



Expert System to Diagnose Extra Lung Tuberculosis Using Bayes Theorem

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ABSTRACT

Tuberculosis is a common infectious disease, and in many cases is deadly. Tuberculosis usually attacks the lungs, but can also affect other body parts. Tuberculosis spreads through the air when someone with active TB infection coughs, sneezes, or spreads their saliva through the air. the limited medical staff in the puskesmas compared to the total population results in often delayed services to TB patients. This research focuses on making an expert system to diagnose tuberculosis using Bayes's Theorem which has been known that the method has been widely used to diagnose diseases in several cases

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1. Introduction

Artificial Intelligence or Artificial Intelligence is one part of computer science that makes machines (computers) can do work as and as well as humans do. An expert system is an artificial intelligence program that connects a knowledge base with an information system to mimic an expert. One of the applications of an expert system in medicine is to diagnose a disease. This expert system is very useful for knowing more clearly about lung disease so that it is expected for users who do not know the problem will understand in detail about lung disease.

The low level of public knowledge about the dangers of lung disease and the symptoms that exist in pulmonary tuberculosis. Lung disease is a very dangerous disease because of its rapid transmission process. Various types of lung disease include: pneumonia, legionnaires, pleural effusion, tuberculosis (TB), pneumothorax, asthma, chronic obstructive, chronic bronchitis, emphysema, silicosis and asbestosis. However, people are less aware of the dangers of lung disease and the symptoms they experience, if left unchecked without proper treatment will cause death. Lung disease sufferers in Indonesia are still fairly high.

In this study the Bayes theorem was used. Bayes' theorem is a theorem with two different interpretations. In Bayes' interpretation, this theorem states how far the degree of subjective belief must change rationally when there are new clues.

2. Theory

2.1 Expert System

Menurut Kusumadewi [2003: 109] sistem pakar (expert system) adalah sistem yang berupaya mengadopsi pengetahuan manusia ke komputer, sehingga komputer dapat menyelesaikan masalah seperti yang biasanya dilakukan oleh para ahli, dan sistem pakar yang baik dirancang sehingga mereka dapat memecahkan suatu masalah khusus dengan meniru karya para ahli. dengan sistem pakar ini diharapkan, pengguna dapat memecahkan masalah tertentu, tanpa bantuan ahli di bidangnya

2.2 Teorema Bayes





Bayes' theorem is a theorem with two different interpretations. In Bayes' interpretation, this theorem states how far the degree of subjective belief must change rationally when there are new clues. In the frequencyist interpretation of the theorem it explains the inverse representation of the probability of two events. Bayes probability is one way to overcome data uncertainty by using Bayes formula which is stated as follows:

$$P(H_k | E) = \frac{P(E | H_k) P(H_k)}{\sum_{k=1}^n P(E | H_k) P(H_k)} \dots\dots(1).$$

Where:

1. $P(H_k | E)$: H_k hypothesis probability if given evidence E.
2. $P(E | H_k)$: The probability of the emergence of E evidence if the hypothesis H_k is given is correct.
3. $P(H_k)$: H_k hypothesis probability, regardless of any evidence.
4. $P(E)$: Probability of evidence E.

Table I
Types of TB Disease

Kode Penyakit	Nama Penyakit
P01	Pleuritis
P02	peritonitis
P03	Tulang
P04	Meninghitis
P05	Limfadenitis

Table II
The value of TB disease

Kode Gejala	Nama Gejala	Nilai
G01	Sakit di salah satu sisi dada	0.20
G02	Sakit di bahu dan Punggung	0.25
G03	Batuk kering	0.13
G04	Sesak napas	0.63
G05	Demam	0.16
G06	Pusing	0.8
G07	Berkeringat di malam hari	0.18
G08	Mual	0.19
G09	Nyeri perut terasa jika bergerak	0.34
G10	Perut kembung	0.08
G11	Nafsu makan menurun	0.15
G12	Diare	0.13
G13	Tidak bisa buang gas (konsepsi)	0.5
G14	Lemas	0.9
G15	Berat Badan menurun	0.9
G16	Bungkuk dan di sertai bengkak di tulang	0.22
G17	Demam terutama pada bayi	0.45
G18	Perubahan pada Kondisi mental	0.18
G19	Sensitif pada cahaya	0.28
G20	Sakit kepala parah	0.15
G21	Leher keram	0.17
G22	Sering Pingsan	0.23
G23	Pembengkakan di kelenjar getah bening di leher ketiak, atau.	0.50
G24	Munculnya abses atau nanah	0.43
G25	Keluarnya cairan dari kelenjar getah bening yang membengkak	0.45
G26	Sakitpunggung pada bagiantertentu.	0.24
G27	mengalamianoreksia.	0.32
G28	Sering Pingsan	0.50

3. Results and Conclusions

Case study :
Symptoms experienced by patients from the results of the consultation



Demam G05 : 0.16

1. Batuk Kering G03 : 0.13

2. Perut Kembung G10 : 0.8

3. Sakit bahu dan
Punggung G02 : 0.25

4. Pusing G06 : 0.8

1. Menentukan nilai Probabilitas

P01 : Pleuitis TB

G05 : P(EI H5) : 0,16

G03 : P(EI H3) : 0,13

G02 : P(EI H2) : 0.25

G06 : P(EI H6) : 0,8

P02 : Perioritis TB

G05 : P(EI H5) : 0.16

G10 : P(EI H10) : 0.8

P03 : TB Tulang

P04 : Mininghitis

G05 : P(EI H5) : 0.16

P05 : Limfadenitis TB

G05 : P(EI H5) : 0.16

Determine universal values: Look for universal values by adding up hypotheses.

