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Diagnosing Bilirubin Disease in Infants Using the Certainty Factor Method

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Abstract: Poor health and an unhealthy lifestyle are vulnerable to making a person more at risk of experiencing certain health problems or diseases. Bilirubin which is related to health is a metabolite in the form of a yellow pigment derived from the breakdown of heme in hemoglobin. Increased Bilirubin in newborns is a common problem that causes a normal or physiological transition during pregnancy. Al Fuadi General Hospital (RSU Al Fuadi) is a hospital located in Binjai that serves general public health. However, the large number of queues of patients waiting for examination results in a lengthy consultation process and treatment that will be received by Bilirubin sufferers. Based on the existing problems, an expert system is needed that can store information from an expert who can help the hospital. The Certainty Factor method is a method that can prove whether a fact is certain or uncertain in the form of metrics that are usually used in expert systems. Based on the results of trials conducted on this system it can be seen that the level belief from results diagnosis to disease i.e. 93% diagnosed with High Bilirubin disease.

Keywords : Bilirubin, Certainty Factor, Expert System.

1. Introduction

Health is an important factor for human life. It is undeniable that every human being wants to live in a healthy state. Poor health and an unhealthy lifestyle are vulnerable to making a person more at risk for experiencing certain health problems or diseases. Health is also related to Bilirubin disease. Bilirubin is a metabolite in the form of a yellow pigment derived from the breakdown of heme in hemoglobin. Bilirubin is carried by the blood to the liver to be conjugated and excreted. Increased Bilirubin is a problem that is often found in newborns, where normal or physiological transitions occur.

Factors that cause jaundice (Bilirubin) in infants where the intestinal and liver functions are not working properly so that a lot of Bilirubin is not conjugated and is not wasted from the body. Generally occurs in the first week to the third week after birth. As for the lack of milk in the first 2-3 days. Prevention that can be done to help reduce Bilirubin levels in newborns includes

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exclusive breastfeeding as early as possible, exposing the baby to the morning sun, phototherapy and giving exchange transfusions.

Al Fuadi General Hospital (RSU Al Fuadi) is a hospital located on Jl. Ahmad Yani no 23, Kartini village, Binjai City District, in accordance with the development of the city of Binjai, Al Fuadi General Hospital is trying to become a hospital that serves public health according to the needs and satisfaction of private patients and company employees who can seek treatment at this hospital.

One of these obstacles or problems is the large number of queues of patients waiting for pediatricians to examine or diagnose patients, resulting in increasingly crowded spaces, so it takes quite a long time to consult. Therefore the authors created a system that is useful for the hospital to help detect Bilirubin disease in patients if a specialist doctor is not in place.

This research was supported by a scientific research journal on implementing the "Expert System for Diagnosing Bilirubin Disease in Infants Using the Certainty Factor Method" which was carried out by Lidia Sinaga, Usti Fatimah Sari Sitorus Pane, S. Kom., M. Kom, Ita Mariami, SE, Msi. (2020). Stella Maris mother and child hospital is an integrated service center to serve the health of women and children. Stella Maris provides high quality health services for all matters relating to fertility, pregnancy, menstrual problems, menopause, pelvic infections, cancer in women, and health care for babies. However, the applied system still does not exist to diagnose diseases, especially in Bilirubin disease or jaundice.

Based on the above problems, it is necessary to have a system to help Stella Maris with the Expert System scientific field using the Certainty Factor method to diagnose this type of disease. It is hoped that this system can get information more quickly, whether the baby has Bilirubin disease or not. The results obtained from this study are an integrated system that is able to solve problems in Stella Maris, especially in diagnosing Bilirubin disease. It is hoped that the applied system can be developed again often with technological developments.

2. Literature

From previous research, the authors raised several studies as references in adding study material to this study as follows:

In a scientific research journal (Sinaga et al., 2020) regarding implementing the "Expert System for Diagnosing Bilirubin Disease in Infants Using the Certainty Factor Method". Stella Maris mother and child hospital is an integrated service center to serve the health of women and children. Stella Maris provides high quality health services for all matters relating to fertility, pregnancy, menstrual problems, menopause, pelvic infections, cancer in women, and health care for babies. However, the applied system still does not exist to diagnose diseases, especially in Bilirubin disease or jaundice.

