FIDELIS JUMARE ASENGI

LASSA FEVER DIAGNOSIS SYSTEM WITH VP - EXPERT SYSTEM USING RULE BASED APPROACH

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A THESIS SUBMITTED TO THE GRADUATE SCHOOL OF APPLIED SCIENCES OF NEAR EAST UNIVERSITY

By
FIDELIS JUMARE ASENGI

In Partial Fulfillment of the Requirements for the Degree of Master of Science in Mechatronic Engineering

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Approval of Director of Graduate School of Applied Science

Prof. Dr. Nadire ÇAVUŞ

We certify this thesis is satisfactory for the award of degree of masters of Science in mechatronics engineering

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I hereby declare that all information in this thesis has been obtained and presented in accordance with the academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all material and results that are not original in this work.

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Date:09/06/2019

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To my parents…

ABSTRACT

At present, Expert Systems which are class of Artificial Intelligence are comprehensively utilized in the field of Medicine for diagnosis, medical examination, and treatment of various kinds of illnesses. The vast majority of the outcomes acquired from different sorts of diagnosis expert system are shut qualities to the human choice, now and again careful qualities are gotten. A comprehensive framework for the analysis and treatment of lassa fever is as yet insufficient.

This aim of this thesis is to develop a system that will diagnose lassa fever, the information obtaining technique in the improvement of this framework were done through direct talking with the therapeutic experts and the knowledge was represented in the rule based procedure. These rules decides if an individual is infected with lassa fever and will go further to predict the level of the infection i.e either mild lassa fever, severe LF or critical lassa fever by the virtue of the test results, signs and symptoms entered by the user as answers to the questions from the system. VPES programming software was utilized for the structure of this system and the system was tested with the data of of a few suspected patients with great accuracy and the results were recommended as ok by a specialist based on his diagnosis.

The created framework can be utilized proficiently for analysis of lassa fever were the number of suspected patients is much, consequently, it will assist the medicinal experts with quick and accurate determinations, and spare time for both the specialists and patients also.

Keywords: Expert System; Artificial intelligent; VP-Expert System; Lassa Fever; Lassa Fever Diagnosis System

ÖZET

Günümüzde Yapay Zeka sınıfı Uzman Sistemler Tıp alanında çeşitli hastalıkların teşhisi, tıbbi muayenesi ve tedavisi için kapsamlı bir şekilde kullanılmaktadır. Farklı tipteki uzman tanı sistemlerinden elde edilen sonuçların büyük çoğunluğu, insan seçimine kapalı niteliklerdir, şimdi ve tekrar dikkatli nitelikler kazanılmıştır. Lassa ateşinin analizi ve tedavisi için kapsamlı bir çerçeve henüz yetersizdir.

Bu tezin amacı, lassa ateşini teşhis edecek bir sistem geliştirmektir, terapötik uzmanlarla doğrudan konuşarak bu çerçevenin geliştirilmesinde bilgi edinme tekniği yapılmış ve bilgi kural temelli prosedürde gösterilmiştir. Bu kurallar, bir bireye lassa ateşi bulaştığına karar verir ve enfeksiyonun seviyesini tahmin etmeye devam eder, yani kullanıcı tarafından girilen test sonuçları, işaretler ve semptomlar nedeniyle ya hafif lassa ateşi, şiddetli lassa ateşi ya da kritik lassa ateşi sistemden gelen soruların cevapları olarak. Bu sistemin yapısı için VP uzman sistem programlama yazılımı kullanılmış ve sistem şüpheli birkaç hastanın verileriyle büyük bir titizlikle test edilmiş ve sonuçları teşhis konusuna dayalı bir uzman tarafından tavsiye edilmiştir.

Oluşturulan çerçeve, lassa ateşinin analizi için yeterince kullanılabilir, şüpheli hasta sayısının çok fazla olması nedeniyle, tıbbi uzmanlara hızlı ve doğru tespitler ve hem uzmanlar hem de hastalar için boş zaman sağlar.

Anahtar Kelimeler: Uzman sistem; Yapay zeki; Başkan Yardımcısı; Lassa Fever; Lassa Fever Teşhis Sistemi

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LIST OF ABBREVIATIONS

AST:	Aminitransferase
ALT:	Alanine transaminase
BSL:	Biosafety level
BCNV:	Bear Canyon Virus
CFR:	Case fatality Risk
DIC:	Disseminated Intravascular Coagulation
ES:	Expert System
FMoH :	Federal ministry of Health
GPC:	Glycoprotein Precursor
GTOV:	Guanarito
IGR:	Intergenomic region
JUNV:	Junin Virus
LF:	Lassa Fever
LCM:	Lymphocytic Choriomeningitis
LASV:	Lassa Virus
LCMV:	Lymphocytic Choreomeningitis Virus
LFDS:	Lassa Fever Diagnosis System
LDH:	Lactate dehydrogenase
MHC:	Mice expressing humanized
MACV:	Machupo Virus

NP:	Nucleoprotein
NCDC :	Nigeria Centre for Diseases and Control
PCR:	Polymerase Chain Reaction
RNA:	Ribonucleic Acid
RNP:	Ribonucoprotein
SL:	Stem loop
SABV:	Sabia Virus
TACV:	TacaribeVirus
TAMV:	Tamiami Virus
TCID:	Tissue culture Infection dose
VP:	Virtual Programming
VPEX:	Virtual Programming Expert System
WHO:	World Health Organization
WWAV:	Whitewater Aroyo Virus

CHAPTER 1
INTRODUCTION

1.1 Epidemiology of Lassa Fever

Lassa fever, LASV was first isolated in 1969 from a missionary nurse who worked in a clinic in a small town, Lassa, in northeastern Nigeria. The nurse presumably acquired infection from an obstetrical patient residing in Lassa. She died approximately one week after the onset of symptoms. Subsequently two more nurses that attended the first patient contracted the disease, which was later named Lassa fever and caused the death of one of them. Infectious virus was isolated from all three cases.

Initially, several countries of West Africa were identified to be endemic for LASV, namely Sierra Leone, Guinea, Liberia and Nigeria. However, a serological survey among patients admitted with a history of fever and missionaries that had experienced a febrile illness showed that LASV was also present in Ivory Coast, Mali, and Central African Republic. The notion that LASV was endemic in larger areas of West Africa was further supported by the results of investigation of an imported case of Lassa fever in Germany in 2000. During the incubation period, the index patient traveled through several countries, namely Ghana, Ivory Coast, and Burkina Faso, that were not considered to be endemic at that time. Later, cases of Lassa fever have been reported from Burkina Faso, Ivory Coast, Ghana, Senegal, Gambia, and Mali.

However, the high degree of seroprevalence of LASV-specific antibodies in the general population residing in the endemic regions, although highly variable depending on the geographical location (from 1.8% to 55%), indicates that most infections are mild or possibly even asymptomatic and do not result in hospitalization. This is also supported by the findings indicating a high incidence of LASV-specific seroconversion, from 5% to 20% of the non-immune population per year. Nosocomial outbreaks are associated with higher mortality rates ranging from 36% to 65%.

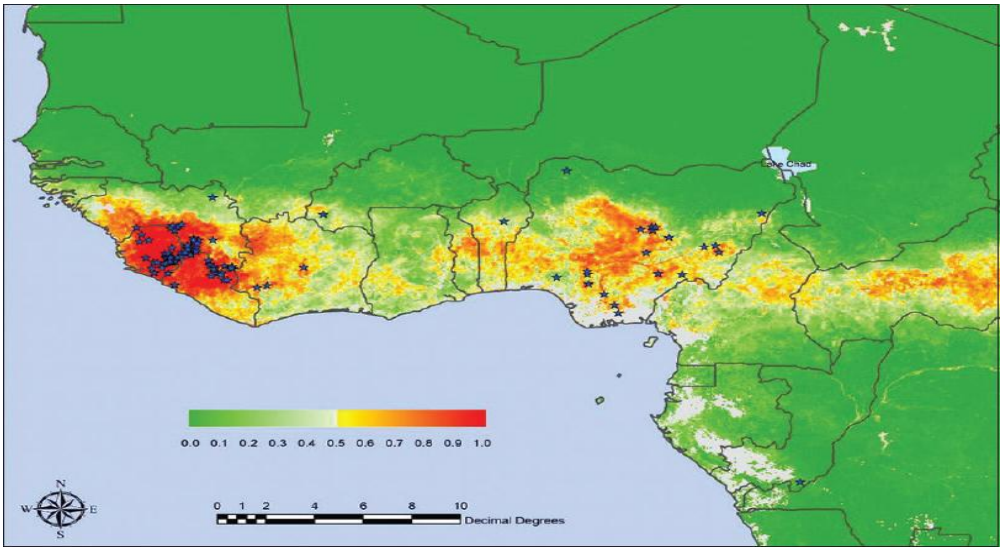

Figure 1.1: Risk map of Lassa fever in West Africa.

The posterior probability colour scale, from 0.0 (no risk) to 1.0 (highest risk) is shown as an inset according to estimations, LASV is responsible for 100,000-300,000 infections and approximately 5,000 deaths annually.

However, serosurveillance studies in hospitals dealing with suspected Lassa fever cases showed that the hospital staff that routinely practiced basic hygiene measures had no higher risk of infection than the local population. Infection with LASV presumably occurs through contact with body fluids or excreta, or inhalation of aerosols produced by infected animals. LASV is stable in aerosol, and animal-to-animal transmission via the airborne route has been demonstrated in the laboratory setting. Hunting of peridomestic rodents and consumption of their meat is another important route of LASV transmission to humans residing in endemic areas of West Africa.

The multimammate mouse, *Mastomys natalensis*, was originally identified as the primary host species for LASV. However, due to the poor understanding of the taxonomy of the genus, it is uncertain which species and particular subspecies serve as a reservoir for the virus. The studies addressing the importance of *M. natalensis* for the circulation of LASV in nature demonstrated that newborn animals inoculated intraperitoneally develop persistent asymptomatic infection. Significant infectious virus titers were detected in many organs, tissues, and fluids including lymph node, liver, spleen, lung, blood, and brain up to 74 days after inoculation. Moreover, LASV was isolated from the urine and throat swabs of infected animals. No significant histopathological alterations were observed in these

animals. Interestingly, adult *M. natalensis* infected with LASV also developed a disseminated infection that lasted up to 30 days. Some animals cleared the virus from some organs, but there was persistence in other organs up to 103 days when the study was terminated. The only consistent histopathological finding observed in adult animals was a moderate chronic meningoencephalitis. These data demonstrate that *M. natalensis* has an optimal pattern of infection and virus shedding for the maintenance of LASV in nature.

Lassa fever outbreak in Nigeria is a regular occurrence especially during the dry season every few years. However, it is gradually becoming perennial with high case fatalities.

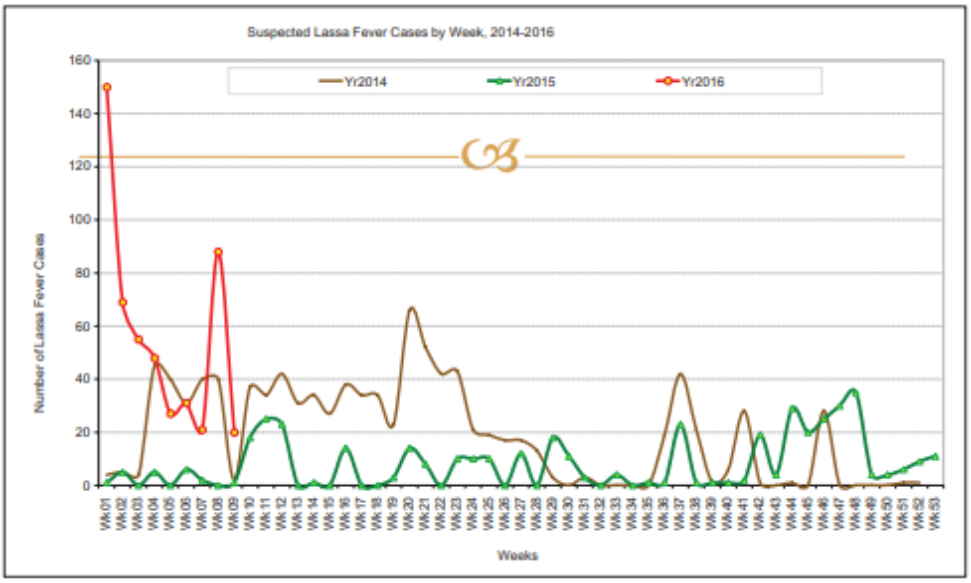

Figure 1.2 Seasonal variation in the incidence of Lassa fever in Nigeria (2014–2016); **Source:** Weekly IDSR002 report from State to National, NCDC,

A serious outbreak in recent memory in Nigeria began in December 2011 and was confirmed in early 2012. Within 6 months of the outbreak i.e., June 2012, 623 suspected cases, including 143 confirmed cases and 93 deaths had been recorded in 23 states out of 36 states of the federation. Based on the 2015 official figures, case fatality rate is significantly high at 37.9% of all cases (53 officially reported deaths). Local media has reported that the Nigerian National Council of Health warned of up to 1,000 potential deaths resulting from the 2015 Lassa fever outbreak.

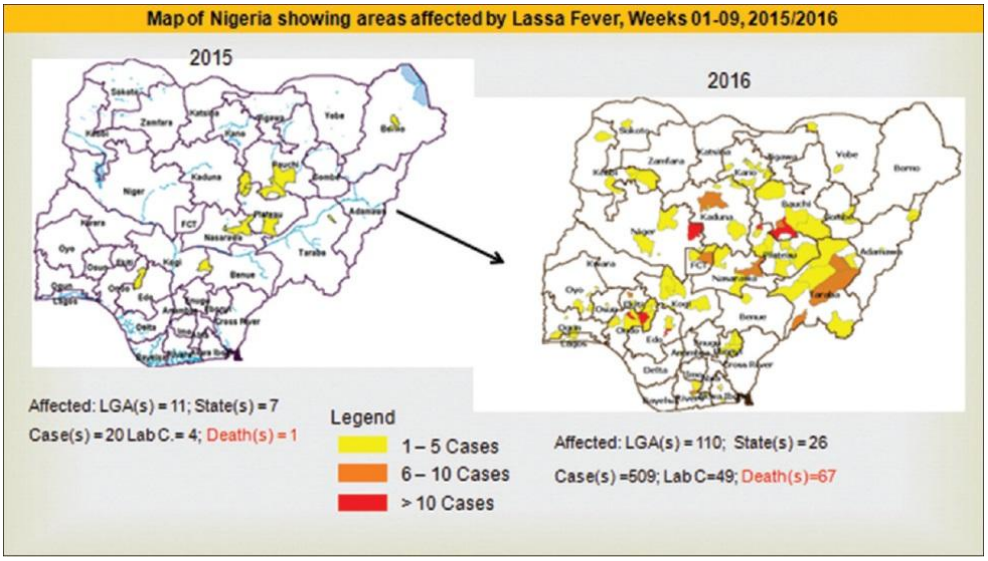

Figure 1.3 Map of Nigeria showing areas affected by lassa fever in 2016

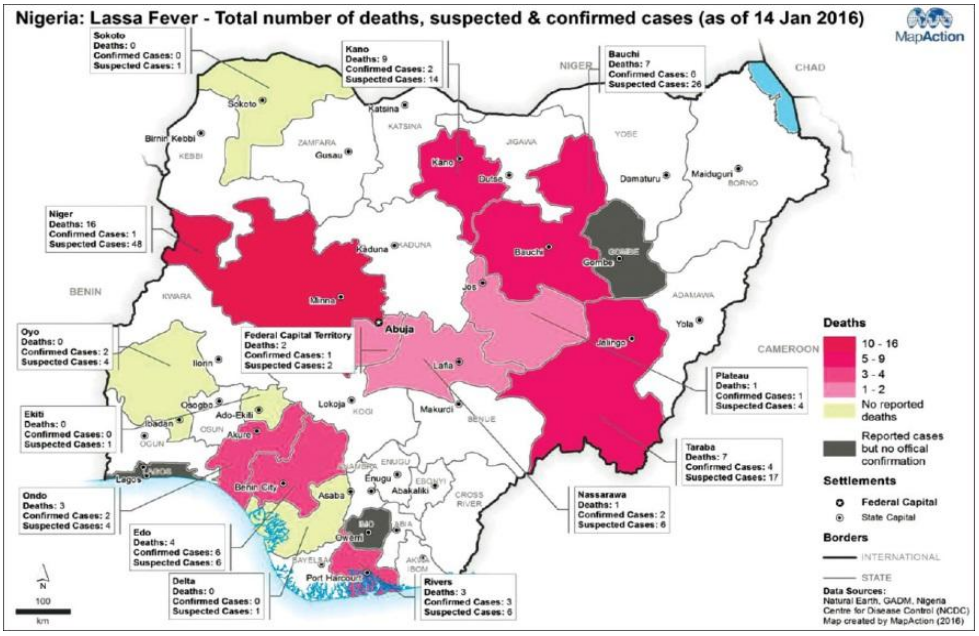

Figure 1.4 Map of Nigeria showing total numbers of deaths, suspected and confirmed cases of LF in 2016.

However, despite the lingering threats pose by LASV, there is lack of comprehensive data and often conflicting report of cases of Lassa fever Nigeria. The population density of Nigeria currently stands at 195 people/km2 , disease surveillance and contact tracing may be challenging in densely populated areas; it spread faster among the population, and if rodents are present, the number of cases may increase exponentially. So far most of the

densely populated states in Nigeria such as Lagos, the most densely populated with 2607 people/km2 , Imo counts 758 people/km2 and Kano with estimated 442 people/km2 have all reported cases of Lassa fever. Other factors militating against effective National Lassa fever response includes weak surveillance reporting, cultural and religious beliefs, especially in the northern Region. Most of the states hosting large numbers of internally displaced persons fleeing Boko Haram insurgents such as Borno, Abuja, Bauchi, Gombe, Kano, Plateau, Taraba and Edo states have recorded an outbreak.20 Furthermore, at present, health system capacity is weak as most Government owned health facilities in Nigeria lack facility for confirmatory diagnosis of Lassa fever with the exception of two tertiary health facilities currently serving as a national reference laboratory (Ballah et al, 2019)

1.2 Artificial Intelligence (AI)

Artificial intelligence (AI) is the simulation of human intelligence processes by machines, especially computer systems. These processes include learning (the acquisition of information and rules for using the information), reasoning (using rules to reach approximate or definite conclusions) and self-correction. AI is sparkling by looking at how person cerebrum reasons, and how individuals settle on a choice and work regardless of the reality endeavoring to answer a hazardous assignment, and after that applying the comes to fruition of this examination as a foundation of making astutely PC program and frameworks. Master frameworks are the classification of Artificial Intelligence framework. The communicated zone of Artificial Intelligence consider is to duplicate feline the working of human acumen limit by PC projects or PCs with the ability to copycat or impersonate the assignments of human bits of knowledge. The area of fake bits of knowledge is huge in degree and measure. Though continuing, we mirror the, as it were, normal and flourishing explore goes inside the zone of Artificial Intelligence which are; Master structure, Neural system, Neural Language planning and Fuzzy rationale (Mishkoff, 1985). Artificial intelligence is used in a customary cycle of life. Computer based intelligence is extensively used in drug and the medicinal services section. The most points of interest of AI inside the universe of drug would be discussed quickly. Changing the social insurance fragment: with later Utilized of computerized reasoning in prescriptions changes the manner in which human services portion works together with

guidance, organizations, and mechanical. It brings new possible results for progress and cooperation. The advanced inside the medicinal services fragment is sure and its advantages should be utilized, academic individuals. Diminishing death rate: Decreasing the period patients spend holding up for thought from bosses, man-made consciousness in medication lessens the death rate and hopefully affects the pervasiveness of this consideration. Having such offer help, masters possess extra energy for headway. There wasn't need to treat Artificial intelligence inside the medicinal field as an effort to displace authorities. Strengthening, it's the effort to support masters. Making diagnostics progressively definite: As therapeutic AI frameworks have the ability to retain from past cases, they offer authorities get to the information around the latest news in medication, the social insurance division, and a couple of scopes of contemplating in explicit. A human can't consolidate taking after the most cutting-edge leanings and treating patients in the meantime. There wasn't sufficient time for that structures however a Artificial intelligence System can. That is the reason it gets the chance to be a basic associate. Lessening the dependence on social organizations: Another approach to utilize man-made consciousness in medicinal services and drug is to enable robots to require care of a couple of patients. For event, remedial robots offer help Alzheimer's patients push ahead the personal satisfaction, decline the reliance on social organizations, and addition the time an individual may stay at household without human therapeutic assistance. Reducing human blunders: With in excess of 100 patients in seven days, authorities find it extraordinary to offer everyone with the similar volume of consideration. As well, there's an alleged human figure. Individuals likely make messes up. Fabricated knowledge in medication could be a procedure to destroy bumbles identified with human tiredness and calm authorities of a couple of dreary errands. Supporting in advancements: The effects communicated over are reasonable and significant. Regardless, this bit of leeway is the first real life. Prosperity care experts every now and again experience the must be move overpowering things or complete a couple of tedious errands like giving out pills. Robots might be the predefined change. Prescription stars may use machines as a system to redistribute these dreary assignments. Improving prominent medical procedure: Surgical mechanical autonomy might be a device that gives authorities with exactness, encouragement, and overwhelming representation. With the help of arranging such robots, masters get the support that shortens patients' recuperating focus remain, decreases torment and restorative expenses.

