

Expert System for Diagnosing Newborn Babies Disease Using the Sorgenfrei Similarity Method

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ABSTRACT

Newborn neonates who are 0-28 days old. At that time the baby has a physical condition that is very weak and helpless to the surrounding environment. Newborns need special handling different from babies at the age of 1 month also above. Diagnosis also treatment is quickly required by the midwife in an emergency. Without there are still many midwives who have not been able to handle it properly, causing the baby's condition to become worse. To get fast and accurate handling information, we need a system in the form of an expert system. Expert systems can diagnose newborn diseases using the Sorgenfrei similarity algorithm. The system can display information about the type of disease, symptoms, solutions, and the percentage of similarity from the results of consulting the symptoms input. The results of testing the system with the consultation of the symptoms included got the highest percentage of similarity results 53.33%. The percentage of similarity results below 20% will be entered into the revised table which will later be corrected by experts. This expert system is built based on a website that can be accessed by all midwives who need handling information



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I. INTRODUCTION

Neonatal is defined as a clinical syndrome in an infant 28 days of life or younger[1]. Newborn children screening is a must for examining every newborn for persuaded dangerous or potentially deadly disorders that aren't otherwise obvious at birth[2]. Weightless or below average becomes a problem that often occurs in newborns. In an emergency, diagnosis and help are needed quickly. Delay in providing help can result in death to the baby. In 2012 the number of neonatal infant deaths was 19 deaths per 1000 live births. In 2017 there were 15 deaths per 1000 live births [3]. In 5 years there was only a significant decrease in mortality.

Lack of adequate health facilities, inadequate diagnosis, and still minimal human resources in the field of health, causes a high rate of newborn mortality. These events, more frequently caused by improper intrauterine transfer of maternal blood oxygen to the fetus resulting in an acute inadequate supply of oxygen to the fetal organs and tissues[4]. Data collection starting from handling pregnancy, managing data of health workers, managing information on

pregnancy problems by the community, delivery by medical personnel and neonatal visits need to be managed properly to produce information about good handling so that neonatal recovery can be adjusted by taking action - appropriate measures for neonatal issuance based on information data that has been generated with these problems, the authors want to create an expert system that is useful for diagnosing newborn diseases.

In the case of report submission, there is a problem caused by the delay in submission of the report which causes the data obtained is not up to date, so the decision making based on the data becomes inaccurate. To provide information about the disease accurately and precisely needed a system that can do this simultaneously. The most appropriate system used for this problem is the expert system.

Expert systems are computer programs that are derived from a branch of computer science research called Artificial Intelligence (AI)[5]. Expert systems are used to solve a large number of problems such as decision-making[6]. Computer-based systems using

knowledge, facts and reasoning techniques for an expert to solve problems. The inference engine applies the rules to known facts to deduce new facts [7]. From the problem the current proposed expert system is specialized in the diagnosis of disease in newborns [8].

II. RESEARCH METHODS

A. Similarity Algorithm

A similarity algorithm is a way to calculate the similarity of two objects by comparing the similarity based on syntax or semantic values. The coefficient is adopted to display the quantity of similarity. Algorithms for solving many pattern recognition problems such as classification, clustering, and data retrieval problems for more details can be seen in Table 1.

TABEL I
SIMILARITY FORMULA

| | 1 (presence) | 0 (Absence) |
|--------------|---------------------|-------------------------|
| 1 (presence) | $a = i . j$ | $b = \bar{i} . j$ |
| 0 (Absence) | $c = i . \bar{j}$ | $d = \bar{i} . \bar{j}$ |

Information:

- a = number of attributes where the values of i and j are equal to 1 (presence), which means positive matches
 - b = number of attributes where the values of i and j are (0,1), which means i absence mismatches
 - c = number of attributes where the values of i and j are (1,0), which means j absence mismatches
- Similarities usually fall in the range of 0 to 1, where 0 there are absolutely no matching or similar cases, and a value of 1 means that it has a 100% match.

B. Similaritas Sorgenfrei

The similarity is a measure of the closeness of an object with other objects. Then what is meant by Sorgenfrei similarity is the method used to calculate the similarity between the distance of two probability distributions with the formula referred to in equation (1).

$$S = \frac{a^2}{(a+b) \times (a+c)} \tag{1}$$

Information:

- S = Value Similarity
- a = The same number of attributes between consultation and data stored in the database.
- b = The amount of data stored in the database, which is not in the consultation.
- c = Number of consulting data attributes, which are not stored in the database.

