



## Expert System for Diagnosis of Malaria and Typhoid Fever

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**Abstract-** In Nigeria today, one of the most common forms of fever are malaria and typhoid. Malaria results in anemia meaning decrease in red blood cells. Health care facility should be accessible to patient at all-time but there has been problem in the access to the facilities because of the few facilities and qualified medical personnel are not always available. This study considers developing an expert system that could assist in diagnosing malaria, the system was developed using Visual Basic.Net and top-down approach was used for the system design. The data collected from the Federal Polytechnic Medical Centre covers seven months period. The total prescriptions issued for this period was 7525 and over 4117 patients out of these are affected by malaria and typhoid fever and this represents 54.71% of prescription issued. Considering the percentage of people being affected with malaria within a particular period, there is an urgent need for a system that will aid the immediate, accurate and reliable diagnosis which will aid and enhance the performance of a medical expert

**Keywords:** *Diagnosis, Malaria, Typhoid, and Expert system.*

### 1. Introduction

Malaria is a mosquito-borne infectious disease affecting humans and other animals caused by parasitic protozoans (a group of single-celled microorganisms) belonging to the *Plasmodium* type. It is a life-threatening disease typically transmitted through the bite of an infected *Anopheles* mosquito. There are various reasons for the usual growth in the disease most especially in West Africa. Some of these reasons include: ignorance, environmental factors and the low percentage of medical practitioners who are keen at diagnosing and providing medical care to patients of this disease. The lastly mentioned reason is seen as the main cause for the high degree of malaria prevalence in West Africa (Alaba and Isaac, 2016).

To tackle this issue of insufficient medical practitioners, many researchers have attempted the application of advancements in Information Technology to equalizing the ratio of patients to medical practitioners by developing expert systems that can personify the human experts in the field of diagnosis and therapy of malaria. With all these available medical expert systems, there is still an unquenched need in helping the equalization of the ratio most especially with the increase in the population of Africans and more so, the weaknesses in strength (accessibility, reasoning, cost, usability, codified expert knowledge) of some of these systems in addressing the issue as expected. Research shows that Nigeria is one of the most commonly affected countries in Africa, according to 2016 World Malaria report as shown in Fig. 1. The estimated malaria cases in Nigeria only is 55% while other west African countries have 45%.

An Expert System (ES) is a computer program that uses artificial intelligence (AI) technologies to simulate the judgment and behavior of a human or an organization that has expert knowledge and experience in a particular field. It is an intelligent computer program that helps to systematize, store and obtain appropriate medical knowledge needed by the practitioner/doctors in dealing with each complicated case and suggesting suitable diagnosis for decision-making procedure. It would be of great necessity to provide a computerized system that will provide complementary medical service, like medical disease diagnosis in places that are difficult to access and health care facilities where qualified experts are lacking. This develops a system that will aid the diagnosis of malaria and typhoid fever.

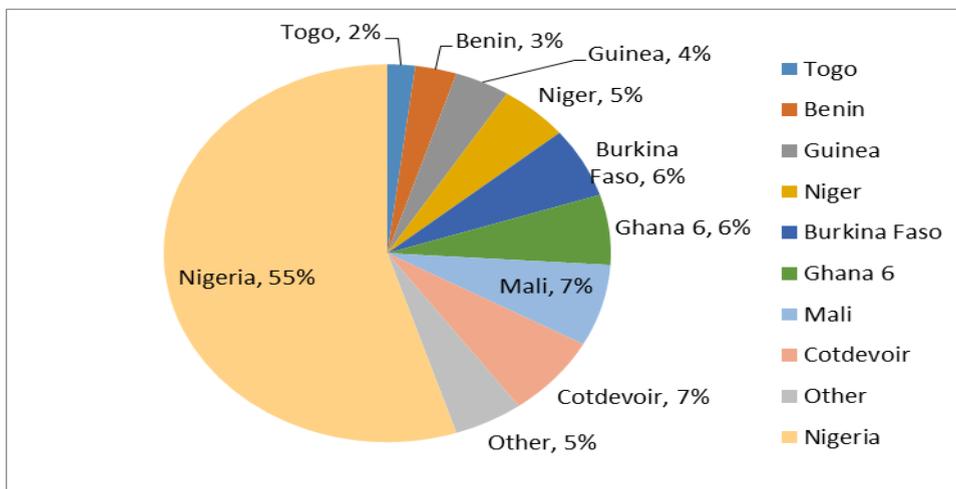


Fig.1: West Africa Estimated Malaria Cases

Source: 2016 World Malaria Report ([www.who.int/malaria/publications/world-malaria-report-2016/report/en/](http://www.who.int/malaria/publications/world-malaria-report-2016/report/en/))

## 2. Literature Review

There have been various research works carried out on the application of Information Technology to medical care. This study is classified into medical information management, telemedicine under which mobile health and electronic health reside and also expert system.

