DIAGNOSIS DETECTION OF ACUTE RESPIRATOR INFECTION WITH FORWARD CHAINING METHOD

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Abstract—Many acute respiratory infections or ARI are caused by viruses that attack the nose, trachea (breathing tube), or the lungs. It can be said that ARI is caused by inflammation that disrupts a person's breathing process. If not treated quickly, ARI can spread to all respiratory systems and prevent the body from getting proper oxygen, moreover it can cause the loss of a person's life. This research aims to diagnose ARI as an early step in practicing artificial intelligence in medicine, designing and apply an expert system that can diagnose ARI. The procedure used in this study uses forward chaining with tracking that begins with input data, and then creates a diagnosis or solution. The expert system used to diagnose acute respiratory inflammation uses the Forward chaining procedure with a data-driven approach, in this approach tracking starts from input data, and then seeks to draw conclusions, so that it can be used, diagnose the type of disease associated with the ARI disease experienced by showing the existing signs.

Keywords: forward chaining, ispa, expert system

Abstrak—Infeksi saluran pernapasan akut ataupun ISPA banyak diakibatkan oleh virus yang menyerang hidung, trakea (pipa pernapasan), ataupun paruparu. Dan dapat dikatakan ISPA disebabkan peradangan yang mengacaukan proses pernafasan seseorang. Apabila tidak lekas ditangani, ISPA dapat menyebar ke segala sistem pernapasan serta membuat badan tidak mendapatkan oksigen yang layak, apalagi yang lebih parah dapat menimbulkan hilangnya nyawa seseorang. Riset ini bertujuan untuk mendiagnosa penyakit ISPA selaku langkah dini mempraktikkan kecerdasan buatan dalam dunia kedokteran. merancang serta mengaplikasikan sistem ahli dapat yang mendiagnosa penyakit ISPA. Tata cara yang digunakan dalam penelitian ini menggunakan forward chaining dengan pelacakan yang diawali dari data masukan, serta berikutnya menciptakan

diagnosa ataupun pemecahan. Sistem pakar yang digunakan untk mendiagnosa peradangan saluran pernafasan akut memakai tata cara *Forward chaining* (pelacakan ke depan) dengan pendekatan yang di jalani dengan informasi (*data-driven*), dalam pendekatan ini pelacakan diawali dari data masukan, serta berikutnya berupaya menggambarkan kesimpulan, sehingga bisa mendiagnosa tipe penyakit yang berhubungan dengan penyakit ISPA yang dialami dengan memperlihatkan tanda-tanda yang ada.

Kata Kunci: *forward chaining*, ispa, sistem pakar

INTRODUCTION

ARI is a disease that is easily spread. People who are easily affected by this disease are those who have immune system disorders, elderly people, and children are also susceptible to this disease, because their immune systems are not fully developed. Acute respiratory infections according to (Mardiah et al., 2017) is a major health problem. Some ARI diseases include influenza, sinusitis, laryngitis, pharyngitis, tonsillitis, epiglottitis and pneumonia. (Wulandari & Basuki, 2019).

The problem that often arises according to (Nuraeni et al., 2016) is the availability of expert doctors or experts who have knowledge in certain fields which is quite limited while many patients need to be diagnosed with their illness and treated immediately. A system is needed according to (Ramadhana et al., 2020) that can provide convenience for the public to know and be aware of the early detection of ARI disease. So that people can know the first action that must be taken before going to the doctor for further treatment.

There are several studies that have been carried out in diagnosing diseases, including a webbased pregnancy diagnosis expert system (Abdillah et al., 2018), an expert system for diagnosing breast



Techno Nusa Mandiri : Journal of Computing and Information Technology As an Accredited Journal Rank 4 based on SK **Dirjen Risbang SK No. 85/M/KPT/2020** cancer and how to treat it (Puspitawati, 2018), expert applications for diagnosing skin diseases using this method, forward chaining (Nuraeni et al., 2016), the design of an expert system for diagnosing renal tubular acidosis using the certainty factor method (Fanny et al., 2017), an expert system for diagnosing allergic diseases in children based on the forward chaining method in the city of Batam (Jarti & Trisno, 2017), an expert system for diagnosing diseases caused by smoking using the forward chaining method (Hidayat & Gumilang, 2017), an expert system for diagnosing osteoporosis in the elderly using the forward chaining method (Permata Sari & Realize, 2019).

