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Drugs Selection in Medical Field: A Survey

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Abstract - *Fuzzy systems have been used to successfully solve a wide range of problems and their application requires a high level of knowledge and experience. The fuzzy system approach to healthcare data obtained from insurance companies may be a helpful way of generating information useful for the drugs selection for similar polymorbid patients in medical practice. Here, a medical application is proposed to assist healthcare professionals. The system maintains a knowledge database handling multiple diagnostic records and the drugs prescribed. A fuzzy based drug recommendation framework is developed to suggest medications.*

Key Words: **Fuzzy system, Recommendation Framework, Polymorbid Patients, Healthcare Professionals, Knowledge Database.**

1. INTRODUCTION

Pharmacotherapy is a therapy using pharmaceutical drugs. Effective pharmacotherapy is based on the drugs prescribed in relevant medicinal products suitable for the patient's current diagnosis or a combination of diagnoses. The clinical decision support software always involved some type of up-to-date passive electronic drug reference database based on data from drug handbooks, pocket cards, published scientific papers or approved by ''Summary of Product Characteristics (SPC),'' which described drug indications, contraindications, doses and interactions. However, the above-mentioned sources used for drug databases do not describe the diagnoses in a uniform manner according to the International Statistical Classification of Diseases and Related Health Problems(ICD). Moreover, the approved SPC do not mention drug indications, which are not licensed but are usually clinically be used as ''off-label.'' Besides, some degree of variability may still exist between licensed indications or frequency of drugs side effects of medicinal products produced by several pharmaceutical companies with regard to the same active substance.

In this case, the processing and evaluation of drug data is more than problematic. On the other hand, the knowledge of individual clinicians about clinical effects of applied drugs in everyday practice reaches a statistical significance in time with the number of drug (co-)applications to individual patients. Moreover, data are generally statistically significant among the clinicians because the numbers of treated patients and drug application occurrences are high. Although these data are available in healthcare databases of insurance companies, they are not systematically summarized in an available database, so it is not possible to establish rules for any expert system. Moreover, the setting up of such a database is problematic also for unrealistic way to ask each clinician for the reason why she/he decided to apply a selected drug(or drug combination) in a selected case. In this case, the potential of fuzzy logic principles in which the variables in the system are represented and manipulated in a binary manner may be applied. The fuzzy system have the structure of a series of ''if-then''-rules to form knowledge base and fuzzy rules present mathematical relationships mapping inputs to outputs. Although the fuzzy logic is not appropriate in all cases like in linear system models or if there are large amounts of missing data. The recommended systems based on fuzzy logic currently present successful solutions to facilitate access for online users to the information fitting their preferences. Collaborative filtering systems can generate recommendations only using users' ratings and without any need for additional information. Collaborative filtering focuses on suggesting to the target user the items that are already preferred by other users with similar preference patterns.

The fuzzy approach to analysis of healthcare databases represents a tool for creating information that is useful for final decision-making process of drug selection for defined polymorbid group of patients in medical practice. But the performance of fuzzy system is slow, so to overcome this problem a rule engine based on the concept of automata is used with this fuzzy approach.

2. LITERATURE SURVEY

2.1. A Recommendation Engine based on Adaptive Automata

The amount of information available nowadays is huge and in raw state; systems have to act proactively on selecting and presenting context-relevant information, but such feature is time-consuming an exhaustive. Paulo Roberto Massa Cereda and João José Neto [1] proposed a recommendation engine based on an adaptive rule-driven device – namely, an adaptive automata – as a lightweight scalable alternative to usual approaches on resource recommendation. The technique employed here is based on frequency analysis instead of relying on usual machine learning.

2.2. The Fuzzy System as a Promising Tool for Drugs Selection in Medical Practice

Monika Fedorová, Daniela Perduková, Zdenko Pirnik, Viliam Fedák, Ondrej Sukel, And Padmanaban Sanjeevikumar [2] proposed a fuzzy system approach to the analysis of healthcare databases for clinicians in their routine daily practice. The results of this system suggest that the fuzzy system approach to healthcare data obtained from insurance companies may be a helpful way of generating information

useful for similar polymorbid patients for final decision process in the drugs selection in medical field. The obtained data can be used as recommendations for other and/or for less experienced clinicians in drugs selection for patients with similar (or unusual) combinations of diagnoses as well as in clinical situations where the "golden" pharmacotherapeutic standards have not been precisely specified or are totally absent for multi-comorbid patients.

