Global Scientific JOURNALS

GSJ: Volume 8, Issue 4, April 2020, Online: ISSN 2320-9186
www.globalscientificjournal.com

DEVELOPMENT OF ANHEPATITIS "B" DIAGNOSTIC SYSTEM

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Abstract

This reserachis a preview of the work so far concluded on Artificial Intelligent Systems for the diagnosis of Hepatitis B, which is one of the most common of all Hepatitis ravaging mankind today. A user friendly application programme has been developed which can diagnose and prescribe treatments or recommend a Hepatitis B patient. The applications software has the capacity to monitor patients. The programme is limited to diagnosis and recommends the patient of Hepatitis B virus to his/her Doctor.The data analysis of this project software was varied using the data collected at the polytechnic's clinic to vary the disease of the various patient diagnosed with Hepatitis B. Thegeneral terms in Hepatitis B are considered under clinical study, general considerations, mechanisms regulation, virology, diagnosis and treatment.Health has a strong impact upon all activities and human experts must have the ability to decide, in any circumstances, what is the illness level of a patient, which is the adequate treatment and which will be the evolution of the patient during the treatment. But medical decision making may be a very difficult activity. There are a lot of applications in artificial intelligence domain that try to help human experts offering solutions for a problem. This paper describes an expert system developed in order to make some predictions regarding the hepatitis infection.

Keyword: *Diagnostic System, Development, Anhepatitis "B"*

1. Introduction

The background history of Hepatitis B, its aim and objectives, as well as a short narrative its symptoms and treatments.Medical domain is characterized, like many other domains, by an exponential evolution of the knowledge. There are a lot of tools which try to reduce the risk of error apparition in medical life. Diagnosis has a very important role here. It is the first step from a set of therapeutic actions; an error at this level can have dramatic consequences.The presence of technology in diagnosis phase is welcome because of its advantages: pragmatism, repeatability, efficiency, immunity toward perturbation factors that are specific to human beings (fatigue, stress, diminished attention). The

technology doesn't replace human experts in this point of medical assistance; it only tries to help them, implementing systems that are able to select or to generate data which are relevant for the physicians.

1.1 Hepatitis B in Nigeria

Vaccination against the hepatitis B virus (HBV) in the West African nation of Nigeria is lower than many Sub-Saharan African countries. In Nigeria to be the most common cause of liver disease. However, the extent of HBV exposure among Nigerians at average risk is unknown. Our aim, there accurately estimate the HBV prevalence for the country and the prevalence for specific subgroups. We used electronic databases to select systemammeter-analyses from 2000 to 2013. Forty-six studies were included (*n* = 840 persons). We used a random effects meta-analysis of cross-sectionalstudies to generate our estimates. The pooled prevalence of HBV in Nigeria was 13.6% (95% confidence interval [CI]: 11.5, 15.7%). The pooled prevalence [CI] among subgroups was: 14.0% (11.7, 16.3) for blood donors; 14.1% (9.6, 18.6) for pregnant women attending antenatal clinics; 11.5% (6.0, 17.0) (11.6, 16.5) among adults; and 16.0% (11.1, 20.9) for studies evaluating adults and children. HBV prevalence in Nigeria varied by screening method12.3% (10.1, 14.4) by using enzyme-linked immune sorbent assay; 17.5% (12.4, 22.7) by immune chromatography; and 13.6% (11.5, 15.7) by HBV DNchain reaction. HBV infection is hyper endemic in Nigeria and may be the highest in Sub-Sahara Africa.Our results suggest that large numbers of and children were exposed to HBV from 2000 to 2013.Increased efforts to prevent new HBV infections are urgently needed in Nigeria.

Hepatitis B, which is one of the most common of all Hepatitis in Nigeria. Hepatitis B is irritation and swelling of the liver due to infection with the Hepatitis B virus - HBV. Hepatitis B may be acute or chronic, the acute hepatitis B last less than six months, and it may lead to various infections that affect the liver. Leading to cirrhosis and liver cancer.The chronic hepatitis B is at the risk of a lasting liver disease.Hepatitis B is a viral infection that attacks the liver and can cause both acute and chronic disease. The virus is transmitted through contact with the blood or other body fluids of an infected person.In 2015, hepatitis B resulted in 887 000 deaths, mostly from complications (including cirrhosis and hepatocellular carcinoma).

Hepatitis B is an important occupational hazard for health workers. However, it can be prevented by currently available safe and effective vaccine.An estimated 257 million people are living with hepatitis B virus infection (defined as hepatitis B surface antigen positive).It continues after and may persist beyond six months.Hepatitis B virus (HBV) is a virus that is spread through blood and other bodily fluids.Symptoms affect some people for a short time, but others will develop chronicsymptoms and complications that can be fatal. Up to 2.2 million people in the United States (U.S.) have chronic HBV infection.Many cases go unreported or remain undiagnosed until a person shows signs offend-state liver disease. HBV can survive for up to 7 days outside the body at room temperature, onenvironmental surfaces.Since 1991, all infants in the U.S. have been vaccinated against HBV.Computer-based methods are increasingly used to improve the quality of medical services. Mostly the remote areas, the population are deprived of the facilities of having experts to diagnose disease. So it is the need of the day to store the expertise of specialists in computers through using Expert System technology. After that they can consult the specialist doctor if it is necessary or serious. Rule based expert system includes both conventional techniques, such as Database Management Systems (DBMSs), and Artificial Intelligence (AI) techniques, such as

Knowledge-Based Systems (KBSs) or Expert Systems (ESs).

Medical diagnosis is a very active field as far as introduction of the above techniques is concerned.Most of the damages from Hepatitis B virus occur because of the way the body responds to the infection, when the body's immune system detects the infection it sends out special cells to fight it off, however, these disease fighting cells can lead to liver inflammation. Hepatitis B is also known as Serum Hepatitis.Hepatitis B is a potentially life-threatening liver infection caused by the hepatitis B virus (HBV). It is a major global health problem. It can cause chronic infection and puts people at high risk of death from cirrhosis and liver cancer.

A vaccine against hepatitis B has been available since 1982.The vaccine is 95% effective in preventing infection and the development of chronic disease and liver cancer due to Hepatitis B.

