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The Use of Case Based Reasoning (CBR) Methods to Diagnosis Diseases in Pregnancy

Nurul Elsa Fadilah[1], Yani Maulita[2], Husnul Khair[3]

[1,2,3] STMIK Kaputama

nurulelsafdlh5@gmail.com[1] ; yanimaulita26@gmail.com[2] ; husnulkhair@gmail.com[3]

Abstract

Diseases in pregnant women are diseases that many people need to watch out for, because diseases that occur in pregnant women will not only endanger one life, but more than that. According to Saifuddin, (2014). During this stage of pregnancy, it is possible for a mother to experience problems with her health, especially the problem of danger signs in her pregnancy which can affect the pregnancy process and the delivery process if the gestational age has entered the term stage, which is 37-40 weeks.

Hypertension currently occupies the 2nd position as a type of disease that threatens the lives of many pregnant women. The application of Case Based Reasoning (CBR) in diagnosing diseases that occur during pregnancy is motivated by the difficulty of consulting an obstetrician because of limited funds, time or even a limited number of doctors in the hospital. The use of CBR aims to solve new problems by adapting solutions from problems that occurred before. The expert system itself is one of the solutions to solve problems faced by users in the health sector, this system can minimize costs incurred to consult about diseases in pregnancy to specialist doctors. "Using Case Base Reasoning (CBR) to Diagnose Diseases in Pregnancy" is expected to help the general public, especially pregnant women, in making a simple diagnosis of symptoms and diseases in pregnancy.

Keywords: *Case Based Reasoning, Diseases of Pregnancy, Hypertension.*

1. Introduction

According to the Minister of Health of the Republic of Indonesia Budi Gunadi Sadiki revealed that if expressed in numbers, cases that occur in pregnant women reach 300 people per 1000 population with the two biggest causes of death one of which is hypertension. An interview was conducted with one of the village midwives who stated that hypertension is a disease that is prone to occur during pregnancy with common symptoms that are often overlooked which can cause severe acute morbidity, long-term disability, and also death in the mother and mother. Mother. Darling. In Binjai, the health facilities provided for pregnant women are still very limited, especially in the places I researched. The limited number of obstetricians or midwives, as well as the lack of counseling information about pregnancy are the factors causing many unhealthy pregnancies and neonatal deaths in infants. Limited funds are also an obstacle for pregnant women to be able to routinely check the condition of their womb directly at major hospitals, making the puskesmas the only facility of choice for pregnant women to be able to check the condition of their pregnancy. Based on the background above, it is necessary to have an expert system that can diagnose diseases that occur in pregnant women, namely by using the Case Based Reasoning (CBR) method where new problems can be solved if similar cases have been found in the past, and their reuse in problem situations. the new [1]

2. Theoretical Basis

2.1. Definition of Expert System

An expert system is a branch of Artificial Intelligence (AI) that utilizes special knowledge to solve human expert-level problems [2] It can be concluded that in general an expert system can be interpreted as a system that can imitate the expertise of an expert in solving a particular problem. There are several methods that can be used in making expert systems, one of which is the Case Based Reasoning method.

2.2. Definition of Case Based Reasoning (CBR)

Case Based Reasoning is an approach to solving a problem (problem solving) faced from a solution to a problem that has occurred before. Case Based Reasoning itself is a problem-solving paradigm that has received a lot of recognition that is fundamentally different from other AI first approaches. A new problem can be solved if you have found similar cases in the past and reused them in new problem situations [3], [4] The stages in the Case Based Reasoning method consist of 4, namely:

1. Retrieve
   The retrieve stage is the stage where a search for the level of similarity of a case will be carried out by entering the input of the symptoms that have been given by the patient on the basis of existing cases in the knowledge base to search for other cases that have the highest similarity (similarity). Only cases that have a level of similarity with the base case can then be processed at the next stage, namely the reuse stage. At this stage the research uses similarity techniques to the k-nearest neighbor algorithm with the following formula:

   $$Similarity\ (T,S) = \frac{S_1 X\ W_1 + S_2 X\ W_2 \ldots + S_n X\ W_n}{W_1 + W_2 + \ldots + W_n} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (n)$$

   S = similarity (similarity value), namely 1 (same) and 0 (different).

