November-December 2019
ISSN: 0193-4120 Page No. 6274 - 6283

Effectiveness of Association Rule Mining in Medical Health Data

K. Mohankumar, S. Devi

Dr.K. Mohankumar, *Head & Research Advisor, PG & Research Department of Computer Science, Rajah Serfoji Govt. College (Affiliated to BharathidasanUniversity,Trichy)Thanjavur, Tamilnadu, India. (Email: tnjmohankumar@gmail.com)*

S. Devi, *Research Scholar, PG & Research Department of Computer Science, Rajah Serfoji Govt. College(Affiliated to BharathidasanUniversity,Trichy), Thanjavur, Tamilnadu, India. (Email: deviraman.72@gmail.com)*

Article Info
Volume 81
Page Number: 6274 – 6283
Publication Issue:
November-December 2019

Abstract

Data mining helps to get a more accurate result from anenormous collection of data using different techniques and algorithms. The techniques are used to analystdata to discover hidden information. In data mining, the most prominent technique is Association Rule Mining (ARM). Many applications like Education, Finance, Business, Health care, Mobile computing,and Web mining uses the ARM technique for their specific purpose. Among the many application Health cares is a most sensitive application, in which, based on the previous data and symptoms clinical decisions are finalized. Data mining helps to form association rules and based on the association in Medical Health Care (MHC) data, early diagnosis of the particular diseases for a patient is possible. ARM also helps in many ways to alert the patients to take necessary precaution to safeguard their life. This paper takesa vast survey regarding the effectiveness of ARM in MHC data. This paper considers a decade of research work already done using ARM in MHC data. The paper presents a comparison of table which considering different parameters to provide the importance of association rule mining in medical health care field. This survey considers research article taken from 2008 to 2019. Finally, paper is concluded with the significance of the association rule mining in medical health care.

Article History
Article Received: *5 March 2019*
Revised: *18 May 2019*
Accepted: *24 September 2019*
Publication: *28 December 2019*

Keywords: *Association Rule Mining; Medical Health care; Medical data Set; AprioriAlgorithm;data mining techniques;*

I. INTRODUCTION

Due to the advancement in Information Technology, a huge volume of data are generated every day and stored in the database. The large volume of data is analyzed for understanding and discovering information and knowledge which are hidden. This can be done by using data mining techniques [1]. Data mining is the method of mining the enormouscollection of data to discover hidden patterns [2].This is known as knowledge excavating or mining [3].Data mining is a mixture of machine learning, statistics,artificial intelligence and database technology[4].Data mining comprises different techniques for classification, prediction, clustering, frequent pattern and association and also it is supported by different algorithms like Decision tree, Genetic algorithm. K-Means, Neural Network, KNN, SVM and etc. [5]alone with data mining

techniques to get hidden information from the large volume of data. It is a significantmethodin data mining, which is applied in different application to finalize decision is association rule mining [6]. It helps to find the association between data by analyzing previous data in the database. Rule mining isasignificantprocess in data mining which generates rules to provide a brief report of potentially needed data which can be easily understood and agreed by users[7].

Recently, Data mining is used in many applications but the utmost imperative field to be concentrated is disease prediction on medical data [8]. The medical field is the most sensitive and emotional environment, it saves many lives and it has a huge amount of medical data to be maintained for future analysis. Based on the previous data, association mining helps to take and find a disease for a patient [9].

Nowadays, there areresearch works carried out on the medical field with data mining and rule mining to produce an intelligent decision support systems to findanexactanalysis and forecast of illnessesparticularly in envisaging cancer in lung and breast,heart attack, remote health monitoring [10], mental disorders Schizophrenia [11] and etc.

This survey presents the effectiveness of association rule mining in the medical field. The survey is based on the existing research work done by different researchers. The survey comprises the research works during the year 2008 to 2019. Many researchers have proposed their ideas with association rule on medical data to improve accurate medical assistance to the patients based on their needs.