1.2 Hepatitis B in the World Health Organization(WHO).

Hepatitis B prevalence is highest in the WHO Western Pacific Region and the WHO African Region,where 6.2% and 6.1% respectively of the adult population is infected. In the WHO EasternMediterranean Region, the WHO South-East Asia Region and the WHO European Region,an estimated 3.3%, 2.0% and 1.6%% of the general population is infected, respectively. 0.7% of the population of the WHO Region of the Americas is infected.

1.3 Prevalence of Hepatitis B in Nigeria and the World at Large.

Hepatitis B virus (HBV) is a major cause of liver disease morbidity and mortality worldwide, accounting for over 360 million cases of chronic hepatitis and 620,000 deaths per a year. It is hyperendemic (i.e. >8% of the population infected) in Sub-Sahara Africa (SSA) and a major cause of chronic liver disease.Perz *etal*. estimated that 44% of cirrhotic liver disease and 47% of heptocellular carcinoma cases in SSA are attributed to HBV. A highly effective and inexpensive recombinant DNA vaccine for hepatitis B has been available since 1982 and debuted in Nigeria in 1995. Unfortunately, vaccination programs in Nigeria have not received adequate attention or funding by the government. Further, community misconceptions have hindered increasing coverage rates.The United Nations Children's Fund (UNICEF) and the World Health Organization (WHO) estimated that only 41% of Nigerians were vaccinated against HBV in 2013.The risk of contracting HBV in Nigeria is substantial, not only due to low vaccination rates but also given that as many as 75% of the population will be exposed. Investigators have reported varying national and risk group-specific estimates. Prior reports suggest a prevalence of 10-15% in the average risk Nigerian population.In Nigeria, investigators have found high HBV prevalence among surgeons (25.7%), voluntary blood donors (23.4%), and infants (16.3%). A 2012 study in Kano Nigeria found that among 440 HIV positive patients, 12.3% were co-positive for HBV.Although, pregnant women are generally considered low risk for HBV infection, rates as high as 11% have been reported in Nigeria.Hepatitis B is the commonest cause of chronic liver disease in Nigeria. In southern parts of the country, up to 58.1% of patients with chronic liver disease were found HBsAg positive.

Table 1: Hepatitis B biomarkers among survey participants (*N* =840)

Biomarker	Frequency	% (95% CI)
HBsAg	118	12.2 (10.3–14.5)
HBsAb	355	36.8 (34.5–40.7)

HBcAb	527	54.6 (52.6–58.9)
HBsAb +ve and HBsAg −ve and HBcAb −ve	76	7.9 (16.1–24.1)
HBsAb +ve and HBsAg −ve and HBcAb +ve	249	25.8 (23.6–29.2)
HBsAb −ve and HBsAg −ve and HBcAb −ve	306	31.7 (29.5–35.4)

Where +ve = positive test
−ve = negative test
CI = confidence interval
HBsAg = hepatitis B surface antigen
HBsAb = hepatitis B surface antibody

HBcAb = hepatitis B core antibody.

2.1 Literature Review

Diagnostic Systems is a branch of Artificial Intelligence (AI), and were developed by the AI community in the mid-1960s. An expert system can be defined as "an intelligent computer program that uses knowledge and inference procedures to solve problems that are difficult enough to require significant human expertise for their solutions". We can infer from this definition that expertise can be transferred from a human to a computer and then stored in the computer in a suitable form that users can call upon the computer for specific advice as needed. Then the system can make inferences and arrive at a specific conclusion to give advices and explains, if necessary, the logic behind the advice. ES provide powerful and flexible means for obtaining solutions to a variety of problems that often cannot be dealt with by other, more traditional and orthodox methods [1].

This knowledge is then converted into a computer program. Software Engineer performs the task of extracting the knowledge from the domain expert. Rule based expert systems are the most commonly known type of knowledge based systems. The knowledge is represented in the form of IF-THEN rules. Figure 2 shows different modules for a rule-based expert system.

Artificial Intelligent (Expert systems) have been developed and applied to many fields. Knowledge is a theoretical or practical understanding of a subject or a domain. In other words, Knowledge is the sum of what is currently known. Diagnosis system is a system which can diagnose diseases through checking out the symptoms. All health care professionals including; doctors, medical students, pharmacists can keep their knowledge up-to-date regarding “Hepatitis B diagnoses and treatment”, as its knowledge base external database is updated on regular basis.There has been various research works carried out on the application of Information Technology to medical care. This study is classified into medical information management, telemedicine under which mobile health and electronic health reside and also expert system [1].

[2] developed Mobile-Based Fuzzy Expert System (MFES) for Diagnosing Malariathat could assist in diagnosing malaria. The fuzzification of crisp inputs by the system was carried outusing an inter-valued and triangular membership functions while the deffuzification of the inference engine outputs was performed by weighted average method. Root sum square method of drawing inferences has been employed while the whole development has been achieved with the help of Java 2 Micro Edition of Java. This expert system executes on the readily available mobile devices of the patients.

Considered in [3] was the development of a rule based expert system for diagnosing fever. The web based expert system used Visual Basic Dot Net (VB.Net) as the language of its implementation while the rules within the knowledge base were

Boolean rules and not fuzzy rules hence; drawing of inference as performed by this system could not have a high degree of human like way of reasoning.

In [4], a web based diagnosis and therapy system that used a machine learning technique was developed. According to the study, a machine learning technique rough set was used on labeled sets of malaria fever symptoms collected to generate explainable rules for each level of severity. The developed system labeled database, was divided into five cases of malaria and the classification accuracy on training dataset was described to be 100% while that of testing data set was 94%. Even though the study claimed to have developed a web based diagnosis and therapy system that could be accessed anywhere and anytime, it should not escape the minds of individuals that not all the intended users of the system have access to reliable network and internet facilities in their various locations.

[5] studied- A Web Base Decision Support System driven by Fuzzy Logic for the diagnosis of Typhoid fever. The motivations for the research include: identification of typhoid fever as the major cause of morbidity and mortality in most developing countries, and to provide decision supportplatform for medical practitioners. Diagnosis of typhoid fever involves several variables which usually make it difficult to arrive at accurate and timely diagnosis.

[6] presented a Mobile Compactable Expert System for the treatment of typhoid fever in developing countries. The motivations for this work include: Typhoid fever is rampant in developing nations with over 21.6 million cases and at least 250,000 deaths occurring annually, expert systemdevelopment today are either web based or stand-alone application. The methodology involved the use ofobject oriented programming approach. The application framework has three parts – user interface, application logic (written in PHP programming language) and Database component using MYSQL server.No evidence of consultation with medical experts, data collection and usage. The prior knowledge and the basis for the diagnosis were not discussed. No computational methodology was deployed.

