

Expert System To Determine Psychological Disorders In Chronic Kidney Failure (CKD) Patients Undergoing Hemodialysis Therapy Using Certainty Factor Method

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Abstract

Chronic Kidney Failure (CKD) is damage to the kidneys both in structure and/or function that lasts for 3 months or more. Hemodialysis is a prolonged therapy that can significantly impact the physical and psychological well-being of patients with chronic kidney disease. This therapy has a big effect on sufferers. The psychological impact that appears can affect the success of therapy so it is important to recognize these symptoms and provide appropriate treatment to overcome them. Based on research at Delia General Hospital, patients who will undergo Hemodialysis therapy must come to the hospital to receive comprehensive therapy by a doctor. Long patient queues when undergoing therapy can make patients tired and remember the patient's condition in order to get information and therapy. Handling of these problems can be overcome by building a system that can determine psychological disorders in patients. Expert systems are computer-based systems that use knowledge, facts and reasoning techniques in solving problems that usually can only be solved by an expert in a particular field. Certainty Factor (CF) is a method capable of defining the degree of certainty of a rule or fact in describing an expert's belief in the problem at hand. With an expert system, it can help identify and determine early on psychological disorders in patients. From the results of trials conducted by expert systems to determine psychological disorders in patients with kidney failure using the Certainty Factor method, the highest value is depression with a percentage of 94.59%.

Keywords : *Certainty Factor, Chronic Kidney Failure, Psychological, Expert System.*

1. Introduction

Chronic Kidney Failure (CKD) is damage to the kidneys both in structure and/or function that lasts for 3 months or more. If the condition of changes in kidney function occurs suddenly or acutely and has not reached 3 months, it is called acute kidney disorder. The most common causes of chronic kidney failure in Indonesia are diabetes mellitus/diabetes and uncontrolled hypertension/high blood pressure. However, the view in the general public is that it is the long-term consumption of high blood pressure or diabetes medications that can actually cause chronic kidney failure [1].

Hemodialysis is a prolonged therapy that can significantly impact the physical and psychological well-being of patients with chronic kidney disease. This therapy has a big effect on sufferers both physically and mentally so naturally the impact of this therapy makes big changes. Some of them are the ability to work, the emergence of feelings of loss of control, anxiety, fear of death, fatigue, and decreased quality of life. The psychological impact that appears can affect the success of therapy so it is important to recognize these symptoms and provide appropriate treatment to overcome them [2].

Delia General Hospital (RSU) is a private hospital engaged in the field of medical or public health services, with the intent and purpose of assisting the government and serving the community in the field of improving health status both physical, spiritual and social health, one of which is Hemodialysis. Based on research at Delia General Hospital, patients who will undergo Hemodialysis therapy must come to the hospital to receive comprehensive therapy by a doctor. However, the problem that occurs is that patients who are going to undergo therapy must wait for a queue of other patients to be handled by a doctor. This of course will make the patient tired and remember the patient's condition in order to get information and therapy.

To deal with the above so that each patient obtains information, appropriate therapeutic management and can be implemented and carried out by the patient at home independently without having to queue at the hospital. So it is necessary to build a system that can determine psychological disorders in patients with chronic kidney failure undergoing hemodialysis therapy. The system built is an expert system. Where an expert system is a computer-based system that uses knowledge, facts and reasoning techniques in solving problems that usually

can only be solved by an expert in a particular field [3]. With this expert system, it is hoped that it will be able to help identify and be able to determine early on psychological disorders in Chronic Kidney Failure (CKD) patients undergoing hemodialysis therapy without going directly to a specialist and only needing to access them via the internet.

Certainty Factor (CF) is a method capable of defining the level of certainty of a rule or fact in describing an expert's belief in the problem at hand [4]. The application of the CF method has been carried out by many researchers, one of which is entitled "Expert System for Leukocyte Disease Diagnosis Using the Certainty Factor Method". In his research it was concluded that the results of CF calculations, the highest value was in the type of neutrophil disease with a value of 0.81 or 81%. From the results obtained, the system identified that the patient had Neutrophil disease [5].