Computer based intelligence is, generally, by and large isolated into 3 phases: Artificial super intelligence (ASI), Artificial narrow insight (ANI), Artificial general intelligence (AGI) Artificial Super Intelligence: ASI is a definitive sort out of Artificial Intelligence foreseen by the analyst where the 3 machines with ASI can ready to pass the ordinary human knowledge. If we reach to that point, we are going have the option to fix every one of the riddles of the universe and can discover everything which is new right directly. Fake Narrow Intelligence: The essential sorts out of AI as the title proposes is basically astoundingly contract. It resembles tyke innovation that can so to speak work in one helpful region. ANI is best after you should run any automated task and inside the reparative plan. It is also caused significant damage saving since it could be an onetime hypothesis dislike getting any human resource and paying him on the month to month or without fail premise. Fake General Intelligence: AGI may as it was be one stage energize from Artificial Narrow Intelligence however this progression is the best achievement of mankind. Humankind has finally fabricated a machine which can't so to speak just as it suspected yet too can deliver his reasoning. With AGI, machines can address themselves as the human and can do whatever human is skilled of doing. AGI is having any kind of effect the associations and government in critical thinking and remarkable considering. In any case, despite everything it needs a couple of more opportunity to make fittingly to that degree where it very well may be work parallel to human.

1.3 Statement of Problem

Medical facilities should be handy at all times to the citizenries. But in most case, the people that supposed to access these facilities are far away from it. Many patients have pass away both in the rural and urban regions as a result of late detection or delay access to proper medical attention. This is due to the fact that most medical centers furnished with equipment to handle Lassa fever cases are located at a distance from the communities.

In view of this, it would be of great inevitable to provide a computerized system that will serve as complementary medical service, such as medical disease diagnosis to proffer way out to the availability of medical health diagnosis where the experts are not sufficient, overcrowding of health facilities and covering long distance before patients can access medical facility.

1.4 Aim and Objective

The aim and objective of this thesis is to develop a user friendly expert system algorithm that will diagnosis Lassa fever and identify the stages of the fever (Mild, Severe or Critical); and able to generate diagnosis report for printing.

1.5 Scope

Lassa fever is an African predominantly infection, which is found in some of the west African countries. For this reason the research work will be concentrated in Africa and precisely Nigeria because most of the clinical data are collected from Nigeria

CHAPTER 2

LITERATURE REVIEW

2.1 Overview

The sources of the information presented were obtained through detailed review of literatures using Medline, Google Scholar, Scopus, African Journal Online, Ovid and PubMed. Search terms used include Lassa fever, Arenaviridae, viral haemorrhagic fever, Nigeria, and similar terms such as LASV, very high frequency, were crossed. Case management and surveys undertaking from the field was studied and reviewed. Relevant websites (such as Nigeria Center for Disease Control (NCDC), Nigerian Federal Ministry of Health (FMoH) and Centres for Disease Control and Prevention were visited for updates on Lassa fever. References were reviewed to extend the search, and Nigerian content experts were consulted for additional materials. This chapter concentrates on what lassa fever is, the possible causes of lassa fever, the signs and symptoms of lassa fever, diagnostic challenges and related research work.

2.2 Lassa Fever, What it is?

Lassa fever is an acute viral haemorrhagic fever caused by the Lassa virus. The first outbreak of Lassa fever was reported in Nigeria around 1969 in a village called Lassa in Borno State, and the disease has assumed an endemic status. About two-third of the 36 states in Nigeria are endemic. There appears to be a seasonal pattern in the outbreak of Lassa fever in Nigeria, with most cases occurring in the dry season. Within the past 7 years, Nigeria reported between 18 and 201 confirmed cases of Lassa fever annually, with annual CFR of between 24% and 79% among confirmed cases.

Lassa fever presents with nonspecific symptoms similar to many other endemic illnesses in West Africa, making it difficult to diagnose clinically; therefore, laboratory testing is needed to confirm the diagnosis. The availability of laboratory testing has been limited by the designation of Lassa virus as a category A pathogen by the National Institute of Allergy and Infectious Diseases. Biosafety precautions are recommended for handling potentially infectious specimens. In 2014, the World Health Organization issued a call for early

diagnostic tests for Lassa fever. This article provides a brief review of the challenges of identifying Lassa fever and the different diagnostic tests available for Lassa fever along with their strengths and weaknesses. (Vanessa et al, 2017).

More than 300,000 people are infected yearly, with deaths in excess of 5,000 people per annual It is quite rampant in West Africa where the Multimammate rat is commonly available, particularly countries like Guinea, Liberia, Nigeria and Sierra Leone. Although, some cases have been reported in the Central African Republic, Mali, Senegal and other neighbouring countries. Its first confirmed case was reported in 2014 in Benin Republic, while Togo had its first confirmation in 2016.

About 80% of infected people with Lassa virus display no symptoms or they have symptoms that are closely related to other febrile illnesses making its treatment challenging in the first instance. Without prompt diagnosis and treatment, 1 in 5 infected people result in severe disease, where the virus damages some organs such as the liver, spleen and kidneys, according to Dr Formenty, expert in hemorrhagic fevers at WHO.

The prevention and control of Lassa fever is centred on vector control, hygiene, sanitation, quarantine affected people, disease surveillance and contact tracing. Also in case outbreaks, patience should be quarantined, treated and monitored before they are discharged. It is also important that cases of Lassa fever should be duely reported and effectively diagnosis and treated faeces, or other bodily fluids of infected person with Lassa fever. There hasn't being any epidemiological evidence supporting its spread between humans through airborne. Person-to-person transmission may occur in the community and health-care settings, where the virus may be spread as result of contaminated medical equipment, such as re-used needles and syrings. Lassa fever occurs across all age groups and both sexes. Although, people at greatest risk are those living in rural areas where rodents are usually found, filty environments especially in communities with poor sanitation or with crowded living conditions. Also, health workers may be at risk if caring for Lassa fever patients is in the absence of proper barrier nursing and infection prevention and control practices. (Hambali, 2017)

A single case of Lassa fever is regarded as an outbreak, and a suspected case of Lassa fever is defined as illness with gradual onset with one or more of the following: Malaise, fever, headache, sore throat, cough, nausea, vomiting, diarrhea, myalgia, chest pain hearing loss, and a history of contact with excreta of rodents or with a case of Lassa fever, while a

confirmed case of Lassa fever is a suspected case that is laboratory confirmed (positive IgM antibody, PCR, or virus isolation) or epidemiologically linked to a laboratory-confirmed case.

2.3 Causes of Lassa Fever

- Once a Mastomys rat is infected with the virus, it can excrete the virus in its feces and urine, potentially for the rest of its life.
- As a result, the virus can spread easily, especially as the rats breed rapidly and can inhabit human homes.
- The most common method of transmission is by consuming or inhaling rat urine or feces. It can also be spread through cuts and open sores.
- The rats live in and around human habitation, and they often come into contact with foodstuffs. Sometimes people eat the rats, and the disease can be spread during their preparation.
- Person-to-person contact is possible via blood, tissue, secretions or excretions, but not through touch. Sharing needles may spread the virus, and there are some reports of sexual transmission.
- Lassa fever can also be passed between patients and staff at poorly equipped hospitals where sterilization and protective clothing is not standard.

2.4 Signs and Symptoms

Because the symptoms of Lassa fever are so varied and nonspecific, clinical diagnosis is often difficult. Lassa fever is also associated with occasional epidemics, during which the case-fatality rate can reach 50% in hospitalized patients.

The most common complication of Lassa fever is deafness. Various degrees of deafness occur in approximately one-third of infections, and in many cases hearing loss is permanent. As far as is known, severity of the disease does not affect this complication: deafness may develop in mild as well as in severe cases or even critical.

Approximately 15% - 20% of patients hospitalized for Lassa fever die from the illness. However, only 1% of all Lassa virus infections result in death. The death rates for women in the third trimester of pregnancy are particularly high. Spontaneous abortion is a serious

complication of infection with an estimated 95% mortality in fetuses of infected pregnant mothers.

An estimated 80 percent of infections do not produce significant symptoms, although there may be a general malaise, headache, and a slight fever. In the remaining 20 percent of cases, Lassa fever becomes serious.

Signs and ymptoms can include:

- Bleeding in the gums, nose, eyes, or elsewhere
- Difficulty breathing
- Cough
- Swollen airways
- Vomiting and diarrhea, both with blood
- Difficulty swallowing
- Hepatitis
- Swollen face
- Pain in the chest, back, and abdomen
- Shock
- Hearing loss, which may be permanent
- Abnormal heart rhythms
- High or low blood pressure
- Pericarditis, a swelling of the sac that surrounds the heart
- Tremors
- Encephalitis
- Meningitis
- Seizures

Death can occur within 2 weeks after the onset of symptoms due to multiple organ failure.

One of the most common complications of Lassa fever is hearing loss, which occurs in around 1 in 3infections.

2.5 Clinical Description and Pathogenesis of Lassa Fever

The incubation period of Lassa fever ranges from 7 to 21 days. The clinical disease begins as a flu-like illness characterized by fever, general weakness, and malaise, which may be

accompanied by cough, sore throat, and severe headache. Gastrointestinal manifestations such as nausea, vomiting, and diarrhea are also common. The differential diagnosis of Lassa fever based on the presenting symptoms can be problematic due to the many other acute undifferentiated febrile illnesses circulating in West Africa. Although, hemorrhagic manifestations are not an important feature of Lassa fever, perturbation of vascular function is likely to be central to Lassa fever-associated pathobiology, since the signs of increased vascular permeability, such as facial edema and pleural and pericardial effusions, indicate a poor prognosis for the disease outcome. Recovery from Lassa fever generally begins within 8 to 10 days of disease onset. In severe cases, the condition of the patient deteriorates rapidly between the 6th and 10th day of illness with severe pulmonary edema, acute respiratory distress, clinical signs of encephalopathy, sometimes with coma and seizures, and terminal shock. Bleeding from mucosal surfaces is often observed; however, it is usually not of a magnitude to produce shock by itself. Sensorineural deafness is commonly observed in patients in the late stages of disease or in early convalescence in survivors.

The level of viremia is highly predictive of the disease outcome. In a study involving 137 patients with Lassa fever, patients that presented with viremia less than 103 median tissue culture infectious dose (TCID50)/ml on the day of hospitalization had 3.7 times greater chance of survival than those admitted with higher levels of viremia. Similarly, the probability of fatal outcome in patients with serum titers > 103 TCID50/ml and serum levels of aspartate aminotransferase (AST) ≥ 150 international units (IU)/L was 21 times higher than that in patients not meeting either of these criteria. Virtually all patients with fatal Lassa fever whose sera were tested were viremic at the time of death with terminal viremia ranging from 103 to 108 TCID50/ml Detailed studies have shown that viremia peaks between 4 and 9 days after the onset of symptomatic disease and is followed by pronounced clinical manifestations. Patients recovering from Lassa fever clear virus from blood circulation about 3 weeks after the beginning of illness.

Table 2.1. Onset and duration of the principal clinicalmanifestation of Lassa fever

Chemical signs and symptoms	Day of illness		Duration Days
	Start day	End day	
Fever	1	11	10
Weakness	3	14	11
Cough	3	14	11
Chest pain	4	13	9
Back pain	4	12	8
Joint pain	4	12	8
Sore throat	4	11	7
Dysuria	4	10	6
Headache	4	11	7
Abdominal pain	5	8	3
Vomiting	5	9	4
Diarrhea	5	9	4
Pharyngitis	7	12	5
Conjunctivitis	7	12	5
Bleeding	7	11	4
Abdominal	9	14	5
Rales	9	14	5
Facial edema	9	16	7

The current knowledge of Lassa fever pathogenesis does not include the chain of events that take place during disease development and lead to death of severely ill patients. Apparently, failure to develop the cellular immune response that would control dissemination of LASV, which is indicated by high serum virus titers, combined with disseminated replication in tissues and absence of neutralizing antibodies, leads to the development of fatal Lassa fever. However, considering the high mortality and truly dramatic course of the disease, the pathological findings do not provide the basis that would explain the mechanism of disease progression and the cause of death from Lassa fever.

Physical examination of patients after the onset of fever often reveals purulent pharyngitis, bilateral conjunctival hemorrhages, facial edema, and generalized abdominal tenderness. Macroscopic pathological changes can include pleural effusions, pulmonary edema, ascites, and hemorrhagic manifestations in the gastrointestinal mucosa. Microscopic findings include hepatocellular necrosis and apoptosis, splenic necrosis, adrenocortical necrosis, mild mononuclear interstitial myocarditis without myocardial fiber necrosis, alveolar edema with capillary congestion and mild interstitial pneumonitis, lymph nodal sinus histiocytosis with mitoses, gastrointestinal mucosal petechiae, renal tubular injury, and

interstitial nephritis. A comprehensive postmortem histopathological examination of 21 virologically confirmed community-acquired cases of Lassa fever in Sierra Leone revealed variable levels of hepatic necrosis involving from 1 to 40% of hepatocytes. The necrotic hepatocytes were randomly distributed often forming foci of contiguous cells. Mononuclear phagocytes were observed either contacting or phagocytosing necrotic hepatocytes. Interestingly, this phagocytic reaction, although highly variable from case to case and even from one necrotic focus to another in the same case, demonstrated a tendency towards homogeneity of the level of involvement within a particular patient. The predominant distribution of splenic necrosis was observed in the marginal zone of the periarteriolar lymphocytic sheath. Close examination of thin tissue sections revealed the presence of fibrin in addition to the debris of necrotic cells. Splenic venous subendothelium appeared to be infiltrated by lymphocytes and other mononuclear cells. Microscopic examination of adrenal glands showed prominent spherical, hyaline, acidophilic cytoplasmic inclusions in cells near the junction of zona reticularis and medulla. In most cases these cells appeared to be adrenocortical cells of the zona reticularis; however, some cells were of adrenal medulla origin (Viruses, 2012)

2.6 Lassa Virus Diagnostic Challenges

One significant challenge in West Africa is differentiating between etiologies of febrile illness with similar initial clinical presentations, including malaria, influenza, dengue, yellow fever, and Lassa fever, with limited laboratory facility and reagent availabilities. Empirical treatment for presumed malaria or bacterial infection is often trialed, and Lassa fever is only suspected when a patient fails to improve with antimalarial and antibiotic therapy. This diagnostic delay leads to delayed patient isolation, an increased potential for transmission to family members and health care workers, and delayed initiation of ribavirin therapy, thereby decreasing its beneficial effect. Further highlighting the challenges of appropriate diagnostics is the emergence of Ebola virus in West Africa. A recent study found 60 to 70% of the patients with blood samples submitted to the Lassa Diagnostic Laboratory in Kenema, Sierra Leone, in the years prior to the Ebola virus outbreak were negative for malaria and Lassa virus, and there

was serological evidence of Ebola and Marburg virus infections. Correctly identifying the cause of an acute febrile illness in West Africa in an actionable time frame requires

validated, rapid region-appropriate diagnostic assays. Given the risk of person-to-person virus spread via bodily fluids, laboratory staff should be aware of the risk of Lassa virus when processing potentially infectious specimens. Poor sample storage and handling may pose a safety hazard to laboratory staff as well as decrease the sensitivity of diagnostic assays. The World Health Organization guidelines for the collection, storage, and handling of specimens for Ebola virus testing should be followed when testing for Lassa virus. BSL-4 precautions are recommended when handling specimens which may contain infectious Lassa virus; however, the availability of such high-containment laboratories is limited worldwide. If BSL-4 precautions are not available, samples may be handled in a class II or III biosafety cabinet or inactivated to allow safe handling of specimens under BSL-2 precautions. While there are multiple methods for viral inactivation in the literature, different methods are appropriate depending on the intended downstream testing (e.g., molecular or immunological pathogen detection, clinical laboratory tests, etc.). Chemical inactivation using solutions containing guanidine salts (e.g., TRIzol, Triton X-100, and buffer AVL combined with ethanol) is well documented, is effective with multiple pathogens, and is commonly used. Inactivation can be achieved by heating a blood specimen to 60°C for 60 min, although inactivation at 56°C for 30 min has been reported. Depending on the sample matrix and the specific pathogen, heat exposure alone may not result in complete inactivation; the use of chemical denaturizing solutions in combination with heating to provide more complete inactivation is recommended. Gamma irradiation is also used to inactivate Lassa virus in liquid and dried samples. Since the required absorbed radiation dose for successful viral inactivation varies depending on the temperature of the sample, empirical sample safety testing is required to confirm inactivation. The high-containment safety requirements complicate Lassa virus assay development and validation studies. Many assay reagents need to be generated under BSL-4 conditions. Synthetic nucleic acids and recombinant proteins are more commonly being used as assay components, but assay validation with mock clinical samples still requires viral materials generated under BSL-4 conditions. The development of appropriate diagnostic assays is further complicated by significant Lassa virus diversity. The high nucleotide and amino acid diversity of Lassa virus isolates sequenced across West Africa can result in false-negative results if the primer/probe or antibody pairs do not bind to the target sufficiently. For example, a commonly used reverse transcriptase PCR (RT-PCR) assay was redesigned

when false negatives were identified due to primer-template mismatches. Furthermore, an NCBI protein BLAST analysis of the Lassa virus Josiah strain showed that glycoprotein ([GPC] NP_694870) and nucleoprotein ([NP] NP_694869.1) varied in percent identity from 91 to 99% and 86 to 99%, respectively, with full-length protein sequences of the other Lassa virus protein sequences in GenBank. For example, Emmerich and colleagues evaluated the anti-Lassa virus antibody response in a human sample set from West Africa by immunofluorescence assay (IFA) and reverse enzyme-linked immunosorbent assays (ELISAs) using several different Lassa virus strains The authors found differing antibody responses depending on the virus strain used; stronger antibody responses were observed with local Lassa virus strains. Reassortant virus ML29, containing the L RNA segment of Mopeia virus and the S RNA segment of Lassa virus (Josiah strain), provides protection when injected into guinea pigs against distantly related strains of Lassa virus from Nigeria; ML29 could potentially serve as a broadly cross-reacting reagent for assay development. Table 1 highlights a selection of Lassa virus assays found in the literature. However, we are currently unaware of any Lassa virus diagnostic validation studies demonstrating assay performance using viruses isolated across West Africa that cover the wide diversity of Lassa genetic variation possible. In the absence of a single, timely, pan-Lassa virus diagnostic assay, one future strategy could be the designing and validating of assays based on geographic region, as Lassa virus diversity generally clusters with geographic location. While ideal for use in specific countries/ regions, this approach, in the context of exported cases of Lassa fever from multiple countries where it is endemic, would require many validated assays being available for accurate diagnosis. (Vanessa, 2017)

