

Application of Expert System With Forward Chaining Method in Detecting Infectious Diseases in Children

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ABSTRACT

Limited information about infectious diseases, especially diseases in children, is a major problem. The application of an expert system in detecting infectious diseases in children is needed in early detection in diagnosing diseases. The purpose of this study was to determine the diagnosis of infectious diseases in children based on the symptoms of the disease and the results of the diagnosis from the system for recommendations to patients with the type of disease suffered and the solutions provided. The stages of the research are collecting data and information on infectious diseases in children. The second is symptom and rule data collection. The third is making each solution from the types of diseases, and the last step is the solution for preventing infectious diseases in children, which is displayed in the system based on the analysis of disease rules. As for the variables in the application of disease tracing graphs, there are 17 rule graphs in detecting diseases in children. Analysis of the rules in the forward chaining method in disease detection for the types of symptoms of high fever (G001), sore throat and cough (G004), persistent hard cough that begins with a long breath through the mouth (G023), and diarrhea (defecation). watery more than three times per day (G030) Itching (G48), irritable and irritable (G033) The upper right abdominal area will feel pain, especially when pressed (G49). Analysis of each symptom G001, G004, G023, G030, G031, G033, G48, G49, the disease that will be detected is P009, namely Hepatitis A. The results obtained are in accordance with patient input by conducting a search using a rule model that utilizes a trace tree. forward based on tracing pediatric disease diagnoses with existing facts. The results of this study can display the results of diagnosis, disease analysis, solutions, and prevention based on the symptoms of the disease in children.

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INTRODUCTION

Health is a valuable thing for humans because anyone can experience health problems. Children are very susceptible to germs and a lack of sensitivity to the symptoms of a disease is a

fear in itself for parents. Parents are ordinary people who do not understand health. If there is a health problem for children, they are more likely to entrust it to experts or expert doctors who already know more about health, regardless of whether the disorder is still low or chronic (Yuhandri, 2014). The development of technology in the field of health, especially medical science, is very fast, so that a system that is built is able to carry out tasks properly by means of human thought processes that are included in the system, which will form rules that will produce a disease diagnosis (Novaliendry et al., 2015).

The existence of a system for seeing diseases in children makes it easier for parents to detect and treat them. Handling directly by parents will cause a reduction in children suffering from the disease, and if there is a delay in treatment, it will risk the difficulty of the disease being cured (D. P. Sari, 2017). The existence of a virus that causes children to get sick is influenced by the rapidly changing climate and weather. The disease can be spread through the air and other tissues. expert system that was developed by being able to consult on the system so that parents of students are not busy directly meeting with other people. (Muntari & Gusmaliza, 2021). Systems are knowledge-based programs that provide solutions to problems with expert quality. An expert system is a computer program that imitates the thought processes and knowledge of experts in solving a particular problem. Expert systems are built to try to resemble human abilities in solving certain problems in the form of heuristics. The implementation of the expert system can also be applied in all fields, including in the health sector (Pasalli et al., 2016).

An expert system is a branch of artificial intelligence (AI) that studies how to adopt the thoughts and reasoning of an expert to solve a problem and make a decision to draw conclusions from a number of facts. The basis of an expert system is how to transfer the knowledge possessed by an expert into a computer and how to make that knowledge a conclusion or decision (Sutojo, 2011).

Expert systems science is also known as intelligent systems that make quick and iterative judgments based on knowledge on a rule-based basis. There are three categories in the expert system, which include factual, sequential, and logical, which can help create a knowledge base (Ramadhan M., 2011). The diagnostic process is carried out to determine a decision. The system will trace the type of disease based on the existing symptoms based on the knowledge representation with the rules of production. The process of diagnosing a disease in the system will be traced based on facts or symptoms, then matched with rules based on the certainty factor method (Maulina, 2020). The role of the hospital is very important in reducing the amount of malnutrition in children. This research is for the first step in looking at the nutritional status of children to diagnose nutrition and identify child diseases in detecting malnutrition (Ula et al, 2021).

