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Knowledge-Based Systems Selection of Contraceptive Equipment for The Handling of Uncertainty

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Abstrak

Alat kontrasepsi merupakan salah satu produk dari program pemerintah untuk pengendalian jumlah penduduk. Pemerintah telah membentuk Dinas Pengendalian Penduduk dan Keluarga Berencana dan Pemberdayaan Perempuan dan Perlindungan Anak yang secara khusus mengelola penyebaran dan sosialisai alat tersebut. Namun untuk memilih alat kontrasepsi yang sesuai untuk dirinya masyarakat masih merasa kesulitan. Bukan hanya calon pengguna yang merasa kesulitan, terkadang petugas KB juga merasa tidak pasti dalam memberikan saran alat kontrasepsi terhadap calon pengguna. Hal tersebut dikarenakan, terkadang kondisi calon pengguna tidak sesuai dengan aturan yang ada, pengetahuan yang terbaru tentang perkembangan alat kontrasepsi belum dimiliki oleh petugas tersebut, sehingga mengakibatkan ketidakpastian dalam pemberian saran pemilihan alat kontrasepsi. Dalam penelitian ini diusulkan sebuah sistem berbasis pengetahuan untuk membantu masyarakat awam dalam memberikan gambaran jenis alat kontrasepsi yang sesuai untuk dirinya sendiri jenis serta dapat membantu petugas KB sebagai media interaktif dan dalam penanganan hal ketidakpastian yang telah disebutkan diatas. Adapun untuk penangan ketidakpastian pada hal tersebut akan digunakan metode dempster shafer pada sistem berbasis pengetahuan ini. Metode dempster shafer dipilih sebab metode ini dapat memberikan perkiraan nilai keyakinan terhadap suatu hasil diagnosis, dengan melakukan perhitungan kombinasi antara gejala-gejala yang sama akan diperoleh nilai keyakinan yang paling tinggi, atau yang paling dominan. Pada proses pengujian, akan ada 40 kasus yang dibandingkan hasilnya. Penelitian ini bertujuan untuk menangani ketidakpastian pemberian saran pemilihan alat kontrsepsi. Hasil dari penelitian ini dapat memberikan suatu media konsultasi yang mampu memberikan pemilihan alat kontrasepsi yang mengatasi permasalahan ketidakpastian dan tingkat kepercayaan sistem terhadap alat tersebut. Pengujian tersebut memperlihatkan tingkat akurasi sebesar 95% .

Kata kunci*—Sistem Berbasis Pengetahuan, Kontrasepsi, Dempster Shafer*

Abstract

Contraceptives is one of the products of the government program for controlling the population. The government has established the Department of Population Control and family planning and empowerment of women and child protection that specifically manages the dissemination and socialization of the apparatus. But to choose the appropriate contraceptives for himself The Community of people still feel trouble. Not only prospective of common people who feel difficulties, sometimes the KB officers also feel uncertain in giving advice of tool contraceptives. That is because, sometimes the condition of the user does not comply with the existing rules, the latest knowledge about the development of contraception has not been owned by the officer, thus resulting in uncertainty in the suggestion of selection of contraceptives. In this study proposed a knowledge-based system to assist the public in providing an overview of

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the type of contraceptive equipment suitable for theyself and can be used by the KB officers the as interactive media and in the handling of the uncertainty problem that mentioned before. Then for the handling of uncertatinty problems will use dempster shafer method. dempster shafer method is Chosen because this method can provide an estimate of the value of confidence against a result of the diagnosis, by conducting the calculation of the combination of the same symptoms will be obtained the highest confidence value, or the most dominant. In the testing process, there will be 40 cases compared to the results. This research aims to solve the uncertainty problems of the suggestion the selection of contraceptives tools. The results of this research can provide a consulting medium that is able to provide selection of contraceptives that solve the problem of uncertainty and confidence level of the system to the tool. The test showed an accuracy rate of 95%

Keywords— *Knowledge Base System, Contraceptives, Dempster Shafer*

1. INTRODUCTION

Family planning is the Indonesian government program to minimize the population. There are various types of services from local governments to help with family planning programs. One form of government services is the provision and extension of the use of contraception in various areas ranging from the national, provincial, district, subdistrict, even to every villages. Choosing contraceptives method or tools is not easy because the effects that affect the body will not be known as long as they have not used it, the knowledge that belongs to potential users (acceptors) are limited, and perhaps even in certain areas to discuss it is still embarrassed.