[7]presented an Intelligent Decision Support System for the prompt diagnosis of malaria and typhoid in the malaria belt of Africa. The motivations for this work include: current diagnostic tools are affected by the harsh tropical weather, lack of qualified laboratory technicians, lack of regular supply of electricity to preserve diagnostic tools, lack of adequate transport facilities to move patients from rural to urban areas and a child dies every 15 seconds form water related diseases in which typhoid fever is one. A study was carried out which confirmed that both typhoid fever and malaria could be diagnosed based on signs and symptoms [8]. The system was developed using rapid prototyping with a simple expert system shell. The system has total of 53 rules in its knowledge base. The performance of the system was also evaluated [9].

3. Methodology

The methodology involved the use ofobject oriented programming approach. The application framework has three parts – user interface, application logic (written in JAVA programming language) and Database component using MYSQL server and Microsoft Access (ODBC).The steps that have been adopted in the diagnosis and treatment of hepatitis B are as follows: The Data analysis, problem of the analysis, analysis of the system, system design, which is classified under Structured Systems Analysis and Design Methodology (SSADM).

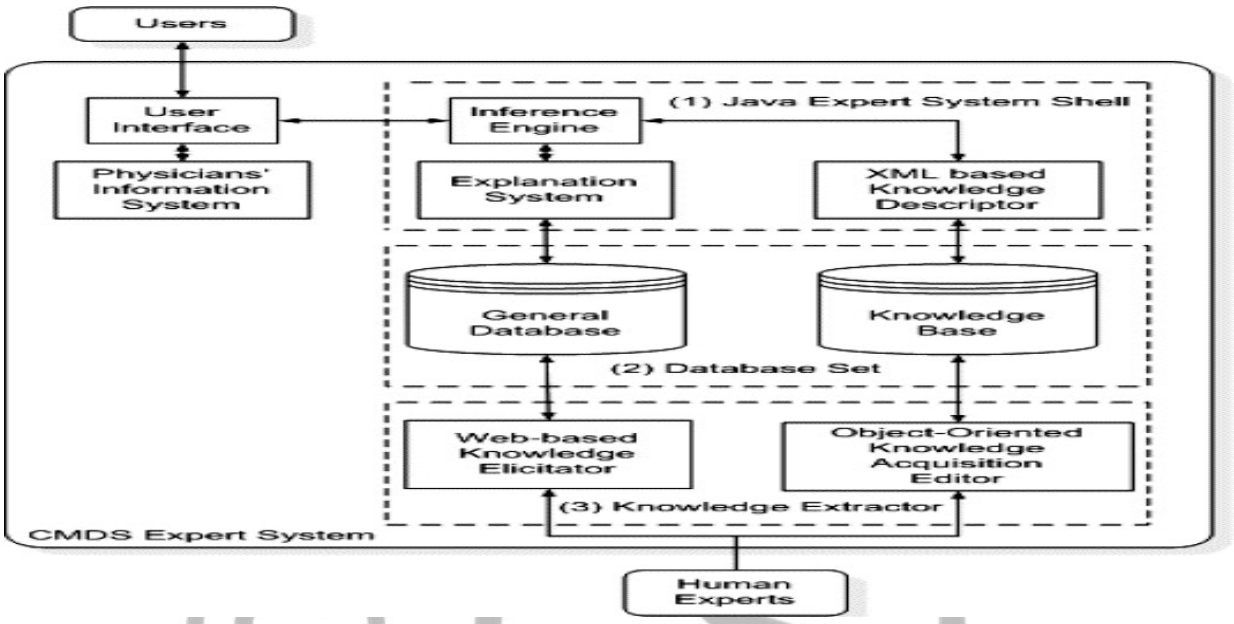


Figure 3.0 The Framework of the Diagnostic System Model

The inference engine uses problem solving knowledge or methods that interacts with the user and processes the result from the collection of rules and data in the knowledge base [10]. An expert-system shell provides customizable inference engines and knowledge base that contains rules that are of the form "IF condition THEN action" [11]. The condition portion of the rule is usually a fact inputted by the user, the action portion of the rule can include actions that affect the outside world, activate another rule or add a new fact to the database. It has the capacity to acquire, store, retrieve, communicate, process and use knowledge for the purpose of solving problem. Figure 1 shows the Rule-based Expert System of the proposed system.Experts systems can enter new rules or edit existing rules. The system automatically adds the new rule to the look ahead list for all parameters mentioned in its premise, and to the updated by list of all parameters mentioned in its action. Methodology for development of this research is given as bellow;

This research was produced to assist the health care centers that arein rural areas of the country and the Federal Polytechnic, Ile Oluji, Ondo State and Nigeria at large.

The diagnosis deals with Hepatitis B virus which is able to prescribe drugs, and to be able to consult the doctor very fast. After meetings with the Medical Doctors, Forty patient's data were collected showing that Twenty were Positive and twenty were Negative to the virus. Which was analysed showing the graph analysis of the database in the Appendix and the database

Table 3.0 Diagnostic System Database

PATIENTS ID	USERNAME	PASSWORD	ADDRESS	STATUS	AGE	GENDER
Fpi/hbv/001	Fpi/hbv/001	Ade	Ile-oluji	Positive	23	Female
Fpi/hbv/002	Fpi/hbv/002	Adeola	Ile-oluji	Positive	24	Female
Fpi/hbv/003	Fpi/hbv/003	Ade	Ile oluji	Positive	22	Female
Fpi/hbv/004	Fpi/hbv/004	Femi	Ile oluji	Positive	21	Male
Fpi/hbv/005	Fpi/hbv/005	Segun	Ile oluji	Positive	20	Male
Fpi/hbv/006	Fpi/hbv/006	Femi	Ile oluji	Positive	20	Male
Fpi/hbv/007	Fpi/hbv/007	Sewa	Ile oluji	Positive	22	Male
Fpi/hbv/008	Fpi/hbv/008	Wale	Ile oluji	Positive	23	Female
Fpi/hbv/009	Fpi/hbv/009	Asabi	Ile oluji	Positive	24	Female
Fpi/hbv/010	Fpi/hbv/010	Paual	Ile oluji	Positive	23	Female
Fpi/hbv/011	Fpi/hbv/011	Dele	Ile oluji	Positive	23	Female
Fpi/hbv/012	Fpi/hbv/012	Sodiq	Ile oluji	Positive	21	Female
Fpi/hbv/013	Fpi/hbv/013	Kamal	Ile oluji	Positive	21	Female
Fpi/hbv/014	Fpi/hbv/014	Qamal	Ile oluji	Positive	22	Male
Fpi/hbv/015	Fpi/hbv/015	Kareem	Ile oluji	Positive	24	Male
Fpi/hbv/016	Fpi/hbv/016	Kazeem	Ile oluji	Positive	25	Male
Fpi/hbv/017	Fpi/hbv/017	Felix	Ile oluji	Positive	22	Male
Fpi/hbv/018	Fpi/hbv/018	Mide	Ile-oluji	Positive	22	Male
Fpi/hbv/019	Fpi/hbv/019	Ayo	Ile-oluji	Positive	21	Male
Fpi/hbv/020	Fpi/hbv/020	Bolu	Ile oluji	Positive	21	Female

