

Knowledge Sharing Tool on Hepatitis B Virus (HBV) Disease and the Risk of Chronicity Rate Using Generalized Regression Neural Network

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Abstract: *This paper proposes a framework for a Knowledge Sharing Tool on Hepatitis B (HBV) Risk of Chronicity Rate in Mubi north metropolis of Adamawa State as Hepatitis is one of the severe diseases which demands exclusive treatment and severe side effects can appear very often. The intelligent system consists of the Generalized Regression Neural Network which gives the result for whether the patient is Hepatitis B positive or not and the severity of the disease in the patient. Here the researchers also considered the Risk of Chronicity as related to age at primary infection stage in such categories as, neonates, children and adults with 150 diagnosis samples collected from five different health centers in Mubi metropolis. These patients were placed on monitoring/observation for a period of six months to study their migration from acute to chronic stage within the period. Simple descriptive statistics of percentage was used in the analysis of the collected samples and the result shows that: 76.19% of neonates are faced with risk of chronicity, 19.05% of children are also faced with the risk of chronicity while 4.76% of adults are faced with the risk of chronicity.*

Keywords: Chronicity, Generalized Regression Neural Network (GRNN), Hepatitis B (HBV), Rate and Diagnosis.

1. Introduction

Since the Conservative manual data analysis techniques are not effective in most clinical diagnosis, using computer based analyses are becoming inevitable in disease diagnosis today. So, it is the time to develop modern, effective and efficient computer based systems for decision support. There are a number of data analysis techniques: statistical, machine learning, expert system and data abstraction [1]. Medical analysis using expert system procedures has been in use for over twenty years. The advantages of using expert system schemes in medical analysis have caused human support and monetary costs to decrease and caused diagnosis accuracy to increase. Hepatitis B is caused by a virus that attacks the liver. The virus, which is called hepatitis B virus (HBV), can cause enduring infection, cirrhosis (scarring) of the liver, liver cancer, liver failure, and death.

The diagnosis is then firm by taking the total available patients' status into justification. The appropriate treatment is set depending on the diagnosis and the entire process might be iterated. The mortality rate and the waiting time to see the specialist could be cut short by employing the computer technology or computer application or software developed which emulates human intelligence and supports the doctors in making decisions without direct consultation with the specialists. It is possible to shortlist the patients with high-risk factors or symptoms or predicted to be highly infected with certain diseases or illness to see the specialist for further treatment [2].

Neural networks are commonly applicable to real world problems and thus have already been employed successfully in several industries. Neural networks are appropriate for prediction or forecasting requirements like sales forecasting,

industrial process control, customer research, data proof, risk management, target marketing and the like since they are capable of efficiently recognizing patterns or trends in data. Besides fields such as identification of speakers in communications; diagnosis of disease; recovery of telecommunications from faulty software; elucidation of multi meaning Chinese words; undersea mine detection; texture analysis; three-dimensional object recognition; handwritten word recognition; and facial recognition extensively make use of Artificial neural network. Artificial Neural Networks (ANNs) is presently a 'hot' research area in medicine and it is believed that they will receive extensive application to biomedical systems in the nearest future. Hepatitis B including chronic liver disease is quite common in the world, which may cause damage to hepatocytes [4].

An Expert System is a computer program normally composed of a knowledge base, inference engine and user-interface [3]. The proposed expert system aids different components including decision support module with shared user interfaces for diagnosis on the basis of response(s) of the user made against the queries related to particular disease symptoms.

Chronicity may range from healthy carrier to decompensate cirrhosis. [2] Stated that the aim is to embed intelligent system for the diagnosis of the Hepatitis B virus disease, as Hepatitis is one of the serious diseases which demands urgent attention and severe side effects can appear very often. The use of computer technology in the fields of medical diagnosis, treatment of illnesses and patient pursuit has highly increased. Despite the fact that these fields, in which the computers are used, have very high complexity and uncertainty and the use of intelligent systems such as fuzzy logic, artificial neural network and genetic algorithm

have been developed. Detecting diseases at early stage can enable a patient to have early treatment which can lead to effective control. Identifying the treatment accurately depends on the method that is used in diagnosing the diseases. A Diagnosis Expert System (DExS) can help a great deal in identifying those diseases and describing methods of treatment to be carried out taking into account the user capability in order to deal and interact with expert system easily and clearly [8]. Expert system uses inference rules and plays an important role that will provide certain methods of diagnosis for treatment [2].