Alaba and Taiwo (2016) developed Mobile-Based Fuzzy Expert System (MFES) for Diagnosing Malaria that could assist in diagnosing malaria. The fuzzification of crisp inputs by the system was carried out using an inter-valued and triangular membership functions while the defuzzification of the inference engine outputs was performed by weighted average method. Root sum square method of drawing inferences has been employed while the whole development has been achieved with the help of Java 2 Micro Edition of Java. This expert system executes on the readily available mobile devices of the patients.

Considered in (Tunmibi et. al, 2013) was the development of a rule based expert system for diagnosing fever. The web based expert system used Visual Basic Dot Net (VB.Net) as the language of its implementation while the rules within the knowledge base were Boolean rules and not fuzzy rules hence; drawing of inference as performed by this system could not have a high degree of human like way of reasoning.

In (Adetunbi et. al, 2012), a web based diagnosis and therapy system that used a machine learning technique was developed. According to the study, a machine learning technique rough set was used on labeled sets of malaria fever symptoms collected to generate explainable rules for each level of severity. The developed system labeled database, was divided into five cases of malaria and the classification accuracy on training dataset was described to be 100% while that of testing data set was 94%. Even though the study claimed to have developed a web based diagnosis and therapy system that could be accessed anywhere and anytime, it should not escape the minds of individuals that not all the intended users of the system have access to reliable network and internet facilities in their various locations.

Omisore (2013) studied- A Web Base Decision Support System driven by Fuzzy Logic for the diagnosis of Typhoid fever. The motivations for the research include: identification of typhoid fever as the major cause of morbidity and mortality in most developing countries, and to provide decision support platform for medical practitioners. Diagnosis of typhoid fever involves several variables which usually make it difficult to arrive at accurate and timely diagnosis.

Oladipo (2016) presented a Mobile Compactable Expert System for the treatment of typhoid fever in developing countries. The motivations for this work include: Typhoid fever is rampant in developing nations with over 21.6 million cases and at least 250,000 deaths occurring annually, expert system

development today are either web based or stand-alone application. The methodology involved the use of object oriented programming approach. The application framework has three parts – user interface, application logic (written in PHP programming language) and Database component using MYSQL server. No evidence of consultation with medical experts, data collection and usage. The prior knowledge and the basis for the diagnosis were not discussed. No computational methodology was deployed.

Adehorand Burrell (2002), presented an Intelligent Decision Support System for the prompt diagnosis of malaria and typhoid in the malaria belt of Africa. The motivations for this work include: current diagnostic tools are affected by the harsh tropical weather, lack of qualified laboratory technicians, lack of regular supply of electricity to preserve diagnostic tools, lack of adequate transport facilities to move patients from rural to urban areas and a child dies every 15 seconds from water related diseases in which typhoid fever is one. A study was carried out which confirmed that both typhoid fever and malaria could be diagnosed based on signs and symptoms. The system was developed using rapid prototyping with a simple expert system shell. The system has total of 53 rules in its knowledge base. The performance of the system was also evaluated.

A Machine Learning Based Clinical Decision Support System for Diagnosis and Treatment of typhoid fever was developed by Oguntimilehin (2007). Motivating factors include: medical personnel and facilities are adequate for effective tackling of tropical diseases, earlier estimates of global burden of typhoid fever indicate that at least 16millions new cases every year with 600,000 deaths. Two sets of data on typhoid fever cases were collected at different periods. Implementation was done using Visual Basic.NET as front end and MYSQL as backend.

### 3. Methods

Technical aspects of our methodology involved the design and implementation of a 4-agent architectural model namely, the user interface component, inference engine, knowledge base and system database. The system was developed using VB.Net and Microsoft SQL Server 2005 was used as the Database. Fig. 2 shows the interconnection of the components. Medical record unit of the Federal Polytechnic Ede Medical Center was consulted to gather required data, this data was collected from available records, the records were perused for the purpose of extraction, malaria prescription details for the period of seven months (February-August 2017) were extracted.

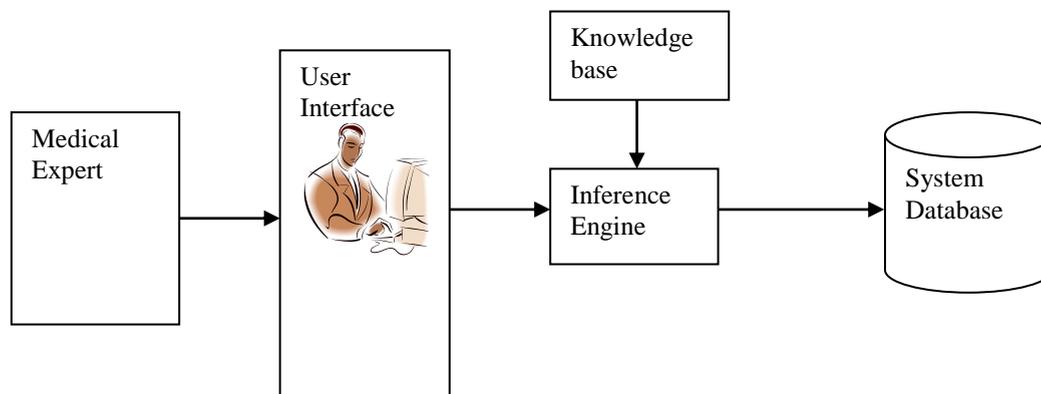


Fig. 2: Architectural design for malaria Expert System

### 4. Data Analysis and Result

Table 1 shows malaria estimate data collected from the medical centre from the month of February to August 2017. It shows the details about the prescription issued and how the prescription was used within the period.