The difficulty in determining the selection of contraceptives is not only experienced by prospective users (acceptors) due to the factors mentioned above, but sometimes also experienced by the Family planning field extension (PKB), but the officer should have been given knowledge and equipped the science of the contraceptive tools. This may be due to some things being given is a very diverse state of acceptor candidates, although there are already red threads as a rule, but sometimes the condition of the prospective user is not always in accordance with the thread of the rule, which causes an officer to advise on the basis of intuition, his experience and feelings that caused between one officer with another has a different opinion. There are also cases that cause more than one selection of contraceptives due to knowledge from officers who have not yet learned the new rules, new knowledge, and still fixed the old rules, or the condition of the prospective user causing it. What has been conveyed above is a form of uncertainty in the suggestion of selection of contraceptives.

Based on the above exposure, there is a knowledge-based system that can help prospective users (axioms) of the KB or spouses in selecting contraceptives and also for the KB extension officers in order to be used in helping to deal with uncertainty in providing advice. Knowledge-based systems are very helpful for decision making where this system can collect and store knowledge of a person or several people who have knowledge in a knowledge base and use advanced reasoning system in solving problems so that knowledge-based systems can solve a certain problem because it already keeps the overall knowledge.

In an effort to overcome uncertainty as mentioned above will be used Dempster Shafer method. Dempster Shafer method is a method of non monotonical reasoning used to calculate uncertainty due to the addition or reduction of new facts that will change the existing rules. In addition, the method of Dempster Shafer can also find out the probability or percentage of the disease that may be suffered [1].

The use of dempster shafer method can provide an estimate of confidence value against a result of diagnosis, by conducting the calculation of the combination of the same symptoms will be obtained the highest confidence value, or the most dominant. Some of the tested cases were obtained the same diagnosis result between the expert system and an expert, which is a

percentage of the accuracy of 96% of the predictions in accordance with the knowledge held by experts [2].

Pre-existing research on contraceptives has been conducted by Qulsum et al [3] In his research on the expert system for the diagnosis of contraceptive equipment selection indicating the system can analyze the type of contraceptives suitable for use by users based on user-selected characteristics, the system can do early diagnosis so that it can be used as an alternative before consulting directly with experts, but there is The same research has been conducted by Yohano [4] which suggests that the developed expert system can conclude a diagnosis or suspected KB acceptor matches in accordance with the symptoms, and there is a suggestion to improve the process of diagnosing the aceptor of KB.

Sembiring and Sinaga [5] do research to diagnose diseases caused by bacteria Treponema pallidum using dempster shafer method, method can be used to perform disease detection. Using the same method, Malinda [6] and Alfatah [7] conducting research that concluded its accuracy results 83%-100%.

2. METHODS

2.1 Knowledge Based System

Knowledge Based System (KBS) is part of artificial Intelligence (AI). KBS has the ability to perform compute, storage, thought processes, and storage of knowledge. KBS can be implemented to help experts answer questions without spending time, can be done anywhere, and anytime. This is because the ones they have are stored first into Knowledge Based. KBS itself consists of Knowledge Based (KB) and inference machines that serve as the search engine of Knowledge . Knowledge Based alone can be a repository of knowledge with various forms. KBS can be a system whose knowledge is automatically updated (machine learning) or manually updated (manual update). The user interface is useful as a liaison between the system and users. Shows the basic architecture of Knowledge Based System.

KBS itself can be classified into 5 types that are expert system, hypertext manipulation System, CASE Based reasoning, Database in conjunction with an intelligent User Interface, and Intelligent Tutoring System (ITS).

2.2 Uncertainty

According to Kusrini [8] uncertainty can be interpreted as the complete lack of information for decision making process. One of the uncertainties is uncertainty that occurs against the rules, in dealing with a problem often found answers that have no full certainty. This uncertainty could be a probability that depends on the outcome of an event. The uncertain results are caused by 2 (two) factors that are uncertain rules and the user answers are uncertain on a question posed by the system.