Rule-based systems can be built either by forward chaining or backward chaining. To identify things that can help parents recognize diseases in children quickly and help parents understand in making policies that can help identify and see signs of children's illness (Rey et al., 2017). Children are more susceptible to diseases that are at the age of one year. As a result, parents must be careful in keeping their children healthy and should be more aware of their children's health. Children's growth will be affected by diseases that attack every day according to the body's immunity. The existence of an expert system will make it easier for parents to learn more about their children's health by using an expert system to diagnose diseases using the forward chaining method. The results of this study are the result of technology that was built and can be useful in treating patients as a medium for patient consultation in seeing the child's condition. The existence of rule design, process design, and system testing has all been used well by the system. Through data and information collection, facts were found regarding disease symptoms, complaints, symptoms, and recommended treatments (Samosir & Yunus, 2020).

Expert systems are used to reduce the risk of increasing the severity of the patient's illness. This is due to the hospital's handling of the patient in accelerating the patient's medical action. The

expert system built has knowledge about diagnosing symptoms, factors that cause the disease, solutions, and prevention of the disease. The results of the system display the patient's consultation process with the expert system, where the patient will respond to questions by entering answers based on symptoms that may be experienced. After the patient consults with the expert system, the results of the patient's consultation will be displayed (Syahputra, 2021) (Ula, M., Ulva, A. F., Saputra, I., Mauliza, M., 2022)

Expert systems and artificial intelligence cover a wide range of key activities: automated reasoning, natural languages, automated programming, machine learning, robotics and vision, software, human performance modeling, and expert systems for complex decisions. Complex medical decisions are critical in every phase and serve the purpose of helping to find solutions to this field of expert systems (Abu-Naser et al., 2008). Sistem pakar dapat memberikan penanganan pertama untuk memudahkan identifikasi Expert systems can provide the first treatment to facilitate the identification of infectious diseases in children before further (medical) action is taken, and action must be taken quickly (Belachew & Tamiru, 2019).

Previous research on expert systems can diagnose early symptoms of viral diseases that attack children. Children are very susceptible to diseases caused by viruses because their immune functions are not so perfect. Doctors are tired of dealing with patients in the hospital because of the limitations of doctors in the medical field. This has an impact on health when the baby is in an abnormal state. Then comes a solution where the system is able to act like an expert. The results of this study have been able to diagnose early symptoms of viral diseases in children very well (Dicki Alamsyah, 2019) (Ula & Saputra, 2022).

With this expert system, parents and other people can easily find out information and diagnose infectious diseases in children through visible symptoms quickly and can prevent disease without directly referring to a doctor. so that the system that has been implemented can be used as a reference as one of the actions in diagnosing patients in terms of pediatric diseases (M. Sari et al., 2020)

The application of an expert system for diagnosing diseases in toddlers using the forward chaining method can be carried out in three stages. The first stage is collecting data and information from IMCI and interviews. The second stage is making rules based on 18 diseases using the forward chaining method. The third stage is the implementation of an Android-based expert system application with features of disease diagnosis, diagnosis history, and a collection of diseases (Yanto et al., 2017). This further research has three stages, namely the first stage of data collection and interviews with experts. Then the expert system with forward chaining makes rules and determines the symptoms, as many as 36 symptoms, and the final stage of application is in the expert system assisted by application tools. The Expert System can also be applied to the Disease Detection Expert System based on complaints from patients. Several types of diseases can be detected based on complaints and produce solutions for early treatment (Husin et al., 2019).

METHOD

Methods and Techniques of Data Analysis

Sampling used a purposive sampling technique. Data collection was taken from several considerations. data analysis techniques in data collection to answer questions and answer phenomena in research problems. The analysis stage includes four mutually continuous stages, starting with the stage of collecting data; the stage of selecting criteria; the stage of reducing variables and making question categories; displaying data and drawing conclusions.

Research Needs Analysis

The analysis of research needs in the expert system for diagnosing infectious diseases in children under five is as follows.