Based on the above problems, it is necessary to have a system to help Stella Maris with the Expert System scientific field using the Certainty Factor method to diagnose this type of disease. It is hoped that this system can get information more quickly, whether the baby has Bilirubin disease or not. The results obtained from this study are an integrated system that is able to solve problems in Stella Maris, especially in diagnosing Bilirubin disease. It is hoped that the applied system can be developed again often with technological developments.

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Making this web-based expert system was built using the CodeIgniter Framework. From the results of system testing, it was found that the accuracy of using the CF formula in diagnosing Bilirubin disease was 98.8%. Based on the manual calculation of the program that has been implemented with the system, it turns out that the Certainty Factor method can provide accurate results obtained from calculations based on the weight of symptoms selected by the user on the system while at the same time being able to provide answers to questions with uncertain truths such as the problem in this study, namely the diagnosis of a disease.

Meanwhile (Pandu Pratama & Pranata, 2019) with the title "Application of the Expert System Using the K-Neares Neighbor Method to Diagnose Jaundice (Jaundice or Icterus) Jaundice is a condition in which the skin and whites of the eyes turn yellow due to high levels of Bilirubin. Bilirubin is formed from the breakdown of red blood cells. The body usually excretes Bilirubin through the liver. Because the liver in newborns is immature, sometimes Bilirubin accumulates faster than the body's ability to remove it, causing jaundice.

In particular, in infants who usually experience physiological jaundice do not cause symptoms. So this disease is classified as very severe for babies because there are things to watch out for if the baby has jaundice. Based on the problem, in building a system that can facilitate the provision of solutions to the problem of jaundice or jaundice without having to consult directly with a special doctor. Because it takes a lot of time and is expensive. This research will apply an artificial intelligence, namely the Expert System (Expert System) using the K-Nearest Neighbor method. The results of this study are expected to assist in the treatment process for the prevention of acute jaundice in infants.

3. Methods

3.1. Calculation Analysis with the Certainty Factor Method

The Certainty Factor method uses one value to assume the degree of confidence of an expert in one data. The Certainty Factor method will make it easier to compile a knowledge base and rules as well as simplify the certainty factor of each implementation of a Bilirubin disease diagnosis.

Table 1. Table of Certainty Factor User Values

No	Information	Symptom Score
1	No	0
2	Not sure	0.2
3	Little Sure	0.1
4	Sure enough	0.6
5	Certain	0.8
6	Very confident	1

Table 2. Expert Trust Value

Type Disease	Symptom	Belief	CF Expert
Bilirubin	Experience fever	Enough Certain	0.6

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Tall	Skin And white eye become yellow	Very Certain	1.0
	No stand air cold	Enough Certain	0.6
Bilirubin Normal	Skin And white eye become yellow	Enough Certain	0.6
	Experience fever	A little Certain	0.4
	No stand air cold	A little Certain	0.4
	Nail seen yellow	A little Certain	0.4
	Often BAK	Enough Certain	0.6
	Mouth feels bitter	A little Certain	0.4
Bilirubin Light	Skin And white eye become yellow	A little Certain	0.4
	Often BAK	A little Certain	0.4
	Mouth feels bitter	No Certain	0.2
	Can't stand cold air	Not sure	0.2
	Nails look yellow	Not sure	0.2

Table 3. User Trust Value

Type Disease	Symptom	Belief	CF Expert
Bilirubin Tall	Experience fever	Enough Certain	0.6
	Skin And white eye become yellow	Certain	0.8
	No stand air cold	Certain	0.8
Bilirubin Normal	Skin And white eye become yellow	Certain	0.8
	Experience fever	Sure enough	0.6
	No stand air cold	Certain	0.8
	Nail seen yellow	Little Sure	0.4
	Often BAK	Not sure	0.2
	Mouth feels bitter	Not sure	0.2
Bilirubin Light	Skin And white eye become yellow	Certain	0.8
	Often BAK	Not sure	0.2
	Mouth feels bitter	Not sure	0.2
	Can't stand cold air	Certain	0.8
	Nails look yellow	Little Sure	0.4

Sample case :
The following is patient data and symptoms experienced
Name : Mukti Pelawi

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Gender : Male
Age : 7 Days
Address : Salaman
Height : 43 cm
Weight : 2.4 kg

Based on the questions posed using a Bilirubin disease symptom questionnaire test, it is known that the symptoms of the disease experienced by these patients are as follows:

1. Has a fever of 0.6 (Pretty Sure)

2. Skin and whites of eyes turn yellow0.8 (Confident)

3. Can not stand cold air0.8 (Confident)

4. Nails look yellow0.4 (Slight Confident)

5. Often BAK0.2 (Not Sure)

6. Bitter mouth 0.2 (Not sure)

From the symptoms that have been described, the system will process according to the CF method. After the calculation process is complete, the system will conclude the disease suffered.