Of these methods, the most frequently used is the forward chaining method, forward chaining is a strategy to predict or find a solution to a problem that starts with a set of known facts (Permata Sari & Realize, 2019). In the Forward Chaining method, tracking starts from tracing all data and rules to achieve the goal (Nuraeni et al., 2016), with the Forward Chaining method departing from left to right, namely from the premise to the final conclusion, this method is often called data driven, namely The search is controlled by the data provided (Kusuma et al., 2018), so that the forward chaining method will be used to match the symptoms in the form of questions which will be answered by the user with existing rules, then conclusions will be obtained (Afandi & Sulistyo, 2019).

With the existence of a system that is useful for diagnosing disease, an expert system is a good solution to identify and provide data about diseases designed by the system so that humans can immediately recognize data about prevention and methods of curing the disease. The expert system used to diagnose throat diseases with the forward chaining method can be used to determine various diseases of the respiratory tract.

The purpose of this study is to facilitate the public in obtaining the necessary data about throat and respiratory diseases clearly and completely, especially those related to the symptoms of ARI.

MATERIALS AND METHODS

Expert System is a system or program that acts like an expert (Masya et al., 2016), and according to (Minarni et al., 2017) an expert system is a computer-based application that is used to solve problems as thought by experts. The experts in question are people who have special skills who can solve problems that cannot be solved by ordinary people (Hidayat & Gumilang, 2017). Most rulebased expert systems use an inference strategy called the ponen mode. Based on this strategy, if there is an "IF A THEN B" rule, and if it is known that A is true, then it can be concluded that B is also true. There are two approaches to control inference in a rule-based expert system, namely backward chaining and forward chaining (Wahyudi et al., 2016). The forward chaining method is said to be an inference method that makes reasoning from a problem to its solution (Permata Sari & Realize, 2019). While the inference engine is a computer program that provides a methodology for reasoning about the information contained in the rule or knowledge base, this component has a mindset and reasoning used by experts in solving a problem (Maliki & Dangkua, 2018). In this study, using the forward chaining method modeling for the manufacture of an expert system for diagnosing acute respiratory infections. The forward chaining method is a decision-making method commonly used in expert systems (Kusuma et al., 2018).

The types of systems that can use forward chaining tracking techniques are: (Kusuma et al., 2018).

- a. A system represented by one or more conditions.
- b. For each condition, the system searches the knowledge base for rules that correspond to the conditions in the if section.
- c. Each rule can generate a new condition from the conclusion requested in the then section, this new condition can be added to other conditions that already exist.
- d. Every condition added to the system will be processed, if a condition is found, the system will return to step 2 and look for the rules in the knowledge base again, if there is no new conclusion, the session ends.

Before implementing an expert system, first design the algorithm of the expert system. Algorithms are used to help make it easier to read the program created. In Figure 1 describes the process to get the results of a diagnosis of a disease, starting from the diagnosis form then answering questions in the form of answer choices that are in accordance with the symptoms after that display the results of the diagnosis.





Figure 1. Algorithm Design

RESULTS AND DISCUSSION

An expert system in the form of representation of knowledge from experts, where the content of this knowledge is composed of facts and rules. This knowledge content is composed of expert tables, expert rules and expert decision trees. The following is a detailed explanation of the knowledge content created:

1. Expert Table.

This design consists of symptom data and disease data which is a very important object to assist in processing an expert system for diagnosing acute respiratory infections. The following table of experts is designed to simplify the process of processing data entered into knowledge content. In table 1 there is a disease code and disease data that is the sample in this study which serves as initial data. The disease code is an alias of the disease data which is used as a comparison in the 'IF' condition.