- a. Input Needs Analysis includes: (1) Data on infectious diseases in children under five; (2) Data on the symptoms of infectious diseases in children; (3) Data on solutions for infectious diseases in children under five; (4) Data on prevention of infectious diseases in children under five.
- b. Process requirements analysis
Input data is entered and processed by the Forward Chaining method in the form of symptom data and solution data.
- c. Output Requirements
Analysis Output Requirements Analysis in the application of this expert system is to display information on the results of disease diagnosis, solutions, prevention and solutions produced by disease

Schematic of the Forward Expert System chaining

The following is the procedure for solving Forward chaining in the application of an expert system for diagnosing diseases, an expert system for diagnosing infectious diseases in children, as follows:

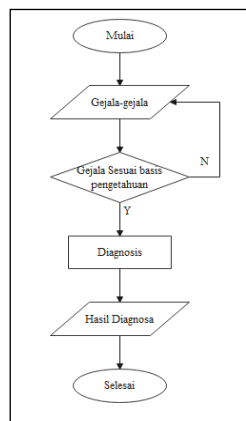


Figure 1. Scheme of The Infectious Disease Analysis System

RESULTS AND DISCUSSIONS

Analysis of Disease Symptoms Children

The symptoms in the application of an expert system using the forward chaining method in detecting infectious diseases in children are as follows:

Table 1. of Symptoms of Childhood Diseases

Code of Symptoms	Symptoms experienced	Code of Symptoms	Symptoms experienced
G001	High fever	G026	Swollen lymph glands in the ears and behind the neck
G002	Runny and stuffy	G027	Runny nose
G003	No appetite and nausea	G028	Weakness and tiredness
G004	Sore throat and cough	G029	Hoarseness
G005	Aches and pains	G030	Diarrhea
G006	Vomiting	G031	Urine Dark
G007	Difficulty breathing or rapid breathing	G032	Dehydration
G008	Chills	G033	Irritable and irritable
G009	Chest pain	G034	Severe weight loss
G010	Breathing sounds by a ringing sound	G035	Infrequent urination
G011	Difficulty breathing	G036	Heart beats faster
G012	Stomach pain due to persistent coughing	G037	shedding tears Difficulty
G013	Brownish -colored	G038	saliva Sunken eyes
G014	Red rash	G039	Wrinkles and dryness
G015	Have watery spots and sores around the mouth, hands and feet	G040	Face is thinner than usual

Code of Symptoms	Symptoms experienced	Code of Symptoms	Symptoms experienced
G016	Red blisters on tongue	G041	Arrhythmia (heart rhythm disturbance)
G017	Sneezing	G042	Low blood pressure
G018	Watery eyes	G043	Lethargy
G019	Difficulty seeing bright light	G044	U only a small amount of
G020	discharge A reddish-brown rash appears on the third day	G045	Seizures
G021	The spots will be red and more intense, but not itchy	G046	Severe diarrhea symptoms
G022	Flu symptoms subside but cough worse	G047	Pale stools
G023	Persistent hard cough G048	G048	Jaundice
G024	Choking or vomiting	G049	Itchy rash
G025	Formation of a grayish white membrane	G050	upper right abdominal area will feel pain especially

Application of Disease Tracing Graphs

As for graph analysis of expert system tracing using the forward chaining method in the detection of infectious diseases in children as follows:

Table 2. of symptoms of pediatric disease analysis

Aturan	Gejala
R1	If G001 and G002 and G003 and G004 and G005 Then P001
R2	If G001 and G002 and G003 and G004 and G006 and G007 and G008 and G009 and G010 and G011 and G012 and G013 Then P002
R3	If G001 and G002 and G003 and G004 and G006 and G014 and G015 and G016 Then P003
R4	If G001 and G002 and G003 and G004 and G006 and G017 and G018 and G019 and G020 and G021 then P004
R5	If If G001 and G002 and G003 and G004 and G025 and G026 and G027 and G028 and G029 then P005
R6	If G001 and G002 and G003 and G004 and G25 and G026 and G027 and G028 and G029 Then P006
R7	If G001 and G030 and G031 and G032 and G033 and G034 and G035 and G036 and G037 and G038 and G039 and G040 Then P007
R8	If G001 and G030 and G031 and G032 and G041 and G043 and G044 and G045 and G046 Then P008
R9	If G001 and G030 and G031 and G047 and G048 and G049 and G050 Then P10
R10	If G001 and G006 and G030 and 49 and G050 Then P010