1. High Bilirubin

In this process, there are 3 data on the same symptoms between the symptoms possessed by Mukti Pelawi and the symptoms contained in the knowledge base regarding High Bilirubin disease

Formula : CF[H,E] = CF[H] * CF[E]

G001 : Experiencing fever (0.6)
CF[H1,E1] = CFexpert * CFUser
= 0.6 * 0.6
= 0.36

G003 : Skin and whites of eyes turn yellow (0.8)
CF[H1,E2] = CFexpert * CFUser
= 1.0 * 0.8
= 0.8

G009 : Can not stand cold air (0.8)
CF[H1,E3] = CFexpert * CFUser
= 0.6* 0.8

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= 0.48

Combining CF values in High Bilirubin disease
CFcombine CF[H,E]1,2 = CF[H1,E2] + CF[H1,E2] * (1 - CF[H1,E2])
= 0.36 + 0.8 * (1 – 0.36)
= 0.36 + 0.8 * 0.64
= 0.36 + 0.512
= 0.872 old1

CFcombine CF[H,E]old1,3 = CF[H,E]old1 + CF[H1,E3] * (1 - CF[H,E])old1)
= 0.872 + 0.48 * (1 – 0.872)
= 0.872 + 0.48 * 0.128
= 0.872 + 0.061
= 0.933 0ld2

The results of the CF value of High Bilirubin disease
CFcombine CF[H,E]old1,3 = CF[H,E]old1 + CF[H1,E3] * (1 - CF[H,E])old1)
= 0.872 + 0.48 * (1 – 0.872)
= 0.872 + 0.48 * 0.128
= 0.872 + 0.061
= 0.933 0ld2

2. Normal Bilirubin
The results of matching the user's input symptoms with the symptoms of Normal Bilirubin disease obtained 6 data of the same symptoms, namely:
G001 : Experiencing fever (0.6)
Formula : CF[H,E] = CF[H] * CF[E]

CF[H2,E1] = CFexpert * CFUser
= 0.4 * 0.6
= 0.24

G003 : Skin and whites of eyes turn yellow (0.8)
CF[H2,E2] = CFexpert * CFUser
= 0.6 * 0.8
= 0.48

G009 : Can not stand cold air (0.8)
CF[H2,E3] = CFexpert * CFUser
= 0.4 * 0.8

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= 0.32

G011 : Nails look yellow (0.4)
CF[H2,E4] = CFexpert * CFUser
= 0.4 * 0.4
= 0.16

G017 : Frequent urination (0.2)
CF[H2,E5] = CFexpert * CFUser
= 0.6 * 0.2
= 0.12

G018 : Mouth tastes bitter (0,2)
CF[H2,E6] = CFexpert * CFUser
= 0.4 * 0.2
= 0.08

Combined CF values in Normal Bilirubin disease
CFcombine CF[H,E]1,2 = CF[H1,E2] + CF[H2,E2] * (1 - CF[H1,E2])
= 0.24 + 0.48 * (1 – 0.24)
= 0.24 + 0.48 * 0.76
= 0.24 + 0.364
= 0.604 old1

CFcombine CF[H,E]old1,3 = CF[H,E]old1 + CF[H2,E3] * (1 - CF[H,E])old1)
= 0.604 + 0.32 * (1 – 0.604)
= 0.604 + 0.32 * 0.396
= 0.604 + 0.126
= 0.73 0ld2

CFcombine CF[H,E]old2,4 = CF[H,E]old2 + CF[H2,E4] * (1 - CF[H,E])old2)
= 0.73 + 0.16 * (1 – 0.73)
= 0.73 + 0.16 * 0.27
= 0.73 + 0.043
= 0.773 0ld3

CFcombine CF[H,E]old3,5 = CF[H,E]old3 + CF[H2,E5] * (1 - CF[H,E])old3)
= 0.773 + 0.12 * (1 – 0.773)
= 0.773 + 0.12 * 0.227
= 0.773 + 0.027
= 0.8 0ld4

