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Healthcare Measurement Analysis Using Data mining Techniques

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Abstract:
Data mining as one of many constituents of health care has been used intensively and extensively in many organizations around the globe as an efficient technique of finding correlations or patterns among dozens of fields in large relational databases to results into more useful health information. In healthcare, data mining is becoming increasingly popular and essential. Data mining applications can greatly benefits all parties involved in health care industry. The large amount problem generated by healthcare transactions are too complex and voluminous to be processed and analyzed by traditional methods The paper provides a brief review of the existing performance measurement frameworks. On the basis of review, performance measurement system criteria are identified and accordingly a framework has been proposed for measuring performance in healthcare processes. Data mining provides the methodology and technology to transform huge amount of data into useful information for decision making. This paper explores data mining applications in healthcare in it discusses data mining and its applications in major areas such as evaluation of treatment effectiveness, management of healthcare itself and lowering medical costs

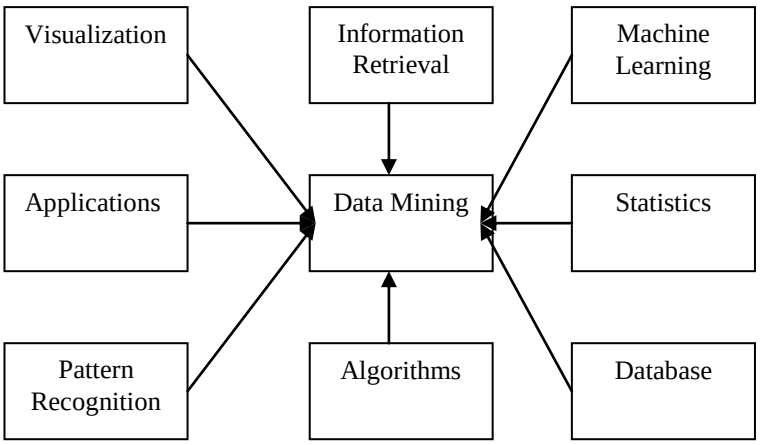
Keyword: ***Data mining, Healthcare application, Knowledge discovery, Data warehousing.***

I. INTRODUCTION

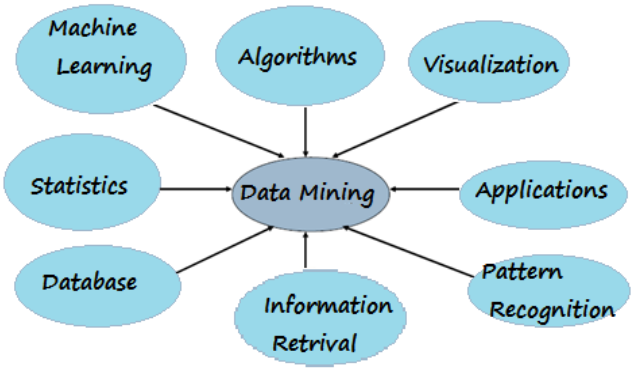
Data mining can be defined as the process of finding previously unknown patterns and trends in databases and using that information to build predictive models. Alternatively, it can be defined as the process of data selection and exploration and building models using massive data stores to uncover previously unknown patterns. Data mining is an analytic process designed to explore large amounts of data in search of consistent patterns and/or systematic relationships between variables, and then to validate the findings by applying the detected patterns to new subsets of data. Data mining is not new idea, it has been used intensively and extensively by financial institutions for activities such as credit scoring and fraud detection; marketers for direct marketing and cross-selling; retailers for market segmentation and store layout; manufacturers for quality control and maintenance scheduling and it

has been used in hospital care as well. Data mining has been becoming increasingly popular, it has been noted that several factors have motivated the use of data mining applications. The existence of medical insurance fraud and abuse, for example has led many healthcare insurers to attempt to reduce their losses by using data mining tools, the application has helped to help them find and track offenders. However fraud detection using data mining applications is prevailing in the commercial world for detection of fraudulent credit card transactions and fraudulent banking activities. Huge amounts of data generated by healthcare transactions are too complex and voluminous to be processed and analyzed by traditional methods hence calls for technological interventions so as to simplify management of those data. Data mining can improve decision making by discovering patterns and trends in large amounts of complex data. Such analysis has become increasingly essential as financial pressures have amplified the need for healthcare organizations to make decisions based on the analysis of clinical and financial data. Insights gained from data mining can influence cost, revenue and operating efficiency while maintaining a high level of care. Healthcare organizations that perform data mining are better positioned to meet their long term needs; data can be a great asset to healthcare organizations, but they have to be first transformed into information Yet another factor motivating the use of data mining applications in healthcare is the realization that data mining can generate information that is very useful to all parties involved in the healthcare industry. For example, data mining applications can help healthcare insurers detect fraud and abuse, and healthcare providers can gain assistance in making decisions. Data mining applications also can benefit healthcare providers such as hospitals, clinics, physicians, and patients by identifying effective treatments and best practices 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. Alternatively, it can be defined as the process of data selection and exploration and building models using massive data stores to uncover previously unknown patterns. Data mining is an analytic process designed to explore large amounts of data in search of consistent patterns and/or systematic relationships between variables, and then to validate the findings by applying the detected patterns to new subsets of data. Data mining is an automated approach for discovering or inferring hidden patterns or knowledge buried in data. ‘Hidden’ means patterns that are not made apparent through casual observation. Data Mining is an interdisciplinary field that combines artificial intelligence, computer science, machine learning, database management, data visualization, mathematic algorithms, and statistics. Data Mining is a technology for knowledge discovery in databases (KDD). This technology provides different methodologies for decision making, problem solving, analysis, planning, diagnosis, detection, integration, prevention, learning and innovation. Data mining is a variety of techniques such as neural networks, decision trees or standard statistical techniques to identify nuggets of information or decision making knowledge in