While in a study entitled "Certainty Factor Method Design for Diagnosing Chronic Kidney Failure". Concluded that an expert system for diagnosing kidney disease can diagnose a disease and can provide information in the form of disease definitions, prevention and also referrals for kidney disease patients. This expert system can be used as an alternative for patients to recognize early through the symptoms they feel [6].

2. Problem Solving Methodology

2.1. Certainty Factor

The Certainty Factor (CF) method is a method for proving whether a fact is certain or uncertain in the form of a metric which is usually used in expert systems. This method is very suitable for expert systems that diagnose something that is not certain. CF was proposed by Shortliffe and Buchanan in 1975 to accommodate the inexact reasoning of an expert.

2.2. Chronic Renal Failure (CRF)

The kidneys are a pair of organs located in the lumbar region, protected by the ribs below the back. It weighs only 120-150 grams (the size of a pea). The main function of the kidneys is to filter the blood and help the body remove excess water, salt, and metabolic waste from the body. It also helps balance electrolyte levels in the body, controls blood pressure, and stimulates the production of red blood cells [7].

Kidney failure is divided into 2 namely acute kidney failure and chronic kidney failure. The definition of chronic kidney failure is damage to the kidneys both in structure and/or function that lasts for 3 months or more. If the condition of changes in kidney function occurs suddenly or acutely and has not reached 3 months, it is called acute kidney disorder. The most common causes of chronic kidney failure in Indonesia are diabetes mellitus/diabetes and uncontrolled hypertension/high blood pressure. However, the view of the general public is that it is the long-term consumption of high blood pressure or diabetes medications that can actually cause chronic kidney failure [1].

Chronic kidney failure or end-stage renal disease (ESRD) is a progressive and irreversible renal function disorder in which the body's ability to maintain metabolism and fluid and electrolyte balance causes uremia (retention of urea and other nitrogenous wastes in the blood). It can be chronic because it occurs slowly over years, or acute (suddenly) [7].

2.3. Psychological Disorders

Psychological factors in patients with chronic kidney failure are also greatly affected by the long course of the disease, the patient's disability and feeling uncomfortable depending on the hemodialysis machine. There is a relationship between experiencing kidney failure and the emergence of psychiatric disorders in patients.

2.4. Hemodialysis

Hemodialysis is a prolonged therapy that can significantly impact the physical and psychological well-being of patients with chronic kidney disease. This therapy has a big effect on sufferers both physically and mentally so naturally the impact of this therapy makes big changes. Some of them are the ability to work, the emergence of feelings of loss of control, anxiety, fear of death, fatigue, and decreased quality of life [2].

3. Application of the Method

Criteria for CKD disorders in those undergoing hemodialysis therapy based on the disease are as shown in the table below.

Table 1: Criteria Based Data on CRF

Symptom Code	Symptom Name	Types of CRF Disorders			
		P01	P02	P03	P04
G01	I feel afraid that something bad will happen	v	v		
G02	Worrying things crossed my mind	v	v		v
G03	When I'm nervous or worried, my stomach feels queasy	v			
G04	I suddenly felt panicked	v	v		

Symptom Code	Symptom Name	Types of CRF Disorders			
		P01	P02	P03	P04
G05	i want to feel tense	v			
G06	I feel never tired when I have to do something	v	v		
G07	I look forward with excitement to the things that are to come	v	v	v	
G08	I have lost interest in my appearance		v	v	
G09	I can laugh and see the happy side of things	v	v		
G10	I feel as if I'm not excited		v	v	v
G11	I still enjoy the things I used to enjoy		v		
G12	i feel elated		v		
G13	I may enjoy reading a book, listening to music, or watching television		v		
G14	I feel low self-esteem (withdraw)		v	v	v
G15	I feel afraid that something bad will happen	v	v		
G16	often feel tired / tired	v	v	v	
G17	poor sleep quality			v	v
G18	feeling depressed or anxious	v		v	
G19	often feel itchy			v	
G20	lack of confidence		v	v	v
G21	my mind was disturbed by the situation that I was experiencing		v	v	v
G22	feel inferior in their own environment				v
G23	feel insecure in society				v

Information :

- P01 : Anxiety
- P02 : Depression
- P03 : Fatigue
- P04 : Decreased Quality of Life

Next is to determine the CF expert weight value against the criteria for CRF disease in those undergoing hemodialysis therapy. This weight is obtained from expert information, while the CF expert weight can be seen in the table below.