2.7 Related Works

2.7.1 GIDEON was developed by specialists in infectious diseases and biostatistics, and computer scientists at University-based medical schools in the United States and Israel. GIDEON is an expert system to diagnosis and reference in the fields of tropical and infectious diseases, epidemiology, microbiology and antimicrobial chemotherapy. It was designed to diagnose most common infectious diseases based on symptoms, laboratory testing and dermatological profile. It aids in diagnosing infectious diseases, but difficult to maintain, manage and upgrade because it is not web-based. It also attempts to diagnose all infectious diseases which introduced certain complexities. (Hambali, 2017)

2.7.2 The MYCIN Program for infectious diseases is one of the earliest medical expert systems to have been developed. It was designed to diagnose and prescribe treatment for infectious diseases particularly spinal meningitis and bacterial infections of the blood. It first identifies what bacterium caused the disease and then suggests antibiotic to give the patient. It is very helpful for physicians that lack expertise at certain diseases because it provides reason for suggesting diagnosis and recommending treatment. The setback of MYCIN is that runs on large time shared systems (slow response), and it is not suitable for the treatment of malaria. (Hambali, 2017)

2.7.3 EMERGE is an expert system that based on rule-based to diagnosis disease. It was designed to be used in an emergency room only. The system uses a form of production rules which incorporates weighing factors that are determined by a neural network. The neural network is composed of input and output blocks with a hidden layer block in between which communicates input to the output. The neural network learns from examples and then predicts an output based on this knowledge. This system also uses an IF THEN-UNLESS statement instead of an IF THEN statement so that the decision process may be more precise, the results more accurate, and the explanations better understood. Its setback is that it is difficult to maintain, manage and upgrade since it is not web-based, beside its restriction to emergency room usage. (Hambali, 2017)

2.7.4 YOUR DIAGNOSIS is an online medical diagnosis and symptoms analysis system. It asks several questions from user about body system and symptoms. Allergies, medications and immunizations are recorded as well as family history and past medical problems. It also does a complex analysis of all information gathered about symptoms and produces a list of all possible and probable medical diagnoses. It is online and can be interacted with in stages. All provided information can be securely stored as confidential personal health record for future retrieval. It also gives a confidential medical report, which could be printed or have emailed for personal usage. The setback of Your Diagnosis is its complexity in trying to diagnose and treat all the ailments in one sweep. (Hambali, 2017)

2.7.5 XDIS is an expert system that was designed to help physicians in diagnosis. The system holds information of more than three hundred (300) internal diseases and pathologic

syndromes most frequently encountered in general practice. For each set of symptoms entered for a case, the system produces the full list of possible diagnosis ranking from the most probable to the least probable. The time spend to display the result of a diagnosis is usually less than ten (10) minutes. XDIS assists in making preliminary diagnosis on the first visit of a patient to the physician and at the same time, decides on the need to refer the patient to a specialist and to select medical tests to make a more exact diagnosis. Its setback is that it gives probable list of diagnosis, not exact diagnosis. (Hambali, 2017)

2.7.6 Djam et al. ([D+11]) designed an expert system called fuzzy expert system for the management of malaria (FESMM). Their research work offers a complementary decision support platform for medical practitioners in malaria prevalent areas. About 35 malaria patients were sampled and their results are computed in the range of predefined limit by the signs monitored via a multi-parameter heart screen. Intelligent systems techniques are applied in the data acquisition and processing (such as sorting, transforming, among others) it into valuable information. The system was used to conduct pre-diagnosis and gives alert signs to the medical staff. (Hambali, 2017)

2.7.7 Senthil ([Sen11]), designed Fuzzy Expert System for Diabetes dignosis using Fuzzy Verdict Mechanism. The researcher proposes a fuzzy expert system framework which builds huge scale of knowledge based system for effective diabetes disease dignosis. The knowledge is designed using the fuzzification to transform crisp values into fuzzy values by employing the fuzzy verdict mechanism to diagnosis diabetes. (Hambali, 2017)

CHAPTER 3

EXPERT SYSTEM AND VP-EXPERT SHELL

3.1 Overview

An expert is someone having comprehensive or authoritative knowledge in a particular field. Therefore a computer system created to act as an expert to provide a solution to a problem in a particular domain is called an expert system**.** There are three individuals who take part in the design of the system; knowledge engineer, domain expert and the user. The domain expert is the person that has the required expertise to solve the problem that the proposed expert system is pre-planned to solve. The knowledge engineer acquires knowledge from the expert and transforms it into a format suitable for the system to use. The user is consults the system to solve her/her problem by responding to questions from the designed system. The knowledge engineer performs the major task of designing an expert system; he obtains the knowledge from the domain expert and presents it in a comprehensive format to the user.

3.2 Expert System

An ES is a subclass of AI developed to solve a specific problem in a particular domain. The designed computer system is able to simulate the conduct of a human expert to solve a problem in a particular domain. An ES is computer system that copycats a human expert.

The term Expert System or Knowledge Base System is used to refer to a computer system that has the same as a human expert in its knowledge base. The synonymous used of the two terms, Expert Systems (commonly called ES) and knowledge-based systems (also referred to as KBS), are frequently used. Expert systems are the greatest common types of artificial intelligence application. In an expert system, the area which human intellectual endeavor to apprehend is identified as the task domain (Mishkoff, 1985).

3.3 Architecture of an Expert System (ES)

Building an Expert System requires a combination of many components that result into the decision making viz. goals, facts, rules, inference engine, etc. (Dennis, 1989), thus we describe an expert system as a system, and not an ordinary computer program.

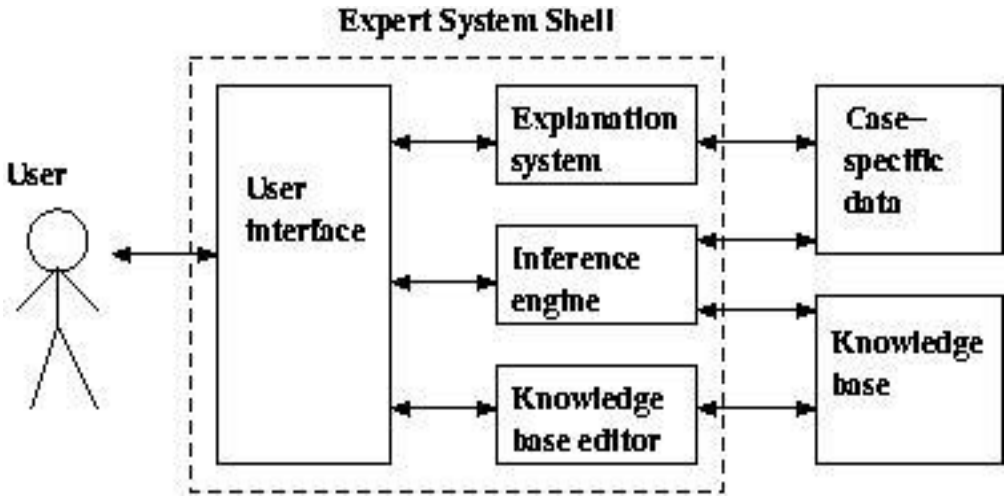

Figure 3.1: ES Architecture: Source: Mishkoff, (1985)

3.3.1 The Knowledge Base of ES

This is the heart of an expert system. Engineering problem solving uses heuristic knowledge, recognized scientific ideologies and computational algorithms. A heuristic knowledge is a rule-of-thumb that aids one to limit how to proceed. The domain knowledge of an expert system is saved in its KB and this module is very important that the successful application of the system relies on the excellence and dependability of the knowledge confined in it (Sayedah and Tawfik, 2013).

The knowledge base consists of stationary knowledge (situation, events and facts about objects) and dynamic knowledge that deals with the information about the sequence of action. There are various methods of representation and organization of knowledge and knowledge base. The If-Then production rules are used to represent the knowledge. The stationary and dynamic knowledge are also called declarative and procedural knowledge respectively.

3.3.2 Inference engine

Representing the domain expert's knowledge in the knowledge base is not enough and there must be an extra component that guides the execution of the knowledge. This component of the expert system is recognized as the control structure, the rule translator or the inference engine. The inference engine chooses the kind of search to be used to solve the problem. In fact, the inference engine runs the expert system, defining which rule is to be useful, executing the rules and defining when a suitable solution is attained. The kind of inference

mechanism relies on equally the nature of the problem domain and the technique in which knowledge is represented in the knowledge base.

3.3.2.1 Forward Chaining

In designing an expert system to solve a particular problem, someone may choose to start with a preliminary state and then tries to reach the goal state. The method of shifting over different solutions to proceed from the preliminary state to goal state is termed search and the realm of all probable paths of search is the search space. There are two search methods broadly used in rule based systems, these are forward chaining and backward chaining.

As the name implies search in forward chaining proceeds in the forward direction. The forward chaining is a data driven search. The forward chaining is advantageous when goal conditions are minor in number when related to the initial state. Antecedent part is checked first and then goes to consequent part.

3.3.2.2 Backward Chaining

In backward chaining the system backs a goal state or suggestion by examining known information's in the framework. The system searches the state space working from goal state to the preliminary state by the applying the inverse operators. When there are rare goal states and many preliminary states, it may be better to start with the goal to work back towards the controller state. Backward chaining is a goal driven or ambitious search.

3.3.2.3 Hybrid Chaining

Hybrid chaining always starts with forwarding chaining and anywhere a fact is required from the operator, go into contrary to the leaf node of the knowledge and have it to proceed with forwarding chaining mechanism.

3.3.3 Working Memory

The working memory aims at the gathering of symbols or reliable information that mirrors the present condition of the problem which comprises of the data gathered during problem implementation.

3.3.4 Knowledge Acquisition

The methods involve in extracting, constructing and organizing information from the domain expert, so that it can be used in the building the system is termed knowledge

acquisition. The success of expert system mainly depends upon the superiority, comprehensiveness, and accurateness of the information stored in its knowledge base. This permits one to obtain more knowledge about the problem realm from the expert (Patel, 2013).

3.3.5 User Interface

This is the component of the system which permits the user to interact with the expert system.

3.3.6 Explanation facility

Expert System is unique and special in the sense that it has the ability to explain to a user how a conclusion was reached and this is achieved through the explanation facility. This is one of the key benefits of the expert system.

3.4 Developing an Expert Systems

The development of any successful expert system involves so many important steps (Nilsson, 1998). These steps are:

• Identify the problem: Just like most compiler programs the expert system is an answer to a crucial problem. The development of an expert system can be validated when there is a problem it can solve.

• Study the alternatives: Though the identified problem in step one above may be suitable to the criteria for an expert system we would be cautious with simpler and cheaper alternative solutions.

• Feasibility: In this step we will try to study the practicability of the design system. The developed system should be practicable from all aspect such as procedural, economical and so on.

• Selection of design tools: There are so many expert system design tools available in the market. These design tools are computer software sets that allow us to key in the expert's knowledge inside the computer without having to program. Though most of these design tools are rule based, some tools allow the execution of the frames and semantic network but they are slightly expensive. Therefore, the selection of the right design tool is key to developing successful expert system.

• Execute the knowledge acquisition: The design of an expert system technically begins with the knowledge acquisition. In this step of the design of the expert system, we acquire relevant knowledge from field experts and other relevant sources such text books, journals, and so on.

• Design and complete the Expert System: Now that we have chosen the proper expert system design tool and have acquired the needed knowledge we may now begin with the design of the expert system. First, we desire to generate a plan for a hierarchical flowchart, matrix decision tree or other plans that will assist us in establishing and understanding the knowledge. By means of these assistances, we will be able to translate the knowledge into the "if-then" rule. Once the elementary design is achieved we can start to create a sample of one of the sections of the system. Once we are satisfied that the system is going to perform properly we can start to increase the sample into the final system.

• Testing and correcting: At this phase of the development of the expert system, we would test the designed system and make corrections where necessary as most expert systems are always faulty at the initial stage. The responses gotten from the users will show the places to make the corrections so that we may achieve the best execution.

• Maintenance: The knowledge base of an expert system can be modified. This provides the opportunity to consistently maintain, update the system with innovative knowledge and eliminate the knowledge that is no longer related. This is a very vital part in the development of expert systems.

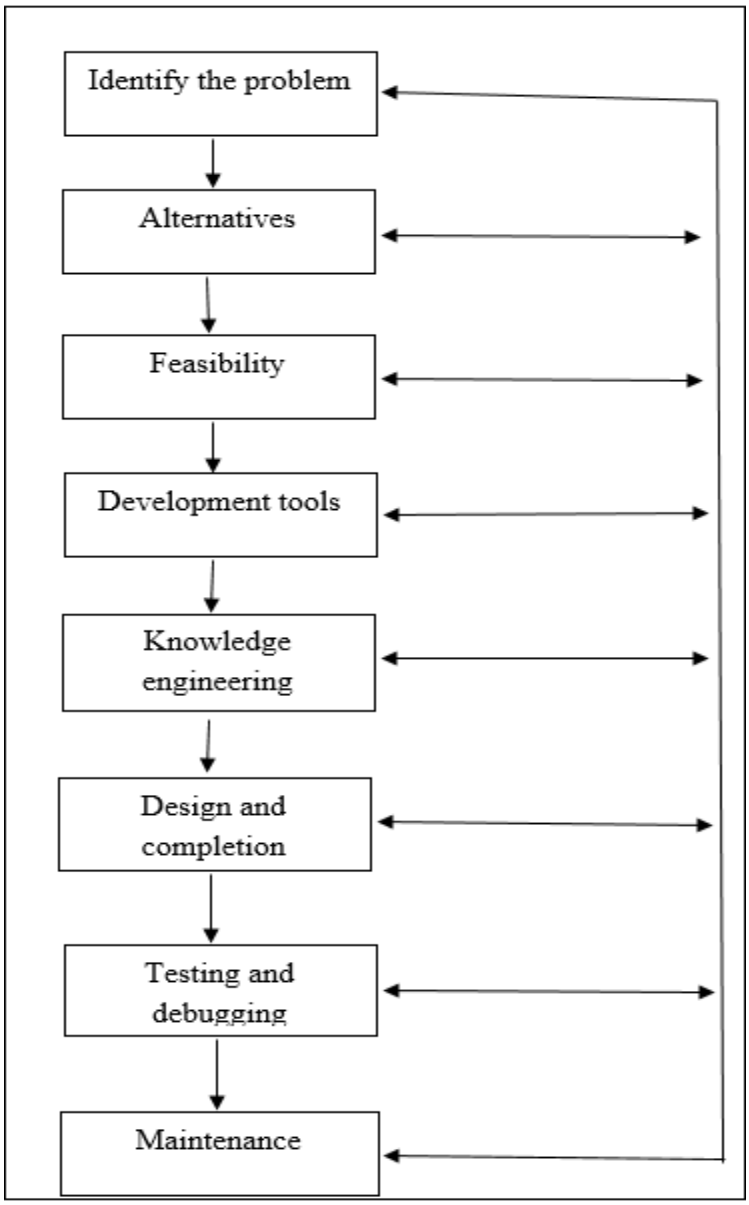

Figure 3.2: Development Cycle of Expert System

3.5 Features of Expert System

• Goal driven reasoning or backwards chaining: This is an inference method which frequently practices the if-then rules and breaks down the goal into easier verifiable minor sub-goals.

• Handling uncertainty: Expert system has the ability to handle uncertainty since it can think with rules and facts that are not surely identified.

• Data-driven reasoning or forward chaining: This is an inference method which infer a problem solution from original facts using the if-then rules.

• Data representation: Is the technique in which the problem precise data inside the system are kept and accessed.

• User interface: This is where the user interacts or communicates with the system.

• Explanations: ES has the potential to explain the procedures that were used to give a commendation.

3.6 Application of Expert System

Expert system has so many applications in our contemporary world. These applications are in various categories, viz. Knowledge domain which is used to detect faults in vehicles and computers. Expert system also finds application in finance and commerce to detect fraud, doubtful transactions, stock market trading, airline scheduling and cargo schedules. In addition it is applied in design domain where camera lens is designed and automobile design. It also applied in monitoring systems for equating data to monitor petroleum pipeline outflow. Another field where expert system is applied is the medical domain for diagnosis and treatment of various diseases. Furthermore it is also used in geology to identify locations that are suitable to drill for oil or water.

3.7 Advantages of Knowledge Based Expert System

1. ES is universal. This helps to solve the problem of scarcity of experts.
2. Human are not totally reliable.
3. Expert systems are economical.
4. Expert Systems are fast i.e. if a human expert has the capacity to attend to 100 clients per day then about 400 users can consult an expert system per day.
5. Reduced risk.
6. Can be used at different locations at a time.
7. The KB can be modified

3.8 Limitations of Expert System

1. Expert system has limited domain.

2. Experts needed to setup and maintain system.
3. They do not study.
4. An expert system cannot refine its own knowledge base.
5. They lack common intellectual and sensitivity.
6. They can't apprehend infrequent knowledge.
7. May have high development cost.
8. They are more appropriate for problems concerning inference.

3.9 Why Used Expert System

The human experts are not always available and also not 100% reliable. A human expert may not be able to explain choices and their cost effective. An expert system can be used anywhere and anytime. Therefore, considering the numerous advantages of expert system and the deficiencies of human experts, expert systems have turned out to be vital in our day to day life.

3.10 Some Expert System Tools

• PROLOG: This is a logic programming language which practices backwards chaining.

• CLIPS: A common domain software tool for constructing expert systems (C-Language Integrated Production System).

• OPS5: First AI language used for Production System (XCON used for configuring VAX computers).

• EMYCIN: Is an expert shell for knowledge representation, reasoning, and description.

• MOLE: A knowledge acquisition tools for obtaining and sustaining domain knowledge.

• ESPLAN: Is based on fuzzy explanation of antecedents and consequents in production rule.

• LIPS: Is used for answering linear programming problems (Linear program solver).

• VP-Expert: This design tool operates base on production rules.

To execute recommended implementation efficiently, a cautious choice of an ES shell for the precise domain purpose is very vital. VP-Expert was finally selected as the development

shell for executing Water Well Location Site Expert System because of the virtuous performance of the interface and command menu of the shell.

3.11 VP-Expert

VP-Expert is a design tool that works base on production. It is made up of inference engine, the user interface, and every component needed to fully design an expert system. An expert system comprising of an empty knowledge base is called an expert system shell. When someone develops a knowledge base for a particular area then it becomes an expert system in that domain. By means of a shell, someone can design an Expert System in several domains. VP-Expert assists only rule-base knowledge illustration or representation, which is easy English similar to rule building (Sayedah and Tawfik, 2013).

VP-Expert works based on the inference method for backward reasoning. The inference engine is used to cruise around the knowledge base in order to answer questions, the rules of the knowledge base are written on the editor and a client's interfaces for supervising the questions, inquiring queries from the clients, and giving recommendations and clarifications, where desired. It also comprises restricted graphical proficiencies. Be warned that this version of VP- Expert is designed for students, therefore some selections won't be accessible and that the magnitude of your knowledge bases will be restricted.

3.12 Reason for Selecting VP-Expert

There are different types of ES shells, but VP- Expert presents a rich combination. It has an input command that robotically produces knowledge by the table confined in a text, database, and an inference engine which practices backward chaining and ideal design windows that makes it possible to detect what is going on behind the screen as the inference engine cruise around the knowledge base. VP-Expert posse's a confidence factor that allows one to justify the content of the knowledge base, an easier English language creation rule, a command that permits the VP-Expert to clarify its actions throughout the period of consultation and it also has a knowledge base chaining which permits one to construct knowledge bases and chain, else it would be too big to fit in memory. Finally, it creates question robotically and has the capacity to perform peripheral DOS programs.