No	Kode Penyakit	Nama Penyakit
1	P01	Rhinosinusitis / Sinusistis
2	P02	Tonsilitis, Faringitis, Laringitis (Radang
		Tenggorokan)
3	P03	Epiglotis
4	P04	Bronkitis
5	P05	Bronkiolitis
6	P06	Pneumonia
7	P07	Pleuritis
8	P08	Commond Cold
9	P09	ILI (Influenza Like Illness)

While in table 2 contains data gejala which contains kode gejala and the name of the symptom by adjusting the types of diseases that can be used in diagnosing ARI disease experienced by the user. The symptom code is an alias of the symptom name which is used as a comparison in the 'IF' condition.

Table 2. Data Gejala				
No	Kode Gejala	Nama Gejala		
1	G01	Demam		
2	G02	Batuk-Batuk		
3	G03	Hidung Tersumbat / Pilek		
4	G04	Sakit Kepala / Pusing		
5	G05	Sakit Tenggorokan / Susah Menelan		
6	G06	Lesu / Lemas		
7	G07	Sesak Napas		
8	G08	Frekuensi Napas Cepat		
9	G09	Suara Napas Kasar		
10	G10	Nafsu Makan Berkurang / Susah Makan		
11	G11	Berkurang Nya Indra Pengecap Dan Bau		
12	G12	Suara Serak		
13	G13	Gelisah / Susah Tidur		
14	G14	Nyeri Didada		
15	G15	Sering Muntah		
16	G16	Nyeri Sekitar Wajah		
17	G17	Nafas Berbau		
18	G18	Sakit Pada Persendian Dan Otot		
19	G19	Sakit Otot Dan Sendi		
20	G20	Perubahan Warna Ingus		

2. Expert Rules.

To reflect knowledge, a method in the form of IF-THEN is used. The rules used in this expert system are as follows:

Rule 1 IF Demam

AND batuk-batuk AND hidung tersumbat/pilek AND sakit kepala/pusing AND sakit tenggorokan/susah telan AND lesu/lemas AND nyeri sekitar wajah AND nafas berbau AND perubahan warna ingus THEN terdiagnosa penyakit rhinosinusitis

Table 1. Data Penyakit



Rule 2

IF Demam AND batuk-batuk AND hidung tersumbat/pilek AND sakit kepala/pusing AND sakit tenggorokan/susah telan AND lesu/lemas AND nafsu makan berkurang AND nyeri sekitar wajah AND nafas berbau AND perubahan warna ingus THEN terdiagnosa penyakit tonsilitis

Rule 3

IF Demam AND batuk-batuk AND hidung tersumbat/pilek AND sakit kepala/pusing AND sakit tenggorokan/susah telan AND nafsu makan berkurang AND nyeri sekitar wajah AND nafas berbau AND perubahan warna ingus THEN terdiagnosa penyakit epiglottis

Rule 4

IF Demam

AND hidung tersumbat/pilek AND sakit kepala/pusing AND sakit tenggorokan/susah telan AND sesak nafas/ AND frekuensi nafas cepat AND nyeri sekitar wajah AND nafas berbau AND perubahan warna ingus THEN terdiagnosa penyakit bronchitis

Rule 5

IF Demam AND hidung tersumbat/pilek AND sakit kepala/pusing AND lesu/lemas AND sesak nafas AND frekuensi nafas cepat

AND frekuensi nafas cepat AND suara nafas kasar AND berkurangnya indra pengecap AND sering muntah THEN terdiagnosa penyakit bronkiolitis

Rule 6

IF Demam AND batuk-batuk AND sakit kepala/pusing AND lesu/lemas AND sesak nafas AND frekuensi nafas cepat AND suara nafas kasar AND suara serak