This paper is based on analyzing the rate of chronicity of HBV among various categories of ages which is one the most common of all Hepatitis types in Nigeria, which is one of the most common of all hepatitis in Nigeria. Hepatitis B is irritation and swelling and inflammation 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. The chronic hepatitis B is at the risk of a lasting liver disease. It continues after and may persist beyond six months [5].

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 [5]. Hepatitis B is also known as Serum hepatitis. It has been in existence for over a thousand years. The disease has been recorded to have had a large number of deaths in most developed countries. The liver is said to be the second largest organ in the body and plays an important role in regulating the composition of various chemical cells in the body, this is the reason why special attention should be given to the liver [5]. The computer which has already stored the relevant information needed by the physician and may be mentioned to as the stethoscope that assists the medical doctors do a very good job. Doctors can direct questions to the computer application and receive answers on what they need in order to have reliable inference(s) on the disease via the screen of the computer. This helps the doctor to draw up an effective diagnostic treatment chart thereby improving efficiency on time, number of patients attended to and save more lives[5].

The intelligent system consists of the Generalized Regression Neural Network which gives the result for whether the patient is Hepatitis B positive or not and the

severity of the disease in the patient. The research also considered the Risk of Chronicity as it relates to age at primary infection stage in such categories neonates, children and adults with 150 diagnosis samples drawn from five different health centers in Mubi metropolis, Adamawa state Nigeria.

2. Review of Related Literatures

2.1 Overview of Hepatitis B

The term 'hepatitis' simply means inflammation of the liver. Hepatitis may be caused by a virus or a toxin such as alcohol. Other viruses that can cause injury to liver cells include the hepatitis A and Hepatitis C viruses. These viruses are not related to each other or to Hepatitis B virus and differ in their structure, the ways they are spread among individuals, the severity of symptoms they can cause, the way they are treated, and the outcome of the infection [8]. Hepatitis B is an infection of the liver caused by the HBV. The major modes of transmission of Hepatitis B (sexual transmission, illicit drug use, exposure to infected blood) and the effect of universal vaccination of infants. When a person first gets hepatitis B, he/she is said to have an 'acute' infection. Most people are able to eliminate the virus and are cured of the infection at that stage. Some are not able to clear the virus and have 'chronic' infection with Hepatitis B that is usually life-long. The HBV is a DNA virus, meaning that its genetic material is made up of deoxyribonucleic acids. It belongs to a family of viruses known as Hepadnaviridae. The virus is primarily found in the liver but is also present in the blood and certain body fluids [7][6].

Hepatitis B virus consists of a core particle (central portion) and a surrounding envelope (outer coat). The core is made up of DNA and the core antigen (HBcAg). The envelope contains the surface antigen (HBsAg). These antigens are present in the blood and are markers that are used in the diagnosis and evaluation of patients with suspected viral hepatitis. The HBV replicates in liver cells, but the virus itself is not the direct cause of damage to the liver. Rather, the presence of the virus triggers an immune response from the body as the body tries to eliminate the virus and recover from the infection [7]. This immune response causes inflammation and may seriously injure liver cells. Hence, there is a balance between the protective and destructive effects of the immune response to the Hepatitis B virus [7].

