A Web Based System for the Appraisal of Human Immuno-Deficiency Virus and Acquired Immune Deficiency Syndrome

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ABSTRACT

This paper presents a web based system that will provide general information on the Human Immuno-Deficiency Virus (HIV) and Acquired Immune Deficiency Syndrome (AIDS) to the general public of Nigeria. We aim to contribute to bridging the digital divide by developing an HIV and AIDS public information portal adequate for edification and evaluation of the disease. The system will be considered local to Nigeria, one of the leading countries hard hit by the HIV and AIDS pandemic where the government is working hard to facilitate the provision of education and raising awareness concerning the pandemic. Whilst current national trend is bridging the digital divide and concentrating on under-privileged people in rural settlements, this alternative is for those who have access to the Internet and hence can use the system wherever they are. The proposed system will act as a platform for self-learning and appraisal of the disease and is aiming at supporting the current government initiative of providing accurate information to the general public.

Keywords: Internet, Self-Learning, Digital Divide, Appraisal, HIV, AIDS,

1. INTRODUCTION

Although global commitment to control the HIV/AIDS pandemic has increased significantly in recent years, the virus continues to spread with alarming and increasing speed. Sub-Saharan Africa remains the region most affected by HIV/AIDS. Since HIV/AIDS was first diagnosed in Nigeria in 1986, the adult prevalence of HIV in the country rose progressively from 1.8% in 1991 to 5.8% in 2006 with an estimated 2.9 million people living with the disease [3]; this figure has risen to 3.2 million by the end of 2009 and as many as 220,000 died from HIV/AIDS that year alone [2]. Lack of instantaneous curative measures has diverted awareness toward preventive and long-term control methods. General intervention techniques employed in the prevention of HIV/AIDS include Information, Education, and Communication (IEC), School-based sex education, Voluntary Counseling and Testing (VCT) and Peer-based programs [5]. Available evidence indicates that the Internet has become the main source for delivering information on the prevention, control and treatment of HIV/AIDS [6].

The Internet, alongside an important service provided by it the World Wide Web, has become an essential resource in the search for current information and references in the practice of medicine. Furthermore, the World Wide Web (WWW), essentially a network of servers that use hypertext to establish a link and access files often with lavish graphics [7], provides a new erudition environment in addition to traditional resources such as books and journals.

The Internet has had tremendous radical impact on healthcare models and specifically on how healthcare is delivered [6]. It has transformed the relationships between healthcare administrations and companies, professionals and patients [1]. The public are using the Internet to gather information about diseases and drugs. In fact health-related sites, according to [10], are among the most frequently accessed information resources on the Web. The impact of this Internet revolution has affected all diseases that have shoddier prognostications, where prevention (information) and containment is vital, as in the case with the HIV/AIDS scourge.

2. RELATED WORKS

The fight against HIV/AIDS has been a three-decade battle during which the HI-Virus has seemingly mutated against all possible treatment methods thrown towards it; as such, no stable curative methods have been successful against the virus. Researchers worldwide have diverted attention to preventive approaches that help in reducing and containing the spread of the virus; among these approaches are the usage of information structures, Internet technologies [6] and artificial intelligence techniques [14] in creating platforms that will either provide useful education or help manage the disease through monitoring of affected individuals by efficient data collection, reporting, analysis and use [19] [14] [6].

3. HIV/AIDS PREVENTION TECHNIQUES

The IEC intervention technique described by [5] includes education on HIV/AIDS and condom use through
pamphlets, brochures, and other promotional materials in classroom or clinic settings or through the radio, television, or press.

The Nigerian public is becoming increasingly aware of how HIV is transmitted and how to avoid the infection, the government also provides public handouts which are distributed by the Federal Ministry of Health, through the National Primary Healthcare initiative, as well as the hosting of public events such as HIV/AIDS fairs and pageants to try to educate and sensitize the public about the disease. Such information, however, has to be broadcast to the greatest number of people possible and in every possible media [8] [9]. The best and more universal media used in the industrialized world is the Internet, and in the HIV/AIDS health care domain, there is a wealth of valuable material available to the interested public [6]. As identified by [6], the problem has always been the vastness of information and misinformation hosted on the numerous web pages accessible via the Internet.

