JURNAL RISET INFORMATIKA
Vol. 4, No. 2. March 2022

P-ISSN: 2656-1743 |E-ISSN: 2656-1735
DOI: https://doi.org/10.34288/jri.v4i2.153

Accredited rank 3 (SINTA 3), excerpts from the decision of the Minister of RISTEK-BRIN No. 200/M/KPT/2020

AUTOIMMUNE DISEASE DETECTION WITH DEMPSTER SHAFER AT TANJUNGBALAI GENERAL HOSPITAL

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Abstrak

Autoimun merupakan salah satu jenis penyakit yang menyerang sistem ketahanan tubuh manusia. Penyakit autoimun terjadi karena adanya gangguan sistem ketahanan pada tubuh akibat gagalnya pertahanan kestabilan kondisi tubuh, pada saat ini lah sistem imun menyerang tubuh yang sehat dianggap sebagai zat asing yang harus dihilangkan. pada penelitian ini dibangun sistem pakar dengan menggunakan metode Dempster-Shafer berbasis web berdasarkan nilai kepercayaan pakar terhadap gejala yang dirasakan pasien. sehingga dapat menyampaikan petunjuk terhadap penyakit autoimun dan langkah selanjutnya secara akurat dan informatif kepada masyarakat awam. Jenis penyakit yang diperoleh dari catatan rekam medik RS Umum Tanjungbalai terdapat 7 jenis penyakit autoimun yaitu ITP (Idiopathic Trombocytopenic Purpura), SLE (Systemic Lupus Erithematosus), DM Tipe 1, Graves Disiase, RA (Reumatoid Artritis), Hepatitis Autoimun, dan Thyroiditis Hashimoto. Dari penelitian ini menghasilkan ITP tingkat akurasi 98%, SLE tingkat akurasi 96%, Diabetes Melitus Tipe 1 tingkat akurasi 96%, Graves Disiase tingkat akurasi 93%, RA (Reumatoid Artritis) tingkat akurasi 99%, Hepatitis Autoimun tingkat akurasi 94%, dan Thyroiditis Hashimoto dengan tingkat ketepatan 99%.

Kata kunci: Autoimun;, Sistem Pakar; Dempster Shafer.

Abstract

Autoimmune diseases are diseases that attack the human immune system. Autoimmunity is a disorder of the immune system due to the failure of the body's defenses to stabilize conditions so that the immune system attacks a healthy body which is considered a foreign object that must be destroyed. Helping the public in the early detection of autoimmune diseases by using an expert system that is expected to detect autoimmune diseases early in Tanjungbalai Hospital so that they can provide early information about autoimmune diseases and appropriate and informative subsequent actions to the community. In this study, an expert system was built using the web-based Dempster-Shafer method based on the value of expert trust in the symptoms felt by the patient. There were 7 types of autoimmune diseases studied: ITP, SLE, Type 1 DM, Graves Disease, RA (Rheumatoid Arthritis), Autoimmune Hepatitis, and Hashimoto's Thyroiditis. This study resulted in ITP with an accuracy rate of 98%, SLE with an accuracy rate of 96%, Diabetes Mellitus Type 1 with an accuracy rate of 96%, Graves Disease with an accuracy rate of 93%, RA (Rheumatoid Arthritis) with an accuracy rate of 99%, Autoimmune Hepatitis with a 94% accuracy, and Hashimoto's thyroiditis with 99% accuracy.

Keywords: autoimmunity, expert system, dempster-Shafer

INTRODUCTION

Autoimmune is a problematic type of disease to detect due to the similarity of its symptoms to several other types of diseases (D. Setiawan, Putri, and Suryanita 2019). Autoimmunity is a disorder of the immune system that results in the failure of the body's defense of stability, causing losses because it can damage the organs of cells that are still healthy in a person's body(R. Setiawan, Suhery, and Bahri 2018). Autoimmune diseases can cause symptoms to affect the human immune system and attack the body (Permata Sari 2019). Based on medical records at the Internal Medicine Unit at Tanjungbalai Hospital, there are 7 types of autoimmune diseases, including ITP (Idiopathic Thrombocytopenic Purpura), SLE (Systemic Lupus Erythematosus), Type 1 DM, Graves Disease, RA (Rheumatoid Arthritis), Autoimmune Hepatitis, and Thyroiditis. Hashimoto.