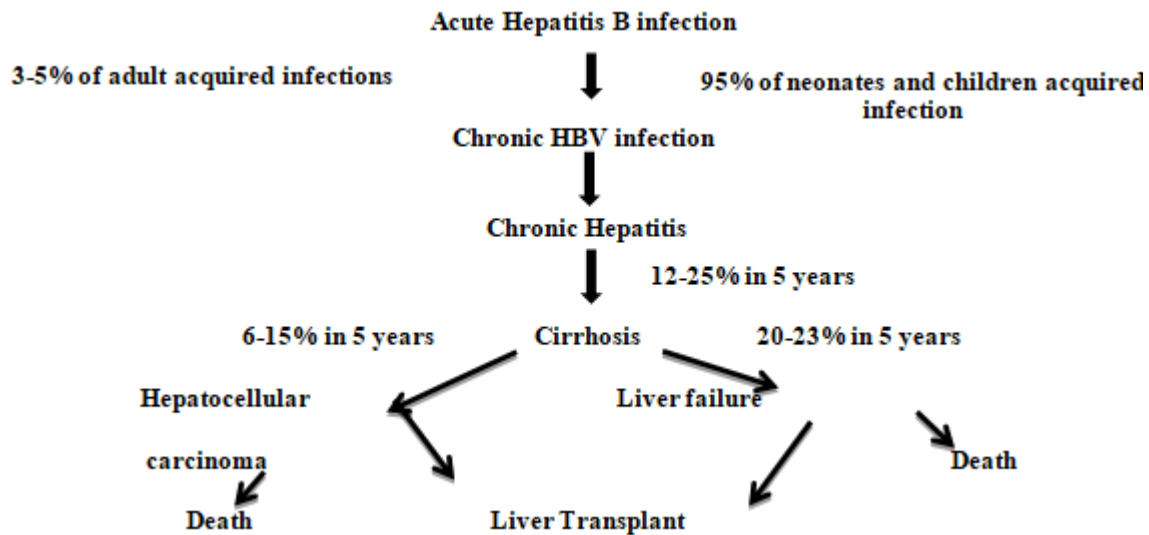


Figure 1: Possible Outcomes of HBV Infection (Source: Lai and Yuen, 2007)

2.1.1 Types of Hepatitis B

These are the three types of hepatitis B

1) Healthy chronic carrier of Hepatitis B:

The carriers in this case are not infectious to other people although they may slightly have a higher risk of cirrhosis and liver cancer. The virus becomes reactivated when the immune system becomes suppressed.

2) Chronic infectious Hepatitis B:

Here the person is highly infectious to people around, they have very inflamed and damaged liver even when the person has few or no symptoms.

3) Chronic mutant Hepatitis B:

The person with this case usually has a mutant strain. A permanent alteration of HBV genetic make-up. They have the potential to be infectious to others and it is thought to be more resistant to treatment than the other types.

2.1.2 Mode of Transmission of Hepatitis B

The hepatitis B virus can survive outside the body for at least 7 days. During this time, the virus can still cause infection if it enters the body of a person who is not protected by the vaccine [7]. The incubation period of the hepatitis B virus is 75 days on average, but can vary from 30 to 180 days. The virus may be detected within 30 to 60 days after infection and can persist and develop into chronic Hepatitis B.

In highly endemic areas, Hepatitis B is most commonly spread from mother to child at birth (perinatal transmission), or through horizontal transmission (exposure to infected blood), especially from an infected child to an uninfected child during the first 5 years of life [7]. The development of chronic infection is very common in infants infected from their mothers or before the age of 5.

Hepatitis B is also spread by percutaneous or mucosal exposure to infected blood and various body fluids, as well as through saliva, menstrual, vaginal, and seminal fluids. Sexual transmission of Hepatitis B may occur, particularly in unvaccinated men who have sex with men and

heterosexual persons with multiple sex partners or through contact with commercial sex workers. Infection in adulthood leads to chronic hepatitis in less than 5% of cases [7]. Transmission of the virus may also occur through the reuse of needles and syringes either in health-care settings or among persons who inject drugs. In addition, infection can occur during medical, surgical and dental procedures, tattooing, or through the use of razors and similar objects that are contaminated with infected blood [5].

2.2 Neural Network Learning and GRNN Architecture

The network touches “learning” through the mathematical process can be disregarded by the final user mainly. This is the way of viewing the network as “gloomy case”. The gloomy case receives a vector with “n” inputs and provides a vector with “m” outputs. The network studies from a sequence of examples that form the training database.

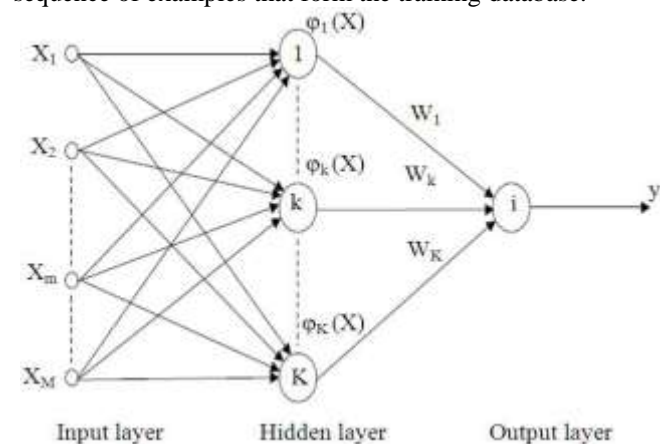


Figure 2: Generalized regression neural network architecture [10].