3.13 Knowledge Base in VP-Expert

Using VP-Expert to design expert system requires inducing a KB which comprises of 3 stages; actions, rules and query statements.

3.13.1 ACTIONS block

This is the code that regulates the implementation of the inference engine. The ACTIONS block includes declarations that regulate the activities of the system. These declarations are performed inside the command in where they appear.

The key DISPLAY explanation guides the client on what to do. The FIND statement speaks the framework's aims. The final declaration presents the results.

3.14 Query Statements

Variables that don't seem as the result of some rule in the knowledge base are referred possible queries for the client. Uncertainty, the inference engine tries to locate such a variable and value drive the client. This process is complete by the ASK and CHOICES statements.

3.14.1 ASK statement

The method of the prompt for a variable is explained by the ASK statement. As with any further program, these prompts must be useful. It contains the subsequent procedure:

ASK variable: "prompt";

Example:

ASK :
ASK TEMP: "PLEASE ENTER BODY TEMPERATURE?"

3.14.2 The CHOICES statement

If there is limited quantity of probable replies towards a query they might be found in a menu well-defined by a CHOICES statement. It contains the subsequent method:

CHOICES variable: list of values;

For instance:

CHOICES TEMP: MEDIUM, HIGH, VERY_HIGH;

This menu is published out once the query is enquired. Be informed that if there wasn't any CHOICES statement for a variable, the client must key in the value on the cursor later the prompt.

3.15 Production Rules

This is the domain knowledge written as If-Then rules. Dissimilar to the statements in the ACTIONS part, they aren't executed in the directive enumerated; as an alternative, they are accessed as desired through the course of backwards chaining. The directive of rules is vital only when there are multiple rules that might be utilized to give a variable a value.

3.16 VP-Expert's Consultation Screen

Consultation is the process of applying the system to solve a particular problem. The system solves problems by using rules from its knowledge base. In general, the client doesn't input questions straight to the system, this happened through the actions part of the knowledge base but does pass in responses to queries related to the question. To start consultation, select Consult found under the main menu, and hit Go.

There are three windows found in the VP-Expert consultation screen; Communication window, Rule Window and Values Window. The communication window is where data or information is inputted by the user, and results are revealed here. The Rules Window permits one to see the action of the VP-Expert's inference engine, as it interrelates with the knowledge base throughout the consultation. The values window records the middle and last resultant values throughout the path of the consultation. The values are shown as variable = value CNF.

3.17 Certainty Factors

Clients might also offer credence in the information they enter in answer to queries. This can be done as follow; press HOME, enter a value between 0 and 100 then hit the RETURN button and END.

The acronym CNF 100, which appears at the side of each variables task in the values windows, denotes the confidence factor. This is a number that shows the degree of certainty that a decision is valid. A confidence factor of 0 shows no confidence while a factor of 100 shows total confidence. Confidence factor can be inputted by the end user when responding queries throughout the consultation. Confidence is a personal method to give variable levels

of certainty to declarations. If there is no confidence factor been stated explicitly, then 100 is assumed.

3.18 Main Menu in VP-Expert

The navigation keys, function keys, initial characters of option term and numbers are used to select choices in any menu. Sub-menu of the choice presently highlighted is display under the main menu. Vital choices in the main menu are shown in Table 3.1 below.

Table 3.1: Important Options of a VP-Expert Main Menu

Consult	**For Executing the system on the present KB**
Path	Change the current drive
Edit	Used to create and modify the knowledge base
File name	Choose extra knowledge base for erasure or consulting
Quit	Quit VP-Expert

The Escape button might at all times be applied to backspace, in precise, to escape a choice that was already selected.

3.19 VP-Expert Editor

This is a text editor found on both consult and main menu. The editor is also cited robotically where ever a grammar blunder is noticed in the KB. When the editor is cited at the main menu, it prompts the client to the folder name to be corrected. The client can select from the present menu or input a name. A new folder might be created by entering a new folder name.

All files name in the editor should always ends with KBS as extension.

3.20 Editor Command Menu

The editor commands are always found at the bottom of the screen (see Figur). These commands can be cited by applying the function keys.

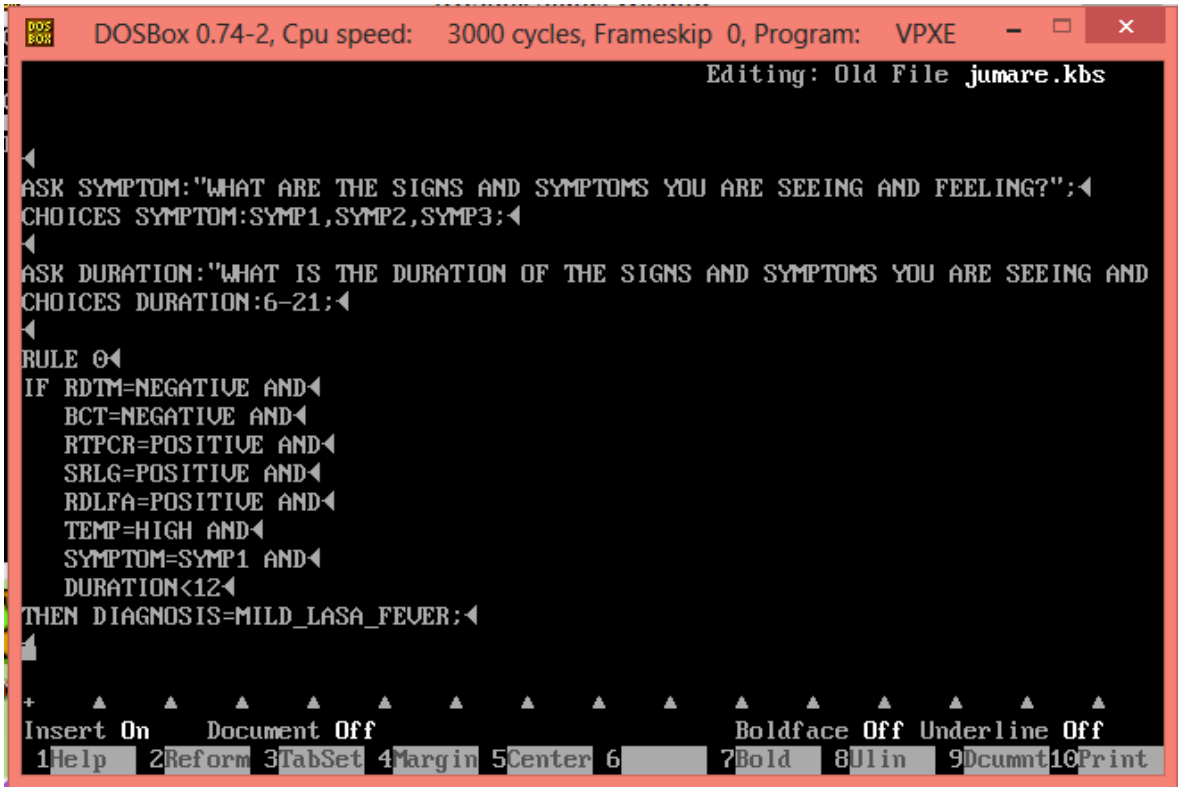

Figure 3.3 Command Menu in editing mode

3.21 Some Common Editor Commands

The table below shows the most common used editor commands.

Table 3.2 Editor Commands for VP-Expert System

F1	**Invokes the help facility**
F10	Print the file
ALT-F5	Save file without exiting
ALT-F6	Save file and exit the editor
ALT-F8	Quit editor without saving
Control-Enter	Input a new line
Delete	Delete character at cursor position

Backspace	Delete character to the left of the cursor position
Control-T	Delete from cursor position to the end of word
Control-Y	Erase the whole line
Page Up	Go up by one screen
Page Down	Go down by own one screen
Home	Move to the beginning of line
End	Move to the end of line

CHAPTER 4

DEVELOPMENT OF LASSA FEVER DIAGNOSIS SYSTEM WITH VP EXPERT SYSTEM

4.1 Brief History of Lassa Fever

Lassa virus, an arenavirus first isolated in 1969 in Jos, Nigeria, is the cause of Lassa fever, an acute viral illness that affects 100,000 to 300,000 persons per year based on 1970s estimate. Lassa fever is endemic in regions of West Africa, including Guinea, Liberia, Nigeria, and Sierra Leone, but cases have been exported to other countries by infected travelers. The natural reservoir for Lassa virus is the African soft-furred rat (*Mastomys natalensis*), which may be found throughout West Africa. The virus is transmitted to humans via direct contact with or the inhalation or ingestion of infected rat excreta or person to person via contact with infected body secretions. Lassa fever presents with nonspecific symptoms similar to many other endemic illnesses in West Africa, making it difficult to diagnose clinically; therefore, laboratory testing is needed to confirm the diagnosis. The availability of laboratory testing has been limited by the designation of Lassa virus as a category A pathogen by the National Institute of Allergy and Infectious Diseases. Biosafety precautions are recommended for handling potentially infectious specimens. In 2014, the World Health Organization issued a call for early diagnostic tests for Lassa fever. This article provides a brief review of the challenges of identifying Lassa fever and the different diagnostic tests available for Lassa fever along with their strengths and weaknesses.

4.2 Mild Lassa Fever

Signs and symptoms of Lassa fever typically occur 1-3 weeks after the patient comes into contact with the virus. For the majority of Lassa fever virus infections (approximately 80%), symptoms are mild and are undiagnosed. Lassa fever is diagnosed as Mild, when symptoms include slight fever, general malaise and weakness, and headache. In 20% of infected individuals, however, disease may progress to more serious symptoms.

4.3 Severe Lassa Fever

Severe lassa fever escalates from mild to severe within 7 to 14 days of contact, it is usually associated with high body temperature, backache, sore throat, chest pain, swollen face and neck, Nausea and vomiting, bleeding nose, eyes and gum.

4.4 Critical Lassa Fever

This is the critical stage of the incubation period of lassa fever, usualy escalates from severe to critical and is associated by signs and symptoms such as convulsion, tremor, stroke, thirst, drowsiness and poor appetite.

4.5 Lassa Fever Diagnosis

Because the symptoms of Lassa fever are so varied and non-specific, clinical diagnosis is often difficult, especially early in the course of the disease. Lassa fever is difficult to distinguish from other viral haemorrhagic fevers such as Ebola virus disease as well as other diseases that cause fever, including malaria, shigellosis, typhoid fever and yellow fever. Definitive diagnosis requires testing that is available only in reference laboratories. Laboratory specimens may be hazardous and must be handled with extreme care. Lassa virus infections can only be diagnosed definitively in the laboratory using the following tests:

- Reverse transcriptase polymerase chain reaction (RT-PCR) assay
- Serology (SRLG)
- Rapid diagnostic lateral flow assay (RDLFA)
- Rapid diagnostic test for malaria (RDTM)
- Blood culture for typhoid (BCT)

Physical examination will be conducted by a satisfied doctor and a through laboratory test which will testify whether the patients are infected or not. If the patients have symptoms of lassa fever, the doctor may order them for blood tests to ascertain their diagnosis.

4.5.1 Reverse transcription-polymerase chain reaction (RT-PCR), result will show positive for Lassa virus RNA.

4.5.2 Serology SRLG Lassa fever can be diagnosed by IgM ELISA. IgM ELISA has demonstrated 88% sensitivity and 90% specificity for acute infection. Results should read positive for Lassa virus IgM antibodies

4.5.3 Rapid diagnostic lateral flow assay RDLFA The ReLASV® Antigen Rapid Test is the only rapid diagnostic test for Lassa fever. It is a dipstick-style lateral flow immunoassay that detects Lassa virus antibodies and antigens in blood from a single finger prick. Performance against PCR has demonstrated sensitivity of 95%. If results are negative, results from RT-PCR or serology should be sought for diagnostic confirmation. Results should show positive for Lassa virus antigen or antibodies

4.5.4 Rapid diagnostic test for malaria RDTM Malaria is usually co-endemic with Lassa fever, and can be difficult to distinguish from Lassa fever; therefore, a rapid diagnostic test for malaria should be carried out immediately. Co-infection is unusual, though not impossible, and consideration should be given to testing the samples for Lassa fever whilst treating malaria infection. Negative (may be positive if co-infection)

4.5.5 Blood culture for typhoid BCT Typhoid is usually co-endemic with Lassa fever, and can be difficult to distinguish from Lassa fever; therefore, testing for typhoid is recommended.

No reliable rapid diagnostic tests are available, and blood culture remains the main diagnostic method for typhoid fever. The Widal test is neither sensitive nor specific and is not routinely recommended, but is often performed in endemic settings. Co-infection is unusual, though not impossible, and consideration should be given to testing the samples for Lassa fever whilst treating typhoid infection. Negative (may be positive if co-infection)

From the signs and symptoms from the suspected patient, the level of the lassa fever will be determined. Those experiencing slight fever, headache and body weakness (SYMP1) with either of this results positive RTPCR, BCT, RDTFM will be diagnose with mild lassa fever, those

4.6 Methodology

The developed system employs the collection of data from an expert precisely a doctor via direct interview and other relevant sources like books, journals and articles to produce the rules using expert system methodology for the actualization of VP-Expert system for

diagnosing LF patients. The designed system development procedure is divided into two categories; Knowledge Acquisitions and Knowledge Representation. Knowledge Acquisitions it includes the acquisition of data from an expert, journals, books and other relevant sources. Knowledge Representation explains how the knowledge is being Represented and it includes coding in terms of IF-THEN statement. Running the system on VP expert software and finally loading the program for consultations.

4.6.1 Knowledge acquisitions

The knowledge acquisition steps in the development of this system were done through direct interviewing with the medical specialists in the field of malaria, medical textbooks, master's thesis, papers and studying the related scientific materials. Also initiating elementary enquiries, adopting essential modifications in each stage and then the developed expert system is designed based on preceding phases.

4.6.2 Knowledge representations

The developed system was a rule-based expert system, for the knowledge representation the IF…THEN rules have been used, where IF demonstrate the condition and THEN provides the solutions. For converting experts' knowledge to these rules, 3 common phases must be handled which are "Block Diagram, and Decision Tables". For diagnosing LF, the knowledge was presented in a Block diagram as shown in Fig 4.

The diagnosis has 3 phases: 1) Simple lassa fever, 2) Severe lassa fever, and 3) critical lassa fever. The diagnosing section consists of 6 attributes, which the diverse mixtures of these attributes would lead to several diagnoses.

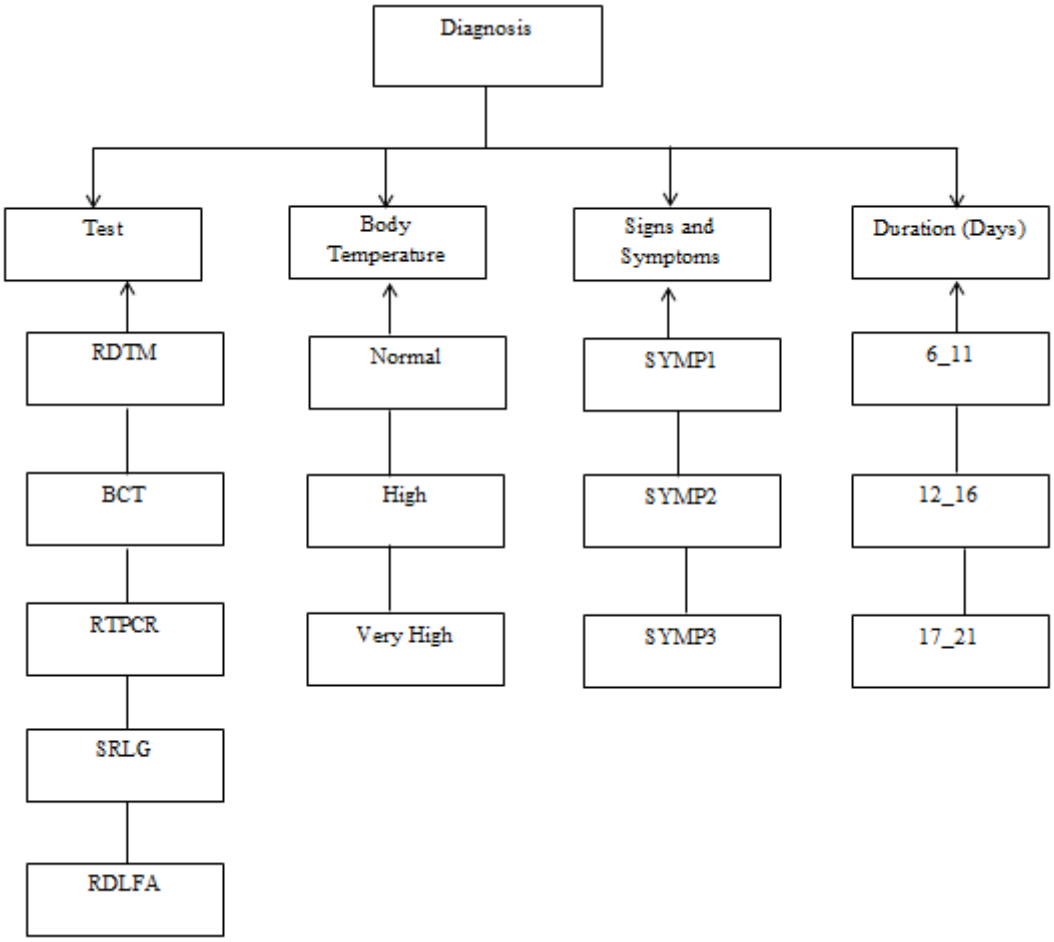

Figure 4.1: Block Diagram for diagnosis

The above figure 4.1 shows the whole diagnosing process of the system which has 8 inputs which incldes 5 laboratory test (Reverse transcriptase polymerase chain reaction (RT-PCR) assay, Serology (SRLG), Rapid diagnostic lateral flow assay (RDLFA), Rapid diagnostic test for malaria (RDTM), Blood culture for typhoid (BCT), Body temperature, Signs and symptoms and Duration of signs and systems. When a user answers all the questions via the options displayed on the user interface window, the inference engine goes through all the rules in accordance to the respose of the user to out the result of the diagnosis. Although in this case it uses the backward chaining.

Table 4.1a: The decision table of sign and symptoms

Signs and symptoms		Mild Lassa fever	Severe Lassa fever	Critical Lassa fever
Slight fever	Symp1	✓		
Headache		✓		
Weakness		✓		
Bleeding gum	Symp2		✓	
Bleeding eyes			✓	
Bleeding nose			✓	
Nausea and vomiting			✓	
Facial and neck swollen			✓	
Diarrheoa			✓	
Chest pain			✓	
Sore throat			✓	
Back ache			✓	
Deafness	Symp3			✓
Convulsion				✓
Tremor				✓
Stroke				✓
Thirst				✓
Drowsiness				✓
Poor Appetite				✓

The "Signs and Symptoms" decision table above is constructed in line with the different "Signs and Symptoms" which the condition of the patient would be finalized. In every row of the table there exist a rule of signs and symptoms.