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CFcombine CF[H,E]old4,6 = CF[H,E]old4 + CF[H2,E6] * (1 - CF[H,E])old4)
= 0.8 + 0.08 * (1 – 0.8)
= 0.8 + 0.08 * 0.2
= 0.8 + 0.016
= 0.816 0ld5

Results of CF value of Normal Bilirubin disease
CFcombine CF[H,E]old4,6 = CF[H,E]old4 + CF[H2,E6] * (1 - CF[H,E])old4)
= 0.8 + 0.08 * (1 – 0.08)
= 0.8 + 0.08 * 0.2
= 0.8 + 0.016
= 0.816 0ld5

3. Mild Bilirubin

From the results of matching between the symptoms entered by the user and the symptoms associated with Mild Bilirubin disease, there are 5 data for the same symptoms
G003 : Skin and whites of eyes turn yellow (0.8)
Formula : CF[H,E] = CF[H] * CF[E]

CF[H3,E1] = CFexpert * CFUser
= 0.4 * 0.8
= 0.32

G009 : Can not stand cold air (0.8)
CF[H3,E2] = CFexpert * CFUser
= 0.2 * 0.8
= 0.16

G011 : Nails look yellow (0.4)
CF[H3,E3] = CFexpert * CFUser
= 0.2 * 0.4
= 0.08

G017 : Frequent urination (0.2)
CF[H3,E4] = CFexpert * CFUser
= 0.4 * 0.2
= 0.08
G018 : Mouth tastes bitter (0,2)
CF[H3,E5] = CFexpert * CFUser
= 0.2 * 0.2

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= 0.04

Combined CF values in Mild Bilirubin disease

CFcombine CF[H,E]1,2 = CF[H1,E2] + CF[H3,E2] * (1 - CF[H1,E2])
= 0.32 + 0.16 * (1 – 0.32)
= 0.32 + 0.16 * 0.68
= 0.32 + 0.108
= 0.428 old1

CFcombine CF[H,E]old1,3 = CF[H,E]old1 + CF[H3,E3] * (1 - CF[H,E])old1)
= 0.428 + 0.08 * (1 – 0.428)
= 0.428 + 0.08 * 0.572
= 0.428 + 0.045
= 0.473 old1

CFcombine CF[H,E]old2,4 = CF[H,E]old2 + CF[H3,E4] * (1 - CF[H,E])old2)
= 0.473 + 0.08 * (1 – 0.473)
= 0.473 + 0.08 * 0.527
= 0.473 + 0.042
= 0.515 0ld3

CFcombine CF[H,E]old3,5 = CF[H,E]old3 + CF[H3,E5] * (1 - CF[H,E])old3)
= 0.515 + 0.04 * (1 – 0.515)
= 0.515 + 0.04 * 0.485
= 0.515 + 0.019
= 0.534 0ld4

Results of CF value of Mild Bilirubin disease

CFcombine CF[H,E]old3,5 = CF[H,E]old3 + CF[H3,E5] * (1 - CF[H,E])old3)
= 0.515 + 0.04 * (1 – 0.515)
= 0.515 + 0.04 * 0.485
= 0.515 + 0.019
= 0.534 0ld4

4. Results And Discussion

Based on the results of CF calculations, the patient on behalf of Mukti Pelawi was diagnosed with High Bilirubin. From the calculation results above, it can be seen that the confidence level of the diagnosis of the disease is 0.933 x 100%, which is 93.3%. With the results obtained, the system identifies that the patient has High Bilirubin disease.

Handling Solution:

1. Carry out exchange transfusion. This action is performed by removing the baby's blood

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by replacing it with transfusional blood, this process takes about 2-4 hours. Blood is removed and inserted through the veins in the umbilical cord or in the legs.
2. Taking medicine from the disease you are experiencing (Must be prescribed by a doctor)
3. Light therapy procedures (blue light therapy). This blue light will help remove Bilirubin from the baby's body.

5. Conclusion

in this research, with an expert system for diagnosing Bilirubin disease in infants, it can help diagnose Bilirubin disease in infants using the Certainty Factor method based on the symptoms the baby has. With this system, it can help the Al Fuadi Binjai hospital in dealing with the large queues of patients waiting for pediatricians, so as to minimize time and speed up the baby consultation process and provide faster solutions. Based on the trials conducted, it was confirmed that the patient on behalf of Mukti Pelawi was diagnosed with High Bilirubin Disease. From the calculation results above, it can be seen that the confidence level of the diagnosis of the disease is 93.3%.

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