GRNN falls into the category of probabilistic neural networks. This neural network like other probabilistic neural networks needs only a fraction of the training samples a back propagation neural network would need. The data available from measurements of an operating system is generally never enough for a back propagation neural network [9]. Therefore the use of a probabilistic neural network is especially advantageous due to its ability to

converge to the underlying function of the data with only few training samples existing. The additional knowledge needed to get the fit in a sustaining way is relatively small and can be done without additional input by the user. This makes GRNN a very useful tool to make predictions and comparisons of system performance in practice [10].

3. Methodology

3.1 Method of Data Collection

The data used for this study was obtained from different sources. Primary data was obtained from field through observations of clinical diagnosis samples monitored for six months between January and July for the age mentioned were gotten and scheduled interviews with stakeholders were also conducted. While secondary data was gotten through consultations in journals, textbooks, articles and conference proceedings.

3.2 System Specification

System specification is a system information utility that produces a specification of a system's hardware and

software to meet certain requirements to produce a system design.

3.2.1 Hardware Requirements

The hardware required for the implementation of the program includes:

- 1) Memory (RAM) 6143MB
- 2) CPU speed 2416. MHz
- 3) CPU Info Intel®, Core(TM)2 Quad CPU @ 2.40GHz
- 4) Printer: HP LaserJet Series

3.2.2 Software Requirements

The applications software that will be developed cannot work without the support of some other categories of software called the system software. Such system software includes:

- 1) Windows 7 professional edition 32bits/64bits
- 2) VB. Net
- 3) Avast anti-virus

4. Results and Discussion

The Figures and Tables below present some useful results and inferences.