Process Requirements Analysis

The input data entered and processed by the Forward Chaining method can be seen in the following tabl:

Table 3. Disease and Disease Name Disease

Code Disease	Disease Name
P001	Influenza
P002	Pneumonia (Acute Respiratory Infection)
P003	Singapore Flu (Foot, Hand and Mouth Disease)
P004	Rubeola (Measles, Measles 9 Days, Measles)
P005	Pertussis (Whooping Cough)
P006	Diphtheria
P007	Muntaber
P008	Ko lera
P009	Hepatitis A
P010	Typhoid
P011	Rubella (German Measles)

Analysis of Expert System Results with Forward Chaining
a. Cholera Disease Analysis

The results of the application of an expert system with the forward chaining method in detecting infectious cholera in children with a tracing tree are as follows:

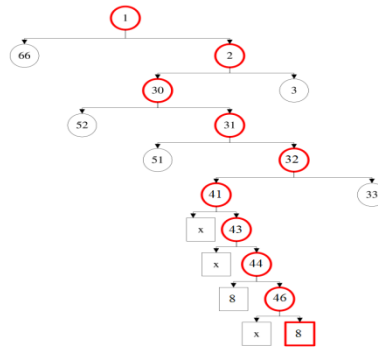


Figure 2. of Cholera Tracing Analysis

Image description

The rules / system rule in determining the analysis of children's disease with the value of the diphtheria variable, namely If High fever and Diarrhea and dark urine and Dehydration and Arrhythmia Heart rhythm disturbances and Lethargy (decreased consciousness and concentration of attention and alertness) and little or no urine and Seizures and severe diarrhea symptoms Then Cholera disease, namely vomiting that has 10 symptoms for the detection of vomiting disease.

b. Analysis of Diphtheria Disease in Children

The results of the application of an expert system with the forward chaining method in detecting infectious diphtheria disease in children with a tracing tree are as follows:

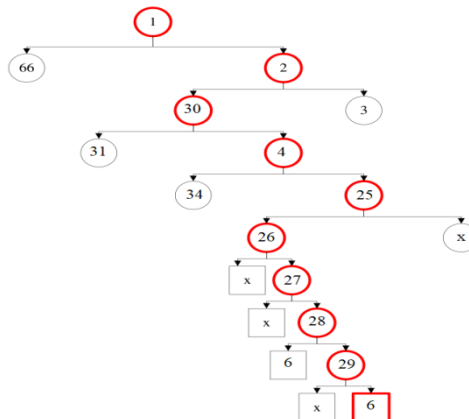


Figure 3. Analysis of Diphtheria Disease Tracking

Image description

Rules / system rules in determining the analysis of diphtheria in children with variables that consists of If High fever and Runny and stuffy nose and No appetite and nausea and Sore throat and cough and Formation of a grayish white membrane covering the throat and tonsils and Swollen lymph glands in the ears and behind the neck and Runny nose, initially runny, over time thick and sometimes bloody and weak and tired and hoarse voice Then diphtheria.