bodies of data, and extracting these in such a way that they can be put to use in areas such as decision support, prediction, forecasting, and estimation. Survey of data mining Nowadays there is huge amount of data stored in real-world databases and this amount continues to grow fast as it creates both an opportunity and a need for semi-automatic methods that discover the hidden knowledge in such database. If such knowledge discovery activity is successful, discovered knowledge can be used to improve the decision making process of an organization. For instance data about a hospital's patient might contain interesting knowledge about which kind of patient is more likely to develop a given disease. This knowledge can lead to better diagnosis and treatment for future patients. Data mining and knowledge discovery is the name often used to refer to a very interdisciplinary field, which consists of using methods of several research areas to extract knowledge from real world data sets. There is a distinction between the terms data mining and knowledge discovery; the term data mining refers to the core steps of a broader process called knowledge discovery in database. In addition to the data mining step which actually extracts knowledge from data, the knowledge discovery process includes several preprocessing and post processing steps. The goal of data preparation methods is to transform the data to facilitate the application of a given data mining algorithms, where the goal of knowledge refinement methods is to validate and refine discovered knowledge. The knowledge discovery is both iterative and interactive. It is iterative because the output of each step is often feedback to previous steps and typically many iterations of this process are necessary to extract high quality knowledge from data. It is interactive because the user or more precisely an expert in the application domain should be involved in this loop to help in data preparation, discovered-knowledge validation and refinement.



Data Mining Architecture



II. LIMITATIONS OF DATA MINING

Data mining applications can greatly benefit the healthcare industry. However, they are not without limitations. Healthcare data mining can be limited by the accessibility of data, because the raw inputs for data mining often exist in different settings and systems, such as administration, clinics, laboratories and more. Hence, the data have to be collected and integrated before data mining can be done. While

several authors and researchers have suggested that a data warehouse be built before data mining is attempted, that can be a costly and time-consuming. Secondly, other data problems may arise whereby this include missing, corrupted, inconsistent or non-standardized data such as pieces of information recorded in different formats in different data sources. In particular, the lack of a standard clinical vocabulary is a serious hindrance to data mining applications. Thirdly, there may be ethical, legal and social issues, such as data ownership and privacy issues, related to healthcare data. Fourthly, the successful application of data mining requires knowledge of the domain areas as well as in data mining methodology and tools. Without a sufficient knowledge of data mining, the user may not be aware or be able to avoid the pitfalls of data mining.

Healthcare sector: an overview the healthcare sector is one of the fastest growing areas of the economy of most developed countries. Governments invest larger amounts of money in it, either directly or indirectly, and expect a high quality services from this sector. In reality, the performance of this sector is quite different and is characterized by long waiting times, inefficiency, low productivity, stressed medical staff and dissatisfied patients. The healthcare system is composed of a complex set of entities, activities and processes – at the core of which inevitably are the clinical ones and involves a wide range of participants, each of them carrying to the system a different set of needs, priorities and evaluation criteria. Like other business organizations, increasing levels of competition, patient service alternatives, joint ventures, quality initiatives and emphasis on continuous improvement evidences dramatic changes in the operation of healthcare organizations. One of the important changes in today's healthcare industry, is an increasingly knowledgeable consumer with intensifying demands to have information available for helping them to make appropriate health care decisions. Good management requires reliable and timely information on facts for making decisions. In spite of the unquestionable truth of this statement, there is a prevalent tendency to rely on intuition and opinions and to assume that the organization is "doing the right things right" without any support from facts. Performance measurement provides hospital administrations with hard evidence about existing practices, values, beliefs, and assumptions and enables the administration to develop a systematic means of identifying shortfalls and improve its future performance.