THEN terdiagnosa penyakit pneumonia

Rule 7

IF Demam AND batuk-batuk AND sesak nafas AND frekuensi nafas cepat AND nafsu makan berkurang AND nyeri dada THEN terdiagnosa penyakit pleuritis

Rule 8

IF Demam AND batuk-batuk AND hidung tersumbat/pilek AND sakit kepala/pusing AND lesu/lemas AND nafsu makan berkurang AND berkurangnya indra pengecap THEN terdiagnosa penyakit commond cold

Rule 9

IF Demam AND batuk-batuk AND sakit kepala/pusing AND lesu/lemas AND nafsu makan berkurang AND sakit pada persendian THEN terdiagnosa penyakit ILI

3. Expert Decision Tree.

After knowing the expert rules, then a decision tree can be made to assist in the process of making a rule base which will later be used to provide solutions to existing problem conditions. This decision tree is created using a depth-first search, which is an in-depth search of the rule from the root node moving downwards to successive deep levels. The decision tree for the expert application designed in this study is shown in Figure 2.

The search on the expert decision tree starts from the top node to the bottom node. The next process depends on how the answer will be given by the user. If the user gives symptoms, then the system will proceed to the next question, namely the second symptom, and so on until it finds the disease that occurs, and if the user does not give symptoms, the search will continue to another question node to determine the existing disease. Node G (Gejala) is associated with node P (Penyakit). For example P01, the rhinosinusitis is in sections G01-G20 and so on until P09.

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Figure 2. Decision Tree.

4. Use Case Diagram Design.

The following is a design use case diagram of its users.





Figure 3 describes the use case diagram of a user on an expert system for diagnosing acute respiratory infections. In the 'Login' use case, the



actor performs is used to enter the system. For the use case data gejala is used to fill in data according to the complaints experienced by the user and the user uses the internet and a browser to use this website application. As for the kelola aturan use case, it is used to add and manage disease data and solutions that can be done and the user uses the internet and browser to use the website application. Use case Manage Symptoms is used to manage data on symptoms of disease and users use the internet and browsers to use website applications. Then for the use case kelola aturan is used to set the rules on the disease and the symptoms of the disease.

5. Entity Relationship Diagram Design.

In Figure 4 there are one/satu (1) and many/banyak (M) cardinality in the entity relationship diagram. Entities in the tbl_penyakit entity set are associated with more than one entity in the tbl_relasi entity set, and entities in the tbl_relasi entity set can only be associated with at most one entity in the tbl_penyakit entity set. the entity in the tbl_relasi set is associated with at most one entity in the tbl_gejala entity set and the entity in the tbl_gejala entity set is associated with more than one entity in the tbl_relasi entity set.



Figure 4. Entity Relationship Diagram

In addition, Figure 4 explains to model the data structure and the relationship between data, where there are three entities, namely tbl_penyakit, tbl_relasi, and tbl_gejala with the attributes in tbl_penyakit are kd_penyakit, nm_penyakit, and diagnosa. For attributes in tbl_relasi there are kd_penyakit, kd_gejala. As for the tbl_gejala attribute, it has kd_gejala and nm_gejala, which serve to make it easier to create relationships in databases and tables.

6. User Interface Design.

The user interface is used to provide an overview of the appearance of the application that will be used by the user.

a. Main Page Design User Login Menu.

In this menu there is a username and password column that must be filled in accordance with the time of registration on the system.

Log in.		
Silahkan Login Untuk Masuk		
Username		
Password		
	Remember me?	
	Log in	
Register as a new	user	

Figure 5. Form Login

Figure 5 describes the login form that serves to access the main page.

b. Main Menu Page Design.

After the user successfully logs in on the previous page, the home page will appear on the system and click the "Mulai Diagnosa" button to continue the system process.