Results of Expert System Analysis Solutions

The results of the application of an expert system solution using the forward chaining method in disease detection with the results of the forward chaining solution are as follows:

Table 4. Results of Expert System Analysis Solutions

No	Relationship Type of Disease - Disease Solution
P001	<p>IF Influenza THEN Solution Keep children away from the outside environment so they don't infect to other children and adequate rest, give plenty of warm water. The drug is given in the form of giving acetaminophen according to the doctor's advice.</p> <p>Warning: If your child's symptoms get worse and don't improve for a long time, see a doctor immediately.</p>
P002	<p>IF Pneumonia (Acute Respiratory Infection) AND Mild Symptoms THEN Solution Give paracetamol or ibuprofen, read the recommendations for ibuprofen use or suffer from asthma, stomach ulcers and liver or digestive disorders</p> <p>Solution: Give enough water to prevent dehydration, get enough rest, take antibiotics regularly. Avoid taking cough medicine, give warm water mixed with honey and lemon to reduce cough. People with physical conditions who are usually healthy will recover normally after 14-21 days.</p> <p>Warning: If the symptoms of pneumonia do not improve at all within 48 hours, you are advised to contact your doctor again.</p>
P003	<p>IF Singapore Flu (Foot, Hand and Mouth Disease) THEN Solution To relieve pain and fever give acetaminophen or ibuprofen.</p> <p>Solution: Get enough rest and give plenty of cold drinks to reduce sore throat.</p> <p>Warning: Do not give aspirin to children and adolescents under 16 years of age.</p>
P004	<p>IF Rubeola Disease (Measles, Measles 9 days, Measles) AND Mild Symptoms THEN Solution See a doctor.</p> <p>Solution: Give lots of water (warm water can relieve cough) and give baby paracetamol (check the recommended age on the package) to lower body temperature. Vaseline will protect the skin around the lips.</p> <p>Warning: It is not necessary to take the child to the doctor because it may infect other children.</p>
P005	<p>IF Pertussis (Whooping Cough) THEN Solution Infants and children with whooping cough will be placed in isolation rooms to prevent the spread of infection.</p> <p>Solution: Help the child in expelling phlegm by laying him on your lap and then patting his back.</p> <p>Warning: The main treatment given is antibiotics to fight the bacteria that cause infection. Give your child easy-to-swallow food and give them plenty to drink.</p>
P006	<p>IF Diphtheria THEN Solution Immediately consult a doctor if you or your child shows symptoms of diphtheria.</p> <p>Solution: This disease is highly contagious and includes serious infections that can be life-threatening so it must be treated as soon as possible to prevent complications.</p>
P007	<p>IF Vomiting THEN Solution In infants, give breast milk to prevent the baby from becoming dehydrated. Switch to lactose-free formula.</p> <p>Solution: ORS solution, which is an oral rehydration solution, may be needed to prevent the baby from becoming dehydrated. This liquid itself consists of salt, sugar, potassium, and other nutrients.</p> <p>Warning: Immediately take to the doctor if the child has persistent vomiting and diarrhea. Children should also be taken to the doctor or hospital immediately if they are significantly dehydrated because it is feared that there are serious things that cause the condition. In cases of persistent vomiting, the doctor may perform an endoscopic examination to check the condition of the gastrointestinal tract.</p>
P008	<p>IF Cholera AND Mild Symptoms THEN Solution Administer ORS to replace lost fluids and electrolytes.</p>

Solution:

ORS is available in powder form that can be mixed with bottled mineral water or boiled water.

Warning:

Giving antibiotics to reduce the number of bacteria, while shortening diarrhea due to cholera.

CONCLUSION

The conclusion of the expert system analysis with the forward chaining method in the detection of infectious diseases in children is as follows With the existence of an expert system, it can diagnose children's diseases based on the rules and facts that have been determined by the experts. This study uses a forward-chaining expert system to analyze the type of disease and the resulting solution based on the symptoms input by the child The results of the analysis of Rubeola disease (Measles, Measles 9 days, Measles) with a diagnosis of "If high fever and runny and stuffy nose and no appetite and nausea and sore throat and cough and vomiting and sneezing and watery eyes and difficulty seeing light, and a reddish-brown rash appears on the third or fourth day behind the ears, and then spreads around the head and neck and The spots will be red and more numerous, but not itchy Expert system analysis with the Forward Chaining Method in Detecting Infectious Diseases in Children can diagnose diseases suffered by children and the level of disease taken based on the analysis of symptoms included in diagnosing the disease. With the analysis of children's diseases, parents are faster in taking preventive action.

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