   W = weight (given weight).

2. Reuse
   At this stage calculations will be carried out from the value of similarity or similarity of each highest case which has previously been matched with the most relevant to the new case to the old case, so that the results of the research on the value of the equation will obtain proposed solutions from previous cases, where things it may be necessary in order to troubleshoot new cases, or in other words reuse old cases as handlers of new, similar cases. The selected similarity value will be multiplied by the weight that has been divided by the total symptom weight value in the old case.

3. Revise
   At this stage is the stage where the solution to the case on drug suggestions is the result of the diagnosis to be corrected. In this validation process, the system will revise, namely where through the considerations of the medical staff, the case solution on drug suggestions will be processed again by the system to proceed to the retain stage. The system will produce solutions that will be developed and stored in the system to become new knowledge.

4. Retain

   Is a stage where solutions that have been repaired previously will be stored and used as patient medical record data. If the expert declares the new case as a valid case, then the new case can be updated into the case base.

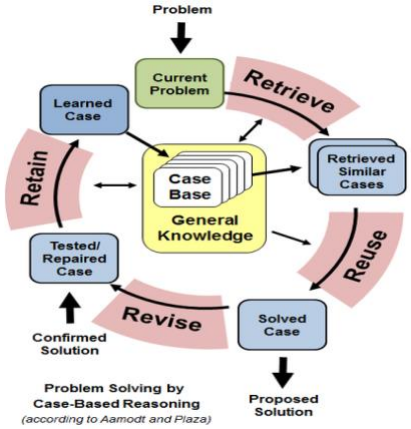

Fig. 1: Case Based Reasoning Method Cycle

2.3. K-Nearest Neighbor

Nearest Neighbor is an approach to finding a case by calculating the closeness/similarity between new cases and old cases, based on matching the weights of a number of existing features. For example, when you want to find a solution to a new case, a patient can use a

solution from the previous patient case that has a close relationship between cases. To find out which patient case will be used as a solution for the new case, the proximity of the two cases will be calculated, the case that has the greatest closeness will be the solution to be used in the case of a new patient [5], [6].

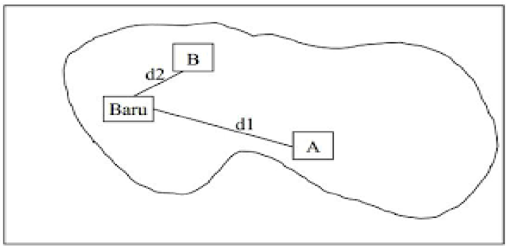

Fig. 2: Illustration of Case Proximity

The formula for calculating the closeness between the two cases is as follows:

$$Similarity\ (T,S) = \frac{\sum_{i}^{n}=1\ \int(Ti,Si)*Wi}{Wi} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots..(n)$$

Information:
T : New case
S : The case that is in the data store
n : The number of attributes in each case
i : individual attribute between 1 to n
f : attribute i similarity function between case T and case S
w : The weight given to the i-th attribute
Proximity is usually rated between 0 to 1. A value of 0 means that the two cases have absolutely no resemblance, otherwise if the value is 1 then the two cases have an absolute similarity value.

3. Research Methods

Library research (library research) is a research process in which the writer conducts study of various forms of written materials, whether in the form of books, articles, and other scientific works. The data obtained are theoretical data. Field research (field research) is a research process carried out directly on the object of study itself which is the subject matter. In this field research the authors collect data through:

a. Interview; Namely conducting questions and answers with midwives at the puskesmas and also obstetricians to obtain information about pregnancy diseases and the symptoms of these diseases. Interviews were conducted with Midwife Henny Rahmayani and also Obstetrician dr. Indra Tarigan, Sp. OG.
b. Observation; Namely observing or seeing the operational system that is currently running where the research is carried out. Observations were made at the Suka Makmur Health Center.