		Pogues Lugan
Portal ISPA Portal ISPA adalah aplikasi sister Akut(ISPA) Mulai Dalgross 1	n pakar berbasis web untuk mendiagnosa p	venyakit Infeksi Saluran Pernafasan
Data Ponyakit	Data Geiala	Rule (Aturan)
Data i eriyakit		
Untuk mengelola Data Penyakti ISPA. Data penyakti bisa ditamabah, dirubah ataspun dihapus	Untuk mengelola Deta Penyakit ISPA. Data gejala bisa dilamabeh, dirubah ataupan dihapus	Untuk mengercia Data Ataran. Data Ataran bisa dirubah atarapan dihapus

Figure 6. Halaman Utama

Figure 6 describes halaman utama portal used for the homepage and for continuing access to the data penyakit of page, data gejala of page, and the rules page.

c. Diagnostic Menu Page Design.

Figure 7 explains that the user will fill in the data, according to the complaints experienced by the user, in the form of a 'iya' or 'tidak' condition and there is a description that the symptoms experienced in 'G01', 'G02', 'G03'.

Sakit Kepala /Pusing _{Otraa} _{Otraak}
G01;G02;G03

Figure 7. Diagnostic Menu

d. Results Menu Page Design.

After the diagnosis is made, a page will appear containing the results of the diagnosis and possible solutions.

	PORTAL ISPA			
Diagnosa penyakit : Rhinosinusitis / Sinusis	tis			
	Solusi :			
	*• Dekongentus, unitai meredakan hisiong terumuhat akhat penumpakan lendi. Ohat dekongentus terusefia dalam benuk caram, tablet, das sempcoran hisiong. • Pereda nyeri, umak meredakan sakit kepala atau nyeri, di bagian majah yang distribukan olish isuna. Belerang jenis olo atau nyeri yang turumu digunakan adalah paracetanol dan Hisiafar penggunaan sapira pada nade-ande usia di barwah. Ita batau, karena mambulikan efek samogr yang berbahaya • Kovidensirota biadang.			
Gejala-gejala	untuk mencegah dan mengobati peradangan pada sinus. Obat kortikosteroid yang biasa digunakan antara lain adalah fluticasone dan budesonide • Antibiotik, umumnya diberikan ketika sinusitis			
G01 Demam	akut disebahkan oleh infeksi bakteri dan gejala yang diracakan semakin memburuk. • Imunoterapi, diberikan jika sinuasis disebahkan oleh alengi. Terapi ini dilaksikan untuk membuntu mengurangi reskis tubuh terhadara elerene. Untuk sinuasisis kromis, landkah esenobatan dilakukan untuk			
G02 Batuk-batuk				
G03 Hidung torsumbat/pilek	mengurangi peradangan sinus, menjaga saluran bidung tetap kering, menangani penyebab dasar			
G04 Sakit Kepala /Pusing	sanusahs, dan menguranga serangan sanusatis. Pengobahan sanusahs kroms umumnya serupa dengan sinusitis akut, namun ada beberapa langkah penanganan tambahan yang dapat dilakukan untuk			
G05 Sakit tenggorokan / Susah menelan	meredakan gejala. Di antaranya adalah: • Saline nasal irrigation, untuk mengurangi penumpukan			
G06 Lesu / Lemas	cairan dan membersiskan zat penyebab iritasi dan atergi. • Kompres hangut, untuk membantu mengurangi rasa nyeri di rongga sinus dan hidung. • Dekongestan semprot dan hidung. Buiti			
G16 Nyeri sokitar wajah	petunjuk dokter untuk jangka waktu pemakaiannya. Jika terapi obat tidak lagi efektif untuk			
G17 Nafas berbau	meredakan gejala sanusitis kronss akibat deviasi septum hidung atau polip, dokter dapat mengambil langkah pembedahan yang disebut prosedur bedah sinus endoskopi fungsional			
G20 Perubahan warna ingus	(BSEF). Possebar mé didakakan umråt mendeka attan melekukan simus dengan cara - Mengengela jarangen, mislospa opio luhoda, syma menyumbat utanne missi. «Menonga balon kerell umråt mendeka anshara soma y ngi resundar. Tadakan att nelds aktend utstaga ällstan den mensamhänn kurskneterken yang dataraktina et dending simus. Possebar BESF datakan at banna pergarah ban total dan menggmahan alter melokepis, yanto selang kerell elasti yängi/virde dan operantikan insekneterken jang singan alter att dending simus. Possebar BESF datakan att banna pergarah banna att dana menggmahan alter melokepis, yanto selang kerell distat yängi/virde dan operantikan insekneterken jang singangan att melokepis, yanto selang kerell distat yängi sing banna pergarah banna att dana singan singangan.			