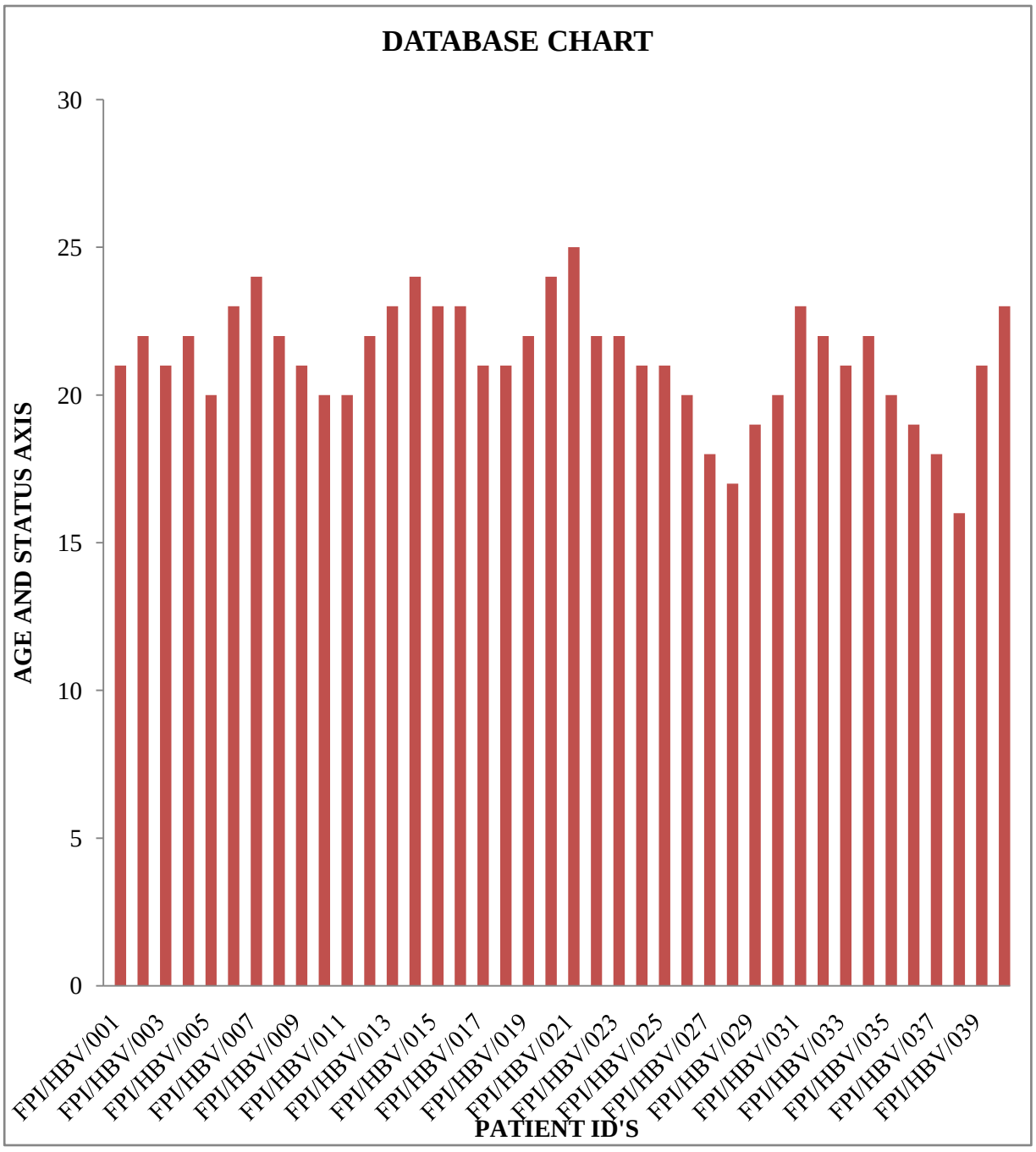


Figure 3.1 Showing Database Graphs

Personnel observations and getting historical data from various Ophthalmology Clinics,Wards in Hospitals, Health Camps, Other Health Care Units and Medical Colleges whuch include:

Using production rules facilitated by Javaprogramming language, Storing additional information using Microsoft Access Database (ODBC), Showing Charts and Graphs using Microsoft Excel Worksheets etc.

3.1. Software Development and Implementation & Maintenanance

Different software modules, like: Java, Microsoft Accessof any version, NetBeans IDE version 6.9.1 above and Microsoft Excel Worksheets of any version. Which were integrated to develop the Software, Validity of software was checked for sample data being acquired through the polytechnic clinic sources [12].

Expanding scope of the system by giving it inputs from different sources like World Wide Web, recent research conducted in the field of ophthalmology. Implementation of software in different health care department: e.g. hospitals, clinics medical college labs, free camps etc.