The concept of this system is given below:

- Experiences and knowledge of clinicians ("know - how") were expressed in their decisions for prescription of drugs combination for a certain patient diagnosis.
- A quantitative relation exists between a certain combination of diagnoses and the suitability of a particular drug application for its treatment.
- With the concurrent application of two or more drugs there was a relation between the suitability of combination of their diagnoses, and this relation quantitatively defines the suitability of application of their mutual combination.
- The more frequently a certain combinations of drugs occurred in the prescriptions for a certain combination of diagnoses, the more it was preferred for their treatment by clinicians.

2.3. A Fuzzy Recommender System for eElections

Luis Ter´an and Andreas Meier [3] introduced an architecture of a fuzzy recommender system for eElections used in eGovernment to increase participation of citizens, could possibly improve democratic processes. The recommender system approach differs from collaborative filtering methods in that they are based on past experiences. It is also suitable in the one and-only scenario where events such as voting and election processes occur only once. Another important feature introduced in the proposed recommendation system is the fuzzy clustering analysis. Fuzzy clustering analysis differ from classic clustering (sharp clustering) in that the observations belong to one and only one cluster. Moreover, classic clustering makes no use of gradual membership.

A prototype of the fuzzy recommender system has been developed to visualize the results of a recommendation using profiles of candidates generated randomly. The FRS computes similarities based on distances in a high-dimensional space. In addition, it computes fuzzy clusters based on the number of political parties which are part of the eElection process, where candidates and voters described in a finest granularity can belong to several clusters.

The recommendations in the FRS are displayed in a bi-dimensional space, which includes the percentage of similarity of the n closest candidates. Therefore, relationships to closest "neighbors" can be derived and analyzed. Although the prototype is used for eElections, it can be applied for other domains such as community building, and public memory, among others. In the case of "Public Memory", past behaviors could be taken in to account with the use of voting records to assess what the elected authorities claimed before the elections, or in the case of candidates that were elected previously. Thus, past behaviors can be used as more reliable profile information [4].

2.4. Fuzzy Inference System for Osteoporosis Detection

Reshmalakshmi C and Sasikumar M [5] proposed a fuzzy inference framework for diagnosis of osteoporosis disease in the field of medical imaging. The idea behind such a framework is to assist the physician to detect, control and treat various forms of osteoporosis in better way. The degree of disease is computed by fuzzy expert system and conventional X – ray image processing technique and a final decision is taken by combining both the results. Primary advantage of proposed algorithm is : (a) The fuzzy expert system performs as an expert to diagnosis and (b) The X – ray imaging system calculates bone density. The use of different membership functions and extensive number of rules; in addition to the fuzzy edge directed image interpolation (FEDI) technique helps design an efficient osteoporosis detection framework. The extensive experiments conducted on 20 patients have demonstrated that the proposed algorithm can replace the existing, expensive and not readily available bone density calculation techniques in this field.

2.5. An Intelligent Medicine Recommender System Framework

More and more people are caring about the health and medical diagnosis problems. However, according to the administration's report, more than 200 thousand people in China, even 100 thousand in USA, die each year due to medication errors. More than 42% medication errors are caused by doctors because experts write the prescription according to their experiences which are quite limited.

Youjun Bao and Xiaohong Jiang [6] proposed a universal medicine recommender system framework that applies data mining technologies to the recommendation system. The medicine recommender system consists of database system module, data preparation module, recommendation model module, model evaluation, and data visualization module. They investigate the medicine recommendation algorithms of the SVM (Support Vector Machine), BP neural network algorithm and ID3 decision tree algorithm based on the diagnosis data. Experiments are done to tune the parameters for each algorithm to get better performance. Finally, in the given open dataset, SVM recommendation model is selected for the medicine recommendation module to obtain a good trade-off among model accuracy, model efficiency, and model scalability. Also proposed a mistake-check mechanism to ensure the diagnosis accuracy and service quality. Experimental results show the system can give medication recommendation with an excellent efficiency, accuracy and scalability.

