APPLICATION OF EXPERT SYSTEM IN DIAGNOSING POLYCYSTIC OVARY SYNDROME

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PCOS (Polycystic Ovary Syndrome) or polycystic ovary syndrome is a condition of impaired ovarian function in women of childbearing age. This condition causes the hormones of women suffering from PCOS to become imbalanced due to unknown reasons. The early signs of PCOS are irregular ovulation or fertility, increased levels of male hormones (androgens) in a woman's body, and the appearance of many cysts (fluid-filled sacs) on the ovaries. Things like that are very feared by women because women's nature is to conceive and have offspring, if it is not taken care of from the start or early on, it is not impossible for this to happen. But in fact, public knowledge is still low about Polycystic Ovary Syndrome, information about Polycystic Ovary Syndrome is still not well socialized to the public so that people still do not know how to handle and treat it. In diagnosing Polycystic Ovary Syndrome, there are several methods that can be used, including the Dempster Shafer method. From the results of the study, it can be concluded, among others: The expert system built can provide convenience for users to diagnose polycystic ovary syndrome, and can provide treatment solutions for the disease. The results of the diagnosis using the Dempster Shafer method have a better percentage value.

Keywords: Polycystic Ovary Syndrome, Expert System, Dempster Shafer.

1. Introduction

PCOS (Polycystic Ovary Syndrome) or polycystic ovary syndrome is a condition of impaired ovarian function in women of childbearing age. This condition causes the hormones of women suffering from PCOS to become imbalanced due to unknown reasons. The early signs of PCOS are irregular ovulation or fertility, increased levels of male hormones (androgens) in a woman's body, and the appearance of many cysts (fluid-filled sacs) on the ovaries. If a woman experiences at least two of these three early signs, then she likely has PCOS. If examined more deeply PCOS disease is very influential for the future. Because if PCOS is allowed to develop without prevention and without treatment, it will turn small cyst granules into large cysts and cause infertility. Things like that are very feared by women because women's nature is to conceive and have offspring, if it is not taken care of from the start or early on, it is not impossible for this to happen. But in fact, public knowledge is still low about Polycystic Ovary Syndrome, information about Polycystic Ovary

Syndrome is still not well socialized to the public so that people still do not know how to handle and treat it. [1]

In diagnosing Polycystic Ovary Syndrome, there are several methods that can be used, including the Dempster Shafer method. Certainty Factor (CF) theory was proposed by Shortlife and Buchanan in 1975 to accommodate the inexact reasoning of an expert. Meanwhile, Dempster Shafer is a mathematical theory for proof based on belief functions and plausible reasoning, which is used to combine separate pieces of information (evidence) to calculate the probability of an event. [1]

2. Research Background

PCOS was first described by Drs. Stein and Leventhal in 1935. This syndrome affects up to 10% of women of childbearing age, and is the most common cause of infertility in industrialized countries. PCOS is associated with metabolic and hormonal disturbances, ovarian dysfunction, and menstrual irregularities. The current definition requires the presence of two of the following three criteria: (1) oligo-ovulation or chronic anovulation, (2) hyperandrogenism (either clinical or confirmed by laboratory testing), and (3) the presence of 12 follicles measuring 2-9 mm in diameter in each ovary and/or increased ovarian volume ($\geq$ 10 ml), detected by ultrasound examination. [2]

There are several hypotheses about the pathogenesis of PCOS invoking various etiologic factors, but the issue remains unclear and is the subject of intense debate. In the last decade, substantial in vitro and in vivo evidence has supported the most important role of insulin resistance and/or compensatory hyperinsulinemia in the pathogenesis of PCOS (present in approximately 80% of obese women with PCOS and 30-40% of lean women with PCOS). The demonstrated efficacy of insulin-sensitizing drugs, such as metformin, troglitazone and pioglitazone in improving ovulatory function and reducing androgen excess in PCOS provides additional evidence to support the insulin resistance role of pathogens in PCOS. However, side effects such as nausea and diarrhea (in the case of metformin) and weight gain (in the case of pioglitazone) can reduce patient compliance and limit the use of this drug (John E. Nestler, Vittorio Unfer: 2015).