III. HEALTHCARE MEASUREMENT:

The review of the recommendations made by various authors, already mentioned throughout this critique, has been used designing the performance measurement system for healthcare processes. The process of deciding what to measure became topical – with several authors discussing it, sometimes in a quite frivolous manner. Keegan et al. Outline three distinct steps for developing performance measurement system:

(1)Defining strategic objectives of the firm and deciding how they can be translated into

divisional goals and individual management actions;

(2)Deciding what to measure; and

(3)Installing performance measurement system into management thinking, possibly through the budgeting process. Wisner and Fawcett suggested a nine-step process for performance measurement system design. This process is similar to that of the process suggested, but it makes explicit that the system be regularly reviewed and updated. Kaplan and Norton paid no attention to the design of performance measurement system, but in 1993 they developed an eight-step process, which they believed that it enables management to design balanced measurement systems. A more dynamic approach to performance measurement design needs to be developed to withstand the evolving changes in organizational performance measures. Beamon presents a set of characteristics that are found in effective performance measurement systems, and can therefore be used in evaluation of the measurement systems. These characteristics include: inclusiveness, universality, measurability, and consistency.

The following characteristics may be considered for the evaluation of the existing performance measurement systems:

- Inclusiveness;
- Universality;
- Measurability;
- Consistency; and
- Applicability.

Proposed framework for performance measurement system Most of the existing performance measurement systems used in organizations lack the flexibility to change as they focus on the past as opposed to the future. In today's highly dynamic environment, it is not appropriate to view the design and implementation of a performance measurement system as a sequential process. The design, implementation and use of measurements should be a simultaneous and continuously evolving process in which changes in the strategic direction and learning requirements of an organization are constantly accounted for. It ensures a speedy and effective implementation of the formulated strategy. A critical examination of above literatures suggests that a good system of performance measurement should exhibit the following characteristics:

- Measure performance from a multi and interrelated perspective;
- Be valid, reliable and easy to use;
- Be linked to the organization's value and strategy;
- Being sensitive to changes in the external and internal environment of an
- Organization i.e. Contains lead measures of performance;
- Enable comparisons to be made and progress to be monitored; and
- Be based on the critical success factors or performance drivers.

According to framework proposed by, performance is equivalent to the concept of efficiency. It is a function of the system's contributions to intrinsic goals taking into account the inputs used to achieve them. The health

system contributes towards many outcomes that are socially desirable, including improving health, educational attainment, and individual incomes.

After reviewing different performance measurement models, it has been observed that the performance measurement framework includes lead performance measure dimension as well as dimensions, which will show effectiveness parameters.

Measurement parameters following three Categories:

(1) Efficiency;

(2) Effectiveness; and

(3) Flexibility.

Effectiveness can be measured by measuring the following dimensions:

- Service quality;
- Customer satisfaction;
- Growth; and
- Safety.

IV. SUGGESTIONS

As it obvious that data mining is very important for healthcare and it can improve the situation from health centers to customers, we recommend that the government has to look at the technology, to invest on it, as we believe that it can prove great positive feedback to the lives of residents and organizations too. However, we recommend during implementation, government has to ensure the integration of data, text and digital diagnostic images for images such as X-rays, MRI's whereby by doing so will provide significant help for most residents who cannot afford to travel far for experts to read their images.

V. CONCLUSION

Currently, Arusha region has few medical personnel and hospitals where data mining can be used as a substitute. We have suggested the implementation and use of data mining technology at Arusha region as this will improve the healthcare industry and well- being of the residents. In the paper we have proposed the integration of data and text mining, using digital diagnostic images which can be brought into healthcare data mining applications. It is our belief that the paper will be a contribution to the data mining and healthcare literature and practice. It also is hoped that this paper can help all parties involved in healthcare reap the benefits of healthcare data mining. The proposed framework broadly categorizes performance measurement parameters into three categories namely efficiency, effectiveness and flexibility. These parameters are further sub-divided to give a detailed description of these parameters. The first dimension efficiency measures the output obtained in relation to consumption of input. Efficiency measure deals with the success with which hospital management uses its funds or resources to produce outputs or outcomes. Second dimension effectiveness of a service is indicated by its overall outcomes or impacts. In healthcare context, effectiveness indicates the extent to which an intervention achieves health improvements and can be measured in terms of various outcomes such as cases of disease prevented, years of life saved etc. Flexibility, the

third dimension, is a lead performance measure, which focuses on analyzing forward looking, predictive and future performance comparisons. This can measure a system's ability or the adaptability to respond to diversity or change. Further division of these parameters will help the healthcare units to directly use the framework for assessment of their performance. This framework will help the health care organizations to know their performance and also it will help in benchmarking the organization so that customers can know the worth of money they pay for the service.

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