2.6. Time to CARE: a collaborative engine for practical disease prediction

A very big cost of health care, especially for chronic disease treatment, is difficult to manage. To overcome this problem, recognizing disease risk and taking action at the earliest signs. However, universal testing is neither time nor cost efficient. Darcy A. Davis , Nitesh V. Chawla, Nicholas A. Christakis and Albert-László Barabási [7] proposed a Collaborative Assessment and Recommendation Engine. This system is used to predict future disease risks by patient's medical history using ICD-9-CMcodes. Based on each patient's medical history and that of similar patients the CARE uses collaborative filtering methods to predict each patient's greatest disease risks. Here, an Iterative version (ICARE) used to improve the performance of system. Also, applied time-sensitive modifications which make the CARE framework practical for realistic long-term use. These systems require no specialized information and also provide predictions for medical conditions of all kinds in a single run.

2.7. Optimization of FIS Tsukamoto using Particle Swarm Optimization for Dental Disease Identification

In the field of dentistry, there are several types of dental diseases. A wide variety of dental diseases become a difficulty for among doctors or medical students to identify the disease. The existence of a decision support system for doctors or medical students to define the disease on the determination of disease using fuzzy logic is still not optimal to generate accuracy point. Diny Melsye Nurul Fajri, Wayan Firdaus Mahmudy and Yusuf Priyo Anggodo [8] proposed a Tsukamoto Fuzzy Inference System for dental recommendation disease which results the optimization of the decision-making. Optimization using Particle Swarm Optimization (PSO) has been done on the membership degree function to get better results. The result shown accuracy point value reached 88% from average accuracy testing.

2.8. A Fuzzy Decision Support System for Therapy Administration in Cardiovascular Intensive Care Patients

Mouloud Denai, Mahdi Mahfouf and Jonathan Ross [9] proposed a fuzzy logic based decision support system for the management of post-surgical cardiac intensive care unit (CICU) patients. The decision support system includes an input module to evaluate the patient's hemodynamic status, a diagnostic module which implements the expert decision-making strategies and a therapeutic module which incorporates a multiple-drug fuzzy control system for the execution of the therapeutic recommendations. The decision support is comprehensively validated on a physiological model of the human cardiovascular hemodynamics whose parameters have been modified to reproduce the key pathophysiological features of hypertension, hypotension hypovolemia and septic shock. Three different scenarios of increasing severity of these pathophysiological conditions are considered to evaluate the effectiveness of the multiple-drug controllers under combined infusions of vasoactive and inotropic drugs.

2.9. Diet recommendation based on Prakriti and season using Fuzzy ontology and Type-2 Fuzzy Logic

People becoming very conscious about their health. Universe is changing at every moment and results in seasonal variations. These seasonal variations affect on human body. Every human being having their own particular type of Prakriti from their birth. Prakriti is one type of energy to control physical and mental state of human body. Imbalance in these energies results in illnesses and different diseases. For maintaining health and prevent from any diseases, in Ayurveda diet is the best medicine. People follow different diet plans recommended from different dietician. In this paper proposed a method to recommend diet based on prakriti of person and current season and data is collected from different websites where different dieticians recommended different diet plans for different prakriti. Shital V. Chavan, S. S. Sambare and Aniruddha Joshi [10] proposed method uses Type-2 Fuzzy Logic to handle uncertainty and Ontology is integrated with fuzzy logic to represent food knowledge. The results shows the efficient and accurate diet recommendation.

2.10. Web – Based Nursing Care Quality Improvement System with Fuzzy Recommendation System

In 1989, the first step in the development of measurement to evaluate quality of nursing care was started by Dr. Hiroko Minami and her research group. The applicants had participated in the group and developed two kinds of questionnaires, one of which was for patients and the other for nurses. Subsequently a measurement tool to evaluate and improve the quality of nursing care was developed from 1993 to 1997.

Reiko Sakashita, Atsuko Uchinuno, Kazuko Kamiizumi, Keiko Tei and Noriko Awaya [11] developed a tool for measuring for the quality of nursing care since 1993. This tool consisted of three dimensions: structure, process, and outcome. It has been developed and posted on a Web site for gathering data from, and returning feedback to the participantspsila units for the quality improvement of nursing. Here, a fuzzy recommendation system for the feedback was developed through an expert panel then evaluated by participants.

3. CONCLUSION

Fuzzy systems have been used to successfully solve a wide range of problems and their application requires a high level of knowledge and experience. The fuzzy system approach to healthcare data obtained from insurance companies may be a helpful way of generating information useful for the drugs selection for similar polymorbid patients in medical practice. Here, a medical application is proposed to assist healthcare professionals. The system maintains a knowledge database handling multiple diagnostic records and the drugs

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