3. Research Method

Dempster Shafer is a mathematical theory for proof based on belief functions and plausible reasoning, which is used to combine separate pieces of information (evidence) to calculate the probability of an event. This theory was developed by Arthur P. Dempster and Glenn Shafer. In general, Dempster Shafer theory is written in an interval: [3]

[Belief,Plausibility].. ....(1)

1. Belief (Bel) is a measure of the strength of evidence in supporting a set of propositions. If it is 0 it indicates that there is no evidence, and if it is 1, it indicates certainty. Where the value of the bell is (0-0.9).

2. Plausibility (Pl) is denoted as:

Pl(s) = 1 – Bell(-s) ....(2)

Plausibility is also 0 to 1. If you believe in -s, it can be said that Bel(-s)=1, and Pl(-s)=0.

In Dempster Shafer's theory, it is known that there is a frame of discrement denoted by . This frame is the universe of talks from a set of hypotheses. The goal is to relate the confidence measure of the elements of . Not all evidence directly supports each element. For this reason, it is necessary to have a probability density function (m). The value of m defines not only the elements of , but also all of its subsets. So if contains n elements, then the subset of is 2n. The sum of all m in the subset is equal to 1. If there is no information whatsoever to choose a hypothesis, then the value:

m{θ} = 1.0.

If it is known that X is a subset of , with m1 as a density function, and Y is also a subset of with m2 as a density function, then the combination function of m1 and m2 as m3, can be formed (Muhammad Dahria, et al : 2013).

$$m_3(Z) = \frac{\sum X \cap Y = Z m_1(X).m_2(Y)}{1 - \sum X \cap Y = \emptyset m1(X).m2(Y)} \dots \dots \dots \dots \dots \dots \dots \dots \dots. (3)$$

4. Results and Analysis

The knowledge base in this expert system will be used to determine the search process or determine the conclusions obtained from the results of the analysis. The results obtained after the user interacts with the expert system are by answering questions posed by the expert system. The knowledge base used in this expert system consists of the name of the disease and the symptoms suffered by the patient.

The following is an example of the application of the Dempster Shafer method in diagnosing Polycystic Ovary Syndrome. The production rules or rules related to Polycystic Ovary Syndrome are as follows: [4]

IF Menstruation is irregular or less than normal
AND Experiencing Hirsutism (excess hair growth in certain body parts)
AND Oily skin and acne
AND There is a cyst on the ovary
AND Depression
THEN Polycystic Ovary Syndrome Mild

Symptom-1: Menstruation period is irregular or less than normal
The first step is to calculate the value of belief and plausibility of the symptoms of irregular or less than normal menstruation (G1), using the formulas (4) and (5):

m_1 (G1) = 0.8
m_1 {θ}   = 1 – m_1 (G1)
            = 1 – 0.8 = 0.2

Symptoms 2: Experiencing Hirsutism (excess hair growth on certain body parts)
If it is known that there are new symptoms, namely experiencing hirsutism (excess hair growth on certain body parts) (G2), with reference to formulas (4) and (5), then the confidence value is:

$m2$ (G2) = 0.6
$m2$ {θ} = 1 – $m2$ (G2)
= 1 – 0.6 = 0.4

Table 1. Illustration of Belief Value Against 2 Symptoms

	m_2 (G2) = 0.6	m_2 {θ} = 0.4
m_1 (G1) = 0.8	0.48	0.32
m_1 {θ} = 0.2	-	0.08

Then calculate the level of confidence (m) combine with the formula (8), then:

$$m_3 = \frac{(0.8*0.6) + (0.8*0.4)}{1-0} = \frac{0.48+0.32}{1-0} = 0.8$$

$$m_3\{θ\} = \frac{(0.2*0.4)}{1-0} = 0.08$$

Symptom-3: Oily skin and acne
Then if there are new symptoms, namely oily skin and acne (G3), with the formula (4) and (5): m_4 (G3) = 0.7
m_4 {θ}   = 1 – m_4 (G3)
= 1 – 0.7 = 0.3