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The expert system developed in 1960 is part of AI (Artificial Intelligence), which is quite old (Sihotang et al. 2018). One branch of artificial intelligence is an expert system, which uses special knowledge from an expert or experts to solve a particular problem(Christy 2018). Someone who has special skills and can solve problems that cannot be solved by the community is called an expert (Aldo, Putra, and Riau 2020). Part of the expert system, namely the consulting environment and development environment (PANESSAI 1375). The purpose of an expert system is to imitate the thought process and transfer knowledge from an expert in a particular field to a computer so that it can replace the task of an expert when the expert is not in place. To detect these autoimmune diseases, an expert system was created to assist the public in making early detection and knowing the types of autoimmune diseases through some of the symptoms experienced by patients.

The author uses the Dempster Shafer method in the detection of autoimmune diseases. Dempster Shafer is used to calculating inconsistencies due to the addition or subtraction of new facts that will change existing rules. The Dempster Shafer calculation process is carried out based on the expert's confidence value of the symptoms of a disease and can calculate the probability of all possible diseases from each symptom.(MZ, Wijaya, and Bimantoro 2020). Dempster Shafer is written with the interval [Trust, Reasonable]. Confidence (Bel) is a measure of the strength of evidence. A value of 0 indicates no evidence, a value of 1 indicates certainty. Reasonable (Pl) Reasonable is also 0 to 1" (Kirman1, Andika Saputra2 2019). The density function (m) defines the elements and all their subsets for which we need probabilities (Handayani Mugirahayu, Taufiq 2016). The results provided by the system must be those given by experts so that this certainty calculation can convince the user (patient)(Dina Hastari* 2018).

This study aims to design an expert system that can detect autoimmune diseases early in Tanjungbalai Hospital so that they can provide initial information about autoimmune diseases and appropriate and informative subsequent actions to the public. This autoimmune disease detection expert system applies the Dempster Shafer method in obtaining the final result of the diagnosis of the disease experienced by the patient based on some of the symptoms experienced by the patient.

RESEARCH METHODS

The research method is a data collection technique with a specific purpose and use. The steps are designed to be easily understood by the reader to solve the problem. The framework in this research is:

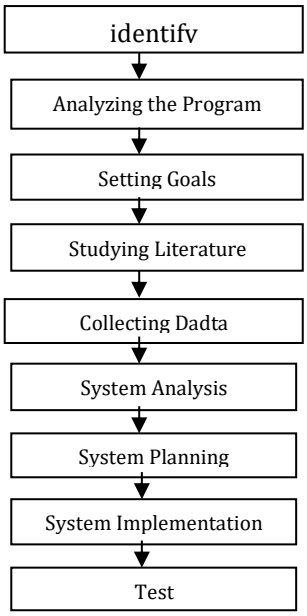

Figure 2 Research Framework

Types of research

Through detailed and in-depth data collection, a qualitative approach involves various sources of information such as observations, interviews, and documents from various reports(Sulistiono 2019). The method used in this research is the qualitative method. The data collection technique was carried out by observing at the Tanjungbalai Poly Internal Medicine Hospital and asking directly to the related parties to receive explanations, observation notes, interview results, and other documents.

Research Time and Place

This research has received ethical approval from the Director of RSUD Tanjungbalai No. 805/10697/RSUD. The study began on December 23, 2021 at the Dr. Tengku Mansyur, better known as the Tanjungbalai Regional General Hospital, located on Jln. Maybe. General Sutoyo No.39, Officer, South Tanjungbalai, Tanjungbalai City, North Sumatra 21313.

Data collection technique

Data collection techniques used in this study include:

1. Interview

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An interview is a conversation carried out by two people with a specific purpose (Dr. Umar Sidiq, M.Ag Dr. Moh. Miftachul Choiri 2019). The author conducted interviews with a doctor or professional expert in the treatment of autoimmune diseases, a specialist in Internal Medicine, namely (Dr. Abdul Jalil Rambe) this interview aims to obtain in-depth data about autoimmune and ensure that the data obtained are truly accurate both from exposure early symptoms to solutions in the prevention of autoimmune diseases.

2. Study of literature

Studying previous and similar research on autoimmune diseases, by collecting data from various literature sources in the form of scientific journals, theses, papers, books, internet (website).

3. Documentation

Data collection was obtained through patients with autoimmune diseases at the Internal Medicine Unit at Tanjungbalai Hospital.