3.2. Systems Analysis

Systems Analysis is defined as the determination of the data processing requirements of an organization, project, procedure, or task, and designing of computing systems to fulfill them [13]. Therefore, in this project the analysis was made through this equation which is used to show case the Prevalence Structure of Hepatitis B in Nigeria and the world at large. The formula for calculating and rebalancing population size to diagnose the Intelligent System so that it can work efficiently is shown in equation 3.1.

$$n = Z^2\, PQ \div \partial^2 \quad (3.1)$$

Where: n = *Population*

Z = *Normal Distribution*

P = *Prevalence*

Q = *1- P*

The $\boldsymbol{Z}$is set at 1.96 with 95% Confidence Interval [CI] as a constant

3.3 System Design and Diagnostic System

System design is the development of the actual mechanism for a workable system. It is a finalized plan for problem solution. During this stage, the analyst focuses attention on ways in which calculations be performed in the system [14]. A detailed system design is desired as it is the basis for future computer programming and system implementation. The quality of the design depends among other things on the quality of the result made available from the investigation as well as the quality of the individual involved in the design process [15]. A team of system designers tactfully map out the procedures and the materials required for the successful development of the system. The system design stage is the architectural stage that dictates precise operations and the necessary resources required for accomplishment of the desired result. Thus, if the design is faulty, definitely a faulty system will be built. Therefore, this stage requires proper attention, understanding of the requirements, and the use of personnel processing requisite experience and skills [16].

This is concerned with procedure followed in registering, diagnosing, and the

status of patients' data into the Artificial Intelligent System which will be later processed and transferred into the output data files. Functions and features delivered to the end users. [17]. The end users of the proposed system are;Patients user registration and login: This helps the users to register and login to homepage only if password and username matches; and Administrator login: Theadministrator manages the master data's like the server details and patient's details. And view the data's of the registered patients and edit and delete from the database [18].

3.4 Flow Chart Diagram

The flow chart for the diagnostic system is shown in Figure 3.0.

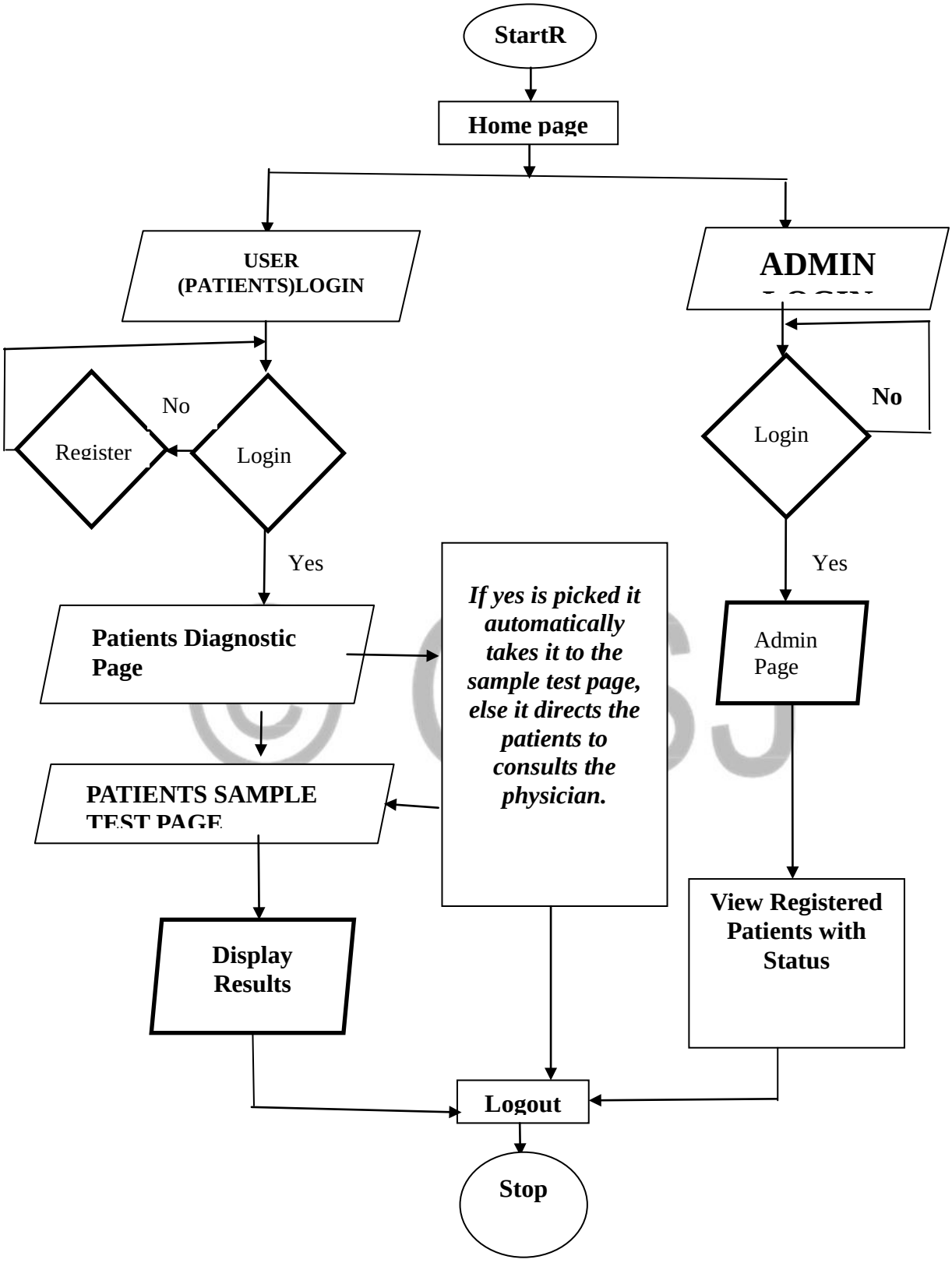
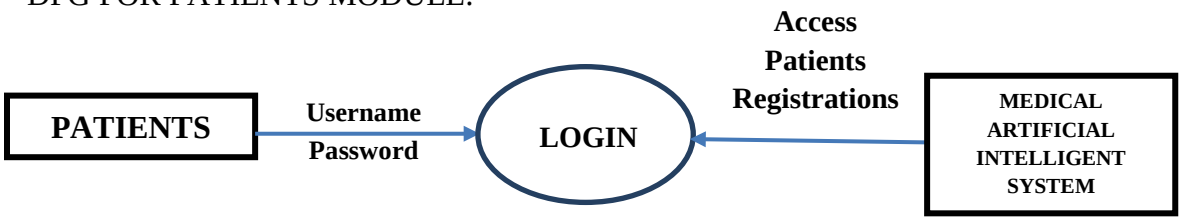


Figure 3 Flow Chart for the Expert System

3.5 Data Flow Diagrams

1. DFG FOR PATIENTS MODULE:



2. DFD FOR REGISTRATION MODULE:

3. DFD FOR ADMINISTRATOR MODULE:

3.6 Software Specification

A major element in building an Expert System is the section of compatible software since the software in the market is experiencing a geometric progression. The selected software is acceptable by the firm and one user as well as it should be feasible for the system. This document gives a detailed description of the software requirement specification. The study of requirement specification is focused specially on the functioning of the system. It allows the developer or analyst to understand the system, function to be carried out the performance level to be obtained and corresponding interfaces to be established.

