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Health Care Management using Data Mining Techniques for Effective Health care Delivery in Nigeria.

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ABSTRACT

Healthcare innovation continues to be a driving force in the quest to balance cost containment and health care quality. The Federal government of Nigeria launched its primary health care plan in 1987 to ensure efficient health care delivery but this health care plan made little impact on the health sector as it continued to suffer major infrastructural and poor public health management. This paper studies health care management using data mining techniques. The paper analyses various data mining techniques and used one of the techniques, Association rule technique to enable Administrators, Health care providers and the masses to uncover hidden data in large data sets on the health care management system. The methodologies adopted in this research are the Cross -industry standard process for data mining (CRISP-DM) and Structured Systems Analysis and Design Methodology (SSADM). This work was able to improve quality of healthcare and information communication technology, lower costs of delivering health care, help policy makers in enacting rules and policies and enhance the services of the healthcare providers.

Keywords: Health care management, Information communication Technology, Data mining, Techniques.



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1. INTRODUCTION

Health administration or healthcare administration is the field relating to leadership, management, and administration of hospitals, hospital networks, and health care systems (Prasanna et al., 2011). Health care (or healthcare) is the diagnosis, treatment, and prevention of disease, illness, injury, and other physical and mental impairments in human beings. Health care is delivered by practitioners in allied health, dentistry, midwifery (obstetrics), medicine, nursing, optometry, pharmacy, psychology and other health professions. It refers to the work done in providing primary care, secondary care, and tertiary care, as well as in public health. (Health topics, 2013).

The Federal government has made effort to revitalize the worsening state of health by the establishment of the Nigerian Health Insurance Scheme (NHIS) in 2005 by Decree 35 of 1999 provided for the establishment of a governing council with the responsibility of managing the scheme. (NHIS Decree No 35 of 1999). The objectives of the scheme were to: Ensure that every Nigerian has access to good health care services, Protect Nigerians from the financial burden of medical bills, Limit the rise in the cost of health care services, Ensure efficiency in health care services, Ensure equitable distribution of health care costs among different income groups; equitable patronage of all levels of health care, Maintain high standard of health care delivery services within the scheme, Improve and harness private sector participation in the provision of health care services, Ensure adequate distribution of health facilities within the Federation, Ensure the availability of funds to the health sector for improved services (Senate, Federal Republic of Nigeria National health bill, 2008) but despite this effort, there is still poor health care in Nigeria.

This paper aims at introducing data mining techniques in order to ascertain the health problems of many people in the society and how to profer solutions to them.

2. LITERATURE REVIEW

Data mining can be defined as the process of finding previously unknown patterns and trends in databases and using that information to build predictive models (Kincade, 1998). Alternatively, it can be defined as the process of data selection and exploration and building models using vast data stores to uncover previously unknown patterns (Milley, 2000). Data mining aims at discovering novel, interesting and useful knowledge from databases. Conventionally, the data is analyzed manually. Many hidden and potentially useful relationships may not be recognized by the analyst. Nowadays, many organizations including modern hospitals are capable of generating and collecting a huge amount of data. This explosive growth of data requires an automated way to extract useful knowledge. Thus, medical domain is a major area for applying data mining. Through data mining, we can extract interesting knowledge and regularities (Jing-song Li et al., 2011). Johnson (2001) has suggested that, at a higher level, data mining can facilitate comparisons across healthcare groups of things such as practice patterns, resource utilization, length of stay, and costs of different hospitals. Recently, Sierra Health Services has used data mining extensively to identify areas for quality improvements, including treatment guidelines, disease management groups, and cost management (Schuerenberg, 2003). Data mining can be used to analyze massive volume of data and statistics to search for patterns that might indicate an attack by bio-terrorists (Piazza, 2002).

Health care now collects data in gigabytes per hour volume. Data mining can help with data reduction, exploration, and hypothesis formulation to find new patterns and information in data that surpass human information processing limitations. There is a proliferation of reports and articles that apply data mining and knowledge discovery in database (KDD) to a wide variety of health care problems and clinical domains and includes diverse projects related to cardiology, cancer, diabetes, finding medication errors, and many others. Over the past two decades, it is clear that we have been able to develop systems that collect massive amounts of data in health care, but now what do we do with it? Data mining methods use powerful computer software tools and large clinical databases, sometimes in the form of data repositories and data warehouses, to detect patterns in data. Within data mining methodologies, one may select from an extensive array of techniques that include, among many others, classification, clustering, and association rules.

