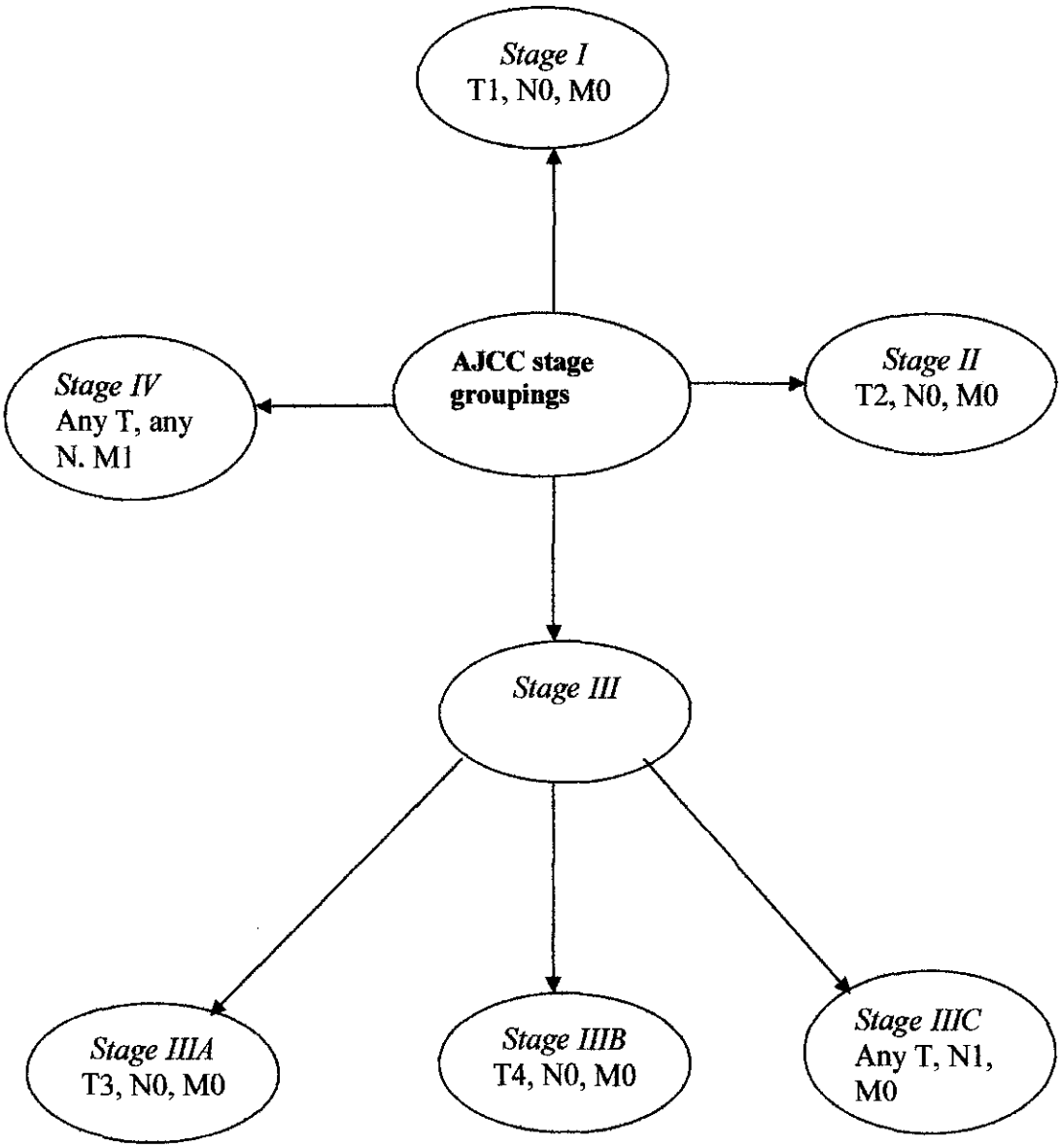
Appendix 3 :Two type of Liver Cancer

PRIMARY TUMOR (T)	
TX	Primary tumor cannot be assessed
T0	No evidence of primary tumor
T1	Solitary tumor without vascular invasion
T2	Solitary tumor with vascular invasion or multiple tumors none more than 5 cm
T3	Multiple tumors more than 5 cm or tumor involving a major branch of the portal or hepatic vein(s)
T4	Tumor(s) with direct invasion of adjacent organs other than the gallbladder or with perforation of the visceral peritoneum