Front End Tool: Netbeans IDE 6.9.1
Backend: GUI JAVA (JESS)
Operating System: Windows 2007 Ultimate.
Client Side: Microsoft Access and Excel
Software: NetBeans IDE V6.9.1

4. Results and Discussion

The function of this class is to analyze the answers supplied by the user in order to determine whether the patient has hepatitis B or not. **If–condition then – else** statements are constructed in some amazing orders to make correct decision. If tests 1,2,3,5 are positive, patient should be placed on regular checkup, treated and advised.

If any of tests 4 and 6 are positive, patient should be placed on constant checkup, treated with stronger medication, monitored

and advised. If test 6 is severely damaged, patient may need a liver transplant.A separate class is also created for this and it is also frame-based. It has only one constructor and several methods. There is a method that accepts the hepatitis B test result.

The frame has several panels. These include the panel containing the patient information (i.e. name, reg. No, age,etc.), the panel containing the diagnostic question, responses of the patient, displaying the test result and the panel containing the appropriate recommendation.

The method that receives the hepatitis B test result displays the result of .

the test on the result panel. The homepage shows the overall design of the homepage.Figure 4.1show the home page of the Diagnostic System.Generally the home page consists of the login page for both the admin and the patient (user) sign up, which take the user to their desire page when clicking on the login button. The six buttons are: clear, login, exit, and sign up,In the home page the Administrator can login and view the registered patients and their status. It is the first page displayed when accessing the the Software. From this page, other user or patients can diagnose themselves

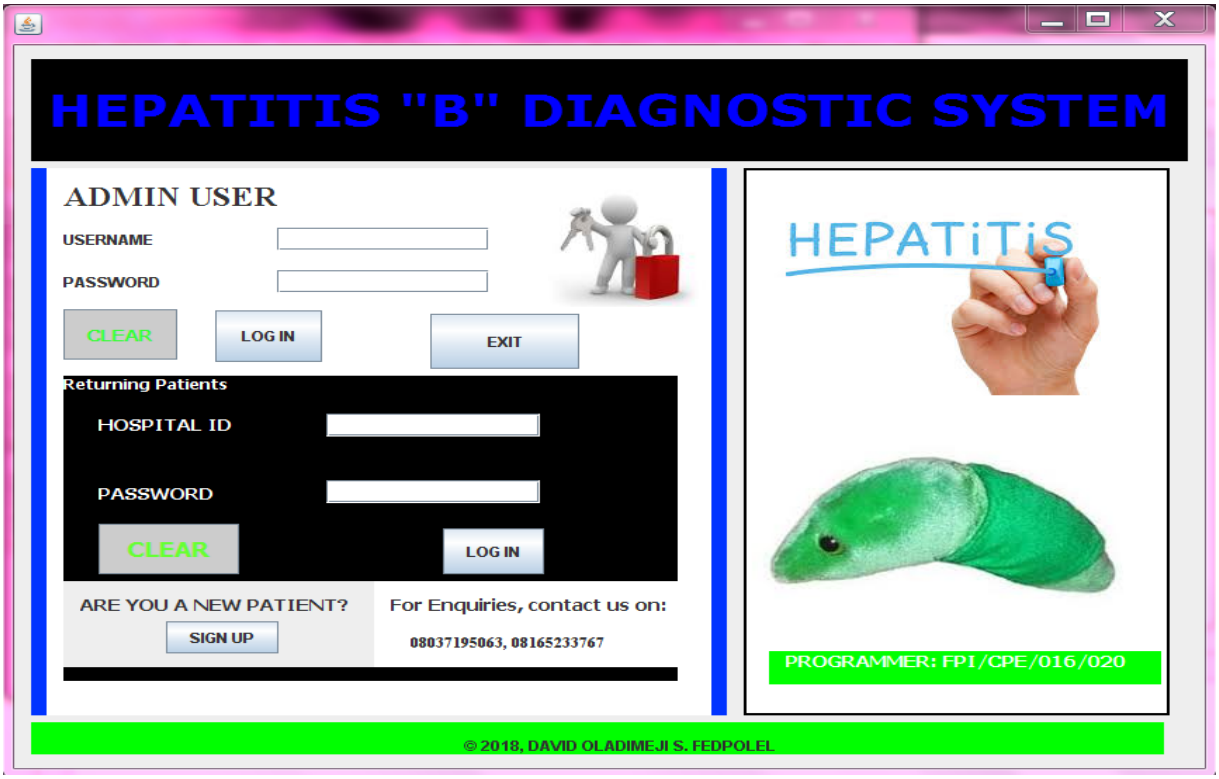


Figure 4.1 Homepage Interface

4.1 Registration Interface Result

The Registration Interface Result deals with the registration of patients into the database. It shows the Hospital ID, Preferred Username, Password, Confirm Password, Address and Age of the patients. The Sample Test Page Interface Result deals with the Sample Test of patients that was taking from the hospital or clinic. It shows

the fields for providing answer to each of these questions that was provided either positive and negative to the following test:HBs Ag test**,** HBe Ag test**,** Anti-Hbc test,LFT (liver function test)**,** Urinalysis**,** Abdominal scan