C. System Description

Website-based expert system for newborns using the Sorgenfrei method. This application allows users to view

newborn disease information. To start the application process, it is divided into two access rights, namely user and admin. The user can consult with the selected symptoms experienced by the baby. While the admin can make a consultation like a user plus the admin can input information, symptoms, and diseases.

In implementing this child expert system, it takes 4 stages of the process, namely retrieve, reuse, revise, and retain. The retrieve process is the process of finding data in a database with method sorgrenfrei. Then the reus system process that provides the results of the calculation of the greatest similarity value will be used as a solution to the disease. Furthermore, in the process of revising process of revising the values that come out of the proposed solution reus process that still does not meet the requirements will be accompanied in a special table, for later repaired experts to find the right solution [9]. After the revision process is finished and the most appropriate solution is found, the expert will add the relation to the relation table which can later be used for solving similar cases in the future [10].

Admin's work process begins with logging in to the login page, then the admin will be directed to a display that has a choice of menus, illnesses, symptoms, solutions, and relationships to maintain data and information. For more clearly how the system works User work system architecture can be seen in Picture 1, while the admin work system architecture can be seen in Figure 2

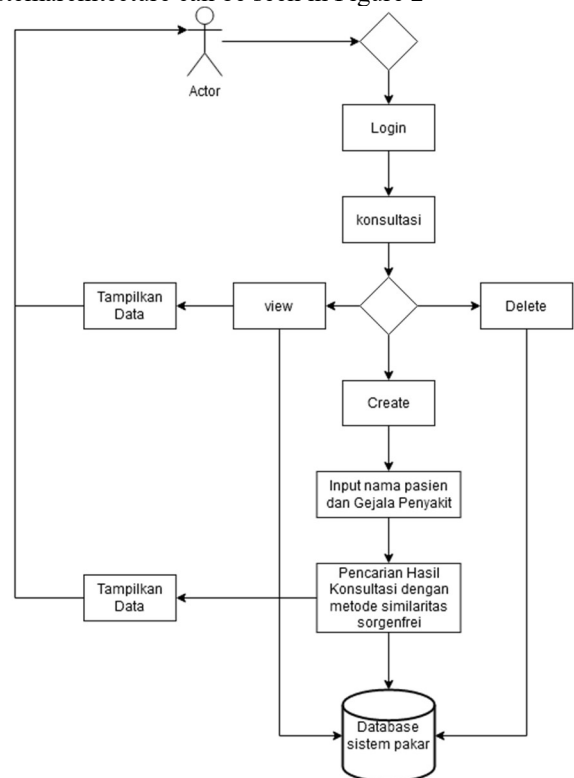


Fig.1 User system architecture.

The picture above explains the flow of the user's role in using the system to consult newborn diseases

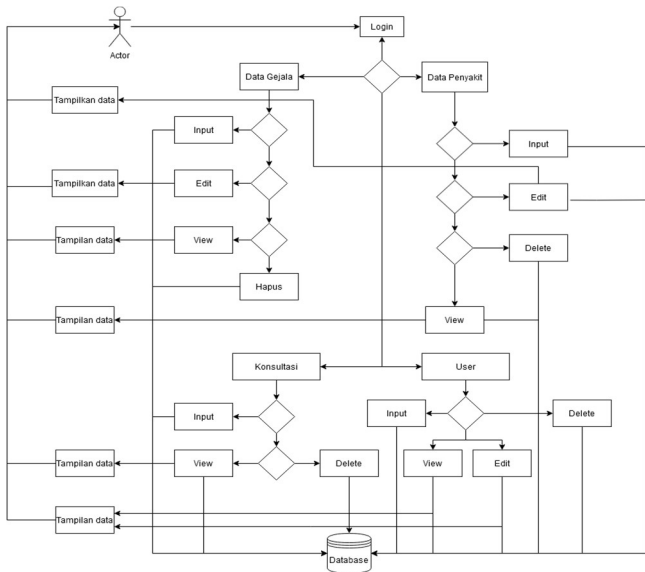


Figure 2. Admin system architecture.

In the figure 2 above is an admin role that can access all the menus or features that are in the system created.

D. Knowledge Representation

The symptoms table is used as a knowledge base that will be compared with many symptoms, both those that have been recorded and those that have never been recorded. This database is used as a basis for comparing a user's consultation with a pre-existing knowledge base. In the symptom table, there is a symptom code that shows the sequential number of symptoms and the name of the disease symptoms that exist in newborns. For more details, can be seen in Table 2.