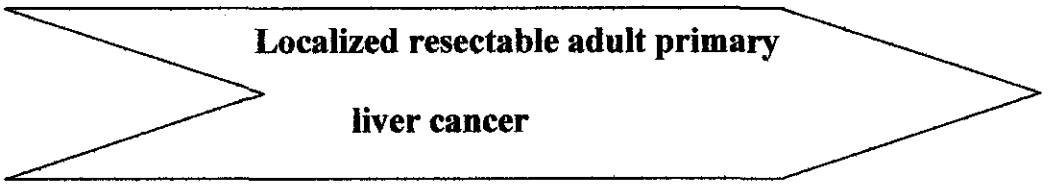
REGIONAL LYMPH NODES (N)	
NX	Regional lymph nodes cannot be assessed
N0	No regional lymph node metastasis
N1	Regional lymph node metastasis

DISTANT METASTASIS (M)	
MX	Distant metastasis cannot be assessed
M0	No distant metastasis
M1	Distant metastasis

Appendix 4 : TNM definitions



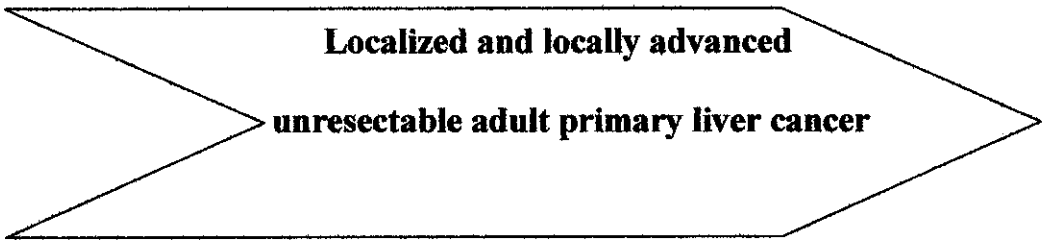
Appendix 5 : AJCC stage groupings



(Selected T1 and T2; N0; M0)

Localized resectable liver cancer is confined to a solitary mass in a portion of the liver, or a limited number of tumors confined to one lobe, that allows the possibility of complete surgical removal of the tumor with a margin of normal liver. Liver function tests are usually normal or minimally abnormal, and there should be no evidence of cirrhosis beyond Child class A or chronic hepatitis. Only a small percentage of liver cancer patients will prove to have such localized resectable disease. Preoperative assessment that includes 3-phase helical computed tomography and/or magnetic resonance scanning should be directed toward determining the presence of extension of tumor across interlobar planes, involvement of the hepatic hilus, or encroachment on the vena cava. A resected specimen should ideally contain a 1 cm margin of normal liver.

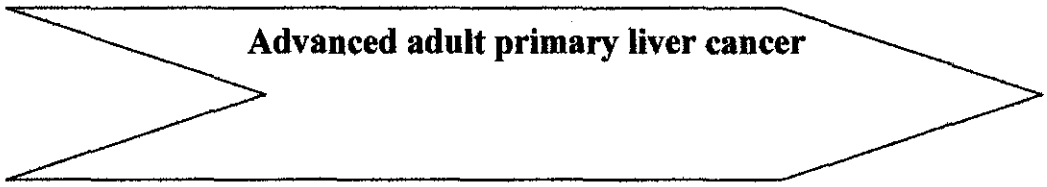
Appendix 6 : AJCC stage groupings 1



(Selected T1, T2, T3, and T4; N0; M0)

Localized and locally advanced unresectable liver cancer appears to be confined to the liver, but surgical resection of the entire tumor is not appropriate because of location within the liver or concomitant medical conditions (such as cirrhosis). These patients may be considered for liver transplantation. [2] [3] [4] [5] For other patients, percutaneous ethanol injection, radiofrequency ablation, or chemoembolization may be options. [6]

Appendix 7 : AJCC stage groupings 2



(Any T, N1 or M1)

Advanced liver cancer is present in both lobes of the liver or has metastasized to distant sites. Median survival is usually 2 to 4 months. The most common metastatic sites of hepatocellular cancer are the lungs and bone. Multifocal disease in the liver is common, particularly when cirrhosis or chronic hepatitis is present. Chemoembolization has been beneficial in selected patients who have no extrahepatic metastases. [6]

Appendix 8 : AJCC stage groupings 3