Research Review of Expert Systems for Newborns

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Abstract— **One of the most popular technology of AI is nothing but Expert system. It is rapidly growing technology. An expert system is a computer system that emulates, or acts in all respects, with the decision-making capabilities of a human expert. Expert systems have been developed in different areas like medicine ,engineering and business. Author wants to review the expert systems for newborns.**

Index Terms— **Artificial Intelligence, Expert system, rule-based system**

I. Introduction

Expert systems are an offspring of the more general area of study known as artificial intelligence (AI). The spectrum of applications of expert systems technology to industrial and commercial problems is so wide as to defy easy characterization. The applications find their way into most areas of knowledge work. They are as varied as helping salespersons sell modular factory-built homes to helping NASA plan the maintenance of a space shuttle in preparation for its next flight.

Applications tend to cluster into seven major classes.

1) Diagnosis and Troubleshooting of Devices and Systems of All Kinds

2) Planning and Scheduling

3) Configuration of Manufactured Objects from Subassemblies

4) Financial Decision Making

5) Knowledge Publishing

6) Process Monitoring and Control

7) Design and Manufacturing

Medical diagnosis was one of the first knowledge areas to which ES technology was applied. Artificial intelligence is a branch of computer science capable of analyzing complex medical data. Its techniques can be applied in almost every field of medicine. Their potential to exploit meaningful relationships within a dataset can be used in the diagnosis, treatment and prediction in many clinical scenarios.

Today, it can be noticed that most modern hospitals are becoming smart hospitals, digitalizing their administrative processes, incorporating latest technology equipment, storing their images in PACS (Picture Archiving and Communication System) and RIS (Radiology Information System), using diagnostic expert systems, smart labels for tracking patients and mobile medical equipment, and making use of smart clothes to monitor pregnant women, children, elderly and patients with particular physical disabilities.

II. Literature Review

The Children's Hospital in Ottawa is using artificial intelligence to gather information on newborns with critical illnesses. The data collected is used to suggest treatment approaches and also to help predict and improve health outcomes. Until now, these methods have only been used in adult medicine and this is one of the few approaches used on newborns. They use monitoring systems which are hooked up to each baby in the unit to collect and store data such as respiratory rates and heart beat rhythms. From this data, the technology can predict outcomes like chance for survival and the length of the hospital stay. This technology has an accuracy rate of over 95% in predicting survivors. Doctors are hoping to be able to use this to predict rates of complication in common health problems in infants. Since the data is collected continuously by the monitoring systems, when babies develop complications the doctors receive warning signs right away that allows them to treat the problem. It is like using instant communication to let the doctors know when there is a crisis to be averted. So far, this system has been very consistent and accurate. It is much more efficient than human observation 24 hours a day. Over the next couple of years, hundreds of new cases (babies) will be added to the baby database, where more clinical trials using this technology will be used.

Jirapaet V.from Chulalongkorn University, Bangkok 10330, Thailand developed a computer expert system prototype for mechanically ventilated neonates and impact on clinical judgment and information access capability of nurses.The system is a multimedia interactive consultation-based program that contains 2 major parts: the nursing diagnosis and the knowledge base on nursing care of mechanically ventilated neonates. A rule-based (Boolean frame) was chosen for the nursing diagnosis decision model. According to developer computer expert system is an alternative method of training and providing real-time clinical decision support for nurses to advance their practices from a novice to a proficient level. The purpose of this study was to develop a prototype of a computer expert system for

Manuscript received September 30, 2013.

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mechanically ventilated neonates (ES-MVN) and to assess the impact of the ES-MVN on the clinical judgment and information access capability of nurses. Lance Everett Rodewald from University of Illinois Urbanna,Champaign developed BABY an expert system that monitors new-born, intensive care unit, on-line patient data. The system monitors the data, looks for significant patterns and suggests further evaluation. BABY also tracks the clinical status of the new-borns and can answer questions about each patient.The system will help clinicians and computer scientists. The clinicians will most likely be interested in BABY for its approach to the common problem or finding significant information and patterns in potentially large amounts or medical data. Patient monitoring with the use of a logical model or a patient within the context of a specific medical knowledge base should also be of interest. Of more relevance to the computer scientists will be the knowledge engineering techniques used in the implementation. The knowledge incorporates control information to reduce compu-tational complexity and knowledge storage costs so that the knowledge base will not become unmanage-able as its size increases. The design of BABY was guided by the role envisioned for it in the nursery.

BABY's task is to find clinically important patterns in the medical and demographic data about NICU patients. It is targeted specifically on the NICU for two reasons-there is a need for a system like

BABY, and the chance for success is good due to peculiarities or neonatology. There are few areas in medicine where the amount of data, especially numeric data, is so great, and where the vast majority or it can be made available on-line for a computer system machines already for many physiologic parameters and have been used for extraction or significant events from the stream or signals coming from monitoring equipment. In contrast with adult medicine, the relative importance or the monitoring data to physical exam findings is greater because the babies often do not demonstrate obvious physical signs with serious disease. Additionally, the past medical history or a newborn is much more concise than that or an adult.

Although the variety or clinical problems encountered in the nursery is large, it is practically limited to a few common diseases and complications.