Table 4.1b: The decision table of sign and symptoms

Signs and Symptoms		
SYMP1	**SYMP2**	**SYMP3**
Slight fever	Bleeding gum	Thirst
Headache	Bleeding eyes	Drowsiness
weakness	Bleeding nose	Tremor
	Nausea and vomiting	Convulsion
	Facial and neck swollen	Poor appetite
	Diarrhoea	Deafness
	Chest pain	Stroke
	Sore throat	
	Back ache	

The decision Table of Tests include the compulsory tests report comprises Reverse transcriptase polymerase chain reaction (RT-PCR) assay, Serology SRLG, Rapid diagnostic lateral flow assay RDFLA, Rapid diagnostic test for malaria RDTM, and Blood culture for typhoid BCT and lastly the decision about the patient's condition has been demonstrated in the table below:

Table 4.2: Decision table of test

CASE	RDTM	BCT	RTPCR	SRLG	RDLFA	DIAGNOSIS
1	NEGATIVE	NEGATIVE	NEGATIVE	NEGATIVE	NEGATIVE	NEGATIVE
2	POSITIVE	POSITIVE	POSITIVE	POSITIVE	POSITIVE	POSITIVE
3	NEGATIVE	POSITIVE	POSITIVE	POSITIVE	POSITIVE	POSITIVE
4	POSITIVE	NAGATIVE	POSITIVE	POSITIVE	POSITIVE	POSITIVE
5	NEGATIVE	NEGATIVE	POSITIVE	POSITIVE	POSITIVE	POSITIVE
6	POSITIVE	NEGATIVE	NEGATIVE	NEGATIVE	NEGATIVE	NEGATIVE
7	POSITIVE	NEGATIVE	NEGATIVE	NEGATIVE	NEGATIVE	NEGATIVE
8	NEGATIVE	POSITIVE	NEGATIVE	NEGATIVE	NEGATIVE	NEGATIVE
9	NO	NO	NO	NO	NO	NO

4.7 Coding

Lassa fever diagnosing Expert system was coded via the use of a VP-Expert shell, the shell is a precise tool for designing expert systems thus only expert's systems developers are acquainted with it. VP-Expert operates based on the backward reasoning for inference. The tool has an inference engine for checking the knowledge base to reply queries, an editor for coding rules of the knowledge base, and a user interfaces for handling the queries, asking questions from the client, and offering suggestions and clarifications, where desirable. It likewise has restricted graphical proficiencies. The production rules of this expert system include 8 attribute question which serves as the input of this system.

1. PLEASE ENTER YOUR RDTM RESULT?
2. PLEASE ENTER YOUR BCFT RESULT?
3. PLEASE ENTER YOUR RTPCR RESULT?
4. PLEASE ENTER YOUR SRLG RESULT?
5. PLEASE ENTER YOUR RDLFA RESULT?
6. PLEASE ENTER YOUR BODY TEMPERATURE?

7. WHAT IS/ARE THE SIGNS/SYMPTOMS YOU ARE SEEING/FEELING?
8. WHAT IS THE DURATION OF THE SIGNS/SYMPTOMS YOU ARE SEEING/FEELING?

The sample of this expert system rules is being demonstrated below for proper explanation.

According to Rule 6;

IF RDTM result equal to NEGATIVE AND

BCT result is equal to POSITIVE AND

RTPCR result equal to POSITIVE AND

SRLG result equal to POSITIVE AND

RDLFA result is equal to POSITIVE AND

Your body temperature is VERY_HIGH AND

Your symptom result is SYMP3 AND

Your duration of seeing symptoms is greater or equal to 17 THEN

Diagnosis = CRITICAL_LASSA_FEVER

```
RULE 6
IF RDTM=NEGATIVE AND
BCT=POSITIVE AND
RTPCR=POSITIVE AND
SRLG=POSITIVE AND
RDLFA=POSITIVE AND
TEMP=VERY_HIGH
SYMPTOM=SYMP3
DURATION>=17
THEN DIAGNOSIS=CRITICAL_LASSA_FEVER
```

Figure 4.3: A Sample of the Lassa fever diagnosis expert system rul

CHAPTER 5
RESULTS

5.1 Design Presentation

In the process of designing the system, all the rules, paths and the relationship amid the attributes has been tested with necessary modification. The VP expert software is used for the design of this system and finally, the designed system is presented.

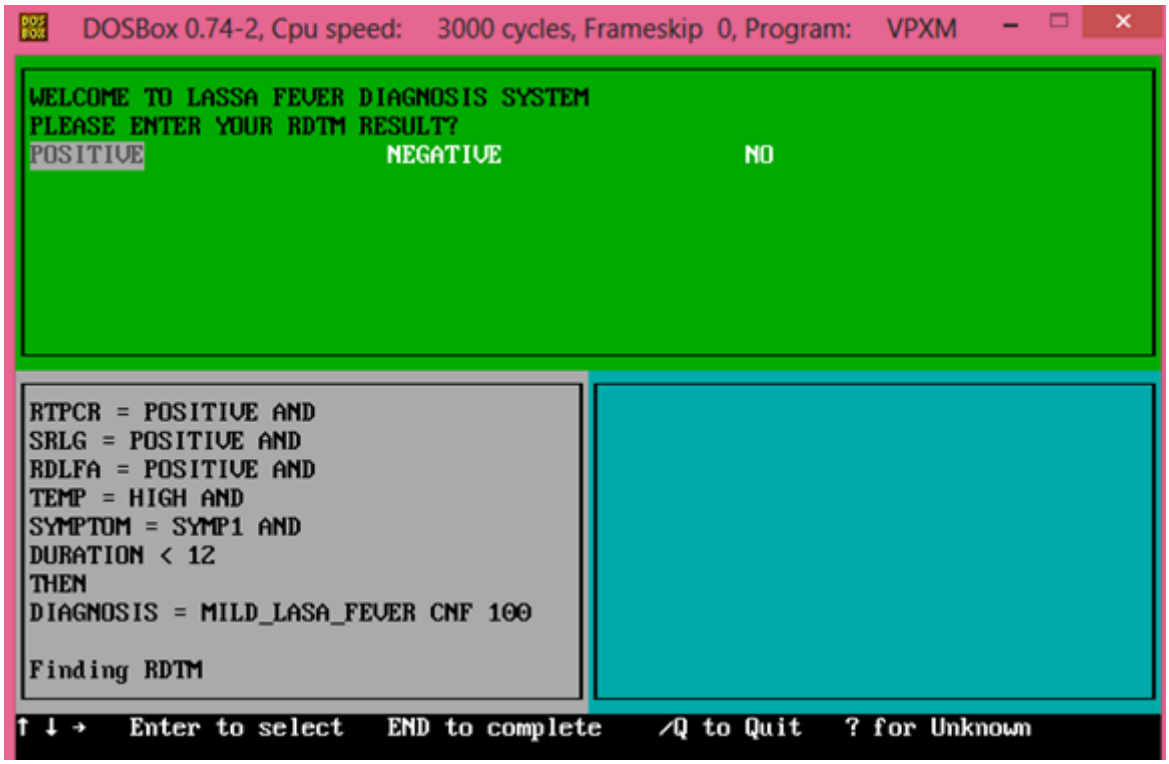

Figure 5.1: Sample Running of the Expert **System**

It is essential to illustrate the Use-case diagram for well understanding on how the system runs. The Use-case diagram as shown in Figure 5.2 demonstrates the interaction between the user and the expert system.

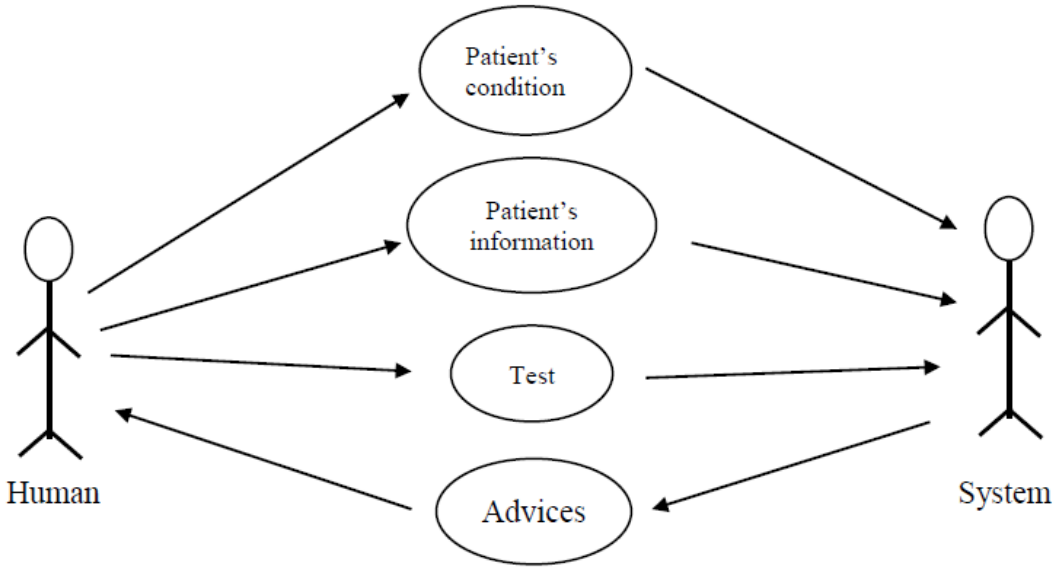

Figure 5.2: Diagnosis in Use-Case Diagram

5.2 Results and Discussion

At this point, all necessary data (as explained in chapter four) would have been inputted. The MALX user interface performs the necessary knowledge evaluation through the Rules and facts windows to determine what result would be giving out base on the questions answered.

The Figures 5.3 and 5.4 demonstrate the execution of the VP-Expert that is the User Interface. On the execution, the user interrelates with the system through the user interface. The "user interface" has 3 windows which are, Questions Window, Rules Window and Facts Window. The questions window is where the questions system should be asked by the users, and their alternatives are illustrated. Rules window presents the rules by how the user answers. The Facts window displays the users answers, which may determine the systems final decision. The main advantage of facts and rules windows is that the user can see vivid clarification for the system's decision-making. After the system has received the facts, the system presents the final answer or decision.

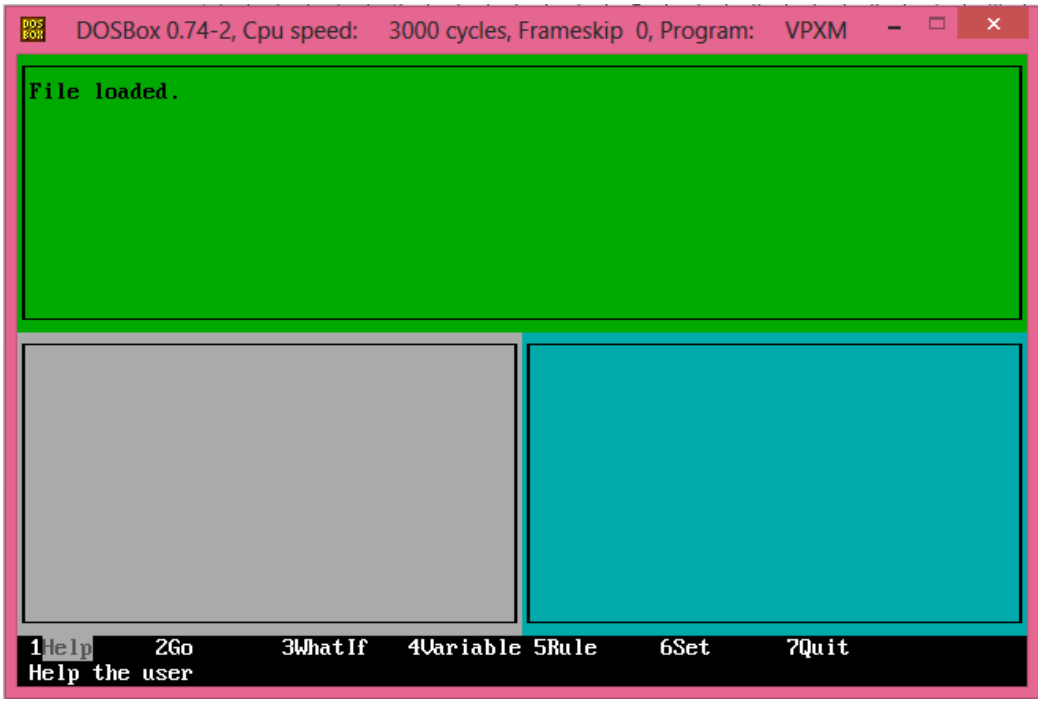

Figure 5.3: The System Consulting the KB

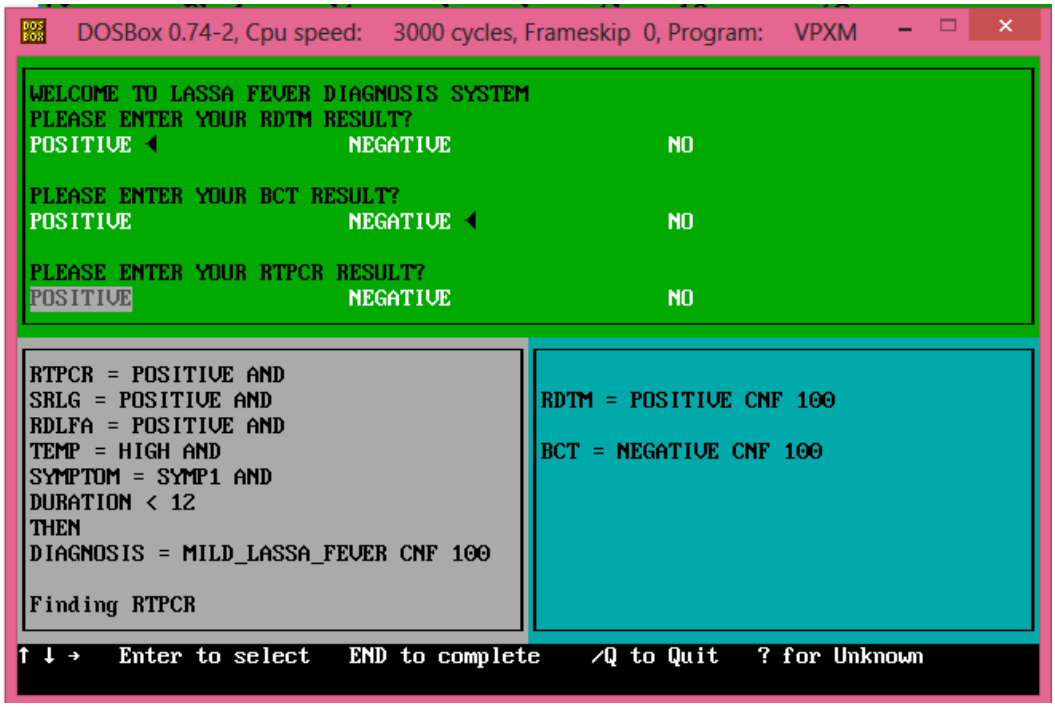

Figure 5.4: User begin answering questions after the system consult the KB

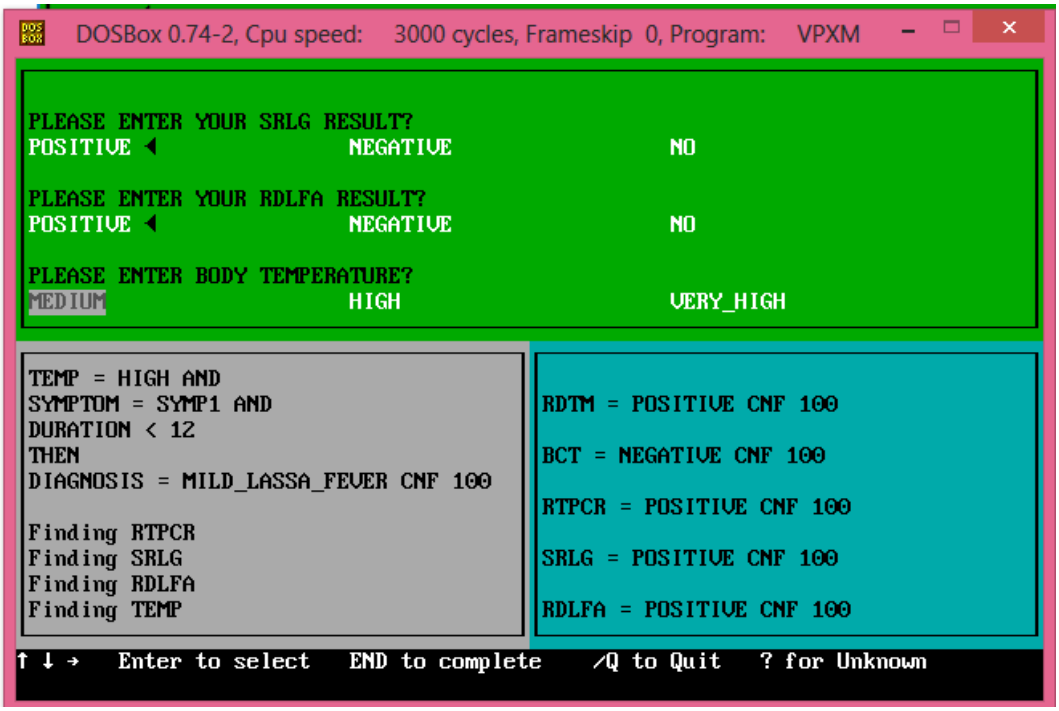

Fig 5.5: User answering questions about the blood test results

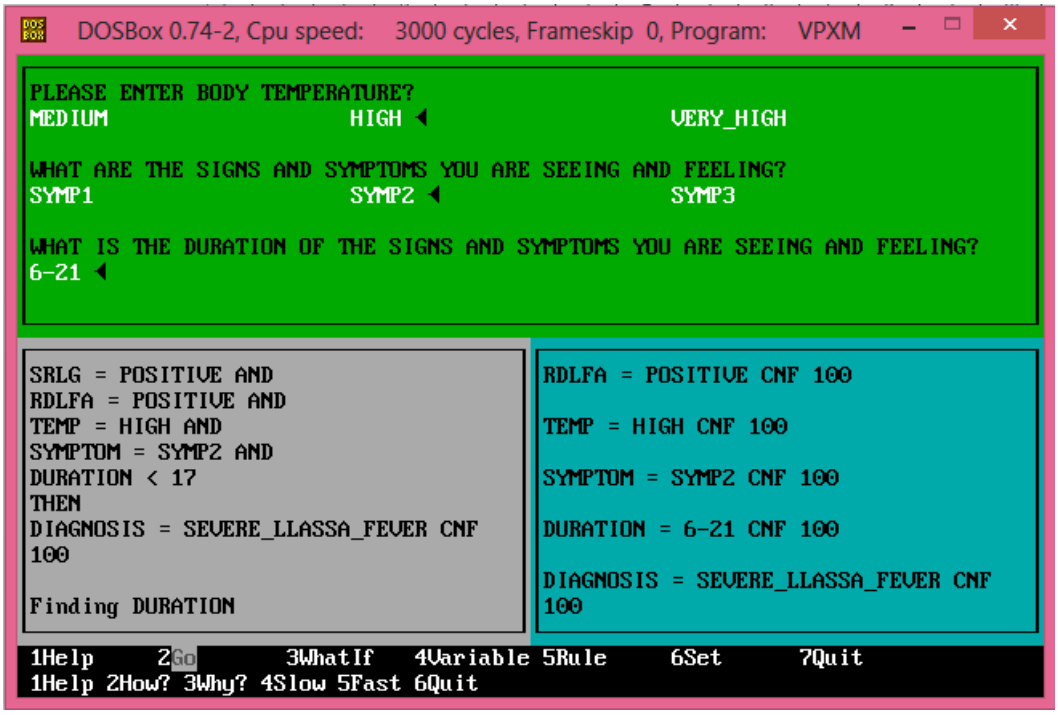

Figure 5.6: Result of a Diagnosis

The LFDS system has demonstrated a good performance as validated by domain experts. The results illustrated in Figure 5.6 have shown the possible value and helpfulness of the

system. It was confirmed by the experts that this system can be used by lassa fever experts and it will be easily accessible by everyone which will remedy the difficulty in accessing an expert doctor as they are short in supply.