2.1 Classification

Classification maps data into predefined groups or classes. It is often referred to as supervised learning because the classes are determined before examining the data. Classification algorithms require that the classes be defined based on data attribute values. They often describe these classes by looking at the characteristics of data already known to belong to the classes. Pattern recognition is a type of classification where an input pattern is classified into one of several classes based on its similarity to these predefined

classes. One of the applications of classification in health care is the automatic categorization of medical images. Categorization of medical images means selecting the appropriate class for a given image out of a set of pre-defined categories.

2.2 Clustering

Clustering is similar to classification except that the groups are not predefined, but rather defined by the data alone. Clustering is alternatively referred to as unsupervised learning or segmentation. It can be thought of as partitioning or segmenting the data into groups that might or might not be disjointed. The clustering is usually accomplished by determining the similarity among the data on predefined attributes. The most similar data are grouped into clusters. Cluster analysis is a clustering method for gathering observation points into clusters or groups to make (1) each observation point in the group similar, that is, cluster elements are of the same nature or close to certain characteristics; (2) observation points in clusters differ; that is, clusters are different from one another. Cluster analysis can be divided into hierarchical clustering and partitioning clustering.

2.3 Association rules

Link analysis, alternatively referred to as affinity analysis or association, refers to the data mining task of uncovering relationships among data. The best example of this type of application is to determine association rules. An association rule is a model that identifies specific types of data associations. These associations are often used in the retail sales community to identify items that are frequently purchased together. Associations are also used in many other applications such as predicting the failure of telecommunication switches. Users of association rules must be cautioned that these are not causal relationships. They do not represent any relationship inherent in the actual data (as is true with functional dependencies) or in the real world (Jing-song Li et al. 2011).

2.4 Importance of Data Mining in Health care

According to the modeling Agency (2015), when healthcare officials use data mining programs to identify and observe high risk patients and chronic diseases and design the right interventions needed, the patients receive more affordable and better healthcare services. These programs also reduce the number of claims and hospital admissions, further streamlining the process.

Healthcare providers use data mining and data analysis to find best practices and the most effective treatments. These tools compare symptoms, causes, treatments and negative effects and then proceed to analyze which action will prove most effective for a group of patients

Insurers are now able to better detect medical insurance abuse and fraud because of data mining. Unusual claims patterns are easier to spot with this tool and it can identify inappropriate referrals and fraudulent medical and insurance claims.

Healthcare facilities and groups use data mining tools to reach better patient related decisions. Patient satisfaction is improved because data mining provide information that will help staff with patient interactions by recognizing usage patterns, current and future needs and patient preferences. (Modelling Agency, 2015)

To aid healthcare management, data mining applications can be developed to better identify and track chronic disease states and high-risk patients, design appropriate interventions, and reduce the number of hospital admissions and claims (Kincade, 1998).

3. RESEARCH PROBLEM

It is found out that healthcare industry today generates large amounts of complex data about patients, hospitals resources, disease diagnosis, electronic patient records, medical devices, etc, it has therefore become necessary to find a way of storing and retrieving this information for future use.

4. SIGNIFICANCE OF THE RESEARCH

The system developed will use data mining to uncover hidden information and trends in the database and evaluate the effectiveness of medical treatments. This will be done by comparing and contrasting causes, symptoms, and courses of treatments, data mining can also deliver an analysis of which courses of action prove effective. The use of Data mining techniques will help in easier and faster retrieval of information about patients thereby helping in cost-savings, life-savings and decision making in any healthcare system.

5. METHODOLOGY

The methodologies adopted in this research include the Cross -industry standard process for data mining (CRISP-DM) and Structured Systems Analysis and Design Methodology (SSADM). CRISP-DM has different phases which include Business or Project understanding, Data understanding, Data preparation, Modeling, Evaluation and Deployment. In this research Crisp -DM was used to analyze the hospital's needs, requirements, goals, and strategies. Hospitals, for example, may need to extract information from their data warehouses either on a one-time basis or on a recurrent one, then the data collected will be evaluated to know whether it is of value before deploying it for use. Structured Systems Analysis and Design Methodology (SSADM) is a system approach to the analysis and design of information systems.