Table 2: CF Expert Weight Value

No.	Level of confidence	Weight Value
1.	Very confident	1
2.	Certain	0.8
3.	Sure enough	0.6
4.	Little Sure	0.4
5.	Don't know	0.2
6.	There isn't any	0

Table 3: CF User Weight Value

No.	Level of confidence	Weight Value
1.	Very confident	1
2.	Certain	0.8
3.	Sure enough	0.6
4.	Little Sure	0.4
5.	Don't know	0.2
6.	There isn't any	0

The method used in this research is using the Certainty Factor method. The steps of this method are as follows:

1. Calculate the CF value with the following formula: CF expert * CF user
2. Combine CF 1.1 with CF 1.2 with the following formula: CF combine (CF1,CF2) = CF[h1,e1] + CF[h1,e2] *(1-CF[h1,e2]) = CF old Then combine CF old and CF[h1,e3]
3. Confidence percentage = CF combine * 100%

Sample case:

following criteria for a CKD disorder undergoing hemodialysis therapy :

1. I am afraid that something bad will happen, user: Somewhat Confident (0.4), expert : Somewhat Confident (0.6)
2. Worried things crossed my mind, user: A little Confident (0.4), expert: A Little Confident (0.4)
3. When I'm nervous or worried, my stomach feels queasy, user: No (0), expert: Don't know (0.2)
4. I suddenly feel panicked, user: Don't know (0,2), expert: Sure (0,4)

5. i want to feel tense, user: Don't Know (0,2), expert : Somewhat Confident (0,4)
6. i never get tired when i have to do something, user: a little sure (0.4), expert: a little sure (0.4)
7. I'm looking forward to what's going to happen, user: Somewhat Confident (0.4), expert: Don't Know (0.2)
8. I've lost interest in my appearance, user: Somewhat Confident (0.4), expert : Confident (0.8)
9. I can laugh and see the fun side of things, user: Don't know (0.2), expert: Pretty sure (0.6)
10. I feel as though I'm not excited, user: Fairly Confident (0.6), expert : Slightly Confident (0.4)
11. I still enjoy the things I used to enjoy, user: A little sure (0.4), expert: a little sure (0.4)
12. I feel happy, user: No (0), expert: Don't know (0,2)
13. I can enjoy reading books, listening to music, or watching television, user: A little sure (0.4), expert: A little sure (0.4)
14. I feel low self-esteem (withdraw), user: Don't know (0.2), expert: Sure (0.8)
15. I am afraid that something bad will happen, user: Don't know (0,2), expert: Pretty sure (0,6)
16. often feel tired/tired, user: sure (0.8), expert: slightly sure (0.4)
17. poor sleep quality, user: Don't know (0.2), expert: Pretty sure (0.6)
18. feeling depressed or anxious, user: Don't know (0.2), expert: Pretty sure (0.6)
19. often feel itchy, user: No (0), expert: A little sure (0.4)
20. lack of confidence, user: Don't know (0.2), expert: Pretty sure (0.6)
21. my mind is disturbed by the situation I am experiencing, user: Don't know (0.2), expert: A little sure (0.4)
22. feel inferior in their own environment, user: Don't know (0.2), expert: Pretty sure (0.6)
23. feel insecure in the community, users: Pretty sure (0.6), experts: Pretty sure (0.6)

From the data above, a calculation or analysis process is carried out using the *Certainty Factor method* to determine CRF disease in those undergoing hemodialysis therapy . Then calculate the value of symptoms of disease disorders Depression with the following calculations:

Table 4: Calculating Depressive Disorder Criteria

Disease Symptom	CF Expert	CF users	Results (CF Expert * CF User)
CF[H ₂ , E ₁]	0.6	0.4	0.24
CF[H ₂ , E ₂]	0.4	0.4	0.16
CF[H ₂ , E ₄]	0.8	0.2	0.16
CF[H ₂ , E ₆]	0.4	0.4	0.16
CF[H ₂ , E ₇]	0.2	0.4	0.08
CF[H ₂ , E ₈]	0.8	0.4	0.32
CF[H ₂ , E ₉]	0.6	0.2	0.12
CF[H ₂ , E ₁₀]	0.4	0.6	0.24
CF[H ₂ , E ₁₁]	0.4	0.4	0.16
CF[H ₂ , E ₁₃]	0.4	0.4	0.16
CF[H ₂ , E ₁₄]	0.8	0.2	0.16
CF[H ₂ , E ₁₅]	0.6	0.2	0.12
CF[H ₂ , E ₁₆]	0.4	0.8	0.32
CF[H ₂ , E ₂₀]	0.6	0.2	0.12
CF[H ₂ , E ₂₁]	0.4	0.2	0.08

From the table above, that is, combining the *Certainty Factor values* :

$$\begin{aligned}
 CF_{\text{combine}} CF[H_2, E]_{1,3} &= CF[H_2, E_1] + CF[H_2, E_2] * (1 - CF[H_2, E_1]) \\
 &= 0.24 + 0.26 * (1 - 0.24) \\
 &= 0.3616_{\text{old1}} \\
 CF_{\text{combine}} CF[H_2, E]_{\text{old2}} &= CF[H, E]_{\text{old1}} + CF[H_2, E_4] * (1 - CF[H, E]_{\text{old1}}) \\
 &= 0.3616 + 0.16 * (1 - 0.3616) \\
 &= 0.4637_{\text{old2}} \\
 CF_{\text{combine}} CF[H_2, E]_{\text{old3}} &= CF[H, E]_{\text{old2}} + CF[H_2, E_6] * (1 - CF[H, E]_{\text{old2}}) \\
 &= 0.4637 + 0.16 * (1 - 0.4637) \\
 &= 0.5495_{\text{old3}} \\
 CF_{\text{combine}} CF[H_2, E]_{\text{old4}} &= CF[H, E]_{\text{old3}} + CF[H_2, E_7] * (1 - CF[H, E]_{\text{old3}}) \\
 &= 0.5495 + 0.08 * (1 - 0.5495) \\
 &= 0.5856_{\text{old4}} \\
 CF_{\text{combine}} CF[H_2, E]_{\text{old5}} &= CF[H, E]_{\text{old4}} + CF[H_2, E_8] * (1 - CF[H, E]_{\text{old4}}) \\
 &= 0.5856 + 0.32 * (1 - 0.5856) \\
 &= 0.7182_{\text{old5}} \\
 CF_{\text{combine}} CF[H_2, E]_{\text{old6}} &= CF[H, E]_{\text{old5}} + CF[H_2, E_9] * (1 - CF[H, E]_{\text{old5}}) \\
 &= 0.7182 + 0.12 * (1 - 0.7182) \\
 &= 0.7520_{\text{old6}}
 \end{aligned}$$

$$\begin{aligned}
CF_{\text{combine}} CF[H_2, E]_{\text{old7}} &= CF[H, E]_{\text{old6}} + CF[H_2, E_{10}] * (1 - CF[H, E]_{\text{old6}}) \\
&= 0.7520 + 0.24 * (1 - 0.7520) \\
&= 0.8115_{\text{old7}} \\
CF_{\text{combine}} CF[H_2, E]_{\text{old8}} &= CF[H, E]_{\text{old7}} + CF[H_2, E_{11}] * (1 - CF[H, E]_{\text{old7}}) \\
&= 0.8115 + 0.16 * (1 - 0.8115) \\
&= 0.8417_{\text{old8}} \\
CF_{\text{combine}} CF[H_2, E]_{\text{old9}} &= CF[H, E]_{\text{old8}} + CF[H_1, E_{13}] * (1 - CF[H, E]_{\text{old8}}) \\
&= 0.8417 + 0.16 * (1 - 0.8417) \\
&= 0.8670_{\text{old9}} \\
CF_{\text{combine}} CF[H_2, E]_{\text{old10}} &= CF[H, E]_{\text{old9}} + CF[H_2, E_{14}] * (1 - CF[H, E]_{\text{old9}}) \\
&= 0.8670 + 0.16 * (1 - 0.8670) \\
&= 0.8883_{\text{old10}} \\
CF_{\text{combine}} CF[H_2, E]_{\text{old11}} &= CF[H, E]_{\text{old10}} + CF[H_2, E_{15}] * (1 - CF[H, E]_{\text{old10}}) \\
&= 0.8883 + 0.12 * (1 - 0.8883) \\
&= 0.9017_{\text{old11}} \\
CF_{\text{combine}} CF[H_2, E]_{\text{old12}} &= CF[H, E]_{\text{old11}} + CF[H_2, E_{16}] * (1 - CF[H, E]_{\text{old11}}) \\
&= 0.9017 + 0.32 * (1 - 0.9017) \\
&= 0.9332_{\text{old12}} \\
CF_{\text{combine}} CF[H_2, E]_{\text{old13}} &= CF[H, E]_{\text{old12}} + CF[H_2, E_{20}] * (1 - CF[H, E]_{\text{old12}}) \\
&= 0.9332 + 0.12 * (1 - 0.9332) \\
&= 0.9412_{\text{old13}} \\
CF_{\text{combine}} CF[H_2, E]_{\text{old14}} &= CF[H, E]_{\text{old13}} + CF[H_2, E_{21}] * (1 - CF[H, E]_{\text{old13}}) \\
&= 0.9412 + 0.08 * (1 - 0.9412) \\
&= 0.9459_{\text{old14}}
\end{aligned}$$

