



# Control of HIV/AIDS Diseases Using Expert System with Dempster Shafer Method

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**Abstract.** HIV or AIDS is a disease that can not be cured. There is a lot of negative stigma for HIV patients in Indonesia. Psychological pressure will occur to HIV or AIDS patients and their families. Ignorance and lack of information about HIV or AIDS the causes and ways of transmission of this disease resulted in HIV infected people. In addition it can also be due to reluctant to consult directly to the health care because of the negative stigma they will receive. For that we need a system called expert system. Basically the expert system is applied to support troubleshooting activities. In addition expert systems can also function as a clever assistant from an expert. The knowledge to be represented in the expert system is filled with elements of uncertainty and disguise. One way to solve the problem of uncertainty can be done by using Dempster Shafer method. This expert system is not to replace the function of HIV counselors but is only used as a complement to the limited tools. This expert system is also expected to help the layman in assessing how much the risk of HIV or AIDS exposure is exposed

## 1. Introduction

Since the discovery of the HIV/AIDS virus, the sufferers of this disease continue to increase[1]. The increase of this disease is caused by the lack of information about the early symptoms, the causes and the transmission methods of this disease, besides that is the unwillingness of people to consult directly to a doctor because they are afraid to be considered as sufferers or they do not want their privacy disturbed [2]. The development of an increasingly advanced era nowadays, moreover encouraged by the rapid advancement of science and technology, makes human needs enhancement. For example, with the existence of computers, all activities can be done quickly and the risk of errors can be reduced. In the development of computers, computer experts try to create a system that is expected to have the ability to solve a problem like an expert. This concept encourages the birth of an expert system [3]. Based on the background above, the researchers conducted a research entitled HIV AIDS Disease Control Through Expert System By Using Dempster Shafer Method which aimed to be an effort to prevent and control HIV/AIDS. This research made a computer application that stored the expert's knowledge to diagnose HIV AIDS disease and provided the consistent, fast and right results. Therefore, the researchers intended to design an expert system application program that was able to diagnose and provided prevention and control of the disease[4]. For HIV/AIDS counselors, this system can be used as an experienced assistant and ease the workload based on the patient risk factor.

## 2. Grounding Theory

Dempster-Shafer is a mathematical theory for proof based on belief functions and plausible reasoning (the reasonable belief and thought functions), which is used to combine the separate pieces of information (evidence) to calculate the probability of an event. This theory was developed by Arthur P. Dempster and Glenn Shafer [5]. In general, the Dempster-Shafer theory is written in an interval (Belief, Plausibility). Belief (Bel) is a measure of the strength of evidence in supporting a set of propositions. If it is 0, then it indicates that there is no evidence, and if the value is 1, it indicates that there is a certainty. Plausibility (Pl) is denoted as:

$$Pl(s) = 1 - Bel(-s)$$

Plausibility is also worth 0 to 1. If you believe on -s, then it can be said that  $Bel(-s) = 1$ , and  $Pl(-s) = 0$ . Plausibility will reduce the evidence confidence level. In the Dempster-Shafer theory, we recognize the frame of discernment which denoted by  $\theta$  and the mass function which is denoted by  $m$ . This frame is a universe of talk from a set of hypotheses.

For example:  $\theta = \{K01, K02, K03\}$

With:

K01 = High Risk

K02 = Moderate Risk

K03 = Low Risk

The goal is to link the size of trust with  $\theta$  elements. Not all evidence directly supports each element. For example, heat may only support  $\{K01, K02, K03\}$ . For this reason, it is necessary to have a density function ( $m$ ). The  $m$  value not only defines the  $\theta$  elements but also all the sub-sets. It must show that the sum of all  $m$  in a sub-set of  $\theta$  is equal to 1. Suppose there is no information to choose the four hypotheses, then the value of  $m\{\theta\} = 1.0$ . If it is later discovered that the disrupted physical development is a characteristic of moderate and severe mental retardation with  $m = 0.7$ , then:

$$m\{K02, K03\} = 0,7$$

$$m\{\theta\} = 1 - 0,7 = 0,3$$

Suppose that you know that  $X$  is a sub-set of  $\theta$ , with  $m_1$  as its density function, and  $Y$  is also a sub-set of  $\theta$  with  $m_2$  as its density function, then we can form a combination function of  $m_1$  and  $m_2$  as  $m_3$ , by using a rule that better known as Dempster's Rule of Combination.

$$m_i(Z) = \frac{\sum_{x \cap y = z} m_{(i-2)}(X) \cdot m_{(i-1)}(Y)}{1 - \sum_{x \cap y = \emptyset} m_{(i-2)}(X) \cdot m_{(i-1)}(Y)}, i = 3, 5, 7, 9 \dots$$

Notes:

$m_1(X)$  is the mass function of evidence  $X$

$m_2(Y)$  is the mass function of evidence  $Y$

$m_3(Z)$  is the mass function of evidence  $Z$

### 3. Methods

The calculation in Dempster-Shafer began by entering the density value of each risk factor into the database as the basis for calculation. Then, the user entered the risk factors that had been experienced in the created expert system application. If there was still a new input, the calculation of the new density value would be carried out by combining the third density value with the next density value. The process would continue to repeat as much as the input made by the user. If all risks had been calculated, then the conclusions would be obtained from the results of the most recent combined density values



On this page, users did HIV risk detection by selecting the symptom data according to the factors that had been experienced.