A number of theories have been found to resolve uncertainty, including the classic probability , Bayesian probability, Hartley theory based on the set of classics, Shannon theory is based on probability, the theory of Dempster-Shafer, the fuzzy Theory of Zadeh and the certainty factor.

The rule of uncertainty is caused by 3 things, namely the singular, the discrepancy between consequent in the rules and conflict resolution [9]. The single rule is influenced by 3 things namely error, probability, and the combination of premise. The error is caused by something defined excessively (ambiguity), data incompleteness, error information, error measurement. Probability caused by an expert's inability to formulate a certain rule, the granting of probability values stating the degree of trust can also lead to uncertainty.

Inconsistency between rules can be caused by contradiction of rules, subconsumption of rules, redundancy of rules, loss of rules and merging of data. Another cause of uncertainty is conflict resolution. Conflict resolution is caused by interaction between rules. Conflict

resolution is the process of selecting an existing rule if there are more than 1 rules activated.

2.3 Dempster Shafer

Dempster Shafer Theory (DST) was first introduced by Dempster, who conducted uncertainty model experiments using a single probability range. Then, in 1976 Shafer published Dempster's theory in a book called Mathematical Theory of Evident [10].

In DST, the level of confidence of evidence is called the degree of belief and is assumed to be mass (represented by m) which is the level of trust of the object or also called the Basic Probability Assignment. In DST, it does not force a belief to be given to ignorance or refutation in a hypothesis, but the value of mass is only given to a subset in an environment that is believed to be given a level of trust. The subset that is not given the level of belief is considered as non-belief (θ) [11].

If it is known that X is a subset of θ, with m_1 as a function of its density, and Y is also a subset of θ with m_2 as its density function, then a combination function of m_1 and m_2 as m_3 can be formed in equation 1[10].

$$m_1 \oplus m_2(Z) = \frac{\sum_{X \cap Y = Z} m_1(X)\, m_2(Y)}{1 - \sum_{X \cap Y = \emptyset} m_1(X) m_2(Y)} \quad (1)$$

where

$m_1 \oplus m_2(Z)$: the result of combination evidence (X) and evidence (Y),
$m_1(X)$: mass function of evidence (X),
$m_2(Y)$: mass function of evidence (Y).

2.4 Knowledge-Based System Architecture

On the knowledge-based system architecture The following contraceptive equipment selection is divided into two blocks. The system development block is used to incorporate knowledge into a knowledge-based system environment, and the consulting environment is used by the user to determine the contraceptive device that it will be applied to. The system architecture of knowledge-based selection of contraceptive tools can be seen in Figure 1 below.

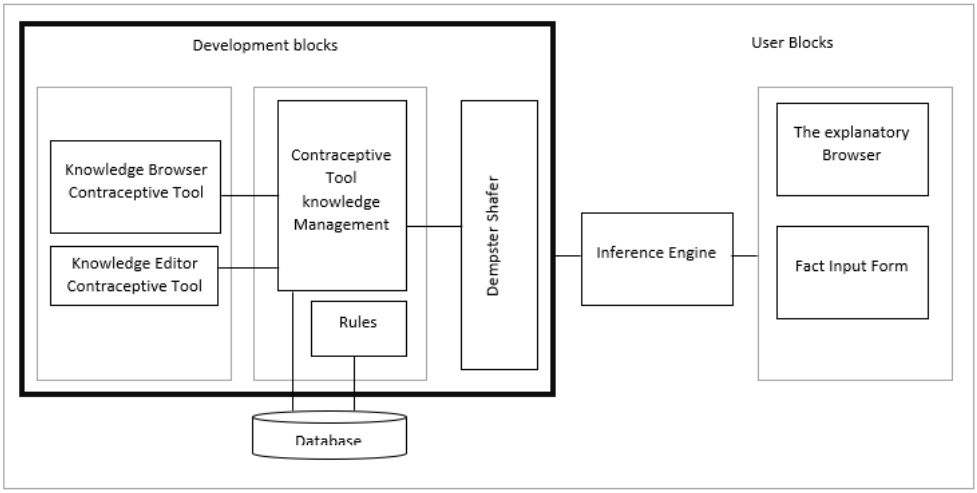

Figure 1. Knowledge-Based System Architecture

2.5 Design Inference Machine

The inference machine in this system is executed to choose the appropriate type of contraceptives suitable for the acceptor based on the result of uncertainty calculation of the method of Dempster Shafer which is evidence or fact entered by the acceptor. The inference