TABLE II
NAME OF SYMPTOMS

| Symptom Code | Name Symptoms |
|--------------|---|
| G01 | Jaundice occurs on days 2 and 3 |
| G02 | Extreme movements are not active |
| G03 | yellow eye sclera |
| G04 | the baby won't suckle |
| G05 | yellow baby jaundice 24 hours after birth |
| G06 | stay for 7-14 days |
| G07 | jaundice of yellow baby accompanied by LBW (BW <2500 gram), infection |
| G08 | Difficulty defecating |
| G10 | Hard stool |
| G11 | Stomach hard or palpable stool mass on the abdominal wall |
| G12 | Pain in the anal area |
| G13 | Fresh blood comes out due to anal injury. |
| G14 | BAB> 4x / day |
| G15 | Unconscious |

| | |
|-----|---|
| G16 | Sunken eyes |
| G17 | Restless / fussy |
| G18 | Non-elastic skin (pinch the skin of the stomach's slow return) |
| G20 | Diarrhea persists for 2 weeks |
| G21 | Acute gastroenteritis in infants aged > 3 months |
| G22 | Clinical syndromes |
| G23 | Active movement (looking healthy) |
| G24 | Self limited disease |
| G25 | Responsif terhadap terapi suportif yang diberikan (kesadaran baik) |
| G26 | Cough |
| G27 | Sometimes sneezing |
| G28 | Secretions from the nose (runny nose) |
| G30 | Body weight at birth LBW = 1500 - 2499 grams |
| G31 | Body weight at birth BBLSR = 1000 - 1499 grams |
| G32 | Weight at birth BBLER = <1000 grams |
| G33 | Body length <45 cm |
| G34 | Head circumference <32 cm |
| G35 | Chest circumference <30 cm |
| G36 | Inactive movements (hypotonic muscles) |
| G37 | Head bigger than body, thin and fine hair |
| G38 | Soft skull bones |
| G39 | Simple-shaped ears and little cartilage |
| G40 | small / not formed nipples |
| G41 | breathing <20x / minute |
| G42 | Thin, transparent skin, lanugo (fine hair), especially on the forehead, forehead temples and arms, visible blood vessels |
| G43 | Genitalia is not perfect, in women the labia minor has not been covered by labia majora, the clitoris protrudes. In small scrotal LK men, the testes are not palpable |
| G44 | Reflexes suck, swallow and cough weak |
| G45 | Edema Extremities (swelling) |
| G46 | Convulsions |
| G47 | Fever (temperature > 37.5°C) |
| G48 | Irregular eye movements |
| G49 | Throw up |
| G50 | The movements of the hands and feet (extremities) are not active |
| G51 | Pain in the head and back |
| G52 | Baby reflex is absent |
| G53 | Cry loud and high pitch |
| G54 | Decreased appetite |
| G55 | Occurs 6-72 hours after birth |
| G56 | Respiratory disorders |
| G57 | Pale / blue baby |
| G58 | Jaundice / jaundice |
| G59 | Diarrhea |
| G60 | Bloated |
| G61 | No response |
| G62 | Release the ties or clamps of the cord that is still attached |
| G63 | Redness on the umbilical cord |
| G64 | There is a secret on the umbilical cord |

| | |
|-----|--|
| G65 | Slimy cough |
| G67 | Rapid baby breathing > 60x / minute (tachypnea) |
| G68 | Hypertherm (temperature > 37.5°C) |
| G69 | Nausea |
| G70 | Urinating is not as usual |
| G71 | Trismus (difficulty opening the mouth) is mild |
| G72 | Stiff / inelastic skin |
| G73 | Perutpapan / keras |
| G74 | Stomach board / hard |
| G75 | No seizures |
| G76 | There is no respiration disorder |
| G77 | Trismus (difficulty opening mouth) moderate |
| G78 | The presence of excitatory seizures, no spontaneous seizures |
| G79 | Mild dysphagia |
| G80 | Trismus (difficulty opening the mouth) is severe |
| G81 | Spastic muscles |
| G82 | spontaneous seizures |
| G83 | Tachycardia (DJB > 160x / minute) |
| G84 | Apneu attack |
| G85 | Severe dysphagia |
| G86 | Autonomous system activity increases |
| G87 | Gong face |
| G88 | Tilted eyes |
| G89 | Labiokizis |
| G90 | Palatoskizis |
| G91 | Labiopalatoskizis |
| G92 | Gnatoskizis |
| G93 | There is no anal canal (atresia ani) |
| G94 | Polydactyl |
| G95 | Sindaktili |
| G96 | Polysindactyl |
| G97 | Yellow skin |
| G98 | High-pitched tears |
| G99 | Takipneu (breath > 60x / minute) |