Hasil Diagnosa

Catatan Tes HIV

No	Tanda/Gejala
1	Perilaku yang berkaitan dengan seks yang berisiko terhadap penularan HIV
2	Merawat luka yang dalam yang tidak dirawat dengan benar
3	Sering menggunakan narkoba
4	Demam berulang dengan tidak teratur

Peringkat risiko secara keseluruhan yang diperoleh berdasarkan hasil tes HIV (0-1)

R	A	B	C
0-0.25	0-0.50	0-0.75	0-1.00
Rendah Risiko	Rendah Risiko	Rendah Risiko	Rendah Risiko

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Figure 3. Inputting the symptoms

Sering menggunakan narkoba (0-1)

R	A	B	C
0-0.25	0-0.50	0-0.75	0-1.00
Rendah Risiko	Rendah Risiko	Rendah Risiko	Rendah Risiko

Demam berulang dengan tidak teratur (0-1)

R	A	B	C
0-0.25	0-0.50	0-0.75	0-1.00
Rendah Risiko	Rendah Risiko	Rendah Risiko	Rendah Risiko

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Rendah Risiko	Rendah Risiko	Rendah Risiko	Rendah Risiko

Figure 4. Result of the diagnose

Figures 3 and 4 were the diagnosis results after inputting the symptoms. Diagnosis results were divided into 3, which were a moderate, high and low risk.

Gejala

Kode	Nama Gejala	Bobot
1	Peran Mengalami Kemeraman Sekali	0.5
10	Peran Menakutkan	0.5
11	Peran menggunakan metode kontrasepsi yang salah sehingga tidak dapat mencegah	0.2
12	Peran menggunakan kondom sekali yang akan akhirnya rusak akibat pemakaian	0.4
13	Peran memiliki transfusi darah	0.5
14	Peran memiliki pasangan yang berganti-ganti	0.2
15	Peran memiliki pasangan yang memiliki status HIV	0.5
16	Peran memiliki pasangan berganti-ganti yang berganti-ganti	0.4
17	Peran memiliki pasangan yang berganti-ganti dan tidak memakai kondom	0.5
18	Peran memiliki pasangan yang berganti-ganti dan tidak memakai kondom	0.4
19	Sering berganti-ganti pasangan	0.4
2	Peran melakukan hubungan seksual tanpa kondom	0.5
20	Menggunakan kondom yang sudah rusak atau tidak terpasang dengan benar	0.4
21	Sering berganti-ganti pasangan	0.2
22	Terpapar pada darah orang lain	0.4
23	Sering berganti-ganti pasangan	0.2
24	Keinginan seks yang tinggi	0.5
25	Menggunakan kondom yang sudah rusak atau tidak terpasang dengan benar	0.4
26	Terpapar pada darah orang lain	0.5
27	Peran memiliki pasangan berganti-ganti	0.4

**Figure 5.** Risk factor HIV/AIDS

Symptoms page was a page that could only be accessed by experts and admin. On this page, the expert and admin could process the data density in the form of add, change, and delete data in the form of symptoms, risks, and density values. The management of density data as a basis for Dempster-Shafer calculations was done on this page.

## 5. Testing and Analysis

The testers used expert system accuracy with 20 test data with the test results that showed 73% accuracy of test System accuracy based on the data observations provided by experts about HIV/AIDS cases that had occurred, so that resulted in an accuracy of 73%. This showed that the expert system functioned properly.

## 6. Conclusion and Suggestion

The conclusions obtained were as follow:

5.1 The modeling of the HIV AIDS disease control system with an expert system using the Dempster-Shafer method determined the decision of the expert by calculating the density value of the factors that became an intermediary for the transmission of the HIV virus. The calculation process with the Dempster-Shafer method produced the highest density value so that the system determined the risk of transmission.

5.2 The Testing of Accuracy Level, the accuracy testing results of HIV risk early detection expert system using the Dempster-Shafer method by matching the results of the system and experts, obtained an accuracy value of 73%. The accuracy was obtained from the success of the system to detect 20 test cases with the results of the appropriate decision from the detection of th

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