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MINING TECHNIQUES IN HEALTH CARE: A SURVEY OF IMMUNIZATION

[1]Dr M.HEMALATHA [2]S.MEGALA

[1]Head, Department of Software Systems, Karpagam University, Coimbatore.
[2] Research Scholars in Computer Science, Karpagam University, Coimbatore.
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ABSTRACT

Data mining has been used intensively and broadly by several organizations. The applications can greatly benefit all parties involved in the healthcare industry. The healthcare background is generally supposed as being information more yet knowledge less. There is a affluence of information obtainable within the healthcare systems. However, there is a lack of useful analysis tools to realize hidden relationships and trends in data. Knowledge discovery and data mining have established frequent applications in commerce and scientific domain. Valuable facts can be exposed from application of data mining techniques in healthcare system. Likewise Immunization and vaccination have been used as an upstream, for protecting children, against such infections and infectious diseases as Polio, DPG, BCG and Measles. This critique explores data mining applications in healthcare. In this study, we briefly examine the potential use of classification based data mining techniques such as decision tree, Artificial Neural Network to massive volume of Immunization data**.**

Keywords: *Descissiontree, Healthcare, Data mining, Immunization, Classification, Neural Network.*

1. INTRODUCTION

DATA Mining or "the efficient discovery of valuable, on-obvious information from a large collection of data"[1] has a goal to discover knowledge out of data and present it in a form that is easily comprehensible to humans. Knowledge detection in databases is precise process consisting of a number of distinct steps[2]. Data mining is the foundation step, which outcome in the discovery of unknown but helpful knowledge from huge databases. A formal definition of Knowledge discovery in databases is given as follows: “Data mining, or knowledge discovery, is the computer-assisted process of digging through and analyzing enormous sets of data and then extracting the meaning of the data. Data mining tools predict behaviors and future trends, allowing businesses to make proactive, knowledge-driven decisions [3].Data mining expertise provide a consumer-leaning approach to new and unknown patterns in the data. The exposed knowledge can be used by the healthcare administrators to progress the superiority of service.

In healthcare, data mining is becoming gradually more well-liked, if not ever more essential. Several factors have motivated the use of data mining applications in healthcare [4]. 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 to help them find and track offenders [5] Fraud detection using data mining applications is prevalent in the commercial world, for example, in the detection of fraudulent credit card transaction[6].

Recently, there have been reports of successful data mining applications in healthcare fraud and abuse detection [7]. Another factor is that the huge amounts of data generated by healthcare transactions are too complex and voluminous to be processed and analyzed by traditional methods. Data mining can improve decision-making by discovering patterns and trends in large amounts of complex data.[8].Such analysis has become increasingly essential as financial pressures have heightened the need for healthcare organizations to make decisions based on the analysis of clinical and

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financial data[9,10].Insights gained from data mining can influence cost, revenue, and operating efficiency while maintaining a high level of care.[11] Healthcare organizations that perform data mining are better positioned to meet their long-term needs, Benko and Wilson argue.[12] Data can be a great asset to healthcare organizations, but they techniques in healthcare; and finally, highlighting the limitations of data mining and offering some future directions.

2. DATA MINING CONCEPTS

A. Definition

Data mining may be defined as "the exploration and analysis, by automatic or semiautomatic means, of large quantities of data in order to discover meaningful patterns and rules" [15]. Hence, it may be considered mining knowledge from large amounts of data since it involves knowledge extraction, as well as data/pattern analysis [16].

B. Tasks

Data mining techniques can be broadly classified based on what they can do, namely description and visualization; association and clustering; and classification and estimation, which is predictive modeling. Description and visualization can contribute greatly towards understanding a data set, especially a large one, and detecting hidden patterns in data, especially complicated data containing complex and non-linear Interactions.

In association, the aim is to decide which variables go jointly [17]. For example, market-basket analysis (the most popular form of association analysis) refers to a method that generates probabilistic statements such as, "If patients undergo treatment A, there is a 0.35 probability that they will exhibit symptom Z" [18]. With clustering, the objective is to group objects, such as patients, in such a way that objects belonging to the same cluster are similar and objects belonging to different clusters are dissimilar. In Koh and Leong,[19]clustering is used to group readmitted patients to better profile and understand such patients.

The most common and important applications in data mining probably involve predictive modeling. Classification refers to the prediction of a target variable that is categorical in nature, such as predicting healthcare racket [20]. Estimation, on the other hand, refers to the prediction of a target variable that is metric (i.e., interval or ratio) in nature, such as predicting the length of stay or the amount of resource utilization. For predictive modeling, the data mining techniques commonly used include traditional statistics, such as multiple discriminate analysis and logistic regression analysis. They also include non-traditional methods developed in the areas of artificial intelligence and machine learning [21].The two for the most part significant models of these are neural networks and decision trees. More details on data mining techniques can be found in Berry and Linoff.[22].