This approach is mainly designed for large scale information systems with high volume of business activities. SSADM starts from defining the information system strategy and then develops a feasibility study module. These are followed by requirements analysis, requirements specification, logical system specification and a final physical system design. In this research SSADM was used to collect information to analyse the problem, proffer solution to the problem and documentation of work.

6. RESULTS

The figures below show the medical history of the patients which includes the Patient's name, address, ID number, diagnosis, vital signs and treatments given to them. The information from here can be used to know the most effective treatment that can be used to treat patients.

First Name	Surname	Address	ID	Diagnosis	Vital Sign	Treatment
Norbert	Okwara	1 Kenyetta St Uwani Enugu	40534	View	View	View
Ngozi	Okoli	Owerri	47800	View	View	View
Chima	Okoye	Ihiala	52215	View	View	View
Chima	Okoye	Ihiala	52450	View	View	View
Okolo	Chijioke	Onitsha	74740	View	View	View
Mary	Onyia	1 Ogui Rd	93314	View	View	View

Figure 1: Patient's Medical History

First Name	Surname	Address	ID	Phone	View	Delete
Norbert	Okwara	1 Kenyetta St Uwani Enugu	40534	08034046347	Yes	Yes
Ngozi	Okoli	Owerri	47800	08145672891	Yes	Yes
Chima	Okoye	Ihiala	52215	08034567812	Yes	Yes
Chima	Okoye	Ihiala	52450	08034567812	Yes	Yes
Okolo	Chijioke	Onitsha	74740	08034567890	Yes	Yes
Mary	Onyia	1 Ogui Rd	93314	0806573356233	Yes	Yes

Welcome chidimma

Figure 2: This shows Patient's registered report

Using Integrated Database and Data Mining Techniques

HOME PATIENT'S REGISTRATION HOSPITAL REGISTRATION SETUP PASSWORD VIEW PATIENTS VIEW HOSPITAL LOG OUT

Patient's Record Details

First Name Okolo
Middle Name Vincent
Surname Chijioke
Designation Admin Assistant
Occupation Civil Servant
State of Posting Anambra
DOB 1975-12-04
Sex Male
Marital Status Married
Age 40
Blood Group AB
National ID No 14:23 PM
Telephone No 08034567890
Residential Address Onitsha
Grade Level 8
Step 4
Employer Ibeto
Healthcare Provider Life Specialist Hospital
Genotype AA
Medical History (Alergy) None

One Spouse and Four Biological Children

	First Name	Sex	Blood Group	DOB
Spouse	Ifeoma	Female	AB	1982-03-04
Child 1	Chik	Female	AB	2010-04-05
Child 2		Male	AB	0000-00-00
Child 3		Male	AB	0000-00-00
Child 4		Male	AB	0000-00-00

Figure 3: shows the patients' record details

7. DISCUSSION

In this paper, the association rule technique was used to enable Administrators, Health care providers and the masses to uncover hidden data in large data sets. For example you can associate diabetes, the state where it is most prevalent and what caused it to be prevalent in that area. The findings can help to advise the people on the diet to take to curtail the spread of the disease. Another example is associating cholera and the areas that have the disease, the findings can help the policy makers to provide facilities like pipe borne water to the area to be able to checkmate the spread of the disease. Association rule can also be used to associate the disease, malaria and the treatment that is most effective for patients; this will help to enhance the services of the healthcare providers.

Below is MySQL command that can be used to query the database using association rule data mining technique to extract information about the most prevalent disease and the state it is most prevalent.

```
SELECT      Disease, State
FROM        Diseases, States
WHERE       Disease = (Select Prevalent (Disease) from Diseases)
           State = (Select Prevalent (State) from States)
```

8. CONCLUSION

In conclusion, applying data mining techniques in healthcare can have tremendous potential and usefulness. However, the success of healthcare data mining hinges on the availability of clean healthcare data. In this respect, it is critical that the healthcare industry consider how data can be better captured, stored, prepared, and mined. It is this situation that led to the development of this paper Healthcare Management Model using data mining techniques for use in Nigerian Hospitals to enable them handle details on patient's medical history and treatment efficiently and effectively.

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