II. ASSOCIATION RULE MINING

ARM is a familiar knowledge gaining process in data mining and it isa good researchschemeto discover remarkableassociationsamong data in huge databases. Association is envisioned to recognizesolid rules from in MHC datausing various methods [12]. There are two categories of association rules can be used in the medical field. Direct Association Rule, which only considered frequent data item set in the medical data. Indirect Association*Rule*,which considered both frequent and infrequent data set in the medical field.

Association ruleshave two main properties to analyst the association, namely Support and Confidence. Support denotes how often a specific item set appears in the dataset, Support (XY) = P (X∪Y). Confidence denotes that how frequently the association rule are found to be correct, Confidence (XY) = P (Y|X)[13] [14] [15].

III. METHODOLOGY

The medical field is very emotional and should be trustworthy to patients and give confidence to their speedy recovery. The method of this paper is survey paper. The paper only talks about already published works with respect to association rule mining on medical health care data. The research works noted in the papers are downloaded and categorized based on the year and disease addressed. Many online databases are used to get the paper-like Scopus, IEEE Xplore, Google Scholar, and etc. Each paper is studied and objective and other relevant details are compared. Generally, mining follows a set of procedure to mine the databases. Procedures followed for association rule mining is as follows.

1. *Begin with the data set*
2. *Choose the item set*
3. *Data are preprocessed to get correct data*
4. *Refined the item set*
5. *Apply Association Rule mining*
6. *Find the frequent item set*
7. *Generating association rules*
8. *Choose the best rule for association*
9. *Apply the rule in the data set*
10. *Find result*
11. *Consideration and suggestion based on the result*

These are the general procedures followed for mining the medical data and discover the data for clinical action.

IV. ASSOCIATION RULE MINING ON MEDICAL DATA

This section presents the details of the research work published inthe last 10 years. The survey considered only the association rule mining-related papers. From that, Nikunj H. Domadiyaet al. [16] proposed an efficient method forprivacy-preserving ARMand find rules with respect to the relationship in distributed partition MHC data with somewhateffective computation and communication cost.

Ramjeevan Singh Thakuret al. [17] discussed the fuzzy rule base Analytic Hierarchy process to evaluate the relative (importance) weight of different measures in order to choose the perfect rule. R. Karthiyayini et al. [18] has proposed an enhanced association rule mining todiscover eye diseases from fundus images. Md Faisal Kabir et al. [19] has appliedARM to getdata about breast cancer in the form of rules that are used to initiate prevention strategies.

Junyan Tan et al. [1] has proposed a method described how to deal witha vast amount of medical data using a case study considered gout disease. Gout is a generalprolongedillnessproducedfrom noticeable reason hyperuricemia. AshwiniRajendraKulkarniet al. [20] has suggested ARM with FP-Growth and Apriori algorithm for manyvirus-relatedinfectioussicknesses and their indications.Lakshmi K.S et al. [8] has presented away to derive association rules from the large collection of MHC data by applying different data mining procedures.RashmiAbeysinghe et al. [21] has introduced a query based mining method for finding diseases from clinical datasets from National Sleep Research Resource (NSRR).

P. SambasivaRao et al. [22] have proposed an Apriori association rule discovery-based technique and demonstrated the improvements over the existing research methods. ChenluLiet al. [10] has analyzedMHC data comprehensively from both techniques association rules with the nature of positive and negative rules. The analysis was performed on the medical and healthcare data collected from a Person's Hospital. J. Sabthami [23]has proposed an approachfor categorizing patients with respect to theirillnesses. Shaoyun SONG et al. [24] has established anintellectualanalysis method for predicting lung cancer and data analysis done by using the test data from medical diagnoses data.Shaufiah et al. [25] have delivered a method for analyzing laboratory tests of human blood, whichmay help to identify abnormalconditions of patients' blood condition.

