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MATERNAL CARE AND MORTALITY CONTROL IN NIGERIA USING KNOWLEDGE DISCOVERY IN DATABASE (KDD)

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ABSTRACT Maternal mortality monitoring model using knowledge discovery in databases (KDD)is an important indicator of a nation's health care delivery system and the level of the society's development. Previous efforts to meet the Millennium Development Goals (MDGs) on the reduction of maternal mortality in Nigeria have shown only marginal reductions in the last five years, making the MDGs targets by 2020 clearly unachievable using current strategies alone (Mid-Point Assessment Overview, MDGs Nigeria, 2008), hence this study; The methodology adopted for this study is Object-oriented analysis and design methodology that starts with understanding the domain, locating proper data sources, preparing the raw data, applying advanced analysis techniques, and extracting and validating the resulting knowledge from a quality registry for maternal mortality. The results will be to develop an integrated IT solution that is suitable for Nigeria, focused on the maternity care conditions and control the rate of maternal mortality in Nigeria using knowledge discovery in database (KDD).
Keywords**:** knowledge discovery in database (KDD; Maternal, Mortality, Model

INTRODUCTION

Nigeria has a population of 140 million people with women of child bearing age constituting about 31 million and children less than five years of age constituting 28 million (National Bureau of statistics, 2010). Women of child bearing age and children under five years of age therefore constitute a significant percentage of the nation's population. Nigeria, which constitutes just 1% of the world population, accounts for 10% of the world's maternal and under-five mortality rates. Nigeria ranks second in the world, after India, in the scale of maternal mortality with the rate of 800 deaths per 100000 live births (Pitterson, 2010). Annually, an estimated 52,900 Nigerian women die from pregnancy related complications out of a total of 529,000 global maternal deaths. A woman's chance of dying from pregnancy and childbirth in Nigeria is 1 in 13, compared with 1 in 35 in Ghana and 1 in 2800 in developed countries, and only about 40% of deliveries are attended to by skilled birth attendants. According to the World Health Organization (WHO)/United Nations Children Fund (UNICEF), in 1995, Nigeria had the third highest number of maternal deaths in the world (approximately 45000 deaths). By the year 2000, for every 100,000 live births, about 800 women died in the process of child birth. Out of the 27 million Nigerian women of reproductive age back then about 2 million did not survive either pregnancy or childbirth. In 2008, according to UN report, the figure stood at between 1000 and 1500 deaths per 100,000 live births. The State of the World Children Report 2009 stated that 1 out of 9 global maternal deaths occurred in Nigeria.

Till date, Nigeria is second on maternal mortality rate in the world with about 144 girls and women dying every day from complication of pregnancy and child birth. 1 in every 18 women die giving birth compared to 1 in 4800 in the US (Pitterson, 2010; Daily Independent, 2010). According to the survey conducted in February 2010, the record stands at between 165 per 100,000 live births in the South West and 1549 per 100,000 live births in the North East (Onumere, 2010).

Government can improve the health facilities to reduce maternal mortality if a control system is put in place to report mortality rate in the country. The neglect which results to a higher mortality rate may be attributed to the lack of information on the rate of death experienced in the country during child birth. More specifically rural areas are the ones lacking the high quality services needed to reduce maternal mortality in the whole region. According to a study, health services and human health resources (such as equipped hospitals and well trained personnel) are more

valuable for rural communities (Jennett, Yeo, Scott, Hebert &Teo, 2015). Thus the delivery of these services remotely using accessible technology could help to level up the unequal access to health services. Electronic health records, risk assessment systems, and remote control are just some examples of how technology can be applied in the healthcare field.

The number and the size of databases recording medical data are increasing rapidly. Medical data, produced from measurements, examinations, prescriptions, etc., are stored in different databases on a continuous basis.
This enormous amount of data exceeds the ability of traditional methods to analyze and search for interesting patterns and information that is hidden in them. Therefore new techniques and tools for discovering useful information in these data depositories are becoming more demanding.