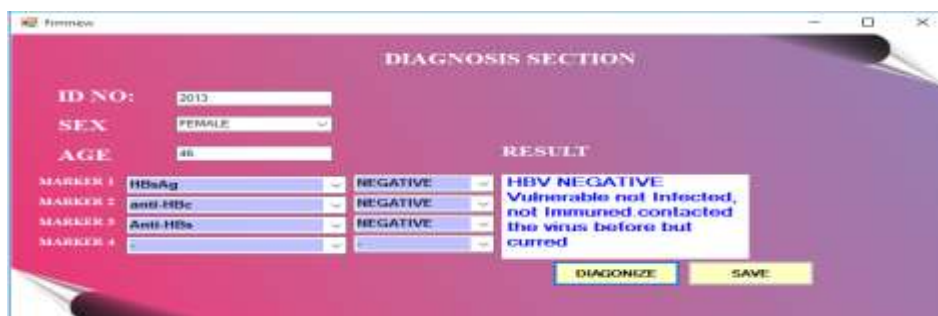


Figure 3: Patient with HBV Negative

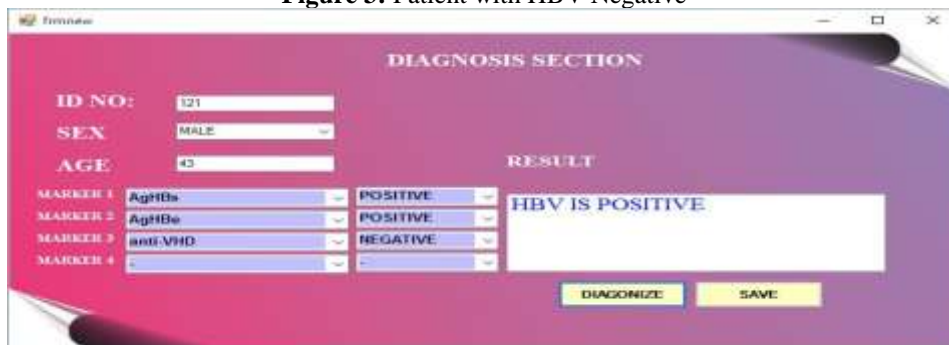


Figure 4: Patient with HBV Positive

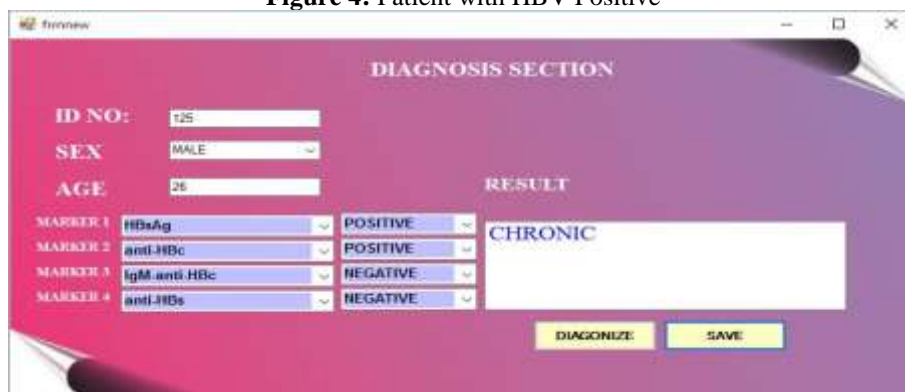


Figure 5: Patient with Chronic infection and defined by the continued presence of HBsAg in the blood for a period more than six (6) months.

Table 1: Diagnosis samples from the Health centers (Field, 2017)

Name of Health Center	Category	No. of samples	No. migration to Chronic	% Chronicity within 6 months
Fed. Polytechnic Mubi Clinic	Neonates	05	2	13.33
	Children	05	0	0.00
	Adults	05	0	0.00
New Life Hospital	Neonates	05	2	13.33
	Children	05	1	6.66
	Adults	05	0	0.00
Bafa Clinic	Neonates	05	1	6.66
	Children	05	0	0.00
	Adults	05	0	0.00
General Hospital	Neonates	05	2	13.33
	Children	05	0	0.00
	Adults	05	0	0.00
Ecolgate Clinic	Neonates	05	1	6.66
	Children	05	0	0.00
	Adults	05	0	0.00
Basira Clinic	Neonates	05	2	13.33
	Children	05	1	6.66
	Adults	05	0	0.00
Beekay Clinic	Neonates	05	1	6.66
	Children	05	1	6.66
	Adults	05	0	0.00
Health Technology Clinic	Neonates	05	3	20.00
	Children	05	1	6.66
	Adults	05	0	0.00
Asaal Clinic	Neonates	05	0	0.00
	Children	05	0	0.00
	Adults	05	0	0.00
Infinox Diagnostic Lab.	Neonates	05	2	13.33
	Children	05	0	0.00
	Adults	05	1	6.66

Table 2: Summary (Field, 2017)

Category	Percentage Chronicity Within 6 months period
Neonates	76.19
Children	19.05
Adults	4.76

Table 2 shows the summary of the results: 76.19% of neonates are faced with risk of chronicity, 19.05% of children are also faced with the risk of chronicity while 4.76% of adults are faced with the risk of chronicity. Hence, migration of HBV from acute to chronic is higher in neonates.

5. Conclusion

This research is a landmark in the sub-field of health informatics as it offers an excitedly accessible Knowledge System to serve as a dependable assistant to the medical practitioners that are more often than not troubled by the overpowering and apparently intimidating number of patients they need to attend to consistently.

In this paper, a description is made of an intelligent system for the diagnosis of the Hepatitis B virus (HBV) disease and the Risk of Chronicity Rate in Mubi metropolis of Adamawa State, Nigeria as Hepatitis is one of the serious diseases which demands urgent attention and treatment. The intelligent system consists of the Generalized Regression Neural Network (GRNN) which gives the result for whether

the patient is Hepatitis B positive or not and the severity of the disease in the patient. Simple descriptive statistics of percentage was used in the analysis of the 150 diagnosis and clinical samples collected in which the result shows that: 76.19% of neonates are faced with risk of chronicity, 19.05% of children are also faced with the risk of chronicity while 4.76% of adults are faced with the risk of chronicity in the selected health centers under study. For future work another researcher can go a step further in this work by finding out what factor(s) necessitate this migration from acute to chronic particularly the high rate in neonates and the recovery rate.

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