Disease tables are used to determine diseases suffered by newborns. Disease determination is based on symptom data in new cases that are matched with symptom data in old cases that show the highest similarity. Disease data displayed in the consultation are data of disease that has the highest similarity value. , calculated based on the Sorgenfrei algorithm. In the disease table, there is code data that shows the sequence of disease codes, and newborn disease names can be seen in Table 3.

TABLE III
DISEASE NAME

| Disease Code | Disease Name |
|--------------|--|
| P01 | Troubled Newborns / with Complications |
| P02 | Physiological jaundice |
| P03 | Pathological jaundice |

| | |
|-----|--------------------------|
| P04 | Kern Ikterus |
| P05 | Constipation |
| P06 | Acute diarrhea |
| P07 | Chronic diarrhea |
| P08 | Cough and cold |
| P09 | Sepsis Neonatorum |
| P10 | Umbilical Cord Bleeding |
| P11 | Pneumonia |
| P12 | Mild Tetanus |
| P13 | Medium Tetanus |
| P14 | Heavy Tetanus |
| P15 | Congenital Abnormalities |

III. RESULT AND DISCUSSION

A. Results

The results of the research from the expert system with the Sorgenfrei method for diagnosing of newborn diseases can be seen in Table 4.

TABLE IV
TEST RESULT

| Selected Symptoms | Emerging diseases | Similarity Percentage |
|--|---|------------------------------|
| 1. Defecate more than 4 times per day. | Acute diarrhea | similaritas 0,5333 or 53,33% |
| | Newborns have problems or complications | similaritas 0,0476 or 4,76% |
| 2. Unconscious. | Cough and cold | similaritas 0,0417 or 4,17% |
| 3. Concave Eyes | | |
| 4. Restless or Fussy | | |
| 5. Movement is less active (Hypotonic Muscle). | | |
| 6. Edema Extremities (Swelling). | | |

B. Discussion

The expert system uses the sorgenfrei method to diagnose newborns calculated by sorgenfrei, referred to in equation (2).

$$S = \frac{a^2}{(a+b)(a+c)} \quad (2)$$

S = Value Similarity

a = The same number of attributes between consultation and data stored in the database.

b = The amount of data stored in the database, which is not in the consultation.

c = Number of consulting data attributes, which are not stored in the database.

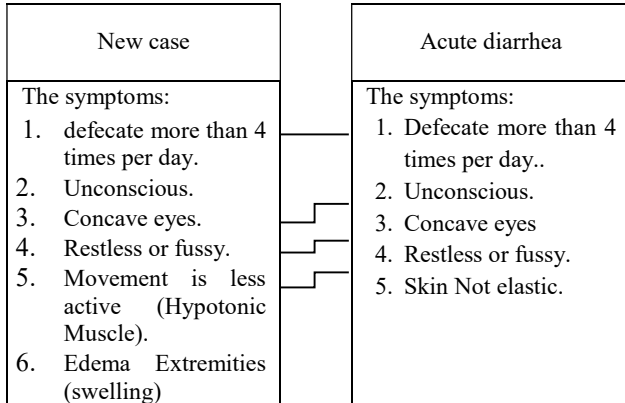
Then the consultation is carried out by selecting the symptoms of newborn diseases, namely:

1. Chapter more than 4 times per day.
2. Unconscious.
3. Concave Eyes
4. Restless or Fussy

- 5. Movement is less active (Hypotonic Muscle).
- 6. Edema Extremities (Swelling).