Universally childbirth is an event that attracts celebration, but this is not so for many women who experience childbirth as suffering and tragedy that may end in death. The state of maternal health is an important indicator of a nation's health care delivery system and the level of the society's development. Previous efforts to meet the Millennium Development Goals(MDGs) on the reduction of maternal mortality in Nigeria have shown only marginal reductions in the last five years, making the MDGs targets by 2020 clearly unachievable using current strategies alone (Mid-Point Assessment Overview, MDGs Nigeria, 2008).

Knowledge Discovery in a Database
Knowledge Discovery in Databases (KDD) is an umbrella name for all those methods that aim to discover relationships and regularity among the observed data (Fayyad, 2006). KDD includes various stages, from the identification of initial business aims to the application decision rules.

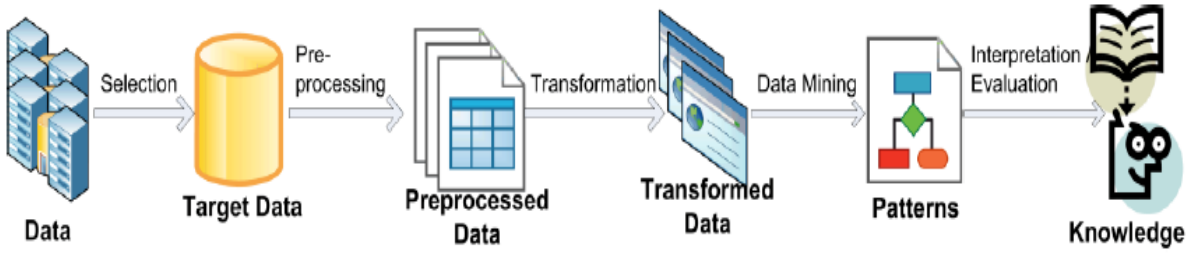

Fig. 2.1: Summarized KDD process steps (Fayyad et al., 2006)

Fayyad's process model shown in Fig. 2.1 includes nine steps:

1. Understanding the application domain: it involves pertinent prior knowledge and the objectives of the application.

2. Constructing a target dataset: consists of choosing a dataset or focusing on a subset of variables or samples of data on which the discovery is to be carried out.

3. Data clean-up and pre-processing: consists of basic operations, such as eliminating noise or outliers if necessary, gathering the necessary information to model or account for noise, coming to a decision on strategies for treating missing data fields, and accounting for time sequence information and changes known, as well as making a decision on DBMS issues, such as schema, data types and mapping of unknown and missing values.

4. Data trimming and projection: consists of finding practical features to represent the data, depending on the objective of the task, and using transformation methods or dimensionality reduction to decrease the effective number of variables that are being considered, or to get invariant representations for the data.

5. Selecting the function of data mining: involves choosing the purpose of the model derived by the algorithm of data mining (e.g., classification, summarization, clustering and regression).

6. Selecting the DM algorithm: involves choosing the method to be used for searching for patterns in the data, such as choosing which parameters and models may be appropriate, (e.g., the categorical data models are different from models on vectors over reals) and matching a certain DM method with the general criteria of the KDD process (e.g., the user might be more interested in understanding the model than in its predictive capabilities).

7. Data mining: involves looking for patterns of interest in a certain representational form or a set of similar representations, including regression, classification rules or trees, clustering, dependency, sequence modeling, and line analysis.

8. Interpretation: involves interpreting the found patterns and possibly returning to any of the prior steps, as well as the possible visualization of the patterns extracted, removing the irrelevant or unnecessary patterns, and translating the useful ones into terms comprehensible by users.

9. Utilizing discovered knowledge: involves incorporating this knowledge into the system's performance, taking actions based on the knowledge, or merely documenting it and reporting it to the interested parties, as well as inspecting and resolving potential conflicts with previously supposed (or extracted) knowledge.

It is, therefore, the name for all the stages of finding and discovering knowledge from data, with data-mining being one of the stages as shown in Table 2.1. According to Giudici (2003), "data mining is the process of selection, exploration, and modeling of large quantities of data to discover regularities or relations that are at first unknown with the aim of obtaining clear and useful results for the owner of the database."