Furthermore, many caregivers of people with AIDS are as concerned about their loved one’s illness and future health prospects as they are concerned with their own health and possible risks attached with caring for people with AIDS. Other practical concerns, such as worries about financial issues and time management, are thus limited because of the dominance of the aforementioned factor and attached myths. Learning more about AIDS is an essential first step for caregivers because of these widespread myths and fears about the disease. People are afraid of "catching" AIDS and, even today, a diagnosis of AIDS can feel like a death sentence. Generally, it can be difficult to learn about a disease when one does not know where to start, or when one has to wait for a particular event before such sensitization and edification. Of all available prevention interventions, providing information and education about HIV/AIDS were identified as perhaps the most difficult to assess for cost-effectiveness [3]. Numerous studies have shown that information alone is typically insufficient to change risk behavior. Accurate information, however, is indisputably the basis for informed policy discourse - a vital ingredient in the fight against fear-based stigma and discrimination.

As earlier identified, the main problem now is that the complexity and incurability of HIV/AIDS requires that in addition to government support in providing clinical support, there should be an emphasis placed on the dissemination of precise information about the disease, prevention methods, curative trends and psychological support. These sort of information should also be made available to the all levels of the Nigerian society as illustrated in Figure 1. In this age it is evident that one of the best ways to do this is through the utilization and provision of ICT technologies [14].

4. SYSTEM DESIGN
In the proposed model, the World Wide Web (WWW) serves as a mechanism for the interaction between the users and the system. Several processes involved in the model include collection of data, diagnosis, prediction and managing databases or systems administering. The architecture of the web based system which is presented in Figure 2 has the following components: Application tiers, Database, Database processing module and HIV diagnosis module.

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The system is a multiple-tiers application consisting of Client-Tier (CT), Web-Tier (WT) and enterprise information system (Database)-Tier, as shown in Figure 3. This design architecture enables great flexibility, modularity and independence of the client from the server application development. A tier can be anywhere on the network, local or remote, and can also be implemented using any programming language.

By employing relational database modeling technology [20] [21], the database model of system was developed. This model is composed of twelve files/relations. A relation is similar to what is customarily referred to as a file and it is generally perceived and represented by a set of structured tuples. Each tuple of a relation corresponds to a record in a file and attributes of a relation corresponds to fields within a record. Each variable is conceptualized as a relation where each attribute of a relation describes temporal characteristics, severity or value of psychological state.

In representing each relation, the attribute which stands for the primary key is usually underlined, if present. The general form of a relation is given by:

\[ R [a_1, a_2, \ldots, a_{k+1}, \ldots, a_{n-1}, a_n] \]

Where R represents the name of the relation, the set \( \{a_i\}, i=1,2,\ldots,n \), represents the attributes, properties and decision variables of R.
Fig 1: Organizational Structure illustrating the Health Care System of Nigeria and Flow of Information from the Federal level to State level and to the Local Government/Community level. (Source: Constructed based on information from [22] [23] [24] [25]).
Among the set of relations supported in the proposed web system are the following:


b. SYMPTOM [general-symptoms, symptom-number, symptom-name, nature-of-onset, duration, nature-of extent, location-of-effect, periodicity, course]


d. PATHIST [Patient-number, date-history-is-taken, time-history-is-taken, history-log, patient-age, patient-address, patient-occupation, sex]

e. HIVSTDIGN [Diagnostic-number, St-finding-log]

Specifically, all available information will be stored and organized into distinct database modules. This distribution depends on the nature of information and it takes place in a way that the modules co-operate as a whole, while on the other hand they preserve their independence. The link between the database modules should be made via some common fields in a way that the retrieval and manipulation time of data is reduced. Moreover, the remote access to the system should be made quite easy, as the user doesn't have to manipulate a great deal of futile information.

4.1 Database Processing Module

Initial decisions taken in this model project are
concerned with the tiers that the application uses. The chosen platform is designed for multi-tier applications, and offers a lot of flexibility in choosing the ways one distributes application functionality across the tiers. The design involves the production of technical and visual prototypes. This stage has some non-technical aspects such as gathering of web content. Researchers have pointed out that content gathering can be one of the biggest problems in web projects. This clearly is not the case with this survey application as there is very little content required.

For the server side programming and other technical aspects of the design, emphasis will be laid on such design concepts and principles as effective modularity (high cohesion and low coupling), information hiding and stepwise elaboration. The goal is to make the system easier to adapt, enhance, test and use.