Early and accurate diagnosis of lassa fever are essential for effective and life-saving diagnosis, hence LFDS is developed with the aim to be the nearest response to this call. If a doctor has the capacity of diagnosing 100 LF patients per day manually, then LFDS have the ability to diagnose 500 LF patients per day, hence it makes the diagnosis of this deadly disease much easier, faster, and more accurate. This offers the expected accuracy of the system since the aims of an expert system is to make fast and accurate decision just the way an intelligent human or human expert does.

CHAPTER 6

6.1 Conclusion

Expert system is one of the largest areas of artificial intelligence which has realized the utmost marketable achievement. Currently, expert systems are applied in different fields, starting from medical sector, military, law, politics, and economics. They are also used in engineering and industries to control robot where they inter-relate with vision systems. Any field in which choices are to be constructed is a potential application of expert systems. AI programs that attain competency at expert level in creating solutions to problems in some task areas by conveying to endure a frame of knowledge about precise tasks are termed expert systems or knowledge-based.

The design of LFDS has been presented and the knowledge acquisition and depiction stages are strikingly portrayed. IF-THEN rules have been selected for the decision making. The knowledge that forms the IF-THEN rules data was collected from medical experts and based on the knowledge acquired, 175 production rules were developed. The production rule entails 8 inputs attributes and has 4 output number of diagnosis.

The lassa fever diagnosis Expert system was developed using VP expert system shell and was tested using few data of suspected infected patients from the Nigeria center for disease control NCDC with a great accuracy. Every procured result from the system were seen by a medical expert dealing with lassa fever cases and it satisfies the efficiency of Lassa fever diagnosis Expert system.

6.2 Recommendation

LFDS in its performance demonstrated effectiveness in diagnosing suspected patience with Lassa Fever and doesn't stop there but goes to the extend of identifying the current status of the infection whether mild, severe or critical. Another key feature of the system is the laboratory test results included in the input section of the LFDS which increase its accuracy in diagnosis rathere than it relying on symptoms alone. However, at the course of testing the system it was realized and recomeded that the overall performance of the system can be improved by adding more inputs such as status of the patient i.e male or female, age of the patient. Again more inputs can be added for treatment with riverbirin

when LF is at its mild state and another knowledge base (KB) can be created in same working memory for other common prevalent disease.

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APPENDIX

LASSA FEVER DIAGNOSIS SYSTEM KB

ASK RDTM: “PLEASE ENTER YOUR RDTM RESULT?”
CHOICES RDTM: POSITIVE,NEGATIVE;

ASK BCT: “PLEASE ENTER YOUR BCFT RESULT?”
CHOICES BCFT: POSITIVE,NEGATIVE;

ASK RTPCR: “PLEASE ENTER YOUR RTPCR RESULT?”
CHOICES RTPCR: POSITIVE,NEGATIVE;

ASK SRLG: “PLEASE ENTER YOUR SRLG RESULT?”
CHOICES SRLG: POSITIVE,NEGATIVE;

ASK RDLFA: “PLEASE ENTER YOUR RDLFA RESULT?”
CHOICES RDLFA: POSITIVE,NEGATIVE?”

ASK TEMP: “PLEASE ENTER BODY TEMPERATURE?”
CHOICES TEMP:MEDIUM,HIGH,VERY_HIGH;

ASK SYMPTOMS: “WHAT ARE THE SIGNS AND SYMPTOMS YOU ARE SEEING AND FEELING?”
CHOICES SYMPTOMS: SYMP1,SYMP2,SYMP3;

ASK DURATION: “WHAT IS THE DURATION OF THE SIGNS AND SYMPTOMS YOU ARE SEEING AND FEELING?”
CHOICES DURATION: 1-7, 8-14, 15-21

ACTIONS

DISPLAY “WELCOME TO LASSA FEVER DIAGNOSIS SYSTEM”

FIND DIAGNOSIS;

RULE 0
IF RDTM=NEGATIVE AND
  BCT=NEGATIVE AND
  RTPCR=POSITIVE AND

SRLG=POSITIVE AND
RDLFA=POSITIVE AND
TEMP=HIGH AND
SYMPTOM=SYMP1 AND
DURATION<12
THEN DIAGNOSIS=MILD_LASSA_FEVER

RULE 1
IF RDTM=NEGATIVE AND
BCT=NEGATIVE AND
RTPCR=POSITIVE AND
SRLG=POSITIVE AND
RDLFA=POSITIVE AND
TEMP=HIGH AND
SYMPTOM=SYMP2 AND
DURATION<17
THEN DIAGNOSIS=SEVERE_LASSA_FEVER

RULE 2
IF RDTM=NEGATIVE AND
BCT=NEGATIVE AND
RTPCR=POSITIVE AND
SRLG=POSITIVE AND
RDLFA=POSITVE AND
TEMP=VERY HIGH
SYMPTOM=SYMP3
DURATION>=17
THEN DIAGNOSIS=CRITICAL_LASSA_FEVER

RULE 3
IF RDTM=NEGATIVE AND
BCT=NEGATIVE AND
RTPCR=NEGATIVE AND
SRLG=NEGATIVE AND
RDLFA=NEGATIVE AND
TEMP=NORMAL AND
SYMPTOM=SYMP1 AND
DURATION<12
THEN DIAGNOSIS<>LASSA_FEVER

RULE 4
IF RDTM=NEGATIVE AND
BCT=POSITIVE AND
RTPCR=POSITIVE AND
SRLG=POSITIVE AND
RDLFA=PPOSITIVE AND
TEMP=HIGH AND
SYMPTOM=SYMP1 AND
DURATION<12
THEN DIAGNOSIS=MILD_LASSA_FEVER

RULE 5
IF RDTM=NEGATIVE AND
BCT=POSITIVE AND
RTPCR=POSITIVE AND
SRLG=POSITIVE AND
RDLFA=POSITIVE AND
TEMP=HIGH AND
SYMPTOM=SYMP2 AND
DURATION<17
THEN DIAGNOSIS=SEVERE_LASSA_FEVER

RULE 6
IF RDTM=NEGATIVE AND
BCT=POSITIVE AND
RTPCR=POSITIVE AND
SRLG=POSITIVE AND
RDLFA=POSITIVE AND
TEMP=VERY_HIGH
SYMPTOM=SYMP3
DURATION>=17
THEN DIAGNOSIS=CRITICAL_LASSA_FEVER

RULE 7
IF RDTM=POSITIVE AND
BCT=POSITIVE AND
RTPCR=NEGATIVE AND
SRLG=NEGATIVE AND
RDLFA=NEGATIVE AND
TEMP=HIGH AND
SYMPTOM=SYMP1 AND

DURATION<12
THEN DIAGNOSIS<>LASSA_FEVER

RULE 8
IF RDTM=POSITIVE AND
BCT=POSITIVE AND
RTPCR=POSITIVE AND
SRLG=POSITIVE AND
RDLFA=POSITIVE AND
TEMP=HIGH
SYMPTOM=SYMP2
DURATION<12
THEN DIAGNOSIS=MILD_LASSA_FEVER

RULE 9
IF RDTM=POSITIVE AND
BCT=POSITIVE AND
RTPCR=POSITIVE AND
SRLG=POSITIVE AND
RDLFA=POSITIVE AND
TEMP=HIGH AND
SYMPTOM=SYMP2
DURATION<17
THEN DIAGNOSIS=SEVERE_LASSA_FEVER

RULE 10
IF RDTM=POSITIVE AND
BCT=POSITIVE AND
RTPCR=POSITIVE AND
SRLG=POSITIVE AND
RDLFA=POSITIVE AND
TEMP=VER_HIGH AND
SYMPTOM=SYMP3 AND
DURATION>=17
THEN DIAGNOSIS=CRITICAL_LASSA_FEVER

RULE 11
IF RDTM=POSITIVE AND
BCT=NEGATIVE AND
RTPCR=POSITIVE AND
SRLG=POSITIVE AND

RDLFA=POSITIVE AND
TEMP=HIGH AND
SYMPTOM=SYMP1 AND
DURATION<12
THEN DIAGNOSIS=MILD_LASSA_FEVER

RULE 12
IF RDTM=POSITIVE AND
BCT=NEGATIVE AND
RTPCR=POSITIVE AND
SRLG=POSITIVE AND
RDLFA=POSITIVE AND
TEMP=HIGH AND
SYMPTOM=SYMP2 AND
DURATION<17
THEN DIAGNOSIS=SEVERE_LASSA_FEVER

RULE 13
IF RDTM=POSITIVE AND
BCT=NEGATIVE AND
RTPCR=POSITIVE AND
SRLG=POSITIVE AND
RDLFA=POSITIVE AND
TEMP=VERY_HIGH AND
SYMPTOM=SYMP3
DURATION>=17
THEN DIAGNOSIS=CRITICAL_LASSA_FEVER

RULE 14
IF RDTM=POSITIVE AND
BCT=NEGATIVE AND
RTPCR=NEGATIVE AND
SRLG=NEGATIVE AND
RDLFA=NEGTIVE AND
TEMP=HIGH AND
SYMPTOM=SYMP1
DURATION<12
THEN DIAGNOSIS<>LASSA_FEVER

RULE 15
IF RDTM=NEGATIVE AND
BCT=POSITIVE AND
RTPCR=NEGATIVE AND
SRLG=NEGATIVE AND
RDLFA=NEGATIVE AND
TEMP= HIGH AND
SYMPTOM=SYMP1
DURATION<12
THEN DIAGNOSIS<>LASSA_FEVER

RULE 16
IF RDTM=NO AND
BCT=NO AND
RTPCR=NO AND
SRLG=NO AND
RDLFA=NO AND
TEMP=HIGH AND
SYMPTOM=SYMP1 AND
DURATION=<12
THEN DIAGNOSIS=MILD_LASSA_FEVER CNF 50

RULE 17
IF RDTM=NO AND
BCT=NO AND
RTPCR=NO AND
SRLG=NO AND
RDLFA=NO AND
TEMP=HIGH AND
SYMPTOM=SYMP2 AND
DURATION=<17
THEN DIAGNOSIS=SEVERE_LASSA_FEVER CNF 75

RULE 18
IF RDTM=NO AND
BCT=NO AND
RTPCR=NO AND
SRLG=NO AND
RDLFA=NO AND
TEMP=VERY_HIGH AND

SYMPTOM=SYMP3 AND
DURATION=>17
THEN DIAGNOSIS=CRITICAL_LASSA_FEVER CNF 90

RULE 19
IF RDTM=POSITIVE AND
BCT=NEGATIVE AND
RTPCR=NO AND
SRLG=NO AND
RDLFA=NO AND
TEMP=HIGH AND
SYMPTOM=SYMP1 AND
DURATION=<12
THEN DIAGNOSIS=LASSA_FEVER CNF 50

RULE 20
IF RDTM=NEGATIVE AND
BCT=POSITIVE AND
RTPCR=NO AND
SRLG=NO AND
RDLFA=NO AND
TEMP=HIGH AND
SYMPTOM=SYMP1 AND
DURATION=<12
THEN DIAGNOSIS=LASSA_FEVER CNF 50

RULE 21
IF RDTM=NEGATIVE AND
BCT=NEGATIVE AND
RTPCR=NO AND
SRLG=NO AND
RDLFA=NO AND
TEMP=HIGH AND
SYMPTOM=SYMP1 AND
DURATION=<12
THEN DIAGNOSIS=MILD_LASSA_FEVER CNF 50

RULE 22
IF RDTM=NEGATIVE AND
BCT=NEGATIVE AND

RTPCR=NO AND
SRLG=NO AND
RDLFA=NO AND
TEMP=HIGH AND
SYMPTOM=SYMP2 AND
DURATION=<17
THEN DIAGNOSIS=SEVERE_LASSA_FEVER CNF 50

RULE 23
IF RDTM=NEGATIVE AND
BCT=NEGATIVE AND
RTPCR=NO AND
SRLG=NO AND
RDLFA=NO AND
TEMP=VERY_HIGH AND
SYMPTOM=SYMP3 AND
DURATION=>17
THEN DIAGNOSIS=CRITICAL_LASSA_FEVER CNF 75

RULE 24
IF RDTM=NO
BCT=NO
RTPCR=POSITIVE
SRLG=NO
RDLFA=NO
TEMP=HIGH
SYMPTOM=SYMP1
DURATION=<12
THEN DIAGNOSIS=MILD_LASSA_FEVER

RULE 25
IF RDTM=NO
BCT=NO
RTPCR=POSITIVE
SRLG=NO
RDLFA=NO
TEMP=HIGH
SYMPTOM=SYMP2
DURATION=<17
THEN DIAGNOSIS=SEVERE_LASSA_FEVER CNF 50

RULE 26
IF RDTM=NO
BCT=NO
RTPCR=POSITIVE
SRLG=NO
RDLFA=NO
TEMP=HIGH
SYMPTOM=SYMP3
DURATION=>17
THEN DIAGNOSIS=CRITICAL_LASSA_FEVER

RULE 27
IF RDTM=NO
BCT=NO
RTPCR=NEGATIVE
SRLG=NO
RDLFA=NO
TEMP=HIGH
SYMPTOM=SYMP1
DURATION=<12
THEN DIAGNOSIS<>LASSA_FEVER

RULE 28
IF RDTM=NO
BCT=NO
RTPCR=NO
SRLG=POSITIVE
RDLFA=NO
TEMP=HIGH
SYMPTOM=SYMP1
DURATION=<12
THEN DIAGNOSIS=MILD_LASSA_FEVER
RULE 29
IF RDTM=NO
BCT=NO
RTPCR=NO
SRLG=POSITIVE
RDLFA=NO
TEMP=HIGH
SYMPTOM=SYMP2
DURATION=<17

THEN DIAGNOSIS=SEVERE_LASSA_FEVER

RULE 30
IF RDTM=NO
BCT=NO
RTPCR=NO
SRLG=POSITIVE
RDLFA=NO
TEMP=VERY_HIGH
SYMPTOM=SYMP3
DURATION=>17
THEN DIAGNOSIS=CRITICAL_LASSA_FEVER

RULE 31
IF RDTM=NO AND
BCT=NO AND
RTPCR=NO AND
SRLG=NEGATIVE AND
RDLFA=NO AND
TEMP=HIGH AND
SYMPTOM=SYMP1 AND
DURATION=<12
THEN DIAGNOSIS<>LASSA_FEVER

RULE 32
IF RDTM=NO AND
BCT=NO AND
RTPCR=NO AND
SRLG=NO AND
RDLFA=POSITIVE AND
TEMP=HIGH AND
SYMPTOM=SYMP1 AND
DURATION=<12
THEN DIAGNOSIS=MILD_LASSA_FEVER

RULE 33
IF RDTM=NO AND
BCT=NO AND
RTPCR=NO AND
SRLG=NO AND

RDLFA=POSITIVE AND
TEMP=HIGH AND
SYMPTOM=SYMP2 AND
DURATION=<17
THEN DIAGNOSIS=SEVERE_LASSA_FEVER

RULE 34
IF RDTM=NO AND
BCT=NO AND
RTPCR=NO AND
SRLG=NO AND
RDLFA=POSITIVE AND
TEMP=HIGH AND
SYMPTOM=SYMP3 AND
DURATION=>17
THEN DIAGNOSIS=CRITICAL_LASSA_FEVER

RULE 35
IF RDTM=NO AND
BCT=NO AND
RTPCR=NO AND
SRLG=NO AND
RDLFA=NEGATIVE AND
TEMP=HIGH AND
SYMPTOM=SYMP1 AND
DURATION=<12
THEN DIAGNOSIS<>LASSA_FEVER

RULE 36
IF RDTM=NO AND
BCT=NO AND
RTPCR=POSITIVE AND
SRLG=POSITIVE AND
RDLFA=NO AND
TEMP=HIGH AND
SYMPTOM=SYMP1 AND
DURATION=<12
THEN DIAGNOSIS=MILD_LASSA_FEVER

RULE 37
IF RDTM=NO AND
BCT=NO AND
RTPCR=POSITIVE AND
SRLG=POSITIVE AND
RDLFA=NO AND
TEMP=HIGH AND
SYMPTOM=SYMP2 AND
DURATION=<17
THEN DIAGNOSIS=SEVERE_LASSA_FEVER

RULE 38
IF RDTM=NO AND
BCT=NO AND
RTPCR=POSITIVE AND
SRLG=POSITIVE AND
RDLFA=NO AND
TEMP=VERY_HIGH AND
SYMPTOM=SYMP3 AND
DURATION=>17
THEN DIAGNOSIS=CRITICAL_LASSA_FEVER

RULE 39
IF RDTM=NO AND
BCT=NO AND
RTPCR=NEGATIVE AND
SRLG=NEGATIVE AND
RDLFA=NO AND
TEMP=HIGH AND
SYMPTOM=SYMP1 AND
DURATION=<12
THEN DIAGNOSIS<>LASSA_FEVER

RULE 40
IF RDTM=NO AND
BCT=NO AND
RTPCR=NEGATIVE AND
SRLG=NEGATIVE AND
RDLFA=NO AND
TEMP=HIGH AND

SYMPTOM=SYMP2 AND
DURATION=<12
THEN DIAGNOSIS<>LASSA_FEVER

RULE 41
IF RDTM=NO AND
BCT=NO AND
RTPCR=NEGATIVE AND
SRLG=NEGATIVE AND
RDLFA=NO AND
TEMP=HIGH AND
SYMPTOM=SYMP1 AND
DURATION=<17
THEN DIAGNOSIS<>LASSA_FEVER

RULE 42
IF RDTM=NO AND
BCT=NO AND
RTPCR=NEGATIVE AND
SRLG=NEGATIVE AND
RDLFA=NO AND
TEMP=HIGH AND
SYMPTOM=SYMP2 AND
DURATION=<17
THEN DIAGNOSIS<>LASSA_FEVER

RULE 43
IF RDTM=NO AND
BCT=NO AND
RTPCR=NEGATIVE AND
SRLG=NEGATIVE AND
RDLFA=NO AND
TEMP=HIGH AND
SYMPTOM=SYMP2 AND
DURATION=>17
THEN DIAGNOSIS<>LASSA_FEVER

RULE 44
IF RDTM=NO AND
BCT=NO AND
RTPCR=NEGATIVE AND

SRLG=NEGATIVE AND
RDLFA=NO AND
TEMP=HIGH AND
SYMPTOM=SYMP3 AND
DURATION=<12
THEN DIAGNOSIS<>LASSA_FEVER

RULE 45
IF RDTM=NO AND
BCT=NO AND
RTPCR=NEGATIVE AND
SRLG=NEGATIVE AND
RDLFA=NO AND
TEMP=VER_HIGH AND
SYMPTOM=SYMP3 AND
DURATION=<17
THEN DIAGNOSIS<>LASSA_FEVER

RULE 46
IF RDTM=POSITIVE AND
BCT=NO AND
RTPCR=NEGATIVE AND
SRLG=NEGATIVE AND
RDLFA=NO AND
TEMP=HIGH AND
SYMPTOM=SYMP1 AND
DURATION=<12
THEN DIAGNOSIS<>LASSA_FEVER

RULE 47
IF RDTM=POSITIVE AND
BCT=NO AND
RTPCR=NEGATIVE AND
SRLG=NEGATIVE AND
RDLFA=NO AND
TEMP=HIGH AND
SYMPTOM=SYMP1 AND
DURATION=<17
THEN DIAGNOSIS<>LASSA_FEVER

RULE 48

IF RDTM=POSITIVE AND
BCT=NO AND
RTPCR=NEGATIVE AND
SRLG=NEGATIVE AND
RDLFA=NO AND
TEMP=HIGH AND
SYMPTOM=SYMP1 AND
DURATION=>17
THEN DIAGNOSIS<>LASSA_FEVER

RULE 49
IF RDTM=POSITIVE AND
BCT=NO AND
RTPCR=NEGATIVE AND
SRLG=NEGATIVE AND
RDLFA=NO AND
TEMP=HIGH AND
SYMPTOM=SYMP2 AND
DURATION=<12
THEN DIAGNOSIS<>LASSA_FEVER