C. The Righteous Cycle of Data Mining

The four stages of the righteous cycle of data mining are:

1. *Categorize healthcare troubles issues*: where the aim is to classify areas where patterns in data have the possible of providing value.
2. *Techniques to renovate difficulty into information*: for this function, the created results need to be tacit in order to make the righteous cycle successful. Several pitfalls can obstruct with the ability to use the results of data mining. Some of the pitfalls are bad data formats, confusing data fields, and lack of functionality. In addition, identifying the right source of data is crucial to the results of the analysis, as well as bringing the right data together on the computing system used for analysis.
3. *Performing of the information*: where the results from data mining are acted upon then fed into the measurement stage.
4. *Evaluate the outcome*: this measurement provides the feedback for continuously improving results. These measurements make the righteous cycle of data mining *righteous.* Even though the value of measurement and continuous improvement is widely acknowledged, it is usually given less attention than it deserves as shown in fig1.

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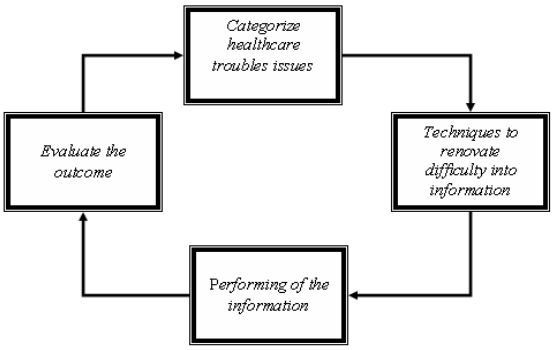
Fig 1: Data mining cycle



3. DATA MINING TECHNIQUES IN HEALTH CARE

There are different data mining techniques presented with their appropriateness needy on the sphere application. Information presents a well-built basic backdrop for quantification and assessment of domino effect. However, algorithms based on information need to be modified and scaled before they are practical to data mining.

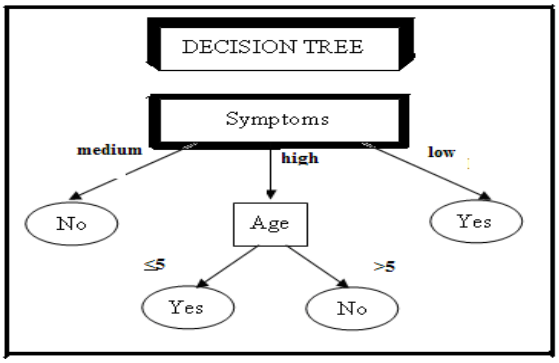
A.Decision Tree:

Decision trees are a approach of representing a sequence of rules that lead to a set or value. As a result, they are used for directed data mining, mainly classification. One of the main reward of decision trees is that the model is quite reasonable since it takes the form of explicit rules. This allows the evaluation of results and the identification of key attributes in the process[23]. It consisting of nodes and branches organized in the form of a tree such that, every interior non-leaf node is labeled with ideals of the attributes. The branches coming out from an inner node are labeled with ideals of the attributes in that node. Each node is labeled with a rank (a worth of the goal characteristic). Treebased models which include classification and regression trees, are the common implementation of induction modeling [24]. Decision tree algorithms such as CART, ID3, C4.5, SLIQ, SPRINT. The decision tree can be built from the very small training set (Table 1). In this table each row corresponds to a enduring record. We will refer to a row as a data instance. The data set contains three predictor attributes, namely Age, Gender, symptoms and one goal attribute, namely disease whose values to be predicted from symptoms indicates whether the corresponding enduring have a certain disease or not.

Table 1**:** Data set used to build decision tree of Figure.2

Age	Gender	Symptoms	Disease (Goal)
5	Female	Medium	Yes
3	Male	High	Yes
2	Female	Medium	Yes
4	Female	High	Yes
10	Female	Low	No
9	Male	Low	No
11	Female	Low	No

Fig. 2**:** A decision tree built from the data in Table 2



Decision tree can be used to classify an polio data of the above data set given in the Table 1. The idea is to push the instance down the tree is shown in fig2, following the branches whose attribute values match the instances attribute values, until the instance reaches a leaf node, whose class label is then assigned to the instance [25]. In this example, Gender attribute is irrelevant to a particular classification task. The tree tests the intensity of symptom value in the instance. If the answer is medium; the instance is pushed down through the corresponding branch and reaches the Age node. Then the tree tests the Age value in the instance. If the answer is 5, the instance is again pushed down through the corresponding branch. Now the instance reaches the leaf node, where it is classified as yes.