The activities of the users on a database are described as transactions. A transaction may be classified as an update or query type. A database administrator (DBA) will be responsible for the initial creation of the database and modification (Update) of the database from time to time to reflect the current state exhibited in real life. The database is the visual image of real life of HIV/AIDS and diagnosis of the disease.

The database should, therefore, constantly exhibit the true position of current trends and real life possibilities in HIV/AIDS and the diagnosis of the disease, to maintain integrity and credibility.

In general, the frequency of update transactions on the database after initial creation is often very low but failure to carry out updates on the database, weekly, monthly, quarterly or yearly, as required can pose a serious threat to the integrity of the database.

Among typical query transactions that should be carried out on the files are the following:

a. Display general information about HIV/AIDS.
b. Display information about the signs of HIV/AIDS.
c. Display information about the symptoms of HIV/AIDS.
d. Display information about the preventive measures of HIV/AIDS.
e. Display information about the curative measures of HIV/AIDS.

The Figure 4 shows the architecture of a general multi-tier application modeled into our web based system and illustrates the flow of data through the system.
f. Display information about the causes of HIV/AIDS.

The transactions on the database should support declarative processing. In declarative processing, the programmer knows what he wants the computer to do but does not care about how the computer produces such information. In practice, the database user issues a high command which serves as an identity to a program which shall be called into action. This called program plays the role of an interface which carries the granular or detail codes of how to produce the output report of the command issued by the database user. Consider for example the relational calculus of the form:

\[
\text{If } \text{patconsultation (medical pract)} = \text{hivdydiagn (patient-number)} \text{ then } \\
\text{Display (patconsultation and the hivdydiagn)}
\]

This query can be described as a command with name “patconsultation and hivdydiagn” which an end user can issue on the HIV diagnosis database. The command “patconsultation and hivdydiagn” shall evoke the above stated relational calculus. In turn, the relational calculus shall call another set of programs which shall be responsible for the following:

a. Search for the records of ‘patient consultation’

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**Figure 4: Flow of Data through the System**
For caregivers, patients, friends and families who depend on the Internet. HIV/AIDS healthcare domain through the use of the system testing show that the system has been developed successfully and found to be a good system to support the delivery of edification on issues in the disease. The system is projected to offer many benefits, but there are functionalities to be included in the system for self-learning and appraisal of the HIV/AIDS that would make uncontrolled access detrimental to the security of the system. Functionalities to be developed in the system means we will be dealing with clinical data, which are very sensitive; the security issue was put into consideration in the development of the system.

5. DISCUSSION

There are not many issues to be taken into account in the development of any web-based information system; but there are functionalities to be included in the system for self-learning and appraisal of the HIV/AIDS that would make uncontrolled access detrimental to the security of the system. Functionalities to be developed in the system means we will be dealing with clinical data, which are very sensitive; the security issue was put into consideration in the development of the system.

5.1 Recommendation

Although most of the system functionalities have been evaluated with very good results, more functionality has been suggested, after the evaluation of the system, that could be added and we are working in that direction. The following suggestions are:

a. to improve the graphical representation and the system user interface;

b. to provide diagnostic assistance to patients albeit online;

c. saving to disk all data gotten from diagnostic assistance, in order to take it to health professionals, without Internet access.

5.2 Benefits

The system is projected to offer many benefits, depending on the user, related to edification on issues in the HIV/AIDS healthcare domain through the use of the Internet.

For caregivers, patients, friends and families who are confused due to myths and fictional accounts from misinformation, they can take advantage of the educational contents of the system and have precise information delivered concerning those mythologies about the disease. Health care providers and students can use the web based system to enrich their knowledge on the HIV/AIDS disease.

6. CONCLUSION

A model web based system for the appraisal of HIV/AIDS in Nigeria has been developed. The results from system testing show that the system has been developed successfully and found to be a good system to support the public with timely information on HIV and AIDS. However, we cannot rule out the possibility of some additional modules being integrated into the system. The diagnosis module earlier mentioned is an incomplete model and is undergoing development; as a result, there is a need to simulate other variations of medical systems’ development. We therefore recognize the potential research areas which include Fuzzy Logic and Neuro-Fuzzy systems. The system is designed to be exhaustive and thus the knowledge database is going to expand phenomenally over time as various other sources of HIV information are used.

REFERENCES