RULE 50
IF RDTM=POSITIVE AND
BCT=NO AND
RTPCR=NEGATIVE AND
SRLG=NEGATIVE AND
RDLFA=NO AND
TEMP=HIGH AND
SYMPTOM=SYMP1 AND
DURATION=<17
THEN DIAGNOSIS<>LASSA_FEVER

RULE 51
IF RDTM=POSITIVE AND
BCT=NO AND
RTPCR=NEGATIVE AND
SRLG=NEGATIVE AND
RDLFA=NO AND
TEMP=HIGH AND
SYMPTOM=SYMP2 AND
DURATION=>17

THEN DIAGNOSIS<>LASSA_FEVER
RULE 52
IF RDTM=POSITIVE AND
BCT=NO AND
RTPCR=NEGATIVE AND
SRLG=NEGATIVE AND
RDLFA=NO AND
TEMP=HIGH AND
SYMPTOM=SYMP3 AND
DURATION=<12
THEN DIAGNOSIS<>LASSA_FEVER

RULE 53
IF RDTM=POSITIVE AND
BCT=NO AND
RTPCR=NEGATIVE AND
SRLG=NEGATIVE AND
RDLFA=NO AND
TEMP=HIGH AND
SYMPTOM=SYMP3 AND
DURATION=<17
THEN DIAGNOSIS<>LASSA_FEVER

RULE 54
IF RDTM=POSITIVE AND
BCT=NO AND
RTPCR=NEGATIVE AND
SRLG=NEGATIVE AND
RDLFA=NO AND
TEMP=HIGH AND
SYMPTOM=SYMP3 AND
DURATION=>17
THEN DIAGNOSIS<>LASSA_FEVER

RULE 55
IF RDTM=NEGATIVE AND
BCT=NO AND
RTPCR=NEGATIVE AND

SRLG=NEGATIVE AND
RDLFA=NO AND
TEMP=HIGH AND
SYMPTOM=SYMP1 AND
DURATION=<12
THEN DIAGNOSIS<>LASSA_FEVER

RULE 56
IF RDTM=NEGATIVE AND
BCT=NO AND
RTPCR=NEGATIVE AND
SRLG=NEGATIVE AND
RDLFA=NO AND
TEMP=HIGH AND
SYMPTOM=SYMP1 AND
DURATION=<17
THEN DIAGNOSIS<>LASSA_FEVER

RULE 57
IF RDTM=NEGATIVE AND
BCT=NO AND
RTPCR=NEGATIVE AND
SRLG=NEGATIVE AND
RDLFA=NO AND
TEMP=HIGH AND
SYMPTOM=SYMP1 AND
DURATION=>17
THEN DIAGNOSIS<>LASSA_FEVER

RULE 58
IF RDTM=NEGATIVE AND
BCT=NO AND
RTPCR=NEGATIVE AND
SRLG=NEGATIVE AND
RDLFA=NO AND
TEMP=HIGH AND
SYMPTOM=SYMP2 AND
DURATION=<12
THEN DIAGNOSIS<>LASSA_FEVER

RULE 59
IF RDTM=NEGATIVE AND
BCT=NO AND
RTPCR=NEGATIVE AND
SRLG=NEGATIVE AND
RDLFA=NO AND
TEMP=HIGH AND
SYMPTOM=SYMP1 AND
DURATION=<17
THEN DIAGNOSIS<>LASSA_FEVER

RULE 60
IF RDTM=NEGATIVE AND
BCT=NO AND
RTPCR=NEGATIVE AND
SRLG=NEGATIVE AND
RDLFA=NO AND
TEMP=HIGH AND
SYMPTOM=SYMP2 AND
DURATION=>17
THEN DIAGNOSIS<>LASSA_FEVER

RULE 61
IF RDTM=NEGATIVE AND
BCT=NO AND
RTPCR=NEGATIVE AND
SRLG=NEGATIVE AND
RDLFA=NO AND
TEMP=HIGH AND
SYMPTOM=SYMP3 AND
DURATION=<12
THEN DIAGNOSIS<>LASSA_FEVER

RULE 62
IF RDTM=NEGATIVE AND
BCT=NO AND
RTPCR=NEGATIVE AND
SRLG=NEGATIVE AND
RDLFA=NO AND

TEMP=HIGH AND
SYMPTOM=SYMP3 AND
DURATION=<17
THEN DIAGNOSIS<>LASSA_FEVER

RULE 63
IF RDTM= NEGATIVE AND
BCT=NO AND
RTPCR=NEGATIVE AND
SRLG=NEGATIVE AND
RDLFA=NO AND
TEMP=HIGH AND
SYMPTOM=SYMP3 AND
DURATION=>17
THEN DIAGNOSIS<>LASSA_FEVER

RULE 64
IF RDTM=POSITIVE AND
BCT=POSITIVE AND
RTPCR=NEGATIVE AND
SRLG=NEGATIVE AND
RDLFA=NO AND
TEMP=HIGH AND
SYMPTOM=SYMP1 AND
DURATION=<12
THEN DIAGNOSIS<>LASSA_FEVER

RULE 65
IF RDTM=POSITIVE AND
BCT=POSITIVE AND
RTPCR=NEGATIVE AND
SRLG=NEGATIVE AND
RDLFA=NO AND
TEMP=HIGH AND
SYMPTOM=SYMP1 AND
DURATION=<17
THEN DIAGNOSIS<>LASSA_FEVER

RULE 66
IF RDTM=POSITIVE AND
BCT=POSITIVE AND
RTPCR=NEGATIVE AND
SRLG=NEGATIVE AND
RDLFA=NO AND
TEMP=HIGH AND
SYMPTOM=SYMP1 AND
DURATION=>17
THEN DIAGNOSIS<>LASSA_FEVER

RULE 67
IF RDTM=POSITIVE AND
BCT=POSITIVE AND
RTPCR=NEGATIVE AND
SRLG=NEGATIVE AND
RDLFA=NO AND
TEMP=HIGH AND
SYMPTOM=SYMP2 AND
DURATION=<12
THEN DIAGNOSIS<>LASSA_FEVER

RULE 68
IF RDTM=POSITIVE AND
BCT=POSITIVE AND
RTPCR=NEGATIVE AND
SRLG=NEGATIVE AND
RDLFA=NO AND
TEMP=HIGH AND
SYMPTOM=SYMP1 AND
DURATION=<17
THEN DIAGNOSIS<>LASSA_FEVER

RULE 69
IF RDTM=POSITIVE AND
BCT=POSITIVE AND
RTPCR=NEGATIVE AND
SRLG=NEGATIVE AND
RDLFA=NO AND
TEMP=HIGH AND

SYMPTOM=SYMP2 AND
DURATION=>17
THEN DIAGNOSIS<>LASSA_FEVER

RULE 70
IF RDTM=POSITIVE AND
BCT=POSITIVE AND
RTPCR=NEGATIVE AND
SRLG=NEGATIVE AND
RDLFA=NO AND
TEMP=HIGH AND
SYMPTOM=SYMP3 AND
DURATION=<12
THEN DIAGNOSIS<>LASSA_FEVER

RULE 71
IF RDTM=POSITIVE AND
BCT=POSITIVE AND
RTPCR=NEGATIVE AND
SRLG=NEGATIVE AND
RDLFA=NO AND
TEMP=HIGH AND
SYMPTOM=SYMP3 AND
DURATION=<17
THEN DIAGNOSIS<>LASSA_FEVER

RULE 72
IF RDTM=POSITIVE AND
BCT=POSITIVE AND
RTPCR=NEGATIVE AND
SRLG=NEGATIVE AND
RDLFA=NO AND
TEMP=HIGH AND
SYMPTOM=SYMP3 AND
DURATION=>17
THEN DIAGNOSIS<>LASSA_FEVER

RULE 73
IF RDTM=NEGATIVE AND
BCT=POSITIVE AND
RTPCR=NEGATIVE AND
SRLG=NEGATIVE AND
RDLFA=NO AND
TEMP=HIGH AND
SYMPTOM=SYMP1 AND
DURATION=<12
THEN DIAGNOSIS<>LASSA_FEVER

RULE 74
IF RDTM=NEGATIVE AND
BCT=POSITIVE AND
RTPCR=NEGATIVE AND
SRLG=NEGATIVE AND
RDLFA=NO AND
TEMP=HIGH AND
SYMPTOM=SYMP1 AND
DURATION=<17
THEN DIAGNOSIS<>LASSA_FEVER

RULE 75
IF RDTM=NEGATIVE AND
BCT=POSITIVE AND
RTPCR=NEGATIVE AND
SRLG=NEGATIVE AND
RDLFA=NO AND
TEMP=HIGH AND
SYMPTOM=SYMP1 AND
DURATION=>17
THEN DIAGNOSIS<>LASSA_FEVER

RULE 76
IF RDTM=NEGATIVE AND
BCT=POSITIVE AND
RTPCR=NEGATIVE AND
SRLG=NEGATIVE AND
RDLFA=NO AND
TEMP=HIGH AND

SYMPTOM=SYMP2 AND
DURATION=<12
THEN DIAGNOSIS<>LASSA_FEVER

RULE 77
IF RDTM=NEGATIVE AND
BCT=POSITIVE AND
RTPCR=NEGATIVE AND
SRLG=NEGATIVE AND
RDLFA=NO AND
TEMP=HIGH AND
SYMPTOM=SYMP1 AND
DURATION=<17
THEN DIAGNOSIS<>LASSA_FEVER

RULE 78
IF RDTM=NEGATIVE AND
BCT=POSITIVE AND
RTPCR=NEGATIVE AND
SRLG=NEGATIVE AND
RDLFA=NO AND
TEMP=HIGH AND
SYMPTOM=SYMP2 AND
DURATION=>17
THEN DIAGNOSIS<>LASSA_FEVER

RULE 79
IF RDTM=NEGATIVE AND
BCT=POSITIVE AND
RTPCR=NEGATIVE AND
SRLG=NEGATIVE AND
RDLFA=NO AND
TEMP=HIGH AND
SYMPTOM=SYMP3 AND
DURATION=<12
THEN DIAGNOSIS<>LASSA_FEVER

RULE 80
IF RDTM=NEGATIVE AND
BCT=POSITIVE AND

RTPCR=NEGATIVE AND
SRLG=NEGATIVE AND
RDLFA=NO AND
TEMP=HIGH AND
SYMPTOM=SYMP3 AND
DURATION=<17
THEN DIAGNOSIS<>LASSA_FEVER

RULE 81
IF RDTM= NEGATIVE AND
BCT=POSITIVE AND
RTPCR=NEGATIVE AND
SRLG=NEGATIVE AND
RDLFA=NO AND
TEMP=HIGH AND
SYMPTOM=SYMP3 AND
DURATION=>17
THEN DIAGNOSIS<>LASSA_FEVER

RULE 82
IF RDTM=POSITIVE AND
BCT=NEGATIVE AND
RTPCR=NEGATIVE AND
SRLG=NEGATIVE AND
RDLFA=NO AND
TEMP=HIGH AND
SYMPTOM=SYMP1 AND
DURATION=<12
THEN DIAGNOSIS<>LASSA_FEVER

RULE 83
IF RDTM=POSITIVE AND
BCT=NEGATIVE AND
RTPCR=NEGATIVE AND
SRLG=NEGATIVE AND
RDLFA=NO AND
TEMP=HIGH AND
SYMPTOM=SYMP1 AND
DURATION=<17

THEN DIAGNOSIS<>LASSA_FEVER

RULE 84
IF RDTM=POSITIVE AND
BCT=NEGATIVE AND
RTPCR=NEGATIVE AND
SRLG=NEGATIVE AND
RDLFA=NO AND
TEMP=HIGH AND
SYMPTOM=SYMP1 AND
DURATION=>17
THEN DIAGNOSIS<>LASSA_FEVER

RULE 85
IF RDTM=POSITIVE AND
BCT=NEGATIVE AND
RTPCR=NEGATIVE AND
SRLG=NEGATIVE AND
RDLFA=NO AND
TEMP=HIGH AND
SYMPTOM=SYMP2 AND
DURATION=<12
THEN DIAGNOSIS<>LASSA_FEVER

RULE 86
IF RDTM=POSITIVE AND
BCT=NEGATIVE AND
RTPCR=NEGATIVE AND
SRLG=NEGATIVE AND
RDLFA=NO AND
TEMP=HIGH AND
SYMPTOM=SYMP1 AND
DURATION=<17
THEN DIAGNOSIS<>LASSA_FEVER

RULE 87
IF RDTM=POSITIVE AND
BCT=NEGATIVE AND
RTPCR=NEGATIVE AND
SRLG=NEGATIVE AND
RDLFA=NO AND

TEMP=HIGH AND
SYMPTOM=SYMP2 AND
DURATION=>17
THEN DIAGNOSIS<>LASSA_FEVER

RULE 88
IF RDTM=POSITIVE AND
BCT=NEGATIVE AND
RTPCR=NEGATIVE AND
SRLG=NEGATIVE AND
RDLFA=NO AND
TEMP=HIGH AND
SYMPTOM=SYMP3 AND
DURATION=<12
THEN DIAGNOSIS<>LASSA_FEVER

RULE 89
IF RDTM=POSITIVE AND
BCT=NEGATIVE AND
RTPCR=NEGATIVE AND
SRLG=NEGATIVE AND
RDLFA=NO AND
TEMP=HIGH AND
SYMPTOM=SYMP3 AND
DURATION=<17
THEN DIAGNOSIS<>LASSA_FEVER

RULE 90
IF RDTM=POSITIVE AND
BCT=NEGATIVE AND
RTPCR=NEGATIVE AND
SRLG=NEGATIVE AND
RDLFA=NO AND
TEMP=HIGH AND
SYMPTOM=SYMP3 AND
DURATION=>17
THEN DIAGNOSIS<>LASSA_FEVER

RULE 91
IF RDTM=NEGATIVE AND
BCT=NEGATIVE AND
RTPCR=NEGATIVE AND
SRLG=NEGATIVE AND
RDLFA=NO AND
TEMP=HIGH AND
SYMPTOM=SYMP1 AND
DURATION=<12
THEN DIAGNOSIS<>LASSA_FEVER

RULE 100
IF RDTM=NEGATIVE AND
BCT=NEGATIVE AND
RTPCR=NEGATIVE AND
SRLG=NEGATIVE AND
RDLFA=NO AND
TEMP=HIGH AND
SYMPTOM=SYMP1 AND
DURATION=<17
THEN DIAGNOSIS<>LASSA_FEVER

RULE 101
IF RDTM=NEGATIVE AND
BCT=NEGATIVE AND
RTPCR=NEGATIVE AND
SRLG=NEGATIVE AND
RDLFA=NO AND
TEMP=HIGH AND
SYMPTOM=SYMP1 AND
DURATION=>17
THEN DIAGNOSIS<>LASSA_FEVER

RULE 102
IF RDTM=NEGATIVE AND
BCT=NEGATIVE AND
RTPCR=NEGATIVE AND
SRLG=NEGATIVE AND
RDLFA=NO AND
TEMP=HIGH AND

SYMPTOM=SYMP2 AND
DURATION=<12
THEN DIAGNOSIS<>LASSA_FEVER

RULE 103
IF RDTM=NEGATIVE AND
BCT=NEGATIVE AND
RTPCR=NEGATIVE AND
SRLG=NEGATIVE AND
RDLFA=NO AND
TEMP=HIGH AND
SYMPTOM=SYMP1 AND
DURATION=<17
THEN DIAGNOSIS<>LASSA_FEVER

RULE 104
IF RDTM=NEGATIVE AND
BCT=NEGATIVE AND
RTPCR=NEGATIVE AND
SRLG=NEGATIVE AND
RDLFA=NO AND
TEMP=HIGH AND
SYMPTOM=SYMP2 AND
DURATION=>17
THEN DIAGNOSIS<>LASSA_FEVER

RULE 105
IF RDTM=NEGATIVE AND
BCT=NEGATIVE AND
RTPCR=NEGATIVE AND
SRLG=NEGATIVE AND
RDLFA=NO AND
TEMP=HIGH AND
SYMPTOM=SYMP3 AND
DURATION=<12
THEN DIAGNOSIS<>LASSA_FEVER

RULE 106
IF RDTM=NEGATIVE AND
BCT=NEGATIVE AND

RTPCR=NEGATIVE AND
SRLG=NEGATIVE AND
RDLFA=NO AND
TEMP=HIGH AND
SYMPTOM=SYMP3 AND
DURATION=<17
THEN DIAGNOSIS<>LASSA_FEVER

RULE 107
IF RDTM= NEGATIVE AND
BCT=NEGATIVE AND
RTPCR=NEGATIVE AND
SRLG=NEGATIVE AND
RDLFA=NO AND
TEMP=HIGH AND
SYMPTOM=SYMP3 AND
DURATION=>17
THEN DIAGNOSIS<>LASSA_FEVER

RULE 108
IF RDTM=NO AND
BCT=POSITIVE AND
RTPCR=NEGATIVE AND
SRLG=NEGATIVE AND
RDLFA=NO AND
TEMP=HIGH AND
SYMPTOM=SYMP3 AND
DURATION=<12
THEN DIAGNOSIS<>LASSA_FEVER

RULE 109
IF RDTM=NO AND
BCT=POSITIVE AND
RTPCR=NEGATIVE AND
SRLG=NEGATIVE AND
RDLFA=NO AND
TEMP=HIGH AND
SYMPTOM=SYMP3 AND
DURATION=<17

THEN DIAGNOSIS<>LASSA_FEVER
RULE 110
IF RDTM= NO AND
BCT=POSITIVE AND
RTPCR=NEGATIVE AND
SRLG=NEGATIVE AND
RDLFA=NO AND
TEMP=HIGH AND
SYMPTOM=SYMP3 AND
DURATION=>17
THEN DIAGNOSIS<>LASSA_FEVER

RULE 111
IF RDTM=NO AND
BCT=NEGATIVE AND
RTPCR=NEGATIVE AND
SRLG=NEGATIVE AND
RDLFA=NO AND
TEMP=HIGH AND
SYMPTOM=SYMP3 AND
DURATION=<12
THEN DIAGNOSIS<>LASSA_FEVER

RULE 112
IF RDTM=NO AND
BCT=NEGATIVE AND
RTPCR=NEGATIVE AND
SRLG=NEGATIVE AND
RDLFA=NO AND
TEMP=HIGH AND
SYMPTOM=SYMP3 AND
DURATION=<17
THEN DIAGNOSIS<>LASSA_FEVER

RULE 113
IF RDTM= NO AND
BCT=NEGATIVE AND
RTPCR=NEGATIVE AND
SRLG=NEGATIVE AND
RDLFA=NO AND

TEMP=HIGH AND
SYMPTOM=SYMP3 AND
DURATION=>17
THEN DIAGNOSIS<>LASSA_FEVER

RULE 114
IF RDTM=NO AND
BCT=NO AND
RTPCR=NEGATIVE AND
SRLG=NEGATIVE AND
RDLFA=NO AND
TEMP=HIGH AND
SYMPTOM=SYMP1 AND
DURATION=>17
THEN DIAGNOSIS<>LASSA_FEVER

RULE 115
IF RDTM=NO AND
BCT=NO AND
RTPCR=POSITIVE AND
SRLG=NEGATIVE AND
RDLFA=NO AND
TEMP=HIGH AND
SYMPTOM=SYMP1 AND
DURATION=<12
THEN DIAGNOSIS=MILD_LASSA_FEVER CNF 75

RULE 116
IF RDTM=NO AND
BCT=NO AND
RTPCR=POSITIVE AND
SRLG=NEGATIVE AND
RDLFA=NO AND
TEMP=HIGH AND
SYMPTOM=SYMP2 AND
DURATION=<17
THEN DIAGNOSIS=SEVERE_LASSA_FEVER CNF 90