engine that runs on this knowledge-based system is a method of advanced tracing, where reasoning is initiated from the evidence or facts that exist and is then used to determine the outcome or type of contraceptive device suitable for the acceptor. Evidence or fact is given the degree of belief, degrees belief have a large range of values between 0 to 1, where for the value of belief that is closer to 1, then the value of the evidence or fact will be higher to approach the decision to a type of contraceptive device. In general the system flow of knowledge-based selection of contraceptive tools using Dempster Shafer shown in Figure 2.

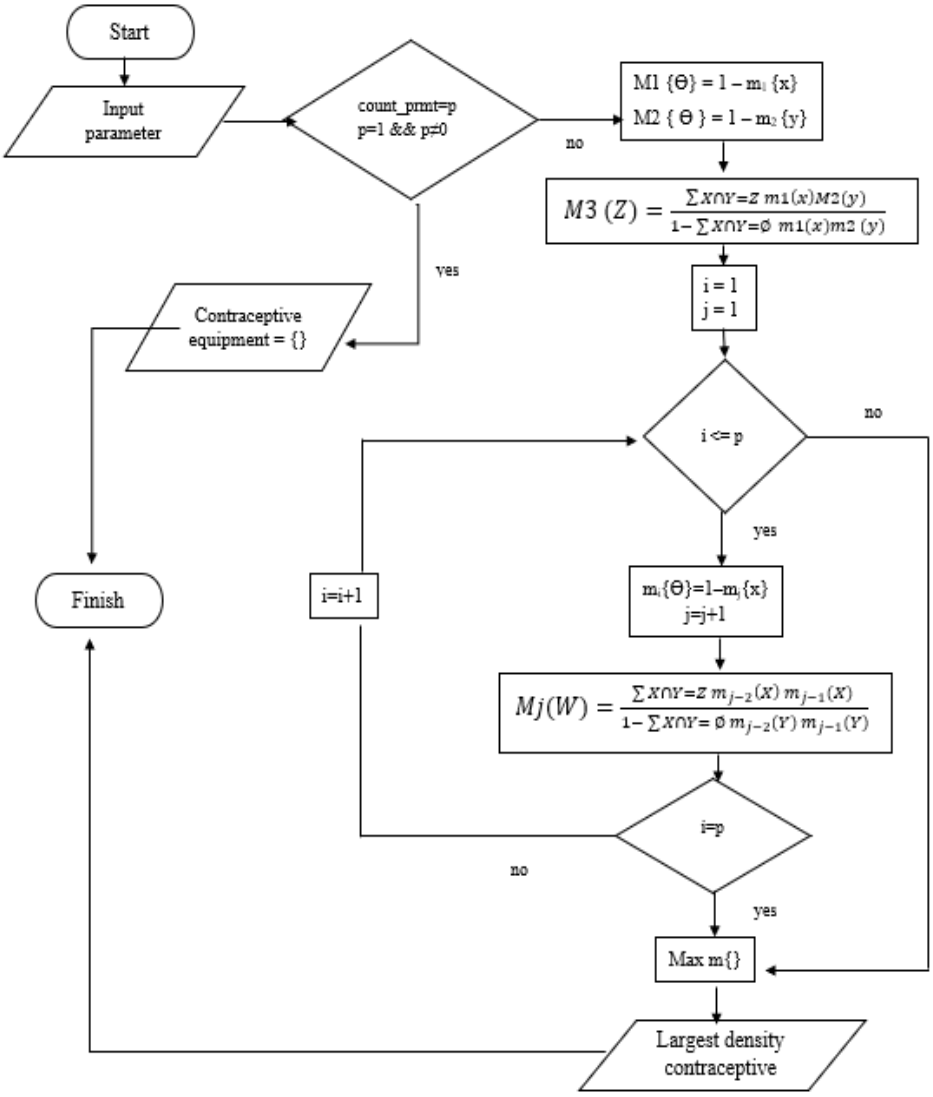

Figure 2. Flowchart Expert System Selections of Contracepvtives

2.6 Illustration of Dempster Shafer

This is an illustration of the Dempster Shafer-based expert system that provides conclusion based on symptoms obtained The example used is one case in the selection of conraceptives. The symptoms/parameters obtained by the system are female (P02), age 25 (P04), 8 years effect (P18), and 1 child (P21).

