



## Expert System Diagnoses Kidney Failure In Hemodialysis Patients Using Forward Chaining Methods

Eka Susanti<sup>1</sup>, R. Mahdalena Simanjorang<sup>2</sup>

<sup>1,2</sup>Informatics Engineering Study Program, STMIK Pelita Nusantara, Medan, Indonesia.

### Article Info

#### Article history:

Received, Nov 18, 2021

Revised, Dec 18, 2021

Accepted, Dec 20, 2021

#### Keywords:

Expert System,  
Forward Chaining Method,  
Diagnosis,  
Kidney failure.

### ABSTRACT

Technological advances, one of which is in the health sector, which is needed to find out the available information, one of which is the diagnosis of kidney failure. The purpose of this study is to be able to find out kidney failure experienced by patients easily without having to manually diagnose and be able to build an expert system application on kidney failure with the Forward Chaining method and produce high accuracy values and provide solutions for every disease experienced by the patient. The development of an expert system uses a research methodology consisting of problem analysis, data collection, data analysis, application of forward chaining methods, system design, system testing and system implementation. The Forward chaining method in the test resulted in an accuracy value of 70% with symptoms fulfilled with the description of Chronic Kidney Failure, so that the treatment solution that can be done is to live a healthy lifestyle by avoiding conditions that can trigger chronic kidney failure. How to treat chronic kidney failure is by giving drugs, dialysis (hemodialysis) and kidney transplantation.

*This is an open access article under the [CC BY-SA](#) license.*



### Corresponding Author:

Eka Susanti

Informatics Engineering Study Program, STMIK Pelita Nusantara, Medan, Indonesia,  
Jl. Iskandar Muda No.1, Merdeka, Kec. Medan Baru, Kota Medan, Sumatera Utara 20154.

Email: [ekasusanti2599@gmail.com](mailto:ekasusanti2599@gmail.com)

## 1. INTRODUCTION

Advances in the field of information and communication technology are now very developed in all corners so that a lot of information is generated from advanced technology so that many are applied in the fields of technology, industry, economy, military, education, health and other fields, of these areas, one of them is the field of computerized technology. In the field of health technology is also needed one of them as information about the diagnosis of kidney failure.

Kidney failure is a pair of organs that are located under the back. The kidneys are an important part of the body that is responsible for filtering blood and detoxifying toxins from the body. To consult kidney failure requires an expert, namely a specialist who treats kidney failure. For this reason, the study was conducted at Grandmed Hospital where data collection through a patient and specialist doctor, With this, the author is interested in conducting research on kidney failure due to the increasing number of kidney failure patients in hemodialysis patients at Grandmed Hospital and for kidney failure diagnosis facilities still using manual input which uses a piece of paper containing records of symptoms, patient complaints and patient data. With this the author build a system with a forward chaining method that has characteristics like an expert.

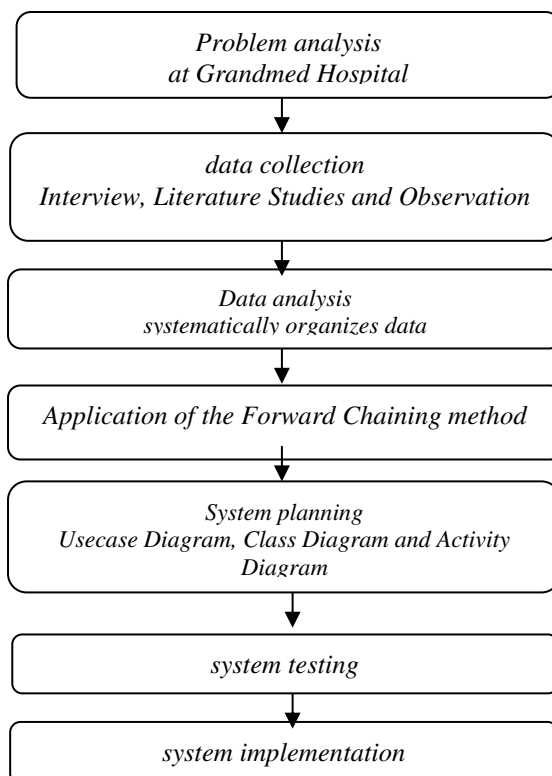
In the previous research (Sitanggang et al., 2017) examined expert systems implemented using backward methods whose search process is accompanied by facts and then draws conclusions. The programming languages are PHP and MySQL databases. The system is done through a consultation process between the system and the user. The answers are given according to the system. If the answer is inputted in accordance with the applicable procedure, the system shows the results of the diagnosis such as information on the diagnosis of the disease. Diagnosing kidney failure with a system that has been designed is expected to have an impact on disease prevention measures. According to (Rosmawanti & Kusumawardhani, 2021), this study was built using Bayes' theorem method, which is an expert system model for diagnosing kidney failure, Its accuracy comes from 20 experts and application verification cases, and its accuracy rate is 65%. Expert system models are not yet fully applicable, especially in terms of their accuracy. Advice that can be given as a reference in developing advanced applications is to add other factors and the use of other methods such as multi-user with the website. The difference in this research is that it was created using web-based applications with forward chaining methods and provides an accuracy value of 70%, can be used anywhere and can now work online.