B.Artificial neural network (ANN):

A Neural network may be defined as "a model of reasoning based on the human brain" [26]. It is probably the most common data mining technique, since it is a simple model of neural interconnections in brains, adapted for use on digital computers. It

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learns from a training set, generalizing patterns inside it for classification and prediction. Neural networks can also be applied to undirected data mining and time-series prediction [27].

Neural networks or artificial neural networks are also called connectionist system, parallel distributed systems or adaptive systems because they are composed by a series of interconnected processing elements that operate in parallel as shown in Fig. 3. A neural network can be defined as computational system consisting of a set of highly interconnected processing elements, called neurons, which process information as a response to external stimuli[28]. Stimuli are transmitted from one processing element to another via synapses or interconnection, which can be excitatory or inhibitory[29]. If the input to neuron is excitatory, it is more likely that this neuron connected to it. Neural networks are good for clustering, sequencing and predicting patterns but their drawback is that they do not explain how they have reached to a particular conclusion[30].

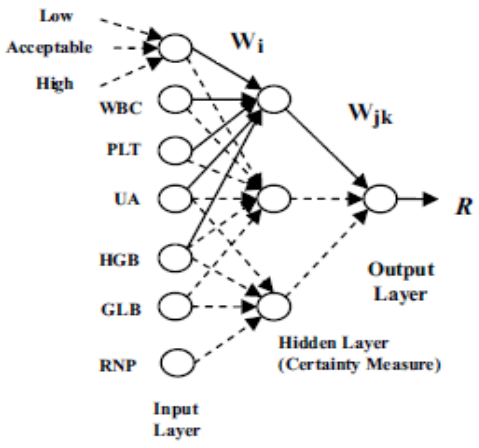
Artificial neural networks (ANN) provide a powerful tool to help doctors analyze, model and make sense of complex clinical data across a broad range of medical applications[31]. In medicine, ANNs have been used to analyze blood and urine samples, track glucose levels in diabetics, determine ion levels in body fluids and detect pathological conditions [32]. A neural network has been successfully applied to various areas of medicine, such as diagnostic aides, medicine, biochemical analysis, image analysis and drug development [33]. Table 2 gives references of some of the medical applications of Neural Networks.

Table 2**:** Applications of neural networks in various medical fields

Applications	References
Image Analysis	
Medical image processing	[34]
Statistical Models for Breast Cancer	[35]
Crohn's Disease and Ulcerative Colitis	[36]
Classification of BloodCells	[37]
Analysis of wave forms ECG	[38]
Cervical cancer	[39]
Tumors	[40]
Retina damage classification	[41]
Analysis of side drug effects	[42]
Outcome Prediction	
Anesthesia	
Breast cancer	[43]
Dental	[44]

The network constructed consists of 3 layers namely an input layer, a hidden layer and an output layer. Sample trained neural network consisting of 9 input nodes, 3 hidden nodes and 1 output node is shown in Figure 3. When a child suffer from high fever 75% of surface area paralytic polio, the polio virus invades the central nervous system the spinal cord and the brain and may cause weakness, paralysis, serious breathing problems or death according to medical guidelines i.e**. R** is generated with reference to the given set of input data.

Fig. 3**:** A simple neural network diagram



C. Classification techniques in healthcare:

The objective of the classification is to assign a class to find previously unseen records as accurately as possible. If there is a collection of records (called as training set) and each record contains a set of attributes, then one of the attributes is class[45,46]. The motive is to find a classification model for class attributes, where a test set is used to determine the accuracy of the mode.

The known figures set are separated into guidance and test sets. The training set used to build the model and test set is used to validate it[47,48]. Classification process consists of training set that are analyzed by a classification algorithms and the classifier or learner[49]. Model is represented in the structure of classification rules[50]. Test data are used in the classification

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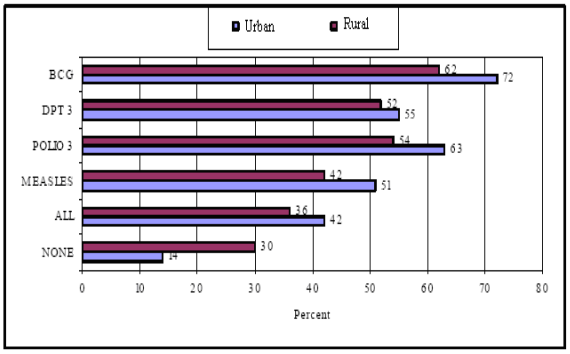
rules to estimate the accuracy. The beginner model is represented in the form of classification rules, decision trees or mathematical formulae. For the doses of OPV2, OPV3, DPT3, and MCV, uptake in males is only slightly higher than in females (approximately 1%). Moreover, in the dose of DPT1, females actually show a slightly higher uptake than that of their male counterparts (41.4% females versus 39.2% in males). Each vaccine was compared and classified across sexes in a series of two-by-two tables(urban & rural) as shown in table 3. Although some differences in sex are observed, none of these differences was found to be statistically significant is shown in fig4.