Data analysis technique

Descriptive data analysis by categorizing one of the data analysis techniques(Lamada, Rahman, and Herawati 2019). Several autoimmune diseases found in the medical records of inpatient morbidity data at Tanjungbalai Hospital for the period 2018 to 2020 include ITP (Idiopathic Thrombocytopenic Purpura), SLE (Systemic Lupus Erythematosus), Type 1 DM, Graves Disease, RA (Rheumatoid Arthritis), Autoimmune. Hepatitis and Hashimoto's thyroiditis.

RESULTS AND DISCUSSION

Knowledge-Based

The knowledge base in research provides much information about various objects such as patients, diseases, and so on (Wahyudi and Akbar 2019). The results of the interviews are shown in table 1.

Table 1. Disease Data

Disease Code	Disease Name
P01	ITP (Idiopathic Trombocytopenic Purpura)
P02	SLE (Systemic Lupus Erithematosus)
P03	Diabetes Mellitus Type 1
P04	Graves Disiase
P05	RA (Reumatoid Artritis)
P06	Autoimmune Hepatitis
P07	Hashimoto's thyroiditis

Table 1 is disease data obtained from medical records at Tanjungbalai Hospital, and this table contains disease codes and 7 types of autoimmune diseases.

Table 2. Data on Autoimmune Disease Symptoms

Disease Code	symptom	Weight
G01	Nosebleed	0.2
G02	Excessive fatigue	0.4
G03	Blood spots in urine or stool	0.4
G04	Bleeding in the gums	0.6
G05	Bruises on body parts for no reason	0.8
G06	Out of breath	0.4
G07	Weight loss	0.2
G08	Joint swelling	0.6
G09	Headache	0.8
G10	Frequent urination	0.6
G11	Often thirsty	0.6
G12	tingling	0.4
G13	Often feel hungry	0.6
G14	myopic	0.4
G15	Eyes more prominent	0.2
G16	Red eye	0.4
G17	Eyes sensitive to light	0.4
G18	Double vision	0.6
G19	Blurred eyes	0.4
G12	tingling	0.4
G20	Joint pain	0.8
G21	Body feels weak	0.8
G22	Fever	0.5
G23	Joints feel warm	0.8
G20	Joint pain	0.8
G24	Fatigue	0.6
G25	Loss of appetite	0.6
G26	Nausea and vomiting	0.4
G27	skin rash	0.4
G28	Easily tired and tired	0.6
G29	Weight gain	0.6
G30	Cholesterol levels increase	0.8
G31	Dry skin	0.6
G32	Irregular menstruation	0.2

Table 2 is the symptom data of autoimmune diseases containing the symptom codes, symptoms, and weights given directly by the expert, namely the doctor on duty at Tanjungbalai Hospital, Internal

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Medicine Specialist, namely (Dr. Abdul Jalil Rambe).

The formation of rules is a rule in making decisions regarding diseases and symptoms obtained from experts, namely because there are 7 diseases, and there will be 7 rules as follows:

RULE 1 = IF G01 AND G02 AND G03 AND G04 AND G05 THEN P01
RULE 2 = IF G06 AND G07 AND G08 AND G09 THEN P02
RULE 3 = IF G10 AND G11 AND G12 AND G13 AND G14 THEN P03
RULE 4 = IF G15 AND G16 AND G17 AND G18 AND G19 THEN P04
RULE 5 = IF G12 AND G20 AND G21 AND G22 AND G23 THEN P05
RULE 6 = IF G20 AND G24 AND G25 AND G26 AND G27 THEN P06
RULE 7= IF G28 AND G29 AND G30 AND G31 AND G32 THEN P07.

After obtaining the rule from the expert, the rule execution process will be carried out based on the answers to the symptoms selected by the user.

a. ITP *(Idiopathic Thrombocytopenic Purpura)* (P1)

The symptoms selected by the patient are as follows.

1) Nosebleed
2) Excessive fatigue
3) Blood in urine or stool
4) Bleeding in the gums
5) Bruises on body parts for no reason

Then get the following results:

Nosebleed Symptoms (G1).

	P1 (0,2)	0 (0,8)
P1-P7 (1)	0,2	0,8

Excessive fatigue (G2).

	P1 (0,4)	0 (0,6)
P1 (0,2)	0,08	0,12
P1-P7 (0,8)	0,32	0,48

Spots of blood in the urine or stool (G3).

	P1 (0,4)	0 (0,6)
P1 (0,52)	0,208	0,312
P1-P7 (0,48)	0,192	0,288

Bleeding gums (G4)

	P1 (0,6)	0 (0,4)
P1 (0,712)	0,4272	0,2848
P1-P7 (0,288)	0,1728	0,1152

Unexplained bruising to any part of the body (G5).