Predictive data mining (PDM) works the same way as does a human handling data analysis for a small data set; however, PDM can be used for a large data set without the constraints that a human analyst has. PDM "learns" from past experience and applies this knowledge to present or future situations. Predictive data-mining tools are designed to help us understand what the "gold," or useful information looks like and what has happened during past "gold-mining" procedures. Therefore, the tools can use the description of the "gold" to find similar examples of hidden information in the database and use the information learned from the past to develop a predictive model of what will happen in the future.

Health Informatics

Health care is a very research intensive field and the largest consumer of public funds in developed countries. With the emergence of computers and new algorithms, health care has seen an increase of computer tools and could no longer ignore these emerging tools. This resulted in the uniting of healthcare and computing to form health informatics. This is expected to create more efficiency and effectiveness in the health care system, while at the same time, improve the quality of health care and lower cost.

Health informatics is an emerging field. It is especially important as it deals with collection, organization, storage of health related data. With the growing number of patient and health care requirements, having an automated system will be better in organizing, retrieving and classifying of medical data. Physicians can input the patient data through electronic health forms and can run a decision support system on the data input to have an opinion about the patient's health and the care required. An example of the advances in health informatics can be the diagnosis of a patient's health by a doctor practicing in another part of the world. Thus, healthcare organizations can share information regarding a patient which will cut costs for communication and at the same time be more efficient in providing care to the patient (George, 2014).

There are other issues like data security and privacy, which is equally important when considering health related data. Thus, health informatics deals with "biomedical information, data, and knowledge with their storage, retrieval, and optimal use for solving problem and decision making process" (George, 2014). This is a highly interdisciplinary subject where fields in medicine, engineering, statistics, computer science and many more come together to form a single field. With the help of smart algorithms and machine intelligence we can provide the quality of healthcare by having, problem solving and decision-making systems. Information systems can help in supporting clinical care in addition to helping administrative tasks. Thus, the physicians will have more time to spend with the patients rather than filling up manual forms (George, 2014).

The applications of information and communications technologies in medicine are commonly referred to as telemedicine and medical informatics. Although these terms are often used together and confused with each other, they are separate and have their own definitions. The Institute of Medicine defines telemedicine as the use of electronic information and communications technology to provide health care when distance separates the participants. It includes all forms of electronic communication between patients and providers and among providers, starting from telephone to interactive video and web-based communication. Medical informatics is defined by The National Library of Medicine as the field of information science concerned with the analysis and dissemination of medical data through the application of computers to various aspects of health care and medicine.Medical informatics can also be referred to as the intersection of information science, computer science and health care. For example, medical informatics includes health care delivery processes

that are supported by computers that help in analysing electronic data. (Christensen &Remler, 2007). Christensen&Remler(2007) have roughly categorized the different possible applications of ICT in chronic disease care in four group: technologies that support -

1) patient self-care and education,
2) communication between patients and providers or between providers,
3) electronic data storage and data sharing across providers, and
4) The technologies that combine all these three applications.

Successful management of chronic disease care is facilitated considerably by active involvement of the patient in his or her own treatment procedure. There is also increasing willingness from the patient side to be integrated in their own health care process, and health consumers are actively searching information independently (Detmer et al., 2013). The involvement is usually realized by patient education and information about his or her disease and information and communications technology can provide effective methods for patient participation.
This category includes medical devices for self-monitoring as well as interactive websites for education on the diseases. Moving towards more self-care and patient and health consumer inclusion is largely associated with new ICT technologies and has been noted by other commentators as well (Christensen,&Remler, 2007).

The ICT applications in electronic data storage and data sharing across providers - have probably received the most attention. It has been stated that shifting from paper based storing to electronic health records (HER), or electronic medical records (EMR) is associated with remarkable cost-savings (Hillestad et al., 2015) and faster access to information, which results in improved efficiency. Also unnecessary tests can be avoided, when information can be easily found from the data base by different users. Electronic process also enables storing bigger quantities of medical data (Haux, 2016). This is essential as the amount and complexity of health-related information and knowledge constantly increases and has already made information processing a major component of any health organization. Health ICT facilitates moving from decentralized and institution-based storage towards more global data storing (Haux, 2016). Having national health records can improve health care processes as different providers can access the same information fast and for example the duplication of tests could be prevented. In the European Union the long term goal is to have a system where all the clinicians in Europe can access health records from all countries (Andersen,Frogner, John & Reinhardt, 2006). This would improve conditions for treatment as the patient as well as the health care professional mobility is expected to increase. Without electronic records and communication technologies having wide databases would practically be impossible.