The results of the CF value from the calculation above are:

$$\begin{aligned}
CF_{\text{combine}} CF[H_2, E]_{\text{old14}} &= CF[H, E]_{\text{old13}} + CF[H_2, E_{21}] * (1 - CF[H, E]_{\text{old13}}) \\
&= 0.9412 + 0.08 * (1 - 0.9412) \\
&= 0.9459_{\text{old22}} \\
&= 0.9459 * 100 = 94.59\%
\end{aligned}$$

Based on the CF calculation results above, the results are obtained as in the table below:

Table 5: CF Calculation Results for CRF

No.	Disease Code	Types of Disease Disorders	Confidence Percentage
1.	P01	Worry	82.33%
2.	P02	Depression	94.59%
3.	P03	Fatigue	82.97%
4.	P04	Decreased Quality of Life	78.48%

From the table above, it was found that the patient had CKD undergoing hemodialysis therapy, namely depression with a confidence value of 94.59%.

3.1. Results Overview

To find out the results in research, of course there must be an overview of the results as an illustration of how the system will be built. this is used to make it easier to build the system later. An overview of the results is made in the form of an interface design (interface). The better the interface design is made, the better the system will be built. The following is an interface design for making an expert system in determining CRF disease in those undergoing hemodialysis therapy using the Certainty Factor method.