The purpose of this study is to be able to find out kidney failure disease experienced by patients easily without having to make a diagnosis manually and can build expert system applications on kidney failure using the Forward Chaining method and produce high accuracy values and produce a reliable for the disease experienced by patients.

The benefit is to add knowledge and insight that can be when conducting direct research, expand the knowledge of researchers for further studies on the field of science pursued not only theoretical but directly to its application, as a reference material that will conduct expert system research with forward chaining methods and can make it easier to identify / get solutions related to problems in hemodialysis patients.

## 2. RESEARCH METHOD

The framework in this study is the steps discussed to solve the problems discussed. The research framework is as follows:



**Figure 1.** Research Framework

This stage describes the framework or stage of research carried out in the research process. Research at this stage is to solve the problem being discussed with the aim of gathering information about the research problem:

1. Problem Analysis

At this stage of problem analysis in Rs.Grandmed, so the author will evaluate the data and will find a problem that exists in Rs.Grandmed so that researchers will solve the problem and get an alternative to the problem.

2. Data Collection

The methods used in data collection are:

a. Interview (interview)

Interviews are conducted directly to find a data and facts by asking questions to a kidney failure specialist, then get the right power. Researchers asked an expert on this study (Dr. Meilindawaty Sp.PD). The purpose of this method is to get data with a high level of accuracy from a specialist who explains the extent of the disease studied.

b. Literature studies

Methods by collecting journals, browsing the internet and books that discuss the issues studied.

c. Observation

At the beginning of the study, researchers will conduct observations and interviews with a kidney failure patient and a specialist doctor who served at Grandmed Hospital.

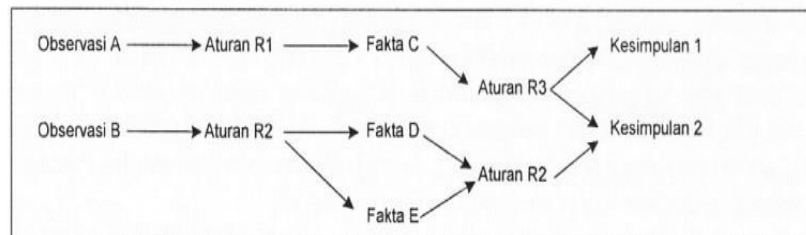
3. Data Analysis

Researchers will compile data systematically based on data collection and techniques and provide a conclusion, so that it is easy to understand.

4. Implementation of Forward Chaining Method

The forward chaining method is a method that allows to draw conclusions (results) from existing data and facts with the stage of finding existing facts, and then the premise of getting results. This method is said to be a method with advanced runut. Starting with input varias IF (input information) and continued to THEN (conclusion) is the process (Silitongah and Budiharto, 2015)

Regarding the realization of this method, there are two ways. First, all the data received is brought to the expert system. Second, only an important part of the data obtained is entered into the expert system. When an expert system connects to an automated process and receives all the data in the database, it is best to use the first method. The second method minimizes the use of time and money by reducing the amount of data and recovering data as deemed necessary. Forward chaining: adjustment of facts or statements, starting from the left (IF). Or it could be called, reasoning begins with facts to verify the truth of a hypothesis.