	P1 (0,6)	0 (0,4)
P1 (0,8848)	0,7078	0,177
P1-P7 (0,1152)	0,0922	0,023

From these calculations, it can be concluded that the most accurate is ITP (Idiopathic Thrombocytopenic Purpura), with a 98% confidence level.

b. SLE *(Systemic Lupus Erythematosus)* (P2)

The symptoms selected by the patient are as follows.

1) Shortness of breath
2) Weight loss
3) Joint swelling
4) Headache

Then get the following results:

Shortness of Breath (G6) :

	P1 (0,4)	0 (0,6)
P1-P7 (1)	0,4	0,6

Weight Loss (G6)

	P2 (0,2)	0 (0,8)
P2 (0,4)	0,08	0,32
P1-P7 (0,6)	0,12	0,48

Joint Swelling (G6) :

	P2 (0,6)	0 (0,4)
P2 (0,52)	0,312	0,208
P1-P7 (0,48)	0,288	0,192

Headache (G9):

	P2 (0,6)	0 (0,4)
P2 (0,808)	0,6464	0,1616
P1-P7 (0,192)	0,1536	0,0384

From these calculations, it can be concluded that the most accurate is SLE (Systemic Lupus Erythematosus), with a 96% confidence level.

C. Diabetes Mellitus Type 1 (P3)

The symptoms selected by the patient are as follows.

1) Frequent urination
2) Often thirsty
3) tingling
4) Often feel hungry
5) nearsightedness

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Then get the following result:

Frequent Urination (G10)

	P3 (0,6)	0 (0,4)
P1-P7 (1)	0,6	0,4

Symptoms of Excessive Fatigue (G11)

	P3 (0,6)	0 (0,4)
P3 (0,6)	0,36	0,24
P1-P7 (0,4)	0,24	0,16

Tingling Symptoms (G12)

	P3,P5 (0,4)	0 (0,6)
P3 (0,84)	0,336	0,504
P1-P7 (0,16)	0,064	0,096

Often feel hungry (G13)

	P3 (0,6)	0 (0,4)
P3 (0,84)	0,504	0,336
P3, P5 (0,064)	0,0384	0,0256
P1-P7 (0,096)	0,0576	0,0384

Myopic (G14)

	P3 (0,4)	0 (0,6)
P3 (0,936)	0,3744	0,5616
P3, P5 (0,0256)	0,0102	0,0154
P1-P7 (0,0384)	0,0154	0,023

From these calculations, it can be concluded that the most accurate is Diabetes Mellitus Type 1, with a confidence level of 96%.

c. Graves Disease (P4)

The symptoms selected by the patient are as follows.

1 Eyes more prominent
2 Red-eye
3 Eyes sensitive to light
4 Double vision
5 Blurred eyes

Then get the following results:

Eyes more prominent (G15)

	P4 (0,2)	0 (0,8)
P1-P7 (1)	0,2	0,8

Red-eye (G16)

	P4 (0,4)	0 (0,6)
P4 (0,2)	0,08	0,12
P1-P7 (0,8)	0,32	0,48

Eyes sensitive to light (G17)

	P4 (0,4)	0 (0,6)
P4 (0,52)	0,208	0,312
P1-P7 (0,48)	0,192	0,288

Double vision (G18)

	P4 (0,6)	0 (0,4)
P4 (0,712)	0,4272	0,2848
P1-P7 (0,288)	0,1728	0,1152

Blurred eyes (G19)

	P4 (0,4)	0 (0,6)
P4 (0,8484)	0,3539	0,5309
P1-P7 (0,1152)	0,0461	0,0691

From these calculations, it can be concluded that the most accurate is Graves Disease, with a 93% confidence level.

d. RA (Reumatoid Artritis) (P5)

The symptoms selected by the patient are as follows.