Figure 8. Results Menu

Figure 8 explains to find out the diagnosis of the disease based on the symptoms that have been summarized according to the options and solutions that can be given to the user.

e. Disease Data Manage Page Design.

This page is used to add and manage disease data and possible solutions.

ielola (Data Penyak	π		
	Kode Penyal	it Nama Penyakit		
	Solu			
Kode Perijakit	Nama Penyakit	Social Est Contro		
PO1	Anhositusēts / Sinusitāts	Networking with a measure mong target and and previous with origin and any end of the sector target and the sector target and the sector target and the sector target and target		
P02	Tonsiltis, Paringitis, Laringitis (Racang Tenggorokan)	"Deter stamp, aan mengkan interesti men jampi person Audeit ange person mekanan een hina taant, dom aan mengan interesti metano unuk enema a mekana mena kana metano kana dara person persona persona persona persona taap kana, kananu dara dara enema persona metano mekana menan persona persona persona persona persona taap kana kananu dara dara persona metano mekana kanan persona persona kanan taap engan para persona persona en bergener membana tempata interesti metan a persona metano tenso desta dara persona persona en bergener membana tempata interesti metan persona metano tenso persona dara persona persona en bergener metana seta persona taap persona intera kanan persona persona dara dara dara persona persona persona persona taap erem persona person		
P03	Epigiotis	Thosan sang pigalawan pasa kasu egipotiti kolan dengan memoka jian napa aktiat ostraki atu pemengakan egipotis. 💉 🗙 Apalat terdesan in tisat disukan masi aka bereka terpan pipula dan terdorum atoro dokata beten jian napa dinia teran tasa. Pemeran doke disukan pengka duhunan gun erasain terbai ngi penerambang an membupakan penergiyakan pengipotis.		

Figure 9. Data Penyakit Manage Page

In addition, Figure 9 explains that you can edit data penyakit and delete data penyakit.

f. Manage Data Gejala of Page Design.

On this page it is used to manage data gejala in disease.



ciola l	Jala Gejala		
	Kade Gejala Nama Gejala		
	Simpan		
Kode Gejala	Nama Gejala	Edit	Delete
301	Demam	1	×
302	Batuk-batuk	1	×
303	Hidung tersumbat/pilek	1	×
304	Sakit Kepala /Pusing	1	×
305	Sakit tenggorokan / Susah menelan	1	×
308	Lesu / Lemas	1	×
307	Sesak Napas	1	×
308	Frekuensi napas cepat	1	×
309	Suara napas kasar	/	×
310	Nafsu makan berkurang / Susah makan	1	×
1 2			

Figure 10. Manage Data Gejala Page.

Figure 10 functions to add, delete, or edit data gejala caused by the disease.

g. User Register Page Design.

This page is used to add users, so that they can access the system.

Portal ISPA Beranda	Tentang
Register. Create a new account	
User Name	Vani
Email	Vani.Tri@gmail.com
Access	User 🗸
Password	
Confirm password	The password and confirmation password do not match.
	Register

Figure 11. User Registration Page

While in Figure 11 it is explained to add a new user to access the system.

CONCLUSION

The expert system application created is based on a web base, so users can easily consult anytime anywhere just by accessing a browser. With this expert system, the general public can find out various kinds of symptoms and types of diseases and diagnoses given. For further development, it is hoped that more symptoms, types of diseases, and diagnoses will be added.

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