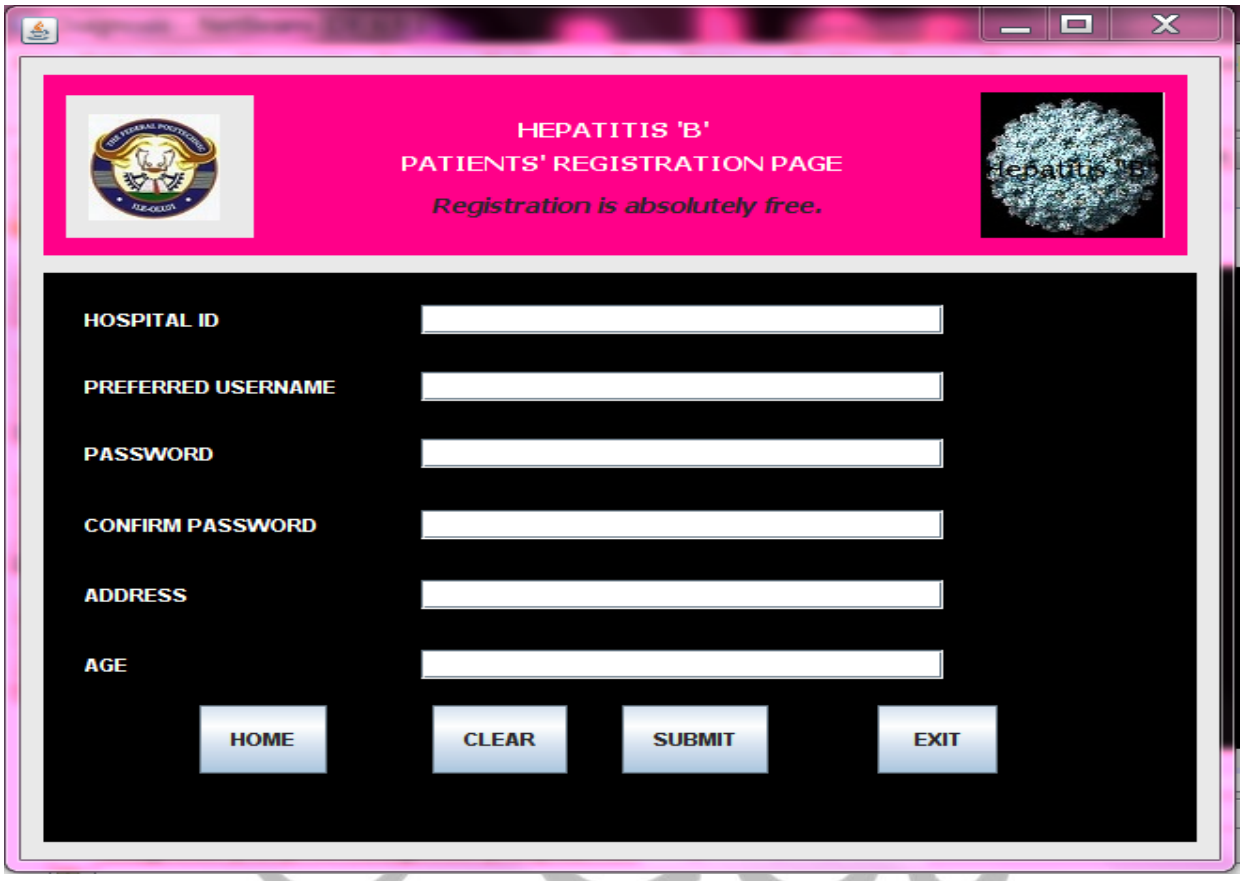


Figure 4.2Registration Interface.

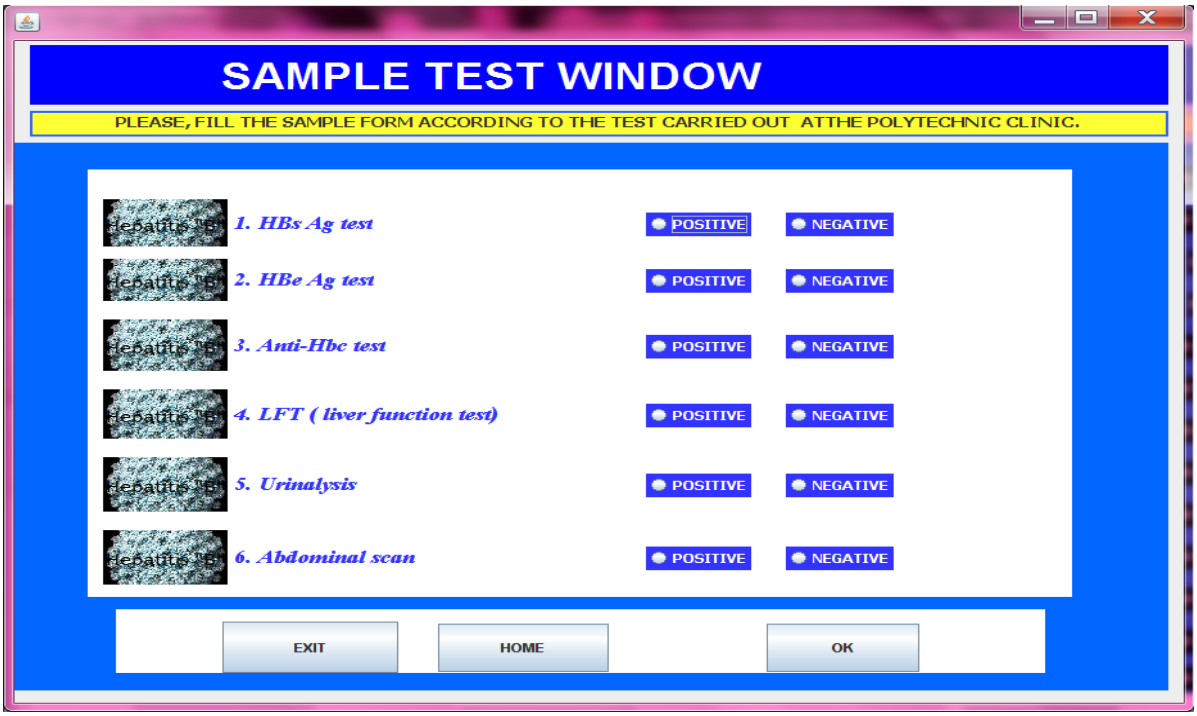


Figure 4.3 Sample Test Page Interface

4.2 Diagnostic Test Page Result

The Diagnostic Test Page Resultdeals with the Diagnosis of the patients symptoms that was felt by the patients. It shows the fields for symptoms of hepatitis B and it is answered either Yes or No.