1) Tingling
2) Joint Pain
3) The body feels weak
4) Fever
5) Joints feel warm

Then get the following results:

Tingling (G12)

	P3, P5 (0,4)	0 (0,6)
P1-P7 (1)	0,4	0,6

Joint Pain (G20)

	P5, P6 (0,8)	0 (0,2)
P3, P5 (0,4)	0,32	0,08
P1-P7 (0,6)	0,48	0,12

Body Feels Weak (G21)

	P5 (0,8)	0 (0,2)
P5 (0,32)	0,256	0,064
P3, P5 (0,08)	0,064	0,016
P5, P6 (0,48)	0,384	0,096
P1-P7 (0,12)	0,096	0,024

Fever (G22)

	P5 (0,5)	0 (0,5)
P5 (0,864)	0,432	0,432
P3, P5 (0,016)	0,008	0,008
P5, P6 (0,096)	0,048	0,048
P1-P7 (0,024)	0,012	0,012

Joints Feel Warm (G23)

	P5 (0,8)	0 (0,2)
P5 (0,932)	0,7456	0,1864
P3, P5 (0,008)	0,0064	0,0016
P5, P6 (0,048)	0,0384	0,0096
P1-P7 (0,012)	0,0096	0,0024

From these calculations, it can be concluded that the most accurate is RA (Rheumatoid Arthritis), with a 99% confidence level.

e. Autoimmune Hepatitis (P6)
The symptoms selected by the patient are as follows.
1) Joint pain
2) Fatigue
3) Loss of appetite
4) Nausea and vomiting
5) Skin rash

Then get the following results:
Joint Pain (G20)

	P5, P6 (0,8)	0 (0,2)
P1-P7 (1)	0,8	0,2

Fatigue (G24)

	P6 (0,6)	0 (0,4)
P5, P6 (0,8)	0,48	0,32
P1-P7 (0,2)	0,12	0,08

Loss of appetite (G25)

	P6 (0,6)	0 (0,4)
P6 (0,6)	0,36	0,024
P5, P6 (0,32)	0,192	0,128
P1-P7 (0,08)	0,048	0,032

Nausea and vomiting (G26)

	P6 (0,4)	0 (0,6)
P6 (0,84)	0,336	0,504
P5, P6 (0,128)	0,0512	0,0768
P1-P7 (0,032)	0,0128	0,0192

Skin rash (G27)

	P6 (0,4)	0 (0,6)
P6 (0,904)	0,3616	0,5424
P5, P6 (0,0768)	0,0307	0,0461
P1-P7 (0,0192)	0,0077	0,0115

From these calculations, it can be concluded that the most accurate is Autoimmune Hepatitis, with a 94% confidence level.

e. Hashimoto's thyroiditis (P7)
The symptoms selected by the patient are as follows.
1) Easily tired and tired
2) Weight gain
3) Cholesterol levels increase
4) Dry skin
5) Irregular menstruation

Then get the following results:
Quickly tired and tired (G28)

	P7 (0,6)	0 (0,4)
P1-P7 (1)	0,6	0,4

Weight gain (G29)

	P7 (0,6)	0 (0,4)
P7 (0,6)	0,36	0,24
P1-P7 (0,4)	0,24	0,16

Cholesterol levels increase (G30)

	P7 (0,8)	0 (0,2)
P7 (0,84)	0,672	0,168
P1-P7 (0,16)	0,128	0,032

Dry skin (G31)

	P7 (0,6)	0 (0,4)
P7 (0,968)	0,5808	0,3872
P1-P7 (0,032)	0,0192	0,0128

Irregular menstruation (G32)

	P7 (0,2)	0 (0,8)
P7 (0,9872)	0,1972	0,7898
P1-P7 (0,0128)	0,0026	0,0102

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From these calculations, it can be concluded that the most accurate is Hashimoto's Thyroiditis, with a 99% confidence level.

Results

The calculation results from P1-P7 can be seen in the following table:

Table 3. Results

No	Disease Name	Results
1.	ITP (Idiopathic Thrombocytopenic Purpura)	98%
2.	SLE (Systemic Lupus Erythematosus)	96%
3.	Diabetes Mellitus Type 1	96%
4.	Graves Disease	93%
5.	RA (Rheumatoid Arthritis)	99%
6.	Autoimmune Hepatitis	94%
7.	Hashimoto's thyroiditis	99%

Table 3. The final results of each type of the disease are calculated using the Dempster Shafer method.

System Implementation

The stages of the design after which the system is implemented to ensure the system is by design made.

1. Web Main Page Display

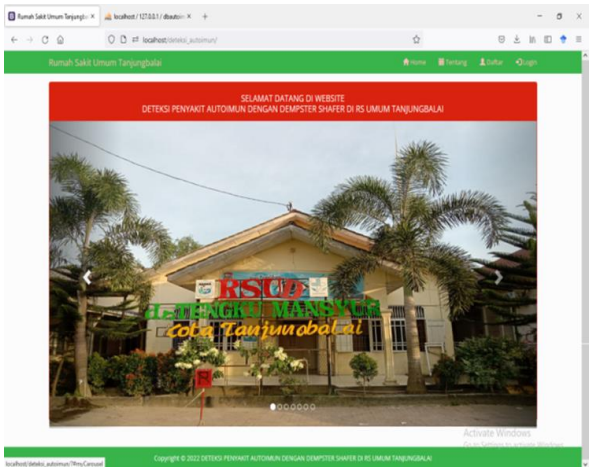

Figure 2. Display of the leading web page

Figure 2 is the main web page display where the user first accesses the system. Users can access other menus, such as the about menu, containing information about Tanjungbalai Hospital, menu lists, and login menus.