**Figure 2.** Forward Chaining Process

Forward chaining method formula:

$$P(A) = \frac{\text{the number of symptoms and disorders in the decision table}}{\text{total number of symptoms and disorders in the decision table}} \times 100$$

5. System Planning

The system design used is the design of use case diagrams, class diagrams, and Activity diagrams which are to describe activities, as well as database design, PHP and MySQL programming languages.

6. System Testing

System testing aims to see the results of whether the results of the system are satisfactory or still have errors in inputting data from symptoms that have been determined by the Doctor / expert.

#### 7. System Implementation

The system was developed using the PHP programming language which adopts the forward chaining method. Implementation of the ertujuan to see the comparison of results obtained with manual analysis using the system.

### 3. RESULTS AND DISCUSSION

The type of disease that often occurs in kidney failure can be seen from the table that has been created based on data from the hospital. Grandmed as described in the following table.

**Table 1.** Types – Types of Kidney Failure

disease code	Name of disease
P1	Acute kidney failure
P2	Chronic kidney failure

The type of symptoms that often occur in kidney failure can be seen from a table created based on data from hospitals. Grandmed.

**Table 2.** Symptoms – Symptoms of Kidney Failure

symptom code	name of symptoms
G01	reduced or completely in the form of urine.
G02	reduced taste, especially in the hands or feet
G03	Changes in mental or mood occur
G04	Hand tremors
G05	Pain in the back and back
G06	nausea, vomiting and loss of appetite
G07	Prolonged itchy skin
G08	weak, pale, swollen/bruised body
G09	shortness of breath and breath smells like amunia/ pesing
G10	weight loss or even increase due to fluid buildup
G11	More often want to urinate, especially at night
G12	swelling of the eyes, legs, or hands
G13	High blood pressure that is difficult to control
G14	Sleep disorders or insomnia
G15	cramps and muscle spasms
G16	back pain
G17	kidney stone
G18	kidney infection

The table of solutions of kidney failure disease experienced in hemodialysis patients is as follows:

**Table 3.** Disease Solutions

disease	solution
Acute kidney failure	Dietary regulation, especially by limiting the use of foods high in salt and potassium during the kidney repair process, provides drugs that can balance electrolyte levels in the blood, donates diuretic drugs to eliminate excess fluid, antimicrobials in case of kidney failure. by bacterial disease
Chronic kidney failure	To prevent it is to live a solid lifestyle by avoiding conditions that can trigger persistent kidney failure. How to treat kidney failure that is unrelenting is by giving drugs, dialysis (Hemodialysis) and kidney transplants.

Example case :

A patient comes to the hospital experiencing several symptoms, namely reduced feeling in the hands or feet (G02) Mental or mood changes (G03) Stomach and back pain (G05) Prolonged itchy skin (G07) Weakness, paleness, and swelling/bruising (G08) weight loss or even increase due to fluid accumulation (G10) swelling of the ankles (G12) High blood pressure that is difficult to control (G13) Sleep disturbances and insomnia (G14) and low back pain (G16).

Solution:

### 1. Explanation of the list of symptoms experienced by the patient

Symptom code	symptoms experienced
G02	reduced taste, especially in the hands or feet
G03	Changes in mental or mood occur
G05	Pain in the back and back
G07	Prolonged itchy skin
G08	weak, pale, swollen/bruised body
G10	weight loss or even increase due to fluid buildup
G12	swelling of the eyes, legs, or hands
G13	High blood pressure that is difficult to control
G14	Sleep disorders or insomnia
G16	back pain

### 2. Symptoms experienced by the patient

symptom code	P1	P2
G02	√	
G03	√	
G05	√	
G07		√
G08		√
G10		√
G12		√
G13		√
G14		√
G16		√

Information :

P1 = Acute renal failure

P2 = Chronic renal failure

### 3. Calculation of the percentage of symptoms experienced by the patient

$$\begin{aligned}
 P1 &= G02, G03, G05 \\
 &= \frac{3}{10} \times 100\% = 30\% \\
 P2 &= G07, G08, G10, G12, G13, G14, G16 \\
 &= \frac{7}{10} \times 100\% = 70\%
 \end{aligned}$$

## 4. CONCLUSION

So the results of the symptoms experienced by the patient produce Chronic Kidney Failure with the result that 70% of the symptoms are met. So the treatment solution that can be done is to do a healthy lifestyle such as not doing activities that cause chronic kidney failure. The way to treat the disease is by giving drugs, dialysis (hemodialysis) and kidney transplantation.

