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A Review of a Decision Support System for Diagnosis (DSS) of Tropical Diseases

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ABSTRACT
Tropical diseases account for some of the major causes of death in Africa. However, most existing decision support systems (DSS) for early diagnosis of tropical diseases are less effective owing to its vagueness and unstructuredness in making decisions. In this study, a decision support system, which is capable of addressing vagueness and confusion associated with early diagnosis of tropical diseases, was proposed. Information overload in medicine has long been acknowledged and remedies sought. One option is to devise medical expert system programs that reason for the doctor. For complex specialized areas we may be content to compartmentalize the knowledge and embed it in a machine that provides doctors with high-quality solutions as long as the machine can explain those solutions to the doctor's satisfaction. One of the problems that characterized the traditional method of medical diagnostic is inaccuracy and imprecision which has claimed many life. The advent of computer has led to the development of several algorithms, models and technologies to ensure accuracy and precision and this has greatly reduced the death rate of patients daily in numbers the hospitals. This paper carried out a brief review of the research work done in knowledge based system in the field of medical diagnosis of tropical diseases.Various techniques used in some of the clinical systems that have being developed over time were discussed and the limitations were identified. In conclusion, Fuzzy-Ahp approach was proposed for optimal diagnosis of the diseases.

Keyword: Tropical Disease, DSS, Medical Experts, Fuzzy logic, Ahp

INTRODUCTION
The diagnosis of tropical disease involves several levels of uncertainty and imprecision (Torres and Nietto, 2006). Tropical diseases encompass all diseases that occur solely, or principally, in the tropics. In practice, the term is often taken to refer to infectious diseases that thrive in hot

and humid conditions according to World Health Organisation (WHO). Medical diagnosis is the art of determining a person's pathological status from an available set of finding. It requires an integration of results from most of the many sub-disciplines of information processing and, especially, AI (Uzoka and Famuyiwa, 2004).

However, a number of tropical diseases constitute conditions that are of concern to health authorities, physicians and the community at large, because of difficulties in their early diagnosis and associated mortality rates.(Olabiyisi ,Omidiora ,Olaniyan and Derikoma, 2011).

These conditions and a number of other tropical diseases present with symptoms that overlap, and thus become confusable (Nilson,2006).Accurate and timely diagnosis of these conditions are considered absolutely essential in their eventual prevention and management (Praven *et al.,* 2008).

The difficulties in the diagnosis of these conditions are compounded by the fact that early symptoms of these diseases are very similar and therefore might present unique challenges in differential diagnosis. These confusing early symptoms often result in mis-diagnosis, inadequate assessments, poor disease management and subsequent increased morbidity and mortality rates in sub-Saharan Africa. This is compounded by high rate of poverty, lack of education and medical infrastructure, poor medical record keeping, poor training and lack of adequate number of medical practitioners (Uzoka, 2011).

Overview of Clinical Decision Support System (CDSS)

Telemedicine is a fast growing application in the health sector; telemedicine involves the use of information and communication technology in the health care sector. It also involves the provision of clinical services. In the early manifestations of telemedicine, African

villagers used smoke signals to warn people to stay away from the village in case of serious disease (Birmbanmer and Ratkowski, 2003). In the early 1900s, people living in remote areas in Australia used two-way radios, powered by a dynamo driven by a set of bicycle pedals, to communicate with the Royal Flying Doctor Service of Australia. There are different types of telemedicine: store and forward telemedicine, monitoring telemedicine and interactive services. Medical knowledge is vast and constantly changing, as well as expanding.

Decision Support Systems constitute a class of computer-based information systems including knowledge-based systems that support decision-making activities. Decision Support Systems (DSS) are a specific class of computerized information system that supports business and organizational decision making activities. A properly-designed DSS is an interactive software based system intended to help decision makers compile useful information from raw data, documents, personal knowledge, and/or business models to identify and solve problems and make decisions (Uzoka, 2011).

According to past research with an estimation of approximately 500 million people, most of them poor, suffer from tropical diseases. This exposes them to many kinds of suffering, including deformity, blindness, brain damage and premature death. Tropical diseases are a serious impediment to individual and national development. They impair intellectual and physical growth, make fertile land unuseable, and burden economies with huge costs for treatment and control (Uzoka and Baker, 2004). However, substantial progress has been made on

Existing Medical Expert Systems

Obot andUzoka (2011) proposed a framework for application of neuro-case-rule base hybridization in medical diagnosis through Neural network technology using Neuro Solutions 5.0. They proposed that diagnostic decision support systems are designed to improve the

diagnostic performance of physicians. They also agreed that the problem of managing imprecise knowledge exists and the process of combining facts in medical problem to obtain an optimal diagnostic result is complex. However, the utilization of neural networks and fuzzy logic became very popular in attempting to resolve the problems of imprecision and uncertainty. They used a tight coupling of case base, rule base and neural networks methodologies.