AnqiGuo et al. [26] hasdiscovered the relationship between readmission and the other features recorded in the data of diabetic patients from the Health Facts Database in the United States using Association Rule Mining. Umesh D R et al. [27] has developed a model for predicting breast cancer on the MHC data from SEER, which may more helpful to Clinical Oncology Doctor. This method follows a classical method to predict breast cancer from the SEER dataset.MajidKhalilian et al. [28] hasproposed a method to generate frequent patterns and mining rules to categories the breast cancer based on FP-growth algorithm.

Neha Sharma et al. [29] has proposed a method to detect and avoid oral cancer and the author make a discussion on how the proposed rules are efficiently used by the doctors.Lakshmi K.S et al. [30] has proposed a technique for identifying diseases which may affect the patient alone with diabetic's problems. M. Ilayarajaet al. [31] hasused ARM and Apriori technique to develop a system for early detection of a specific disease in a particular geographical area in specific time

period. T.Rajesh et al. [32] haveproposeda method with the use of enhanced equal distance binning interval approach to identify continuous-valued attributes to improve the accuracy of disease prediction for lung cancer.

VipulRahejaet al.[33] has proposed the epidemiology method to improve disease identification by using ARM and associatingresults to spatially explicit disease patterns and find dissimilarities in health dangers. AnkitAgrawalet al. [34] hasproposed a system that uses ARMdata scrutiny on SEER data set with details of lung cancer to recognize hotspotson where the patient survival period is expressivelyupper than and minor than the average survival period across the entire dataset.YanqingJiet al. [35] hasdeveloped a data mining technique to signaling possible ADRs in MHC data set and also proposed potential rule mining PCARs to denote relationship between binary numbers. Xiaofeng Zhao et al. [36] hasintroduced a method tofind factors involved in diagnosis relational factors of diabetes from large amount of MHC data set.

Gaurav N. Pradhanet al. [37] has proposed different approaches to find the frequent pattern of diseases,the emphasis is on discovering regular patterns in many time series by doing serial mining across time slices. LailaElfangaryet al. [38] has delivered an approach and a tool for analyzing previous data. This may help to narrow down to increase distance between data comprehension and datagathering.

V. RESULT AND DISCUSSION

Totally, 26 numbers of previously presented research work from the last ten years were studied for this survey. Based on the study, it shows how the association mining plays adynamiccharacter in the health field. ARM gives accurate result to make the right direction of treatment for the detected diseases. It helps to identify the disease patterns based on different association rules from the large collection of data. Each researcher was considered a unique disease to design rules and make the system smarter to identify the diseases. This section presented a comparison between some parameters which shows the effectiveness of the ARM in the medical field. Table 1 shows the comparison of effectiveness ARM in the MHC

Table 1. Comparison of Effectiveness of Association Rule Mining in Medical Field

S. No	Paper Year of publications	Methods/ Techniques used	Disease Considered	Findings/ Discussion	Data Set Used	Advantages	Disadvantages/ Future enhancement
1.	[18] 2018	Association rule mining with apriori and fuzzy C-means clustering algorithms	Eyes Retinal diseases	It is suitable to classify diseased fundus images from generalized feature set values extracted by any previous process	Isfahan University of Medical Sciences Persian Eye Clinic (Feiz Hospital)	This method enhances and brings more confidence in the diagnosis process of retinal fundus images	• Takes a long time • Complexities in acquiring images, • Enormous time and are slow in comparisons. • Segmentation on images is a very complex task
2.	[19] 2018	Association rule mining, logit model and data-	Breast Cancer	Topredict breast cancer risks among the target population	Breast Cancer Surveillance	This approach producesthe highest confidence level on	• No control over the overall quality of the data collected