## REFERENCES

- [1] Dicki Alamsyah, A. P. (2019). Sistem Pakar Diagnosa Penyakit Ginjal Menggunakan Metode Forward Chaining Berbasis Android. *International Journal of Artificial Intelligence*, 6(1), 53–74. <https://doi.org/10.36079/lamintang.ijai-0601.32>
- [2] Fitri Ayu and Nia Permatasari. (2018). perancangan sistem informasi pengolahan data PKL pada divisi humas PT pegadaian. *Jurnal Infra Tech*, 2(2), 12–26. <http://journal.amikmahaputra.ac.id/index.php/JIT/article/download/33/25>
- [3] Handayani, S. (2018). Perancangan Sistem Informasi Penjualan Berbasis E-Commerce Studi KaHandayani, S. (2018). Perancangan Sistem Informasi Penjualan Berbasis E-Commerce Studi Kasus Toko Kun Jakarta. *ILKOM Jurnal Ilmiah*, 10(2), 182–189. <https://doi.org/10.33096/ilkom.v10i2.310>. *ILKOM Jurnal Ilmiah*, 10(2), 182–189. <https://doi.org/10.33096/ilkom.v10i2.310.182-189>
- [4] Julita, R. (2018). Sistem Pakar Pemilihan Menu Makanan Berdasarkan Penyakit Dan Golongan Darah. *Pseudocode*, 5(1), 56–67. <https://doi.org/10.33369/pseudocode.5.1.56-67>
- [5] Komputer, J. I., Matematika, F., Ilmu, D. A. N., & Alam, P. (2017). *Chaining Untuk Mendiagnosa Penyakit*.
- [6] Kristen, U., & Wacana, K. (2020). *PERANCANGAN SISTEM PAKAR DIAGNOSIS PENYAKIT GINJAL MENGGUNAKAN METODE DEMPSTER-SHAFFER BERBASIS WEBSITE JISICOM ( Journal of*