Table:3 Vaccine coverage Among Children birth to 36 months

Vaccine	Urban				Rural			
	Males		Females		Males		Females	
	Yes	No	Yes	No	Yes	No	Yes	No
BCG	679 (72.6)	256 (27.4)	588 (70.1)	251 (29.9)	411 (47.4)	456 (52.6)	374 (47.6)	412 (52.4)
OPV1	706 (75.5)	229 (24.5)	621 (73.8)	221 (26.2)	491 (55.7)	391 (44.3)	444 (55.7)	353 (44.3)
OPV2	619 (67.6)	297 (32.4)	537 (64.7)	293 (35.3)	404 (46.2)	471 (53.8)	360 (45.5)	432 (54.6)
OPV3	493 (54.7)	409 (45.3)	427 (52.7)	383 (47.3)	334 (38.3)	539 (61.7)	288 (36.6)	499 (63.4)
DPT1	567 (61.3)	358 (38.7)	513 (60.9)	329 (39.1)	344 (39.2)	534 (60.8)	327 (41.4)	463 (58.6)
DPT2	493 (54.1)	418 (45.9)	436 (52.8)	390 (47.2)	309 (35.4)	563 (64.6)	276 (35.1)	510 (64.9)
DPT3	466 (51.8)	434 (48.2)	398 (49.1)	412 (50.9)	278 (32.0)	590 (68.0)	240 (30.7)	543 (69.3)
Measles	419 (47.6)	462 (52.4)	367 (45.4)	441 (54.6)	231 (27.5)	610 (72.5)	190 (25.3)	561 (74.7)

Fig 4: Percentage of Children age 0-36 month who have specific Vaccinations



4. RESULTS AND DISCUSSION

With the current rapid increase in the amount of medical data being collected electronically in critical care and the widespread availability of cheap and reliable computing equipment, many researchers have already started, or are eager to start, exploring these data. The outcome obtained by data mining, in particular from the subfield of machine learning, may not only be oppressed to recover the worth of care by implement particular change to care policies but can also be used as a basis for the structure of computer-based decision-support systems.

We present a case study of application of data mining and analyze data of children with Immunization details. The concept of Classification method has been applied in the study of child vaccine. Polio is a opportune disease for data mining technology for a number of factors, the huge amount of data polio virus invades the central nervous system the spinal cord and the brain and may cause weakness, paralysis, serious breathing problems or death. HealthCare administers would like to know how to improve outcomes as much as possible.

Table 4: Number of Reported Cases of Vaccine-Preventable Diseases.

Vaccine	Coverage Survey(%)	Estimate(%)	Difference
BCG	67	93	-26
DPG	71	86	-15
Polio	63	76	-13
Measles	89	74	15

After preliminary results were analyzed, the program projected that over three million cases deaths would be prevented and it has been resulted in a statistically significant in table survey as shown in table4. There is still, however, much that can be done. Through the use of data mining algorithms it was possible to verify the improvement of quality. Future work includes the Collecting information about levels of disease. In this study, no information about prevalence of disease was available. It would be beneficial to compare immunization uptake by district to disease levels in those same areas, as immunization areas with higher disease rates may be potential targets for future efforts and to obtain with higher accuracies in their prediction capabilities.

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AUTHOR PROFILES:

S.Megala received her MCA.,M.Phil., from Bharathiar University, Coimbatore.
Currently she is pursuing her Ph.D Full- time in Karpagam University. Her research interest in the areas of Data Mining and Knowledge Discovery, Pattern Recognition and Machine Learning.

Dr.M.Hemaltha completed MCA MPhil., PhD in ComputerScience and Currently working as a Asst Professor and Head , Dept of Software systems in Karpagam University. Ten years of Experience in teaching and published Twenty seven papers in International Journals and also presented seventy papers in various National conferences and one international conference. Area of research is Data Mining, Software Engineering, Bioinformatics, Neural Network. Also reviewer in several National and International journals.