Furthermore, Obot and Uzoka (2009) obtained data from three hospitals that employ case base reasoning in their diagnoses in order to develop an integrated Neuro Case Rule base system which trains on Back Propagation Neural Network (BPNN). Diagnosis of Hepatitis was used to explain the architectural framework that contained five subsystems. The subsystems are database, case base reasoning, neural network, rule base and an inference engine. They obtained the unstructured knowledge through interaction with fifteen experienced medical practitioners.

Monedero (2003) proposed a rule-based expert system based on rules called Datacab and developed at Enditel Endesa in collaboration with the Electronic Technology Department of the University of Seville, for the design of a HFC (Hybrid Fiber Coax) cable network. It uses input data from a GIS (Geographic Information System) and obtains a design for the network. Datacab is an expert system based on rules for automatic routing of a HFC telecommunication network. Datacab will be applied to various cable communications Networks with an average of more than 200.000 users each. Some of the advantages of the proposed expert system approach are the possibility of adding new rules and to modify present rules easily if the design criterion changes. Design rules can be stored in a database in order to improve accessibility; finally the developed system can be used to train new staff.

Obot and Uzoka (2011) proposed a Fuzzy rule-based framework for the management of tropical diseases. The objective of this research is to apply the concept of fuzzy logic technology to determine the degree of severity or degree of influence to the symptoms and diseases which already applied the knowledge technology to the management of tropical diseases. The fuzzy logic of the diagnosis of tropical diseases involves fuzzification, inference and defuzzification. Chiminah and Muttan (2005) proposed an ICD 10 Based Medical Expert System Using Fuzzy Temporal Logic. In this work, an ICD10 based Medical Expert System that provides advice, information and recommendation to the physician using fuzzy temporal logic was developed. The knowledge base used in this system consists of facts of symptoms and rules on diseases. It also provides fuzzy severity scale and weight factor for symptom and disease and can vary with respect to time. The system generates the possible disease conditions based on modified Euclidean metric using Elder's algorithm for effective clustering. The minimum similarity value is used as the decision parameter to identify a disease.

However, they proposed a medical expert system that separates rules into non-temporal and temporal components in which both components can be used by the inference engine to make predictions and decisions using fuzzy and temporal rules.(Wang, *et al.,* 2005). The major advantages of this proposed medical expert system in comparison with the existing medical expert systems are the provision of temporal data base for storing the past and present data, a knowledge Base for inference using fuzzy temporal rules, ICD coding and a user interface for knowledge acquisition and querying. The architecture of the proposed system consists of seven major components namely user interface, ICD coding module, Inference Engine, Temporal Information Manager, Temporal Fuzzy Decision Manager and Knowledge Base. The user interface accepts details regarding symptoms, vital signs, diseases and stores them in the knowledge base during knowledge acquisition (Klopper *et al.,* 2006)

Uzoka and Famuyiwa (2004) proposed a framework for the application of knowledge technology to the management of diseases. They said that the research seeks to develop a knowledge-based system for the diagnosis and treatment of tropical diseases. The proposed system can assist medical experts in the tedious and complicated task of diagnosing and providing treatment for tropical diseases. It also provides a scheme that will assist medical personnel, especially in rural areas where there is shortage of doctors, in the process of offering primary health care to people. The architecture of the proposed system has 3 subsystems; the knowledge base, inference engine and decision support filters. Twenty (20) tropical diseases were considered in this research work. About 30 specialist doctors were interviewed in Nigeria and questionnaires were also administered in order to obtain the unstructured knowledge. Forward chaining technique was adopted for the inference engine. The decision making process was made up of 3 components; users, information technology (computers) and decision support filters (emotional and cognitive). The major contribution of the system is that it enhances doctors' performance for quick and effective diagnosis and treatment of preventable tropical diseases (Cochran and Chen, 2005).

Gannot *et al.,* (1996) worked on combining uncertainty and imprecision in models of medical diagnosis; uncertainty and imprecision are important concepts of medical knowledge. A symptom is an uncertain indication of a disease as it may or may not occur with the disease. Thus, a measure of uncertainty should be used to estimate the disease risk when the symptom is observed. Linguistic statements, for instance 'high fever' or 'overweight', are in common use when describing symptoms. A measure of imprecision is advantageous for their representation. Uncertainty characterizes a relation between symptoms and diseases, while imprecision is associated with the symptom representation. Uncertainty and imprecision can be used to estimate the disease risk. Fuzzy sets are often applied to medical reasoning with intent to model both uncertainty of a diagnosis and imprecision of

symptoms. Diagnosis support systems operate on rules with fuzzy premises which represent imprecise symptoms.(Gannot *et al.,* 1996).