- Information System , Informatics and Computing ) p-ISSN : 2579-5201 ( Printed ) JISICOM ( Journal of Information System , Informati. 4(1), 107–115.*
- [7] Kusbianto, D., Ardiansyah, R., & Hamadi, D. A. (2017). Implementasi Sistem Pakar Forward Chaining Untuk Identifikasi Dan Tindakan Perawatan Jerawat Wajah. *Jurnal Informatika Polinema*, 4(1), 71. <https://doi.org/10.33795/jip.v4i1.147>
- [8] M Teguh Prihandoyo. (2018). Unified Modeling Language (UML) Model Untuk Pengembangan Sistem Informasi Akademik Berbasis Web. *Jurnal Informatika: Jurnal Pengembangan IT*, 3(1), 126–129.
- [9] Maiyendra, N. A. (2018). Perancangan Sistem Pakar Mendiagnosa Penyakit Kulit Pada Anak Dengan Menggunakan Metode Backward Chaining. *Jursima*, 6(2), 6. <https://doi.org/10.47024/js.v6i2.120>
- [10] Muhammad, A. (2019). *Serba-serbi gagal ginjal* (M. Ulfah (ed.); ke2 ed.). DIVA Press.
- [11] Murtadho, A. (2020). *NASKAH PUBLIKASI RANCANG BANGUN SISTEM INFORMASI PENJUALAN SMARTPHONE BERBASIS WEB (STUDI KASUS: Gemah Ripah Sellular)*.
- [12] Muslim, B., Yadi, & Harta, M. (2017). Sistem Pakar Diagnosa Awal Penyakit Ginjal Berbasis Web Menggunakan PHP DAN MYSQL. *Jurnal Ilmiah Betrik*, 8(03), 115–122. <https://doi.org/10.36050/betrik.v8i03.72>
- [13] Negeri, S. M. A., Hulu, B., & Web, B. (2020). *menyimpan data dan menampilkannya data* (. 8(2).
- [14] Nurajizah, S., Saputra, M., Informatika, M., & Informasi, S. (2018). *SISTEM PAKAR BERBASIS ANDROID UNTUK DIAGNOSA PENYAKIT*. 14(1), 7–14.
- [15] Prof.Dr.Rully MA Roesli, dr., SpPD-KGH, D. R. B. dr. S.-K. (2019). *SIMPOSIUM DIALISIS 2019*. Perhimpunan Nefrologi Indonesia (Pernefri) korwil jabar.
- [16] Putri Barka; Seniwati, Erni, A. E. S. (2018). Implementasi Metode Forward Chaining Pada Sistem Pakar Pendiagnosis Gangguan Ansietas (Studi Kasus: Pijar Psikologi). *Jurnal Mantik Penusa*, 2(Vol 2, No 2 (2018): Computer Science), 9–14. <http://ejournal.pelitanusantara.ac.id/index.php/mantik/article/view/369>
- [17] Rosmawanti, N., & Kusumawardhani, G. P. (2021). *Model Sistem Pakar Diagnosa Penyakit Gagal Ginjal*. 9.
- [18] Sanger, J. B., Insani, F., & Nugroho, P. (2018). *Pengembangan Sistem Pakar Untuk Mengidentifikasi Permasalahan Layanan Jaringan Internet*. 14(1). <https://doi.org/10.31227/osf.io/xmku5>
- [19] Sanubari, I., Rosely, E., & Wijayanto, P. W. (2020). Aplikasi Pelaporan Kerusakan Fasilitas Yang Ada Di Stasiun Dan Dalam Gerbong Kereta Api Berbasis Web. *EProceedings of Applied Science*, 6(1), 101–112.
- [20] Septiani, M., & Kuryanti, S. J. (2018). Sistem Pakar untuk Mendiagnosa Penyakit Saluran Pernapasan pada Anak. *Publikasi Jurnal & Penelitian Teknik Informatika*, 2(2), 23–27. <https://jurnal.polgan.ac.id/index.php/sinkron/article/download/99/62/>
- [21] Sitanggang, D., Pasaribu, W., & Turnip, M. (2017). Sistem Pakar Untuk Mendiagnosa Penyakit Ginjal Menggunakan Metode Backward Chaining. *Jurnal Informatika Kaputama (JIK)*, 1(2), 42–49.
- [22] Syarif, M., & Nugraha, W. (2020). Pemodelan Diagram UML Sistem Pembayaran Tunai Pada Transaksi E-Commerce. *Jurnal Teknik Informatika Kaputama (JTik)*, 4(1), 70 halaman. <http://jurnal.kaputama.ac.id/index.php/JTIK/article/view/240>
- [23] Tazkia, Z. Z. (2019). Perancangan Sistem Informasi Akuntansi Laporan Keuangan Laba Rugi pada Restoran Eatboss Dengan Menggunakan PHP dan MySQL. *Is The Best [Accounting Information System & Information Technology Business Enterprise]*, 4(1), 426–440. <https://doi.org/10.34010/aisthebest.v4i1.1831>
- [24] Techno, J., Mandiri, N., Xiii, V., & September, N. (2016). *ISSN 1978-2136 | Rancang Bangun Sistem ... ISSN 1978-2136 | Rancang Bangun Sistem ... XIII(2)*, 63–71.
- [24] Wahyuti, W., Permana, I., & Salisah, F. N. (2018). Aplikasi Sistem Pakar Berbasis Android untuk Diagnosa Awal Penyakit Ginjal Manusia Menggunakan Metode Forward Chaining. *Sntiki*, 10(November), 121–128.
- [26] Zulfian Azmi, S.T., M.kom dan Verdi Yasin , S.Kom., M. K. (2019). *pengantar sistem pakar dan metode*. Mitra Wacana Media.