		driven approach			Consortium (BCSC) data set	data set predicted	• Low Support Value
3.	[1] 2018	Association Rules, Apriori algorithm, and Logistic regression analysis,	metabolic diseases and hyperuricemia	Toincrease the risk of hyperuricemia.	Metabolic and Hyperuricemia Medical Dataset	This approach producesa high degree of confidence	High data complexity and Inaccessibility of hugerare medical data.
4.	[20] 2017	Association Rule, Apriori Algorithm, Rapid miner text mining tool	Viral infective diseases	AR is generated with minimum support value and confident by using FP-Growth association rule technique.	Viral Fever related to Medical Dataset	Intended to generate association rule to identify the viral cause diseases	Failed to denote the support value level
5.	[8] 2017	ARM, FP Growth, Eclat, Apriori TID, Apriori algorithm,	Health Diseases	Effectiveness of ARM is proved by using Apriori and FP-Growth Algorithms by relating this algorithm with previous algorithms	Medical health records	Extended support to identify and protect the disease early and prevent the patients from risk.	Number of diseases are not gettingan accurate result
6.	[21] 2017	Association Rule Mining	Health Diseases	Rules generated are only applied to the specific data set and exclusive identification of diseases.	National Sleep Research Resource:	Helps to do an extensive review on huge biomedical datasets to early identification of diseases.	More counting of generating rules are made confusion on specific time condition.
7.	[22] 2017	Association Rule Mining, Apriori Rule.	Heart disease	Apriori based rule set for detection of influences of various parameters	UCI heart disease dataset	Improve the precaution measures	Extended to consider more AR for identifying health diseases.
8.	[23] 2016	Association rule mining, KNN	Health Diseases	Detailed about the disease and corresponding medicine is cure the disease is described	Obesity challenge dataset from www.i2b2.org	By analyzing data set based on the risk factor of the disease, help to improve the patient's health care.	This is a time-consuming process by reading every medical record and it is difficult to understand the nature of the diseases.
9.	[24] 2016	Association rules, Apriori algorithm	Lung cancer	Proposed a method for establishing an on-line diagnosis system	Data on college enrollment.	Enhancement is done in the stage of diagnosis the disease using Artificial neural network.	Early warning of lung cancer identification may help the patients for their secure life.
10.	[25] 2016	FP-growth algorithm, IST-EFP algorithm, and ARM	typhoid fever and Dengue hemorrhagic fever (DHF)	The system helps to identify the high support value of factor causing dengue fever and it is the alarm of abnormal condition of the patient.	DHF or TF Data Set	The improved prediction level of the disease using IST_EFP algorithm.	Further, work extended to analyst other serious diseases.

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ISSN: 0193-4120 Page No. 6274 - 6283

11.	[26] 2016	Apriori algorithm and Frequent Patter) growth (FP-growth)	Diabetic patients	It is found that the treatment effects corresponding to patients' personal characteristics.	Health Facts Database from the United States	Enhanced treatment effects and reduces readmission of patients for a particular disease	Further, statistical methods can be employed to ensure that there is even distribution of the values of each attribute.
12.	[27] 2015	ARM	Breast cancer	Construct a model to predict Breast cancer	SEER Dataset	Accurate prediction of the disease by choosing a minimum number of rules	Further, the prediction is extended by involving additional attributes and improve the holdon missing values
13.	[28] 2015	ARM, FP-Growth algorithm	Breast cancer	The support of algorithm, pattern and association are generated and categorize the disease masses care.	Cancer data set from Wisconsin Database	High prediction and accuracy of disease identification	Further, a knowledge system may develop with generated rules and classify disease pattern accurately.
14.	[29] 2014	Association rule, Apriori Algorithm	Oral cancer	Practitioners are supported by rules to early identification of oral cancer.	Medical health records	ARM helps to detect and prevent patients from cancer	Further, attempt to improve ARM to generate rules to get accurate results
15.	[30] 2014	Association rule, Apriori Algorithm, FP-Growth	Diabetics	Transformation of knowledge from data set to human-understandable structure	Data set of medical transcripts.	ARM describes association disease with other possible diseases	The small size of data set should produce correct detection of disease identification
16.	[31] 2013	Association rule, Apriori Algorithm	Health Diseases	ARM helps to find the disease affects the human those who are living in different location of the area.	Training data set	ARM and FP-G help to find frequent pattern of disease heartwarming patients.	It is difficult to collect details about disease frequency in a certain area.
17.	[32] 2012	Association rule, Apriori Algorithm	type -2 diabetic patients	Produces effective diabetic patient's informative rules from using improved apriori and multilevel association rules.	Medical Diabetics data set	executes less time usage for rule extraction compare to the existing algorithm like apriori	Thereis an insufficient effective analysis tool to discover invisible relationships.
18.	[33] 2012	MiSTIC algorithm, spatio-temporal,Traditional association rule mining	Salmonellosis disease management	STM helps to give differentiation of area where a particular disease is dangerous	Spatio-temporal datasets	The system takes small input and produces better and relative output at a qualitative level.	Many rules derived are not addressing the objective of the question asked.
19.	[34] 2011	Automated association rule	Lung cancer	Find the survival of patients based on their characteristics segments and identify	SEER Data Set	Identify that survival patients are higher and lower than the average	Further, this analysis may include other diseases in the near future.