RULE 117
IF RDTM=NO AND
BCT=NO AND
RTPCR=POSITIVE AND
SRLG=NEGATIVE AND
RDLFA=NO AND
TEMP=HIGH AND
SYMPTOM=SYMP3 AND
DURATION=>17
THEN DIAGNOSIS=CRITICAL_LASSA_FEVER CNF 90

RULE 118
IF RDTM=NO AND
BCT=NO AND
RTPCR=NEGATIVE AND
SRLG=POSITIVE AND
RDLFA=NO AND
TEMP=HIGH AND
SYMPTOM=SYMP1 AND
DURATION=<12
THEN DIAGNOSIS=MILD_LASSA_FEVER CNF 75

RULE 119
IF RDTM=NO AND
BCT=NO AND
RTPCR=NEGATIVE AND
SRLG=POSITIVE AND
RDLFA=NO AND
TEMP=HIGH AND
SYMPTOM=SYMP2 AND
DURATION=<17
THEN DIAGNOSIS=SEVERE_LASSA_FEVER CNF 75

RULE 120
IF RDTM=NO AND
BCT=NO AND
RTPCR=NEGATIVE AND
SRLG=POSITIVE AND
RDLFA=NO AND
TEMP=HIGH AND

SYMPTOM=SYMP3 AND
DURATION=>17
THEN DIAGNOSIS=CRITICAL_LASSA_FEVER CNF 75

RULE 121
IF RDTM=POSITIVE AND
BCT=NO AND
RTPCR= POSITIVE AND
SRLG= POSITIVE AND
RDLFA=NO AND
TEMP=HIGH AND
SYMPTOM=SYMP1 AND
DURATION=<12
THEN DIAGNOSIS=MILD_LASSA_FEVER

RULE 122
IF RDTM=POSITIVE AND
BCT=NO AND
RTPCR= POSITIVE AND
SRLG= POSITIVE AND
RDLFA=NO AND
TEMP=HIGH AND
SYMPTOM=SYMP2 AND
DURATION=<17
THEN DIAGNOSIS=SEVERE_LASSA_FEVER

RULE 123
IF RDTM=POSITIVE AND
BCT=NO AND
RTPCR= POSITIVE AND
SRLG= POSITIVE AND
RDLFA=NO AND
TEMP=HIGH AND
SYMPTOM=SYMP3 AND
DURATION=>17
THEN DIAGNOSIS=CRITICAL_LASSA_FEVER

RULE 124
IF RDTM=POSITIVE AND
BCT=NO AND

RTPCR=POSITIVE AND
SRLG=NO AND
RDLFA=POSITIVE AND
TEMP=HIGH AND
SYMPTOM=SYMP1 AND
DURATION=<12
THEN DIAGNOSIS=MILD_LASSA_FEVER

RULE 125
IF RDTM=POSITIVE AND
BCT=NO AND
RTPCR= POSITIVE AND
SRLG=NO AND
RDLFA= POSITIVE AND
TEMP=HIGH AND
SYMPTOM=SYMP3 AND
DURATION=<17
THEN DIAGNOSIS=CRITICAL_LASSA_FEVER

RULE 126
IF RDTM=POSITIVE AND
BCT=NO AND
RTPCR= NEGATIVE AND
SRLG=NO AND
RDLFA= NEGATIVE AND
TEMP=HIGH AND
SYMPTOM=SYMP1 AND
DURATION=>12
THEN DIAGNOSIS<>LASSA_FEVER

RULE 127
IF RDTM=POSITIVE AND
BCT=NO AND
RTPCR= NEGATIVE AND
SRLG=NO AND
RDLFA= NEGATIVE AND
TEMP=HIGH AND
SYMPTOM=SYMP2 AND
DURATION=>17
THEN DIAGNOSIS<>LASSA_FEVER

RULE 128
IF RDTM=POSITIVE AND
BCT=NO AND
RTPCR=NEGATIVE AND
SRLG=NO AND
RDLFA= NEGATIVE AND
TEMP=HIGH AND
SYMPTOM=SYMP3 AND
DURATION=>17
THEN DIAGNOSIS<>LASSA_FEVER

RULE 129
IF RDTM=NEGATIVE AND
BCT=NO AND
RTPCR=NEGATIVE AND
SRLG=NO AND
RDLFA= NEGATIVE AND
TEMP=HIGH AND
SYMPTOM=SYMP1 AND
DURATION=<12
THEN DIAGNOSIS<>LASSA_FEVER

RULE 130
IF RDTM=NEGATIVE AND
BCT=NO AND
RTPCR=NEGATIVE AND
SRLG=NO AND
RDLFA= NEGATIVE AND
TEMP=HIGH AND
SYMPTOM=SYMP1 AND
DURATION=<17
THEN DIAGNOSIS<>LASSA_FEVER

RULE 131
IF RDTM=NEGATIVE AND
BCT=NO AND
RTPCR=NEGATIVE AND
SRLG=NO AND
RDLFA= NEGATIVE AND

TEMP=HIGH AND
SYMPTOM=SYMP1 AND
DURATION=>17
THEN DIAGNOSIS<>LASSA_FEVER

RULE 132
IF RDTM=NEGATIVE AND
BCT=NO AND
RTPCR=NEGATIVE AND
SRLG=NO AND
RDLFA= NEGATIVE AND
TEMP=HIGH AND
SYMPTOM=SYMP2 AND
DURATION=<12
THEN DIAGNOSIS<>LASSA_FEVER

RULE 133
IF RDTM=NEGATIVE AND
BCT=NO AND
RTPCR=NEGATIVE AND
SRLG=NO AND
RDLFA= NEGATIVE AND
TEMP=HIGH AND
SYMPTOM=SYMP1 AND
DURATION=<17
THEN DIAGNOSIS<>LASSA_FEVER

RULE 134
IF RDTM=NEGATIVE AND
BCT=NO AND
RTPCR=NEGATIVE AND
SRLG=NO AND
RDLFA= NEGATIVE AND
TEMP=HIGH AND
SYMPTOM=SYMP2 AND
DURATION=>17
THEN DIAGNOSIS<>LASSA_FEVER

RULE 135
IF RDTM=NEGATIVE AND
BCT=NO AND
RTPCR=NEGATIVE AND
SRLG=NO AND
RDLFA= NEGATIVE AND
TEMP=HIGH AND
SYMPTOM=SYMP3 AND
DURATION=<12
THEN DIAGNOSIS<>LASSA_FEVER

RULE 136
IF RDTM=NEGATIVE AND
BCT=NO AND
RTPCR=NEGATIVE AND
SRLG=NO AND
RDLFA=NEGATIVE AND
TEMP=HIGH AND
SYMPTOM=SYMP3 AND
DURATION=<17
THEN DIAGNOSIS<>LASSA_FEVER

RULE 137
IF RDTM= NEGATIVE AND
BCT=NO AND
RTPCR=NEGATIVE AND
SRLG=NO AND
RDLFA= NEGATIVE AND
TEMP=HIGH AND
SYMPTOM=SYMP3 AND
DURATION=>17
THEN DIAGNOSIS<>LASSA_FEVER

RULE 138
IF RDTM=POSITIVE AND
BCT=POSITIVE AND
RTPCR=NEGATIVE AND
SRLG=NO AND

RDLFA= NEGATIVE AND
TEMP=HIGH AND
SYMPTOM=SYMP1 AND
DURATION=<12
THEN DIAGNOSIS<>LASSA_FEVER

RULE 139
IF RDTM=POSITIVE AND
BCT=POSITIVE AND
RTPCR=NEGATIVE AND
SRLG=NO AND
RDLFA= NEGATIVE AND
TEMP=HIGH AND
SYMPTOM=SYMP1 AND
DURATION=<17
THEN DIAGNOSIS<>LASSA_FEVER

RULE 140
IF RDTM=POSITIVE AND
BCT=POSITIVE AND
RTPCR=NEGATIVE AND
SRLG=NO AND
RDLFA= NEGATIVE AND
TEMP=HIGH AND
SYMPTOM=SYMP1 AND
DURATION=>17
THEN DIAGNOSIS<>LASSA_FEVER

RULE 141
IF RDTM=POSITIVE AND
BCT=POSITIVE AND
RTPCR=NEGATIVE AND
SRLG=NO AND
RDLFA= NEGATIVE AND
TEMP=HIGH AND
SYMPTOM=SYMP2 AND
DURATION=<12
THEN DIAGNOSIS<>LASSA_FEVER

RULE 142
IF RDTM=POSITIVE AND
BCT=POSITIVE AND
RTPCR=NEGATIVE AND
SRLG=NO AND
RDLFA= NEGATIVE AND
TEMP=HIGH AND
SYMPTOM=SYMP2 AND
DURATION=<17
THEN DIAGNOSIS<>LASSA_FEVER

RULE 143
IF RDTM=POSITIVE AND
BCT=POSITIVE AND
RTPCR=NEGATIVE AND
SRLG=NO AND
RDLFA= NEGATIVE AND
TEMP=HIGH AND
SYMPTOM=SYMP2 AND
DURATION=>17
THEN DIAGNOSIS<>LASSA_FEVER

RULE 144
IF RDTM=POSITIVE AND
BCT=POSITIVE AND
RTPCR=NEGATIVE AND
SRLG=NO AND
RDLFA= NEGATIVE AND
TEMP=HIGH AND
SYMPTOM=SYMP3 AND
DURATION=<12
THEN DIAGNOSIS<>LASSA_FEVER

RULE 145
IF RDTM=POSITIVE AND
BCT=POSITIVE AND
RTPCR=NEGATIVE AND
SRLG=NO AND
RDLFA= NEGATIVE AND
TEMP=HIGH AND

SYMPTOM=SYMP3 AND
DURATION=<17
THEN DIAGNOSIS<>LASSA_FEVER

RULE 146
IF RDTM=POSITIVE AND
BCT=POSITIVE AND
RTPCR=NEGATIVE AND
SRLG=NO AND
RDLFA= NEGATIVE AND
TEMP=HIGH AND
SYMPTOM=SYMP3 AND
DURATION=>17
THEN DIAGNOSIS<>LASSA_FEVER

RULE 147
IF RDTM=NEGATIVE AND
BCT=POSITIVE AND
RTPCR=NEGATIVE AND
SRLG=NO AND
RDLFA= NEGATIVE AND
TEMP=HIGH AND
SYMPTOM=SYMP1 AND
DURATION=<12
THEN DIAGNOSIS<>LASSA_FEVER

RULE 148
IF RDTM=NEGATIVE AND
BCT=POSITIVE AND
RTPCR=NEGATIVE AND
SRLG=NO AND
RDLFA=NEGATIVE AND
TEMP=HIGH AND
SYMPTOM=SYMP1 AND
DURATION=<17
THEN DIAGNOSIS<>LASSA_FEVER

RULE 149
IF RDTM=NEGATIVE AND
BCT=POSITIVE AND
RTPCR=NEGATIVE AND
SRLG=NO AND
RDLFA= NEGATIVE AND
TEMP=HIGH AND
SYMPTOM=SYMP1 AND
DURATION=>17
THEN DIAGNOSIS<>LASSA_FEVER

RULE 150
IF RDTM=NEGATIVE AND
BCT=POSITIVE AND
RTPCR=NEGATIVE AND
SRLG=NO AND
RDLFA= NEGATIVE AND
TEMP=HIGH AND
SYMPTOM=SYMP2 AND
DURATION=<12
THEN DIAGNOSIS<>LASSA_FEVER

RULE 151
IF RDTM=NEGATIVE AND
BCT=POSITIVE AND
RTPCR=NEGATIVE AND
SRLG=NO AND
RDLFA=NEGATIVE AND
TEMP=HIGH AND
SYMPTOM=SYMP2 AND
DURATION=<17
THEN DIAGNOSIS<>LASSA_FEVER

RULE 152
IF RDTM=NEGATIVE AND
BCT=POSITIVE AND
RTPCR=NEGATIVE AND
SRLG=NO AND
RDLFA= NEGATIVE AND
TEMP=HIGH AND

SYMPTOM=SYMP2 AND
DURATION=>17
THEN DIAGNOSIS<>LASSA_FEVER

RULE 153
IF RDTM=NEGATIVE AND
BCT=POSITIVE AND
RTPCR=NEGATIVE AND
SRLG=NO AND
RDLFA= NEGATIVE AND
TEMP=HIGH AND
SYMPTOM=SYMP3 AND
DURATION=<12
THEN DIAGNOSIS<>LASSA_FEVER

RULE 154
IF RDTM=NEGATIVE AND
BCT=POSITIVE AND
RTPCR=NEGATIVE AND
SRLG=NO AND
RDLFA= NEGATIVE AND
TEMP=HIGH AND
SYMPTOM=SYMP3 AND
DURATION=<17
THEN DIAGNOSIS<>LASSA_FEVER

RULE 155
IF RDTM= NEGATIVE AND
BCT=POSITIVE AND
RTPCR=NEGATIVE AND
SRLG=NO AND
RDLFA= NEGATIVE AND
TEMP=HIGH AND
SYMPTOM=SYMP3 AND
DURATION=>17
THEN DIAGNOSIS<>LASSA_FEVER

RULE 156
IF RDTM=POSITIVE AND
BCT=NEGATIVE AND
RTPCR=NEGATIVE AND
SRLG=NO AND
RDLFA= NEGATIVE AND
TEMP=HIGH AND
SYMPTOM=SYMP1 AND
DURATION=<12
THEN DIAGNOSIS<>LASSA_FEVER

RULE 157
IF RDTM=POSITIVE AND
BCT=NEGATIVE AND
RTPCR=NEGATIVE AND
SRLG=NO AND
RDLFA= NEGATIVE AND
TEMP=HIGH AND
SYMPTOM=SYMP1 AND
DURATION=<17
THEN DIAGNOSIS<>LASSA_FEVER

RULE 158
IF RDTM=POSITIVE AND
BCT=NEGATIVE AND
RTPCR=NEGATIVE AND
SRLG=NO AND
RDLFA= NEGATIVE AND
TEMP=HIGH AND
SYMPTOM=SYMP1 AND
DURATION=>17
THEN DIAGNOSIS<>LASSA_FEVER

RULE 159
IF RDTM=POSITIVE AND
BCT=NEGATIVE AND
RTPCR=NEGATIVE AND
SRLG=NO AND
RDLFA= NEGATIVE AND
TEMP=HIGH AND

SYMPTOM=SYMP2 AND
DURATION=<12
THEN DIAGNOSIS<>LASSA_FEVER

RULE 160
IF RDTM=POSITIVE AND
BCT=NEGATIVE AND
RTPCR=NEGATIVE AND
SRLG=NO AND
RDLFA= NEGATIVE AND
TEMP=HIGH AND
SYMPTOM=SYMP2 AND
DURATION=<17
THEN DIAGNOSIS<>LASSA_FEVER

RULE 161
IF RDTM=POSITIVE AND
BCT=NEGATIVE AND
RTPCR=NEGATIVE AND
SRLG=NO AND
RDLFA= NEGATIVE AND
TEMP=HIGH AND
SYMPTOM=SYMP2 AND
DURATION=>17
THEN DIAGNOSIS<>LASSA_FEVER

RULE 162
IF RDTM=POSITIVE AND
BCT=NEGATIVE AND
RTPCR=NEGATIVE AND
SRLG=NO AND
RDLFA= NEGATIVE AND
TEMP=HIGH AND
SYMPTOM=SYMP3 AND
DURATION=<12
THEN DIAGNOSIS<>LASSA_FEVER

RULE 163
IF RDTM=POSITIVE AND
BCT=NEGATIVE AND
RTPCR=NEGATIVE AND

SRLG=NO AND
RDLFA= NEGATIVE AND
TEMP=HIGH AND
SYMPTOM=SYMP3 AND
DURATION=<17
THEN DIAGNOSIS<>LASSA_FEVER

RULE 164
IF RDTM=POSITIVE AND
BCT=NEGATIVE AND
RTPCR=NEGATIVE AND
SRLG=NO AND
RDLFA= NEGATIVE AND
TEMP=HIGH AND
SYMPTOM=SYMP3 AND
DURATION=>17
THEN DIAGNOSIS<>LASSA_FEVER

RULE 165
IF RDTM=NEGATIVE AND
BCT=NEGATIVE AND
RTPCR=NEGATIVE AND
SRLG=NO AND
RDLFA=NEGATIVE AND
TEMP=HIGH AND
SYMPTOM=SYMP1 AND
DURATION=<12
THEN DIAGNOSIS<>LASSA_FEVER

RULE 166
IF RDTM=NEGATIVE AND
BCT=NEGATIVE AND
RTPCR=NEGATIVE AND
SRLG=NO AND
RDLFA=NEGATIVE AND
TEMP=HIGH AND
SYMPTOM=SYMP1 AND
DURATION=<17

THEN DIAGNOSIS<>LASSA_FEVER
RULE 167
IF RDTM=NEGATIVE AND
BCT=NEGATIVE AND
RTPCR=NEGATIVE AND
SRLG=NO AND
RDLFA= NEGATIVE AND
TEMP=HIGH AND
SYMPTOM=SYMP1 AND
DURATION=>17
THEN DIAGNOSIS<>LASSA_FEVER

RULE 168
IF RDTM=NEGATIVE AND
BCT=NEGATIVE AND
RTPCR=NEGATIVE AND
SRLG=NO AND
RDLFA= NEGATIVE AND
TEMP=HIGH AND
SYMPTOM=SYMP2 AND
DURATION=<12
THEN DIAGNOSIS<>LASSA_FEVER

RULE 169
IF RDTM=NEGATIVE AND
BCT=NEGATIVE AND
RTPCR=NEGATIVE AND
SRLG=NO AND
RDLFA= NEGATIVE AND
TEMP=HIGH AND
SYMPTOM=SYMP2 AND
DURATION=<17
THEN DIAGNOSIS<>LASSA_FEVER

RULE 170
IF RDTM=NEGATIVE AND
BCT=NEGATIVE AND
RTPCR=NEGATIVE AND
SRLG=NO AND
RDLFA= NEGATIVE AND
TEMP=HIGH AND

SYMPTOM=SYMP2 AND
DURATION=>17
THEN DIAGNOSIS<>LASSA_FEVER

RULE 171
IF RDTM=NEGATIVE AND
BCT=NEGATIVE AND
RTPCR=NEGATIVE AND
SRLG=NO AND
RDLFA= NEGATIVE AND
TEMP=HIGH AND
SYMPTOM=SYMP3 AND
DURATION=<12
THEN DIAGNOSIS<>LASSA_FEVER

RULE 172
IF RDTM=NEGATIVE AND
BCT=NEGATIVE AND
RTPCR=NEGATIVE AND
SRLG=NO AND
RDLFA= NEGATIVE AND
TEMP=HIGH AND
SYMPTOM=SYMP3 AND
DURATION=<17
THEN DIAGNOSIS<>LASSA_FEVER

RULE 173
IF RDTM= NEGATIVE AND
BCT=NEGATIVE AND
RTPCR=NEGATIVE AND
SRLG=NO AND
RDLFA= NEGATIVE AND
TEMP=HIGH AND
SYMPTOM=SYMP3 AND
DURATION=>17
THEN DIAGNOSIS<>LASSA_FEVER

RULE 174
IF RDTM=NO AND
BCT=POSITIVE AND
RTPCR=NEGATIVE AND
SRLG=NO AND
RDLFA= NEGATIVE AND
TEMP=HIGH AND
SYMPTOM=SYMP1 AND
DURATION=<12
THEN DIAGNOSIS<>LASSA_FEVER

RULE 175
IF RDTM=NO AND
BCT=POSITIVE AND
RTPCR=NEGATIVE AND
SRLG=NO AND
RDLFA= NEGATIVE AND
TEMP=HIGH AND
SYMPTOM=SYMP3 AND
DURATION=<17
THEN DIAGNOSIS<>LASSA_FEVER