Michinikowski M.and team ,Institute of Biocybernetics and Biomedical Engineering PAS, Warsaw, Poland evaluated the artificial ventilation expert system for neonates (AVES-N) using archival data.

The recommendations of the system were compared to the decisions made by the expert-physician in the same clinical situation (patient condition, respirator settings). In this study they used data of 320 newborns which were ventilated in the Neonatal Intensive Care Unit of the Vanderbilt University Hospital in Nashville (USA). Best agreement between the recommendations of the system and the decisions of the experts was found for positive end expiratory pressure (PEEP), inspired oxygen fraction (FiO2) and peak inspiratory pressure (PIP)--about 70%. Worse agreement was found for time related parameters: respiratory frequency (f) - 54%, time of inspiration (ti) - 46%, time of next blood gas analysis - 15%. The expert system advised lower FiO2 PEEP and f. The differences were smaller in a group of patients who survived than in a group of patients who died. The overall agreement of the AVES-N advice and real therapeutic actions leads to the clinical evaluation of the expert system. The differences can be attributed to a) different therapeutic strategies at 2 NICU's, b) missing data regarding complications in the data base which were not taken into account by the expert system.

A number of expert systems to assist nurses have been developed in recent years. One such system is called Expert Nurse., This system allows nurses to rapidly input patient data and obtain all known possible diagnoses which can be reached from known patient data, specific patient data which support each diagnosis, and suggested patient goals which may be modified for individual patients. Evaluation data collected in the use of this system shows nurses spent less time arriving at a nursing diagnosis, identified a greater number of diagnostic possibilities and increased the quality of patient records.

Another successful expert system in the nursing domain is CANDI (Computer Aided Nursing Diagnosis and Intervention) It is used to assist in assigning nursing diagnoses based on clinical assessment data. CANDI uses a rule-based system that processes the data entered by the nurse on the computer during an assessment. The inference engine takes into account the possibility of the presence of multiple diagnoses.

Parental Nutrition Solutions (PNS)project is a joint cooperation of the Department of Medical Cybernetics and Artificial Intelligence the Austrian Research Institute for Artificial Intelligence and the Neonatal Intensive Care Unit (NICU) of the Department of Pediatrics of the University of Vienna.

The aim of the project was to develop an expert system representing the clinical and theoretical knowledge about the composition of parenteral nutrition solutions for newborn infants treated at neonatal intensive care units (NICUs).

Planning of an adequate nutritional support for maintaining the metabolic needs of sick newborn infants is time consuming, needs experts' knowledge and involves the risk of introducing possibly fatal errors. Recent systems used for composing parenteral nutrition solutions mainly support the calculation and the documentation process and cannot easily be adapted for neonates. Computerized expert system technology may help to develop time saving solutions to a given problem and to avoid errors within certain limits. It is an interactive expert system for calculating the composition of parenteral nutrition solutions (PNS) for newborn infants.

The knowledge base of the expert system consists of the rules for composing the PNS according to heuristic rules used at the cooperating NICU. Applying these rules, the daily fluids, electrolytes, vitamins, and nutritional requirements were calculated according to the estimated needs, the patient's body weight, the age, and the individual tolerance. The requirements were also corrected according to the daily measurements of serum electrolytes, triglycerides and protein if available. Glucose supply was adjusted depending on the type of venous access used (peripheral or central venous line), on the glucose tolerance and on the total fluid allowances. Finally, the PNS was reduced according to the proportion of oral feedings. The program works interactively asking for

relevant data, calculating the PNS, and displaying the results. The physician has the choice to adjust calculated values according to special clinical requirements. The final output is a PNS schedule that can be used directly in the case history of neonates. Possible input and dosage errors are eliminated by methods of data validation using body weight and age dependent thresholds.

Dr. C.A.Holzman and team developed an expert system for automated classification of the sleep/waking states in human infants; i.e. active or rapid-eye-movement sleep (REM), quiet or non-REM sleep (NREM), including its four stages, indeterminate sleep (IS) and wakefulness (WA). A model to identify these states, introducing an objective formalisation in terms of the state variables characterising the recorded patterns, is presented. The following digitally recorded physiological events are taken into account to classify the sleep/waking states: predominant background activity and the existence of sleep spindles in the electro-encephalogram; existence of rapid eye movements in the electro-oculogram; and chin muscle tone in the electromyogram. Methods to detect several of these parameters are described. An expert system based on artificial ganglionar lattices is used to classify the sleep/waking states, on an off-line minute-by-minute basis. Algorithms to detect patterns automatically and an expert system to recognise sleep/waking states are introduced, and several adjustments and tests using various real patients are carried out. Results show an overall performance of 96.4% agreement with the expert on validation data without artefacts, and 84.9% agreement on validation data with artefacts. Moreover, results show a significant improvement in the classification agreement due to the application of the expert system, and a discussion is carried out to justify the difficulties of matching the expert's criteria for the interpretation of characterising patterns.

III. CONCLUSION

Today many new problems or diseases are occuring to babies. Researcher wants to design and develop a rule-based system for different diseases or problems faced by baby and possible causes of it by concerning experts from the field.Junior doctors or nurses may get help from the proposed system.

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