1. Main page

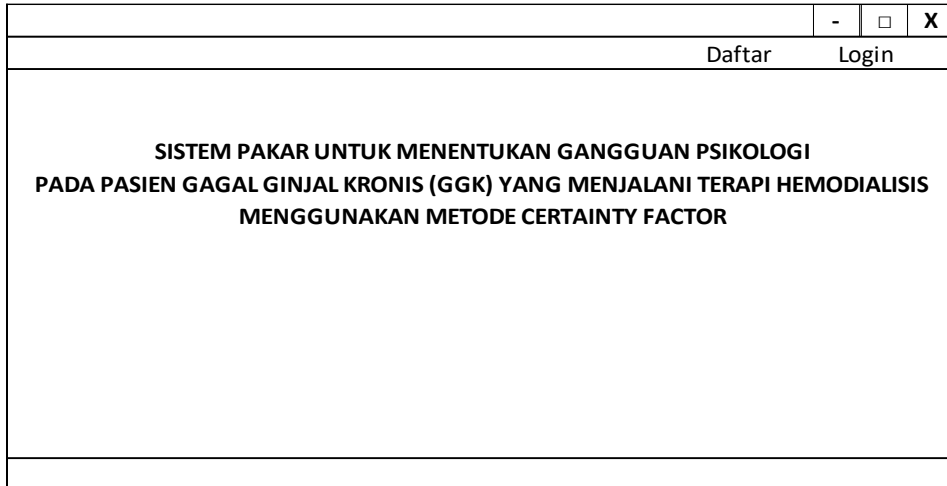


Figure 1: Main page

2. Login Page

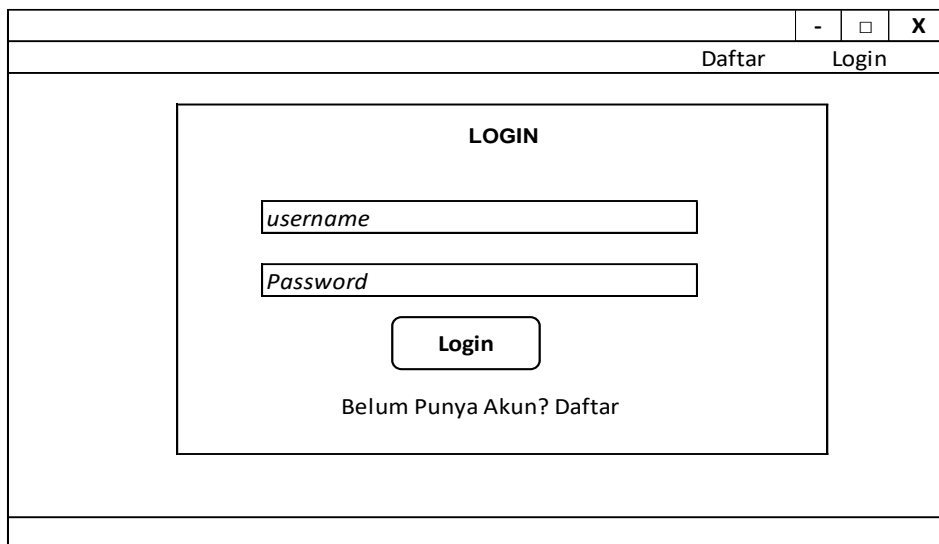


Figure 2: Login Page

3. Result Rules

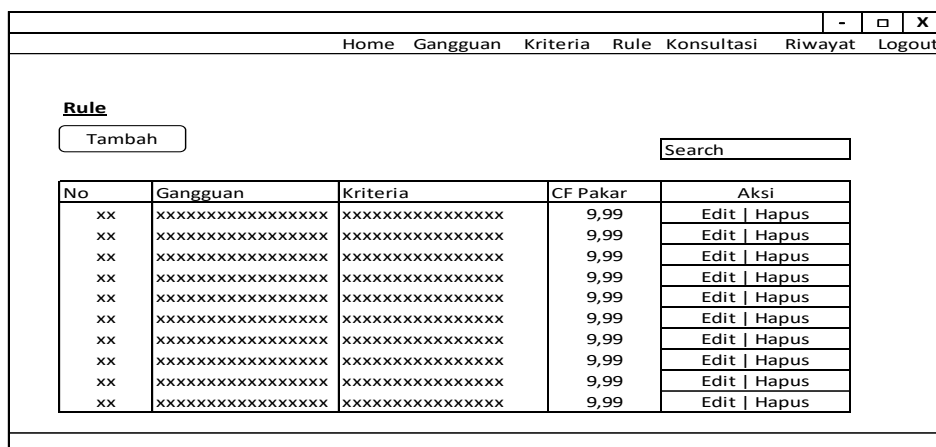


Figure 3: Ha Rules page

4. Conclusion

With the existence of an expert system to determine psychological disorders in chronic kidney failure patients undergoing hemodialysis therapy using the certainty factor method, including the following:

1. Helping Delia General Hospital in overcoming queuing problems that occur in patients with chronic kidney failure who are undergoing therapy so they are no longer waiting, bearing in mind the importance of maintaining the patient's condition in order to receive information and therapy.
2. Helping to minimize patient time so that they can determine psychological disorders in patients from the start so that treatment of psychological disorders can be followed up more quickly.
3. Based on the value of each symptom and disease that has been made, the system can determine psychological disorders in CRF patients with different accuracy results, the highest value or percentage which is the result of a diagnosis of psychological disorders of kidney failure. From the results of trials that have been carried out by the expert system, it determines psychological disorders in kidney failure patients undergoing hemodialysis therapy, namely depression with a confidence value of 94.59%.

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