4. Results And Discussion

In designing an expert system for diagnosing diseases in pregnancy, the authors use the case based reasoning method to solve existing problems, the system designed is a system with conditions that adjust the symptoms of pregnant women with the conclusion that the data obtained and collected into the database, as for the steps – the steps that the author takes are as follows:

1. Collecting theories about diseases in pregnancy that have almost similar symptoms, including types of pregnancy diseases, symptoms of these diseases, and also methods of treatment which come from midwives, obstetricians and also books related to diseases on pregnancy.
2. Program design, programs designed to match the types of diseases in pregnancy with the symptoms of patients/pregnant women after being collected into the database.

Calculations with the Case Based Reasoning method

Table 1: Types of hypertension in pregnancy

No	Disease Name	Disease Code
1	Gestational Hypertension	K001
2	Preeclampsia	K002
3	Eclampsia	K003

After conducting an interview with obstetrician Dr. Indra Tariga, Sp.OG at RSU Arta Medica Binjai, from the interview results and also the analysis process, the weighting value for each symptom can be determined as follows:

Table 2: Weighting of Symptoms of Gestational Hypertension

No	Symptoms of Gestational Hypertension	Weight
1	Nausea and vomiting	3
2	Severe headaches	3
3	Nosebleeds	5
4	Shortness of breath	1
5	Pain in the solar plexus	3
6	Impaired vision	1

7	ringing in the ears	5
8	Cardiac arrhythmias	5
9	Blood in the urine	5
10	Abnormal increase in blood pressure	1
11	Impaired organ function	3
12	Dizziness/vertigo	3
13	Often experience numbness in the limbs	5

Table 3: Weighting of Symptoms of Preeclampsia

No	Symptoms of Preeclampsia	Weight
1	Severe headache	5
2	Impaired vision	3
3	Pain in the solar plexus	3
4	Pain in the right upper abdome	3
5	An abnormal increase in blood pressure	3
6	Shortness of breath	1
7	Decreased frequency of urination	1
8	Nausea and vomiting	1
9	Swelling of the legs, hands, face and several other body parts	1
10	Unnatural weight gain	1
11	Increased protein in the urine	5
12	Dizziness/vertigo	3
13	Impaired function of organs	3

Table 4: Weighting Symptoms of Eclampsia

No	Symptoms of Eclampsia	Weight
1	Abnormal increase in blood pressure	5
2	Severe headaches	3
3	Dizziness/vertigo	1
4	Swelling of the legs, hands, face and several other limbs	1
5	Unnatural weight gain	1
6	Impaired vision	5
7	Nausea and vomiting	5
8	Pain in the right upper abdomen	3
9	Decreased frequency of urination	5
10	Shortness of breath	5
11	Pain in the solar plexus	5
12	Impaired function of organs	5

Table 5: Proximity of Attribute Values of Disease Symptoms

Old Cases	New Cases	Proximity
Yes	Yes	1
No	No	1
Yes	No	0
No	Yes	0

After doing the weighting, a table like the following will be obtained to calculate between old cases and new cases. Next is an example of an old case :

Table 6: Old Case Example

Old Cases : K001	Old Cases: K002	Old Cases: K003
1. Nausea and vomiting 2. Headache feels heavy 3. Nosebleed 4. Shortness of breath 5. Pain in the solar plexus 6. Ringing ears 7. Heart rhythm disturbances 8. Abnormal increase in blood pressure 9. Often experience numbness in several parts of the body	1. Severe headache 2. Pain in the solar plexus 3. Pain in the right upper abdomen 4. Abnormal increase in blood 5. Shortness of breath 6. Swelling of the legs, hands, face and several other limbs 7. Weight gain is not normal 8. Heart rhythm disturbances 9. Nausea and vomiting	1. Swelling of the legs, face and several other limbs 2. Nausea and vomiting 3. The frequency of defecation decreases 4. Pain in the solar plexus 5. Abnormal increase in blood pressure 6. Shortness of breath 7. Weight gain is not normal
Diagnosis : Gestational Hypertension	**Diagnosis :** Preeclampsia	**Diagnosis :** Eclampsia
Treatment : Labetalol Ji Nifedipine	**Treatment :** Antihypertensive Anticonvulsant Corticosteroid	**Treatment :** benzodiazepines phenytoin