				the higher/lower than average survival significantly.		survival time across the entire dataset.	
20.	[35] 2011	Potential causal association rules	Adverse drug reactions	Based on knowledge representation PCAR, a potential causal measure is developed.	Electronic patient data from Veterans Affairs Medical Center in Detroit	Enhanced identification of disease pattern is derived	Wrong drug association improves the computational cost
21.	[37] 2009	Association rule mining	Muscular activities recorded by the surface electromyography	Discover Hybrid-multidimensional AR from multiple time-series and synchronous data set	Electromyogram real-life data set	ARM with high confident values and bottom-up computations method provide multi-dimensional pattern mining	Further, work extended to analyst other serious diseases.
22.	[38] 2008	Enhanced Association Rule Algorithm	IGA Glomerulonephritis diagnosis	Applying the Incremental Enhanced Association Rule Algorithm to findtheleastamount of assessments for each finding.	Medical episode database	The Incremental Enhanced ARtechnique produced morevaluable rules	Make use distributed and parallel computing helps to process large volume of data
23.	[16] 2019	Association Rule Mining	Breast cancer	The approach preserves privacy and finds accurate results.	Wisconsin breast cancer dataset	The approach gives better privacy with lower communication and computational cost	This approach can be applied to analyze the correlation between other critical disease and symptoms.
24.	[17] 2019	Association Rule Mining, Analytic Hierarchy Process, fuzzy logic approach	Liver disorder	Use of fuzzy logic in data mining to get result with higher accuracy that is easy to implement.	Liver disorder medical data	Fuzzy AHP based association rule evaluation method has efficiently handled the fuzziness in rules.	Due to the sharp boundary between the intervals. The elements that are near the boundary values are either ignored or overemphasized in the mining process.
25.	[10] 2017	Apriori algorithm of mining association	Pneumonia, coronary heart disease,	Introduces the 2LMS FP algorithm to mine positive/negative association rules in healthcare and medical data	Medical and healthcare data	Discovery of negative association rules is the newest techniques that can be used both by doctors and professors to mine	Further, the work will be extended to dig more valuable information and knowledge for the development of medicine and health
26.	[36] 2010	Association Rule Mining	Diabetes	Method to identify the direct and indirect factor causing diabetics	Diabetes data set	By introducing important attributes of the degree to find the relation diabetics factors at the earliest.	Limited numbers of input records considered for the testbed. No accurate result.

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VI. CONCLUSION

Data mining helps the medical field by finding the association between symptoms and diseases using ARM. In this paper, it presented a survey of effectiveness ARM in the medical field. Many published works with respect to ARM on medical data from the last ten years were collected and presented a comparative study which shows that the effectiveness of association mining in the medical field. ARM is used for diagnosing diseases such as cancer, diabetics, schizophrenia, depression, etc. to take a clinical decision and early prediction of disease symptoms. Hence, ARM is an intelligence system which is suitable for effectively diagnosing diseasesandenhance the patient's life quality.

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