Dempster Shafer Algorithm:

Symptom 1: Female (P02)

Calculate the belief and plausibility values (represented by m1) from increasing of the female. Female is symptom/Parameter of the following contravepties (A01,A02,A03,A04,A05,A06,A07,A08,A09,A10,A11,A12,A13,A14,A17). The belief value from female is 0.4.

m1 { A01,A02,A03,A04,A05,A06,A07,A08,A09,A10,A11,A12,A13,A14,A17} = 0.4

m1 {θ} = 1- m1{ A01,A02,A03,A04,A05,A06,A07,A08,A09,A10,A11,A12,A13,A14,A17}

= 1 – 0.4

= 0.6

Symptom 2: age 25 (P04)

Calculate the belief and plausibility values (represented by m2) from age 25. The age 25 is symptom of the following contraceptives {A01,A02,A03,A04,A05,A06,A07,A08,A09,A10,A11,A12,A13,A14,A15}. The belief value from the age 25 symptom/parameter is 0.35

m2 {A01,A02,A03,A04,A05,A06,A07,A08,A09,A10,A11,A12,A13,A14,A15} = 0.35

m2 {θ} = 1- m2{ A01,A02,A03,A04,A05,A06,A07,A08,A09,A10,A11,A12,A13,A14,A15}

= 1- 0.35

= 0.65

These are the combination illustration of P02 and P04 which is seen in Table 1.

Table 1. The Combination Illustration of P02 and P04

	m2 {A01,A02,A03,A04,A05,A06,A07, A08,A09,A10,A11,A12,A13,A14, A15} (0.35)	m_2{θ} (0.65)
m1{A01,A02,A03,A04, A05, A06,A07,A08,A09,A10 ,A11,A12,A13,A14,A17 } (0.4)	{A01,A02,A03,A04,A05,A06 ,A07,A08,A09,A10,A11, A12,A13,A14} (0.4x0.35=0.14)	{A01,A02,A03,A04,A05,A06, A07, A08,A09,A10,A11,A12,A13, A14, A17} (0.4x0.65=0.26)
m_1{θ} (0.6)	{A01,A02,A03,A04,A05,A06,A07, A08,A09,A10,A11,A12,A13,A14, A15} (0.6x0.35=0.21)	θ (0.6x0.65=0.39)

Next, calculate the belief value in the combination of m_1 and m_2 (represented by m_3) using equation 1.

m_3 {A01,A02,A03,A04,A05,A06,A07,A08,A09,A10,A11,A12,A13,A14} = 0,14

m_3 {A01,A02,A03,A04,A05,A06,A07,A08,A09,A10,A11,A12,A13,A14,A15} = 0,21

m_3 {A01,A02,A03,A04,A05,A06,A07,A08,A09,A10,A11,A12,A13,A14,A17} = 0,26

m_3 {Θ} = 0,39

Symptom 3: 8 years effect (P18)

Calculate the belief and plausibility values (represented by m4) from 8 years effect. The 8 years effect is symptom of the following contraceptives {A02}. The belief value from the 8 years effect symptom/parameter is 1

m4 {A02} = 1

m4 {θ} = 1- m4{ A02}

= 1- 1

= 0

These are the combination illustration of P02,P04 and P18 which is seen in Table 2.

Table 2. The Combination Illustration of P02,P04 and P18

	m4{A02} 1	m4{Θ} 0
m3{A01,A02,A03,A04,A05, A06,A07,A08,A09,A10, A11,A12,A13,A14} 0,14	{A02} 0,14	{A01,A02,A03,A04,A05, A06,A07,A08,A09,A10, A11,A12,A13,A14} 0
m3{A01,A02,A03,A04,A05, A06,A07,A08,A09,A10, A11,A12,A13,A14,A15} 0,21	{A02} 0,21	{A01,A02,A03,A04,A05, A06,A07,A08,A09,A10, A11,A12,A13,A14,A15} 0
m3{A01,A02,A03,A04,A05, A06,A07,A08,A09,A10, A11,A12,A13,A14,A17} 0,26	{A02} 0,26	{A01,A02,A03,A04,A05, A06,A07,A08,A09,A10, A11,A12,A13,A14,A17} 0
m3{Θ} 0,39	{A02} 0,39	{Θ} 0