Next is an example of a new case :

Table 7: New Cases Example

X disease	
1. Nausea and vomiting	Yes
2. Shortness of breath	Yes

3.	Pain in the right upper abdomen	Yes
4.	Swelling of the legs, hands, face and several other limbs	Yes
5.	Dizziness/Vertigo	Yes
6.	Abnormal increase in blood pressure	Yes
7.	Rhythm disturbances in the heart	Yes
8.	Pain in the solar plexus	Yes

The calculation process uses the Case Based Reasoning method, as follows Calculating the proximity of a new case to case K001:

K001	New Cases	Proximity	Weight
Nausea and vomiting	Nausea and vomiting	1	3
Severe headache		0	3
Nosebleed		0	5
Shortness of breath	Shortness of breath	1	1
Pain in the solar plexus	Pain in the solar plexus	1	3
Ringing ears		0	5
Disturbance in heart rhythm	Disturbance in heart rhythm	1	5
bnormal increase in blood pressure	bnormal increase in blood pressure	1	1
Often experience numbness in several parts of the body		0	5
	Pain in the right upper abdomen	0	0
	Swelling of the legs, hands, face and several other limbs	0	0
	Dizziness/vertigo	0	0
	Frequency of defecation decreased	0	0

Calculation of similarity / similarity using
Equality :
Similarity (Disease X, Gestational Hypertension)

$$Similarity\ (T, S) = \frac{(S_1\ X\ W_1)+(\ S_2 X\ W_2)\ldots+(S_n X\ W_n)+}{(W_1+W_2)+\ \ldots\ +W_n)} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ (n)$$

$$= \frac{(1x3)+(0x3)+(0x5)+(1x1)+(1x3)+(0x5)+(1x5)+(1x1)+(0x5)+(0x5)+(0x0)+(0x0)+(0x0)+(0x0)}{3+3+5+1+3+5+5+1+5+\ +5+0+0+0+0}$$

$$= \frac{3+0+0+1+3+0+5+1+0+0+0+0+0+0+0}{3+3+5+1+3+5+5+1+5+5+0+0+0+0}$$

Distance = 13/36
Distance = 0.36
Then the results of the calculation obtained a similarity value of 0,36 or 36%

Calculating the proximity of a new case to case K002:

K002	New Cases	Proximity	Weight
Severe headache		0	5
Pain in the solar plexus	Pain in the solar plexus	1	3
Pain in the upper right abdomen	Pain in the upper right abdomen	1	3
Abnormal increase in blood	Abnormal increase in blood	1	3
hortness of breath	hortness of breath	1	1
Swelling of the legs, hands, face and several other limbs.	Swelling of the legs, hands, face and several other limbs.	1	1
Unnatural weight gain		0	1
Nausea and vomiting	Nausea and vomiting	1	1
	Rhythm disturbances in the heart	0	0
	Dizziness/vertigo	0	0
	Frequency of defecation decreased	0	0

Similarity (Disease X, Preeclampsia)

$$Similarity\ (T, S) = \frac{S_1\ X\ W_1 + S_2 X\ W_2 \ldots + S_n X\ W_n}{W_1+W_2+\ \ldots\ +W_n} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ (n)$$

$$= \frac{(0x5)+(1x3)+(1x3)+(1x3)+(1x1)+(1x1)+(0x1)+(1x1)+(0x0)+(0x0)+(0x0)}{5+3+3+3+1+1+1+1}$$

$$= \frac{0+3+3+3+1++1+0+1+0+0+0}{5+3+3+3+1+1+1+1}$$

Distance = 12/18
Distance = 0.66

Then the results of the calculation obtained a similarity value of 0,66 or 66%

Calculating the proximity of a new case to case K003:

K003	New Cases	Proximity	Weight
Swelling of the legs, hands, face and several other limbs	Swelling of the legs, hands, face and several other limbs	1	3
Nausea and vomiting	Nausea and vomiting	1	5
Decreased frequency of defecation	Decreased frequency of defecation	1	5
Pain in the pit of the stomach	Pain in the pit of the stomach	1	5
Abnormal increase in blood pressure	Abnormal increase in blood pressure	1	5
Shortness of breath	Shortness of breath	1	5
Abnormal weight gain		0	3
	Pain in the right upper abdomen	0	3
	Dizziness/vertigo	0	1
	Rhythm disturbances in the heart	0	0

Similarity (Disease X, Eclampsia)

$$Similarity\ (T, S) = \frac{S_1 X\ W_1 + S_2 X\ W_2 \ldots + S_n X\ W_n}{W_1 + W_2 + \ldots + W_n} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (n)$$

$$= \frac{(1x3) + (1x5) + (1x5) + (1x5) + (1x5) + (1x5) + (0x3) + (0x1) + (0x0)}{3+5+5+5+5+5+3+1+0}$$

$$= \frac{3+5+5+5+5+5+5+0+0+0}{3+5+5+5+5+5+5+3+1+3}$$

Distance = 28/35
Distance = 0.80

Then the results of the calculation obtained a similarity value of 0,80 or 80%

From the results of calculating the closeness of old cases to new cases, the full details can be seen in the following table:

Table 8: Proximity of Old Cases to New Cases

Old Cases	Value of Similarity	Criteria for Similarity
K001	0,36	low
K002	0,66	Moderate
K003	0,80	High

From the calculation above, there are 3 types of existing cases, the case with the lowest similarity weight is the case with code K001 with a similarity value of 0.36. Meanwhile, the case that has the highest weight value with similarity is the case with the K003 code of 0.80. So, the solution to be given certainly lies in the case with the highest similarity. The results of calculations with weights show a similarity value of around 80% to the K003 solution recommended by the system with eclampsia.

5. Testing

The display results of the system program that will diagnose hypertension in pregnancy will be designed as follows:

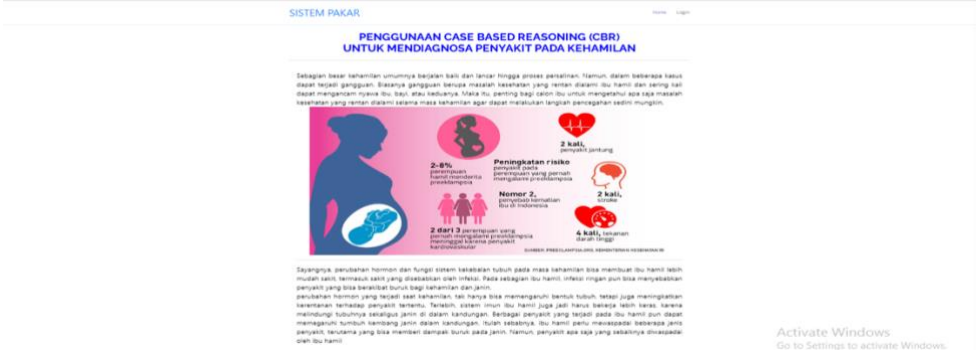

Fig 5: Login Page

Fig. 6: Admin Page

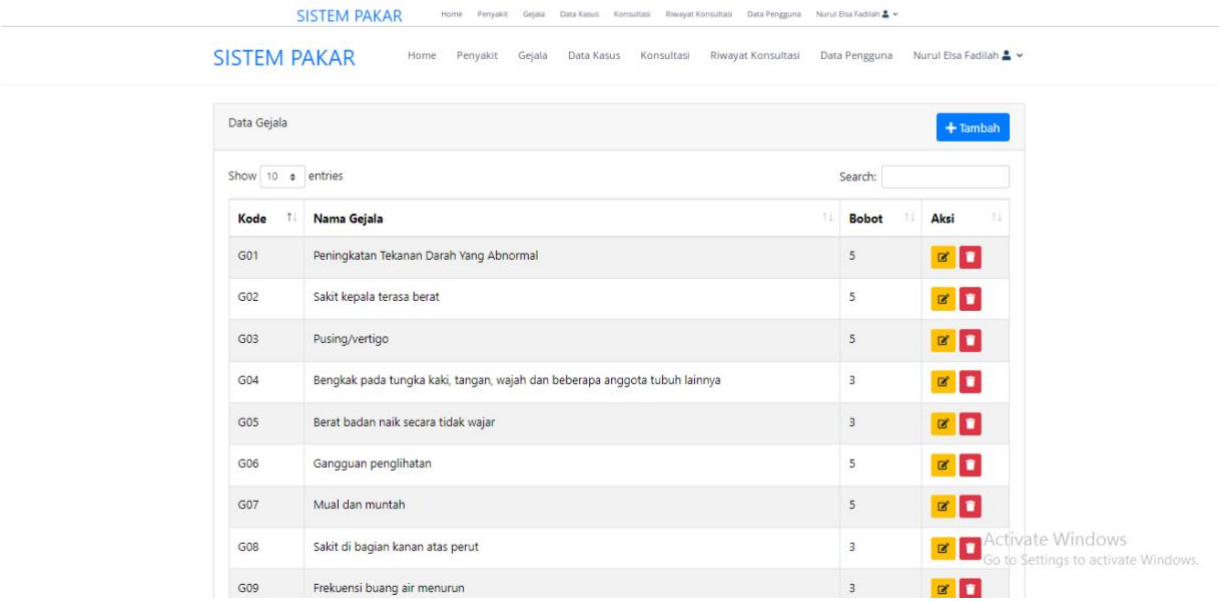

Figure 7: User Page

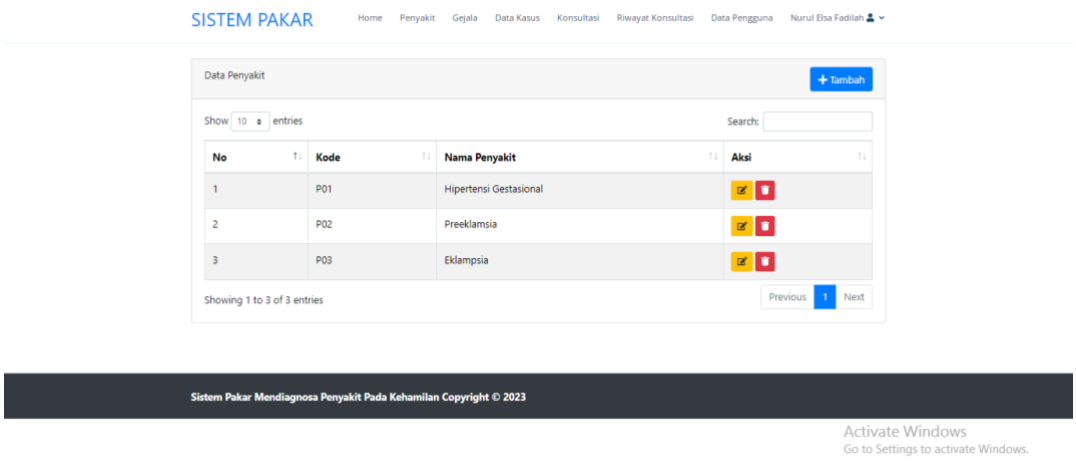

Fig. 8: Disease data page

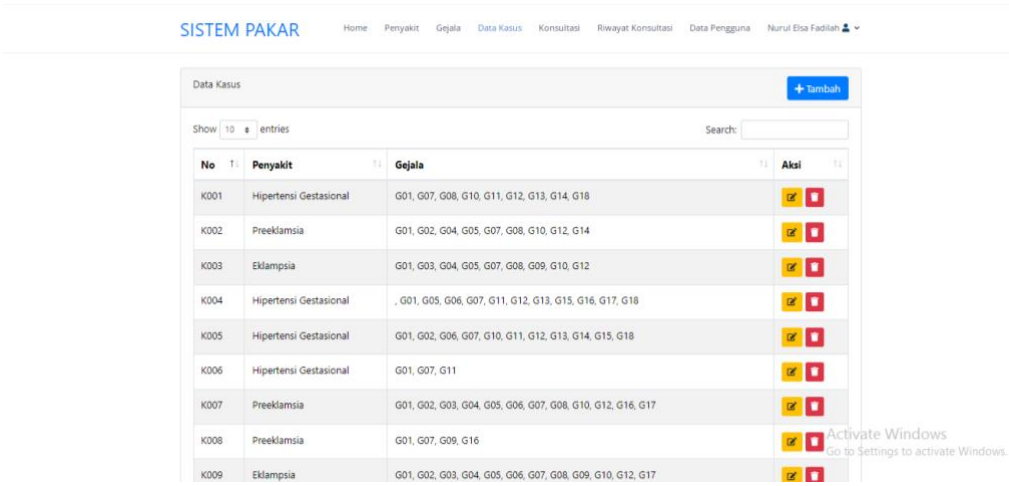

Fig. 9: Symptoms page

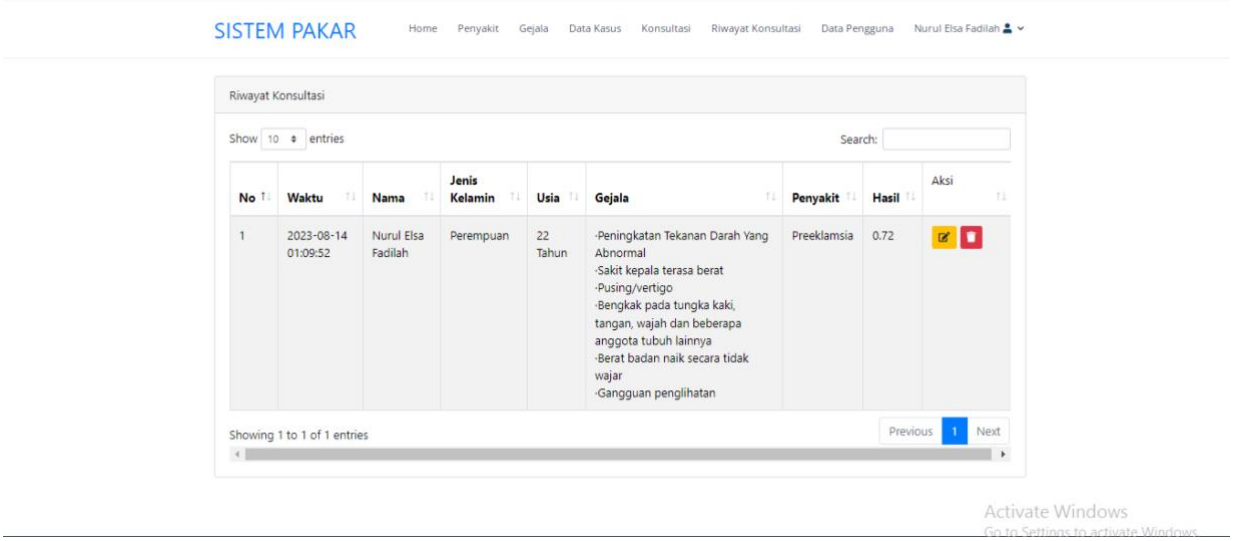

Fig. 10: Case data page

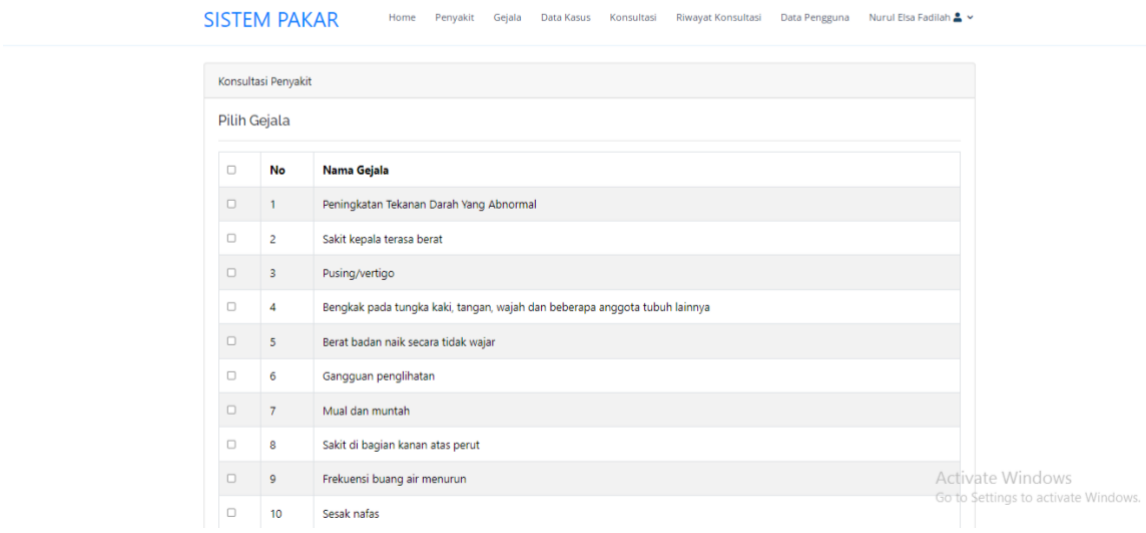

Fig. 11: Consultation history page

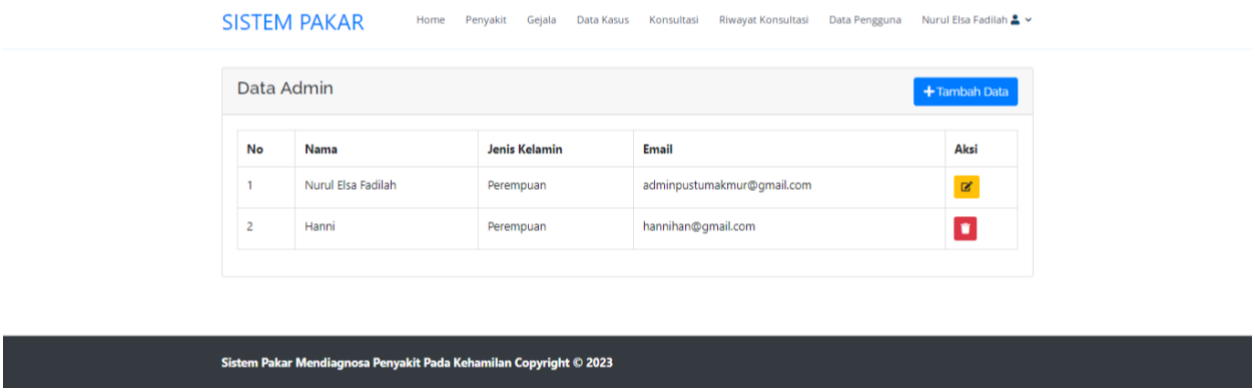

Fig. 13: User data page

6. Conclusion

Based on the research that has been conducted during the application of the Case Based Reasoning (CBR) method in the Use of the Case Based Reasoning Method to Diagnose Diseases in Pregnancy, several conclusions can be drawn as follows:

1. By building an expert system that is useful in diagnosing hypertension properly. Hypertension is not something that can be ignored anymore, an initial understanding with this research is believed to be able to help many people who want to know about hypertension, especially in pregnant women.
2. The existence of this system will greatly help midwives, pregnant women and even prospective pregnant women to know and add insight that hypertension in pregnancy is different from hypertension that occurs in ordinary people.
3. By using the CBR method, calculations can be performed automatically when the Admin inputs the weight values and similarity values, so as to reduce obstacles in diagnosing hypertension in pregnancy.

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