For instance, software that integrates and analyzes provider and self-monitored patient data combined with communication technology makes it possible to do certain monitoring tests at home and send the data to health care professionals to be analyzed. When there is need for intervention, it can be done inexpensively and without delay. These kind of technical solutions have already been used in continuous remote clinical monitoring and have brought significant benefits to both patients and payers. For instance in care of hypertension patients, remote monitoring has helped to drop the blood pressure of the test groups and reduce the costs of the care (Christensen &Remler, 2007). There is also a steady increase of new technologies such as ubiquitous computing environments and sensor-based technology for health monitoring from distance (Haux, 2016).

The Electronic Medical Record comprises health-related information that is created by health care providers on behalf of a patient, such as diagnostic tests or prescriptions for medications. The main objective of an EMR is to improve the ability of a care provider to document observations and findings and to provide more information on treatment of persons in his or her care. EMR can also provide the underlying patient information for functions such as drug-drug interactions, recommended care practices or interpretation of data to support and improve clinical decisions (The National Alliance for Health Information Alliance Technology, 2008). However, these functions are limited by the extent of the information available in a provider-focused EMR within a single health care organization, hence the need to document how EMR is utilized and supports medical services in centers that use EMR system. The EMR is expected to replace paper-based medical records as the primary source of medical history for each person seeking health care, while still complying with all clinical, legal and administrative requirements in developed countries (Janusz, 2013).

To date, the digitization of health care typically has focused simply and solely on electronic records for patients. Most EMR systems are relational databases with a finite number of intra-enterprise applications and are limited to in-house use by health care facilities. Very few of these systems have realized fully functional, scalable, distribution capabilities, not to mention interoperability with external systems. This short-sighted tendency to build large-scale but

restrictive automated systems that ignore the interactive nature of health care has resulted in limited operational success and acceptance (Wullianallur, 2009). Electronic records have the potential to improve the quality of health care delivery and reduce costs (Hillestad et al., 2015). Accurate and up-to-date health information is critical. When an individual seeks health care, in order to provide effective and timely treatment, the provider needs to have information about the patient, including known allergies, chronic conditions, current medications and other pertinent health care data. However, such information is not always readily available. It may sometimes be available but incomplete or inaccurate, depending on whether the patient's records have been updated or not.Though there have been challenges and failures in the implementation of EMR, their potential benefits are numerous. Some of the benefits are: complete and accurate information; universal and timely access to a patient's lifetime health information; knowledgeable sources to direct a patient to the appropriate care and substantially fewer medical errors. The EMR may exist in a distributed database, accessible from anywhere through a networked environment or a mobile smart card that a patient carries with him/her. If appropriate security measures are adopted, computerization also provides greater protection of confidential information via sophisticated keys and access controls. Additionally, the EMR system helps improve the quality of patient visit documentation and data, free up facility storage space, improve efficiency by eliminating time spent hunting down lost charts and provide immediate, simultaneous access to patient records (Janusz & Grzegorz, 2013).

CONCLUSION

The maternal mortality rate monitoring using KDD as developed in this paper is a work in progress that is expected to make a positive impact once it is implemented in any of the hospitals in Nigeria. Research demonstrates that the maternal mortality rate monitoring is a viable solution to the maternal-infant mortality problem that is currently present among the rural community areas in various states of Nigeria.

Also the use of electronic healthcare services makes possible to reduce attention issues associated with the main causes of death (hypertension, haemorrhages, and other complications of delivery) that are much higher in maternity-infant care. The mortality rate control system is a two-part system developed both for antenatal record assessment from any hospital terminal and maternal mortality rate monitoring reports.

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