The results of the expert system consultation with Sorgenfrein's similarity to diagnose newborn diseases are:

1. Calculation of acute diarrheal disease



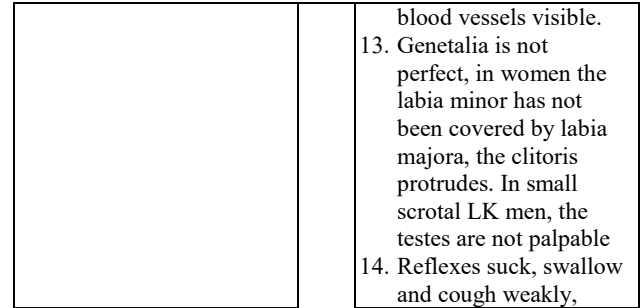
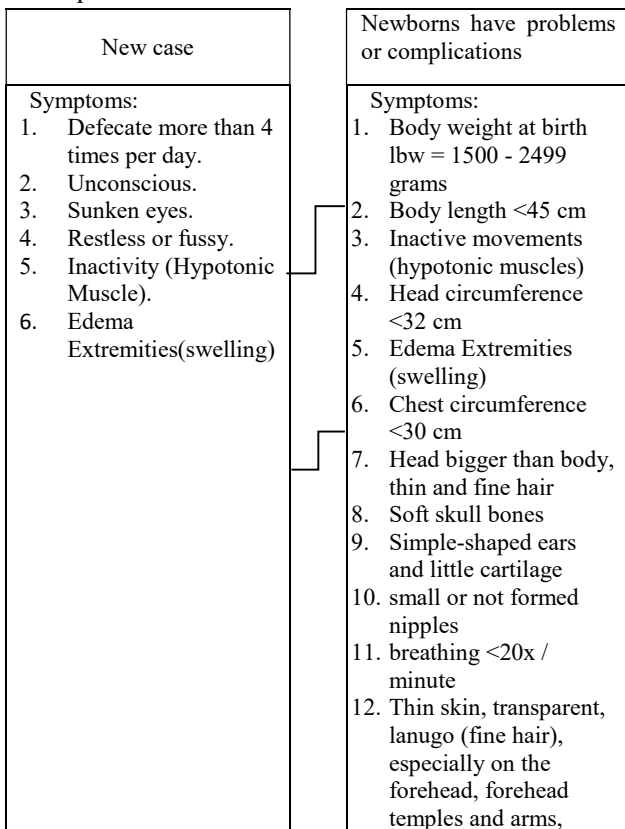
Based on calculations with Sorgenfrein's similarity, acute diarrhea has a value indicated in equation (3).

$$S = \frac{a^2}{(a+b)(a+c)} \quad (3)$$

a = 4, b = 2, c = 1

so the similarity value S = 0.5333 x 100% = 53.33%.

2. Calculation of newborn problems with problems or complications



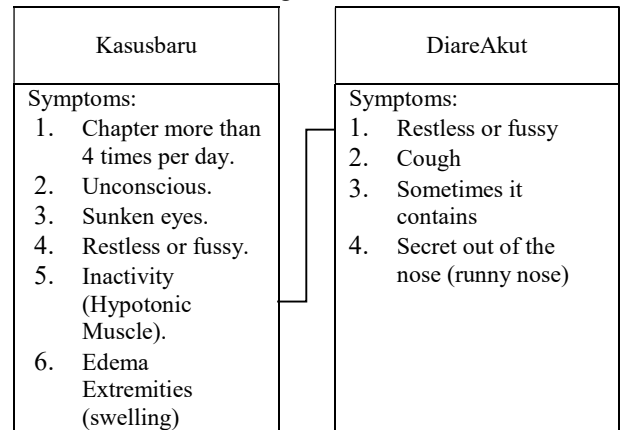
Based on calculations with Sorgenfrein's similarity, newborns with problems or complications have a value indicated in equation (4):

$$S = \frac{a^2}{(a+b)(a+c)} \quad (4)$$

a = 2, b = 4, c = 12

so the similarity value S = 0,0476 x 100% = 4,76%

7. Calculation of cold cough disease



Based on calculations with Sorgenfrein's similarity, cold cough has a value indicated in equation (5).

$$S = \frac{a^2}{(a+b)(a+c)} \quad (5)$$

a = 1, b = 5, c = 3

so the similarity value S = 0,0417 x 100% = 4,17%

IV.CONCLUSION

The results of the research that the researchers have described in the previous chapters, the Sorgenfrei similarity method for diagnosing newborn diseases can be summarized as follows:

- 1. The Sorgenfrei similarity method can be used to find diagnoses of newborn diseases to users.
- 2. Sorgenfrei similarity produces a final value of similarity between 0 zero and 1 one.
- 3. Consultation results that show a percentage below 20% will be accommodated in the revised table to find the most appropriate solution.

4. The highest value of the research trial from the random selection of symptoms gets a percentage of 53.33%.

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