Next, calculate the belief value in the combination of m_3 and m_4 (represented by m_5) using equation 1.

m_5 {A02} = 1
m_5 {A01,A02,A03,A04,A05,A06,A07,A08,A09,A10,A11,A12,A13,A14} = 0
m_5 {A01,A02,A03,A04,A05,A06,A07,A08,A09,A10,A11,A12,A13,A14,A15} = 0
m_5 {A01,A02,A03,A04,A05,A06,A07,A08,A09,A10,A11,A12,A13,A14,A17} = 0
m {Θ} = 0

Symptom 4: 1 child (P21)

Calculate the belief and plausibility values (represented by m6) from 1 child. The 1 child is symptom of the following contraceptives { A01,A02,A03,A04,A05,A06,A07,A08,A09,A10,A11,A12,A13,A14,A15}. The belief value from the 1 child symptom/parameter is 0.45

m4 { A01,A02,A03,A04,A05,A06,A07,A08,A09,A10,A11,A12,A13,A14,A15} = 1
m4 {θ} = 1- m6{ A01,A02,A03,A04,A05,A06,A07,A08,A09,A10,A11,A12,A13,A14,A15}
= 1- 0.45
= 0.55

These are the combination illustration of P02,P04,P18 and P21 which is seen in Table 3.

Table 3. The Combination Illustration of P02,P04,P18 and P21

	m6{A01,A02,A03,A04,A05, A06,A07,A08,A09,A10, A11,A12,A13,A14,A15} 0,45	m6{Θ} 0,55
m5 {A02} 1	{A02} 0,45	{A02} 0,55
m5 {A01,A02,A03,A04,A05 A06,A07,A08,A09,A10, A11,A12,A13,A14} 0	{A01,A02,A03,A04,A05, A06,A07,A08,A09,A10, A11,A12,A13,A14} 0	{A01,A02,A03,A04,A05, A06,A07,A08,A09,A10, A11,A12,A13,A14} 0
m5{A01,A02,A03,A04,A05, A06,A07,A08,A09,A10, A11,A12,A13,A14,A15} 0	{A01,A02,A03,A04,A05, A06,A07,A08,A09,A10, A11,A12,A13,A14,A15} 0	{A01,A02,A03,A04,A05, A06,A07,A08,A09,A10, A11,A12,A13,A14,A15} 0
m5{A01,A02,A03,A04,A05, A06,A07,A08,A09,A10, A11,A12,A13,A14,A17} 0	{A01,A02,A03,A04,A05, A06,A07,A08,A09,A10, A11,A12,A13,A14,} 0	{A01,A02,A03,A04,A05, A06,A07,A08,A09,A10, A11,A12,A13,A14,} 0
m5 {Θ} 0	{A01,A02,A03,A04,A05, A06,A07,A08,A09,A10, A11,A12,A13,A14,A15} 0	{Θ} 0

Next, calculate the belief value in the combination of m_3 and m_4 (represented by m_5) using equation 1.

m7 {A02} = 1
m7{A01,A02,A03,A04,A05,A06,A07,A08,A09,A10,A11,A12,A13,A14} = 0
m7{A01,A02,A03,A04,A05,A06,A07,A08,A09,A10,A11,A12,A13,A14,A15} = 0
m7 {Θ} = 0

The largest belief value (density) in the last calculation is m7 {A02} with the belief value is 1. So, based on the symptoms/parameter obtained by the system such as P02,P07,P18 and P21, the Dempster Shafer method was obtained a diagnosis of the contraceptives as well as A02

2.7 Design of Testing

Testing is done by measuring the level of accuracy of the knowledge base system using Dempster Shafer method for all test cases in each domain with the following calculation.

$$The\ Value\ of\ Accuracy = \frac{M}{N}\ x\ 100\% \quad (2)$$

Where
M : number of case match of that solve by system and an expert
N : number of cases

2.8 Implementation of knowledge-based systems

This knowledge-based system is developed as a Web-based application with the programming language used is PHP and MySQL database. Implementation of implementations on this system is based on the DFD (Data Flow Diagram) which has been discussed in the previous chapter. Home page display on a knowledge-based system shown figure 3.