Razaz and King, (2003) worked on fuzzy reasoning in medical diagnosis. This is concerned with the phenomenon of vagueness in the physician's "style of thinking" and with the use of fuzzy sets, systems, and relations with a view to create a model of such reasoning when physicians make a diagnosis; symptoms and diseases are fuzzy in nature and fuzzy sets are feasible to represent these entity classes of medical knowledge. The use of this approach contributed to medical decision making and the development of computer-assisted diagnosis on medicine.

The table 2.1 below shows the summary of the related works done in the area of medical diagnosis systems with the methods used and limitations.

Table 2.1: A Review of Related Works (Summary)

AUTHOR	YEAR	METHOD	LIMITATION
Monedero Topic: A rule-based expert system based on rules called Datacab for the design of a HFC (Hybrid Fiber Coax) cable network	2003	Datacab is an expert system based on rules for automatic routing of a HFC telecommunication network. It uses input data from a GIS (Geographic Information System) and obtains a design for the network.	The expert system which as at the time had one hundred design problems in its knowledge base.
Uzoka and Famuyiwa Topic: A framework for the application of knowledge technology to the management of diseases	2004	The research seeks to develop a knowledge-based system for the diagnosis and treatment of tropical diseases. The proposed system can assist medical experts in the tedious and complicated task of diagnosing and providing treatment for tropical diseases.	It requires time and lots of manpower to develop. And just 20 tropical diseases are considered in this research work.

Naser and Ola Topic: An expert system for diagnosing eye diseases using CLIPS programming environment	2005	an expert system for diagnosing eye diseases using CLIPS programming environment (C Language Integrated Production System) which is designed to facilitate the development of software to model human knowledge or expertise for medical therapy. The proposed system will use the answers provided by the user to diagnose eye diseases based on the questions that the system asks the user.	The method makes use of IF-THEN in diagnosing which is time consuming.
Stoitsis Topic: Computer aided diagnosis based on medical image processing and artificial intelligence methods	2006	The objective of image pre-processing is to improve the quality of data through the application of methods for denoising (application of mean filters, median filters, Laplacian filters and Gaussian filters), enhancing the edges of image structures (unsharping, wavelet transform), and enhancing image contrast (histogram equalization).	They said one of the most common problems of pattern recognition in medical image analysis is the classification of a set of features into the proper class.
Pomi and Olivera Topic: A research on Context-sensitive autoassociative memories as expert systems in medical diagnosis	2006	The complexity of our contemporary medical practice has impelled the development of different decision-support aids based on artificial intelligence and neural networks and that distributed associative memories are neural network models that fit perfectly well to the vision of cognition emerging from current neurosciences.	It has not really been tested as a basic model was constructed to encourage further development.

Obot and Uzoka Topic: A framework for application of neuro-case-rule base hybridization in medical diagnosis	2008	A framework for application of neuro-case-rule base hybridization in medical diagnosis via Neural network technology using Neuro Solutions 5.0. They said that diagnostic decision support systems are designed to improve the diagnostic performance of physicians.	the problem of managing imprecise knowledge still exists.
Obot and Uzoka Topic: A Fuzzy rule-based framework for the management of tropical diseases	2008	The objective of this research is to apply the concept of fuzzy logic technology to determine the degree of severity or degree of influence to the symptoms and diseases which already applied the knowledge technology to the management of tropical diseases.	More techniques can be applied to increase the accuracy of diagnoses in this system.
Chiminahand Muttan Topic: proposed an ICD 10 Based Medical Expert System Using Fuzzy Temporal Logic	2009	An ICD10 based Medical Expert System that provides advice, information and recommendation to the physician using fuzzy temporal logic was developed. The knowledge base used in this system consists of facts of symptoms and rules on diseases. It also provides fuzzy severity scale and weight factor for symptom and disease and can vary with respect to time. The system generates the possible disease conditions based on modified Euclidean metric using Elder's algorithm for effective clustering.	The system finds only the elementary and routine diseases in all parts of the body. In future, the system can be divided into separate expert systems that focus on only one area of human body so that the accuracy of decision making can be aided with a single domain expert.

Gholami*et. al.,* Topic: Application of Neural Networks in Diagnosing Cancer Disease Using Demographic Data	2010	It has been used to analyse demographic data from lung cancer patients with a view to developing diagnostic algorithms that might improve triage practices in the emergency department. For the lung cancer diagnosis problem, the concise rules extracted from the network achieve an high accuracy rate of on the training data set and on the test data set	Patient data is very individual and it is difficult to generalize from one patient to another.

CONCLUSION

This paper shows the methodologies applied in medical diagnosis of tropical diseases and their limitations. However, a decision support system, which is capable of addressing vagueness and confusion associated with early diagnosis of tropical diseases, using Fuzzy-Analytic Hierarchy Process is now proposed for initial diagnosis.

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