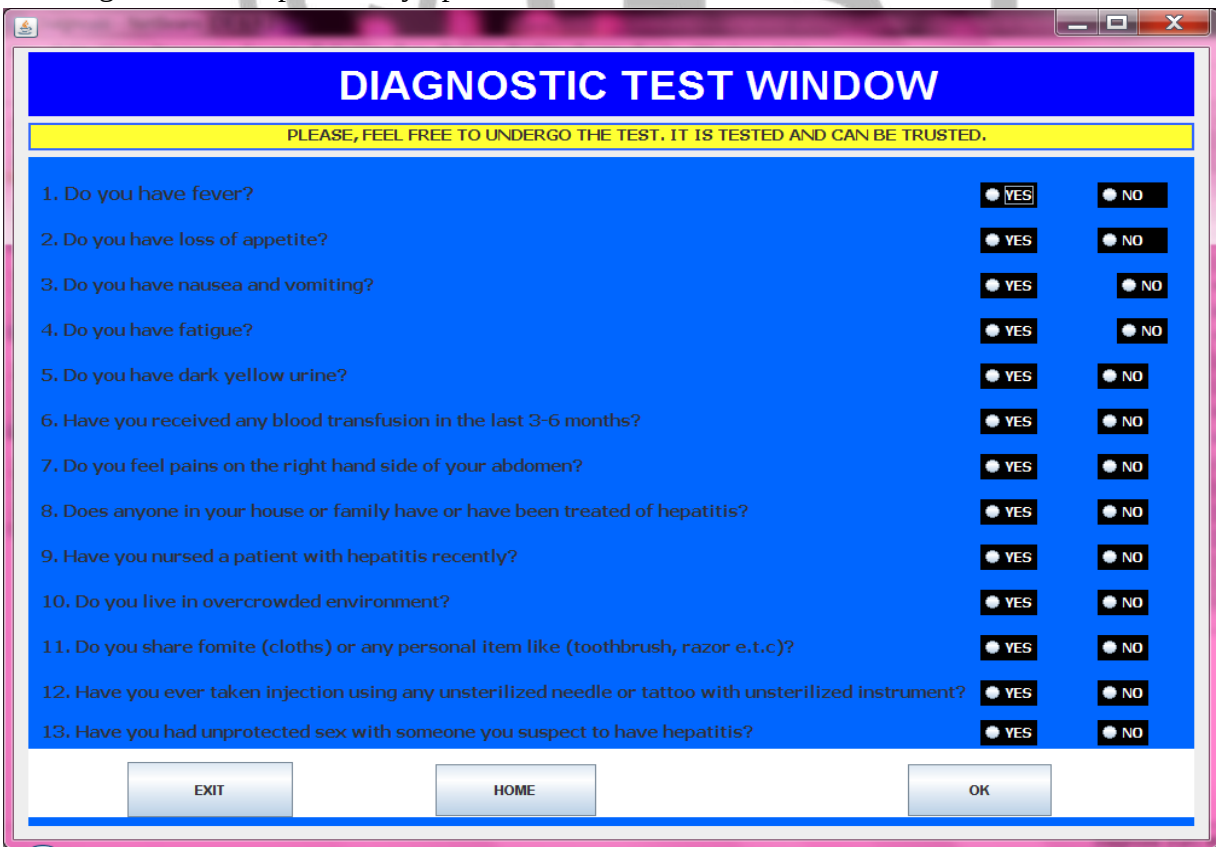


Figure 4.4Diagnostic Test Page Interface

4.5

Drug Prescription Page Results

Drug Prescription Page Results this shows the prescription of drugs to be taking by the patients after they must have been tested to have the virus. It shows the drug prescription and the dosage.

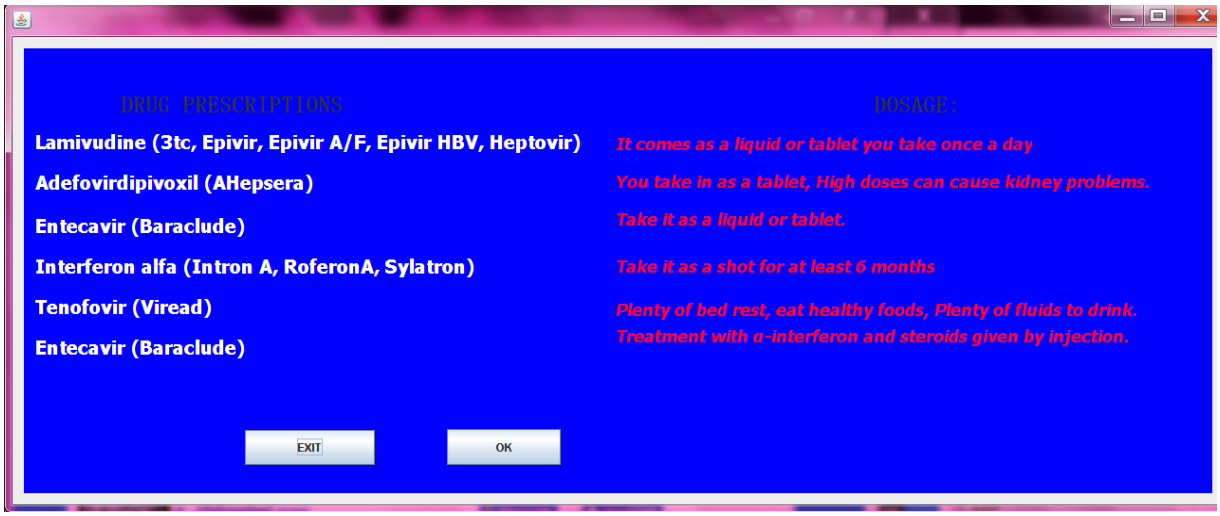


Figure 4.5 Drug Prescription Page Interface

The Administrator Page Result Shows the Registered Patients Report and their Status as shown in the database

5. Conclusion

Doctors will be interviewed to gain insight into their expectation as they would be part of the end-users. After taking into consideration the facts gained from the interviews and the questioners the output of this investigation that will be analyzed and the design that will be made which will be implementedsuccessfully. This research explains and shows how possible expert systems can be used for the diagnosis of hepatitis B and can be implemented. Below are some benefits:It makes diagnosis faster and less prone to errors, the operation proved to be more consistent, prescribes drug, reliable and accurate compared to the existing system.

This research adequately solvesthe problems mentioned. It will integrate expert systems into healthcare services via the creation of an expert system for hepatitis B diagnosis.

If this research is fully implemented it will greatly aid the distribution of primary health care services around Nigeria, Africa and the world.The result of this project has shown that an expert system for diagnosis and management of hepatitis B would be of immense help to hepatitis, non-hepatitis, medical experts and all who are interested in gaining information about hepatitis B and its symptoms.

This system is not meant to replace doctors but to assist them in the quality service they render to humanity.

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