Table 2. Illustration of the Value of Belief in 3 Symptoms

	m_4 (G3) = 0.7	m_4 {θ} = 0.3
m_3 = 0.8	0.56	0.24
m_3 {θ} = 0.08	-	0.024

Then calculate the level of confidence (m) combine with the formula (8), then:

$$m_5 = \frac{0.56 + 0.24}{1 - 0} = 0.8$$

$$m_5 \{θ\} = \frac{(0.08*0.3)}{1-0} = 0.024$$

Symptom 4: There is a cyst on the ovary
Then if there are new symptoms, namely there is a cyst on the ovary (G4), with formulas (4) and (5), then:

m_6 (G4)   = 0.7
m_6 {θ}   = 1 − m_6 (G4)
               = 1 − 0.7 = 0.3

Table 3. Ilustrasi Nilai Keyakinan Terhadap 4 Gejala

	m_6 (G4) = 0.7	m_6 {θ} = 0.3
m_5 = 0.8	0.56	0.24
m_5 {θ} = 0.024	-	0.007

Then calculate the level of confidence (m) combine with the formula (8), then:

$$m_7 = \frac{0.56 + 0.24}{1 - 0} = 0.8$$

$$m_7 \{θ\} = \frac{0.024*0.3}{1-0} = 0.007$$

Symptom-5: Depression
Then, if there are new symptoms, namely depression (G5), with formulas (4) and (5), then:

m_8 (G5)   = 0.6
m_8 {θ}   = 1 − m_8 (G5)
               = 1 − 0.6 = 0.4

Table 4. Illustration of the Value of Belief in 5 Symptoms

	m_8 (G5) = 0.6	m_8 {θ} = 0.4
m_7 = 0.8	0.48	0.32
m_7 {θ} = 0.007	-	0.003

Then calculate the level of confidence (m) combine with the formula (8), then:

$$m_9 = \frac{0.48 + 0.32}{1 - 0} = 0.8$$

$$m_9 \{θ\} = \frac{0.007*0.4}{1-0} = 0.003$$

Final Score = (m_9 + m_9 {θ}) * 100%
          = (0.8 + 0.003) * 100%
          = 0.803 * 100 %

= 80.3 %

With the Dempster Shafer method of 80.3%, the percentage of the confidence level is that someone suffers from Mild Polycystic Ovary Syndrome (P001).

Table 5. Final Results

Dempster Shafer (P001)
80.3 %

The conclusion from the results of the comparison of methods in table III.8 can be seen that the difference in the application of the Certainty Factor method and the Dempster Shafer method in diagnosing Mild Polycystic Ovary Syndrome is the percentage of the confidence level of a person suffering from Mild Polycystic Ovary Syndrome (P001) While the final results using the Dempster Shafer method can be concluded that you have 80.3% mild Polycystic Ovary Syndrome.

4. Conclusions

From writing a thesis entitled the comparison of certainty factor and dempster shafer methods in diagnosing polycystic ovary syndrome, the conclusions that can be drawn are as follows The expert system built can provide convenience for users to diagnose polycystic ovary syndrome, and can provide treatment solutions for the disease. The expert system application for diagnosing polycystic ovary syndrome is implemented with Microsoft Visual Studio 2010, which displays simple menus so that anyone who needs it can use it, no need to have special computer skills. The conclusion from the results of the comparison of methods in table III.8 can be seen that the difference in the application of the Certainty Factor method and the Dempster Shafer method in diagnosing Mild Polycystic Ovary Syndrome is the percentage of the confidence level of a person suffering from Mild Polycystic Ovary Syndrome (P001) While the final results using the Dempster Shafer method can be concluded that you have 80.3% mild Polycystic Ovary Syndrome.

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