$$\sum_{Gn}^n = G1 + \dots + Gn$$

- a. P01 : Pleusitis
- G05 : P(EI H5) : 0,16
- G03 : P(EI H3) : 0,13
- G02 : P(EI H2) : 0.25
- G06 : P(EI H6) : 0,8

- b. P02 : Peritoritis
- G05 : P (EI H5) : 0.16
- G10 : P(EI H5) : 0.8

$$\sum_{Gn}^n = 0.16 + 0.8 = 0.24$$

- d. P04 : Mininghitis TB
- : P(EI H5)=0.16

$$\sum_{Gn}^n = 0.16$$

- e. P05 : Limfadenitis
- P(EI H5)=0.16

$$\sum_{Gn}^n = 0.16$$

After the results of the sum are known, the formula for calculating temporary values is obtained.

$$P(Hi) = PHI / \sum_{Gn}^n$$



a. P01 :Pleuritis TB

$$G05 := \frac{0.16}{1.34} = 0.11$$

$$G03 := \frac{0.13}{1.34} = 0.09$$

$$G02 := \frac{0.25}{1.34} = 0.18$$

$$G06 := \frac{0.8}{1.34} = 0.59$$

b. P02 :Peritonitis TB

$$G05 := \frac{0.16}{0.24} = 0.66$$

$$G10 := \frac{0.8}{0.24} = 3.33$$

c. P04 :Meninghitis TB

$$G05 := \frac{0.16}{0.16} = 1$$

d. P05 :Limfadenitis

$$G05 := \frac{0.16}{0.16} = 1$$

Determine the Hypothesis P (Hi) Probability Value after the known P (Hi) P value, Hypothesis H probability value without dressing any evidence

a. P01 :Pleuritis TB

$$\sum_{Gn}^n = (0.11 \times 0.16) + (0.19 \times 0.3) + (0.18 \times 0.25) + (0.59 \times 0.8) = 0.54$$

b. P02 :Peritonitis TB

$$\sum_{Gn}^n = (0.66 \times 0.16) + (3.33 \times 0.8) = 0.276$$

c. P04 :Meninghitis TB

$$\sum_{Gn}^n = 1 \times 0.16 = 1$$

d. P05 :Limfadenitis TB

$$\sum_{Gn}^n = 1 \times 0.16 = 1$$

Determine the value of P (Hi|E) looking for the value of P (Hi|E) or the probability of Hypothesis Hi is true if given evidence E. Hypothesis Hi True if given evidence E. $P(Hi | Ei) = P(Hi) P(Ei | Hi)$

a. P01 =Pleuritis TB

$$P(Hi|E) = \frac{0.11 \times 0.16}{0.54} = 0.32$$

$$P(Hi|E) = \frac{0.19 \times 0.13}{0.54} = 0.021$$

$$P(Hi|E) = \frac{0.18 \times 0.25}{0.54} = 0.83$$

$$P(Hi|E) = \frac{0.59 \times 0.28}{0.54} = 0.874$$

b. P02 = Peritonitis TB

$$P(Hi|E) = \frac{0.66 \times 0.16}{2.75} = 0.038$$

$$P(Hi|E) = \frac{3.33 \times 0.8}{2.75} = 0.968$$



c. P04 = Meninghitis TB

$$P(HiiE) = \frac{1 \times 0,16}{1} = 0,1$$

d. d. P05 = Limfadenitis TB

$$P(HiiE) = \frac{1 \times 0,16}{1} = 0,16$$

5. Menentukan Nilai Bayes

After all the p (hIE) values are known, then add up all the bayes values using the following formula:

$$\sum_{Gn}^n \text{bayes} = p(e|H1) * p(H1|e) + \dots + p(e|Hi) * (H1|e)$$

a. P01 :Pleuritis TB

$$\sum_{Gn}^n \text{bayes: } (0,16 \times 0,032) + (0,13 \times 0,021) + (0,25 \times 0,08) + (0,8 \times 0,087) \\ = 0,72$$

b. P02 : Peritonitis TB

$$\sum_{Gn}^n \text{bayes: } (0,16 \times 0,038) + (0,8 \times 0,968) \\ = 0,78$$

c. P03 : Meninghitis TB

$$\sum_{Gn}^n = (0,16 \times 0,16) = 0,25$$

d. P04 : Limfadenitis TB

$$\sum_{Gn}^n = (0,16 \times 0,16) = 0,25$$

From the calculation process using the Bayes Method above, it is known that patients suffer from perioritis with a certainty value of 0.78% or 0.78.

The results of the Bayes probability values in Table 4 Bayes values.

Table IV

Bayes values

Nilai Bayes	Teorema Bayes
0.0 – 0.2	Tidak Ada
0.3 – 0.4	Mungkin
0.5 – 0.6	Kemungkinan Besar
0.7 – 0.8	Hampir Pasti
0.9 - 1.0	Pasti

The patient's solution if exposed to external tuberculosis (extra pulmonary)

Two antibiotics; isoniazid (INH / H) and rifampicin (R) which must be taken for 6 months, every day for the first two months, and three times a week for four months.

Two additional antibiotics; pyrazinamide and ethambutol taken daily for the first two months, this treatment will vary according to your condition, because there are specific guidelines for doctors who classify TB disease into several categories as an appropriate treatment guideline.

4. Conclusion

a. By using a TBC expert identification system, it can help the community to be able to find out the type of TB disease based on the symptoms experienced.





- b. Expert System that was built with Microsoft Visual Studio 2010 by applying the Bayes Theorem in the Tuberculosis diagnosis process that is in accordance with the stages and system algorithms contained in the Bayes Theorem method, so that the system designed can be implemented as a means of consultation and initial diagnosis in identifying against Tuberculosis.
- c. This expert system software can be used to provide information and solutions about tuberculosis.

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