2. Consultation Page View

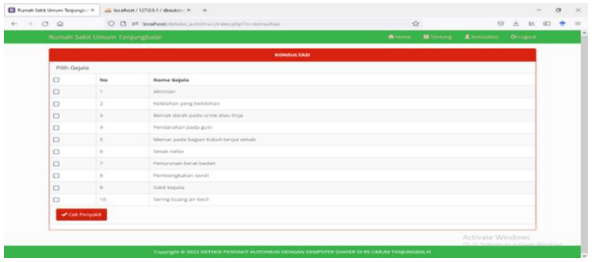

Figure 3. Consultation Page Display

Figure 3 Consultation page display displays where the user performs a consultation to check for diseases on the system. This page contains a selection of autoimmune symptoms that the user will carry out.

3. Display of Disease Check Results Page

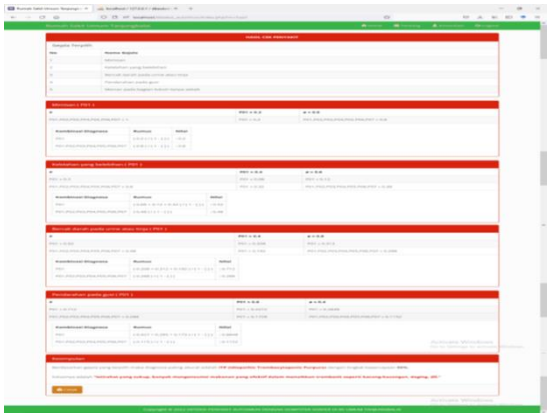

Figure 4. Display of Disease Check Results Pages

Figure 4 page display of disease examination results is a display where the user sees the results of the disease examination on the system based on several selected symptoms, and then the system will carry out the calculation process and display the percentage value of the type of disease that is more dominant and the solution for each type of disease. The disease test results page can be printed by clicking the red print menu in the lower-left corner of the page.

CONCLUSIONS AND SUGGESTIONS

Conclusion

The results of the application of the Dempster Shafer method in an expert system for detecting autoimmune diseases based on the symptoms that have been carried out then obtained the results of ITP (Idiopathic Thrombocytopenic Purpura) with an accuracy of 98%, SLE (Systemic Lupus Erythematosus) with an accuracy of 96%, Diabetes Mellitus 1 with an accuracy of 96 %, Graves Disease

with 93% accuracy, RA (Rheumatoid Arthritis) with 99% accuracy, Autoimmune Hepatitis with 94% accuracy, and Hashimoto's Thyroiditis with 99% accuracy. And the results of designing an expert system that can detect autoimmune diseases in Tanjungbalai Hospital so that patients get accurate results using the PHP programming language can facilitate the process of early detection of autoimmune diseases quickly and accurately by the application of the Dempster Shafer method so that it can be used as a reference in detecting diseases as early as possible. Suffered by the patient without having to come to the hospital. General Tanjungbalai and his system also provide solutions for detecting autoimmune diseases.

Suggestion

After the author has finished carrying out the research process, the author would like to suggest to the reader that it is hoped that there will be developed if there is similar research on Autoimmune Disease Detection with Dempster Shafer at Tanjungbalai Hospital, such as adding types of autoimmune diseases, disease information, and other experts so that research on Autoimmune Disease Detection with Dempster Shafer is carried out in Tanjungbalai Hospital is complete. And it is hoped that Autoimmune Disease Detection research can be developed with other methods so that a higher level of accuracy can be obtained and a comparison of the methods to be used can be made.

REFERENCE LIST

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JURNAL RISET INFORMATIKA
Vol. 4, No. 2. March 2022

P-ISSN: 2656-1743 |E-ISSN: 2656-1735
DOI: https://doi.org/10.34288/jri.v4i2.153

Accredited rank 3 (SINTA 3), excerpts from the decision of the Minister of RISTEK-BRIN No. 200/M/KPT/2020