Table1: Malaria Report

Months	Number of Prescription issued per month	Affected Patients below 5yrs	Affected Patients above 5yrs	Total number of patients affected per month
February	1030	23	456	479
March	1137	23	456	479
April	187	1	83	84
May	0	0	0	0
June	1937	29	1106	1135
July	1850	35	1127	1162
August	1384	36	174	778
TOTAL	7525	147	3970	4117

Source: Federal Polytechnic Ede, Medical Center

#### 4.1 Malaria Prescription

From the data collected, 7525 was the total prescriptions issued for seven months out of which over 4117 patients were affected by malaria and typhoid. The result shows that the population of the patient with malaria and typhoid are more than any other disease. Also from Fig. 3 it can be deduced that malaria and typhoid fever affect most people above age of 5yrs. Therefore, there is a need for an expert system that will diagnosis patient more accurately and timely in the absence of the physicians.

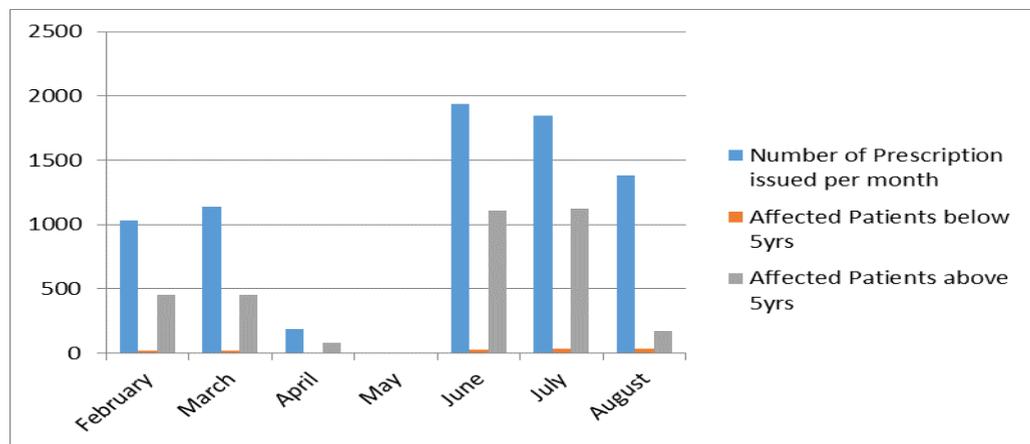


Fig. 3: Graphical Representation of Malaria Prescription

#### 4.2. System Design

This is classified into logical design and physical design. The logical design of the system shows the internal working and relationship of the module in the system while the physical design describes the interfaces and interaction between the system and the users.

#### 4.3. Logical Design

The system is made up different modules and the modules were later linked so as to make a complete working system. The Logical design of the system is represented in Fig. 2.

#### 4.4. Physical Design

This has to do with the input and output. Inputs are obtained from users which are processed to give results of the operation, which forms the output. All file used during the design of this new system were named in a way that made them easy to understand as their name say what they stand for. The file design is given the following consideration;

- Input Media: Keyboard, mouse

- Output Media: monitor and printer
- Storage Media: Hard disk and Compact disc

#### 4.5. User Interface Design

The design of the system involved the driver software environment as well as the interconnection between all other modules. When diagnosis starts as depicted in Fig. 4, each question answered “Yes” will be scored certain percentage depending on the degree of relevance the symptom is to the disease. At the end of each diagnosis, the level of infection in percentage will be shown. The expert system also analysis the case and reveals whether or not it is a severe case with an advice to confirm the test in a laboratory. This form also has a link to the database. As you keep responding to the question of the expert, the database content will be retrieved.



Figure4: Diagnosis Form

#### 4.6. Database Design

The database of system was implemented using SQL (Structured Query Language), it stores the questions and prescription using for the diagnosis. The system interface that interacts with the database is shown in Fig. 5.



Figure 5: Database Design

## 5. Conclusions

The malaria expert system agent built in this paper, was a rule-based system and contained in its knowledge base, some important rules on malaria causative agents, environmental and climatic factors which can favor the multiplicity of malaria transmissions. It also proffers solution to how malaria transmission can be handled by a reasoning approach based on its knowledge base, this system will be very useful in our today's world driven by technology. When expert's knowledge is extracted and stored, such knowledge can be used to replace the human expert.

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