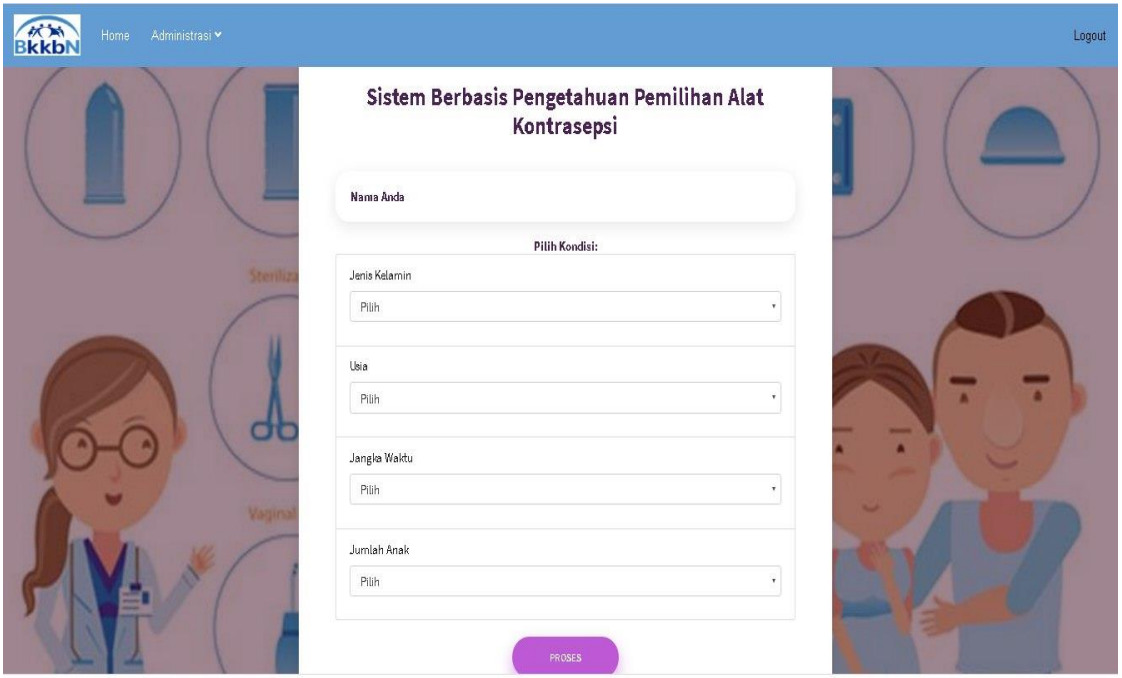

Figure 3 Home page system

3. RESULTS AND DISCUSSION

Testing of 40 cases for the selection of good contraceptives conducted by the system of expert contraceptive equipment selection and conducted by the expert has been completed and when looking at the results of the comparison then obtained the accuracy value for the system Expert contraceptives selection. Get 38 cases match, sothe calculation based on (2) test case results in a value of 95%, then the accuracy of the selection of contraceptive instruments between experts and expert systems has an accuracy value of 95%.

Measurement of the accuracy rate aims to determine whether a single conclusion obtained by the expert system using dempster shafer method is the same as the conclusions of the expert. The accuracy value is obtained by dividing the number of cases that have conclusions by expert conclusions with the number of cases that have one conclusion from the expert system with dempster shafer method. The accuracy rate of the 95%. It was obtained based on 40 test cases.

4. CONCLUSIONS

Produced an knowledge-based system using Dempster Shafer method to overcome the problem of lack of knowledge of acceptor type of contraceptive equipment suitable for him. The use of the Dempster Shafer method on the expert system can provide an estimate of the belief in the results of a type of conforrasepsy tool which is a value in the scale of 1-100, the calculation to find the value is done by combining Between the existing parameters and the most sought-after value. In testing to do comparisons of results among experts with the system acquired the same results. The results of the accuracy test resulted in an accuracy value of up to 95%, of the 40 cases compared.

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