Early Detection of Preeclampsia using a Rule-Based System Information System

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Abstract. Preeclampsia is the highest cause of maternal death. One program to reduce Maternal Mortality Rate (MMR) is by early detection. The incomplete history of maternal history that has occurred has led to the determination of an incorrect diagnosis and has resulted in errors in decision making. The results of the survey in the detection of preeclampsia include midwives not conducting a history of past medical history, physical examination during the first antenatal care visit is incomplete. During this time the detection and diagnosis model is still done manually, so it was not effective and efficient. The inspection data obtained using the information system becomes more complete and faster. Data obtained with information systems can be seen anywhere and anytime. This study produced innovations for the detection of preeclampsia in pregnant women using a rule-based system information system. This study uses the Quasy experimental posttest-only design. The subjects of this study were 66 pregnant women. Data collection was carried out using questionnaires and checklists. The results showed that early detection of preeclampsia using a rule-based system information system could improve the completeness of data on pregnant women up to 35.66%, and speed up the detection time of preeclampsia up to 35.60%. This system also has an effectiveness value 84.8%.

1. Introduction

Preeclampsia is one of the most common causes of maternal and neonatal deaths in the world, especially in developing countries. Many cases of preeclampsia occurred suddenly without any signs before. One effort to solve this problem is to detect the risks of preeclampsia in antenatal care early [1-4]. Screening for the risk of preeclampsia is very important for midwives to prevent maternal and neonatal morbidity and mortality caused by preeclampsia [4, 5]. The completeness aspect of data is very important in decision making. The incomplete data that occurs to date has led to the determination of an incorrect diagnosis to make a decision on the results [6, 7].

The current model of detection of preeclampsia is still done manually, so data does not accumulate, cannot be reported directly, cannot be analyzed quickly and follow-up treatment is delayed [5, 8]. Data collection using a web-based information system is able to collect quality data that is more complete than manual...
records [9]. Early detection of preeclampsia makes it possible for appropriate monitoring planning in clinical management and early identification of complications. Early detection of preeclampsia allows strategies to prevent preeclampsia be more effective [10].

2. Methods
The information system designed is a rule-based system information system. We need an internet network to access this information system. Midwives enter data and the results of examination of pregnant women, then the data is processed by an information system that produces a risk level for preeclampsia. Information on the level of risk of preeclampsia contained in the information system was validated with 2 experts (midwives). The calculation of the information system validity test is done by using the measurement of the true data value divided by the value of the overall data multiplied by 100%. The information system diagram built is shown in figure 1 below:

![Diagram of the information system](image1)

**Figure 1.** The diagram of the information system

![Rule-Based System Architecture](image2)

**Figure 2.** Rule-Based System Architecture

Information systems input the biodata of pregnant women, medical and obstetric history of pregnant women, and the results of physical examinations. Then, the inputted data is processed online and the risk level of preeclampsia is concluded.

The research design used was quasi-experimental with post test only with control group design. This research was conducted at the public health center. The sampling technique used was purposive sampling, with 66 respondents as a sample. The intervention group (n = 33) used an information system, while the control group (n = 33) used the manual checklist. The statistical test used in this study used a different independent t-test.
3. Result and Discussion

3.1. Completeness Data for Risk Factors of Preeclampsia

The completeness of data on the risk factors for preeclampsia is shown in Figure 2. The trial results of 33 respondents in the intervention group and 33 respondents in the control group showed that the intervention group collected was more complete than the manual system. In the intervention group, the data completeness score was 35 (100%), while in the control group it was 22.52 (64.34%) or there was an improvement in the completeness of the data by 35.66%. The differences the completeness of the data of pregnant women data which are recorded by the information system rule-based system between manual systems are shown in Table 1.

![Patient data from the information system](image)

Table 1. The completeness of pregnant women data

| Group                          | N  | Mean | Percentage (%) |
|-------------------------------|----|------|----------------|
| Intervention group (information system) | 33 | 35.00 | 100            |
| Control group (manual system)  | 33 | 22.52 | 64.34         |

Risk factors for preeclampsia can be detected by midwives through antenatal care (ANC), and the data reported in the maternal cohort list. The quality of recording and reporting data is very important for health workers, but it is often problematic due to the technical limitations of health care providers, the high cost of medical examinations or the high risk of damage to the health of patients. Recording current risk factors are still incomplete and consistent. This can cause data interpretation to be wrong [6, 11].

By using the information system for early detection of preeclampsia (PE Care) data for pregnant women and examinations to detect risk factors for preeclampsia, it becomes more complete compared to the manual system. This is consistent with the research of Graham et al (2016) that the use of information systems can be used as a solution to incomplete data. Health workers can view patient data anytime and anywhere. This process will support the speed of health workers in making clinical decisions [12]. In addition, with information systems health workers get a convenient tool for collecting and managing patient data to minimize negative impacts on patients [6, 13].

3.2. The speed of detection for preeclampsia

The output of the risk level of preeclampsia in pregnant women is shown in Figure 3. The results of statistical tests for the speed of detection of preeclampsia are shown in Table 2. The speed for detected preeclampsia using information system was 352.12 seconds with a standard deviation of 42,914. The speed of the control group using the manual system needs 522.42 seconds to detect preeclampsia with a standard deviation 62,990. So it can be concluded that early detection of preeclampsia using the rule-based system information system is 35.60% faster than the manual system. The results of statistical tests using Independent T-Test obtained a p-value of 0.036 <0.05 (α) so that there was a difference in the time of early detection of preeclampsia using the rule-based system information system in pregnant women.
Figure 3. Results of detection of preeclampsia using an information system

The speed of detection preeclampsia on pregnant women is shown in Table 2 below.

Table 2. Distribution of detection speed of preeclampsia risk in pregnant women

| Group                        | N  | Mean (second) | SD     | P-Value |
|------------------------------|----|---------------|--------|---------|
| Intervention group           | 33 | 352.12        | 42.914 | 0.036   |
| Control group (manual system)| 33 | 522.42        | 62.990 |         |

Every pregnant woman should be assessed for risk factors for preeclampsia as a basis for regular antenatal supervision and case selection. So far, prevention of preeclampsia in pregnant women has not provided encouraging results despite the many studies that have been conducted. With the effort of early detection of preeclampsia, it is expected that the handling of patients with preeclampsia and eclampsia can be done quickly and precisely so that maternal morbidity and mortality decreases. This was also revealed in a study conducted by Trayner and Taylor in 2017, who said that seven million people who were not diagnosed hypertension were found and they did not know they had risk factors for hypertension. The speed and accuracy of diagnosing will cause a reduction in the number of patients who do not understand the condition and the patient will be able to better understand and receive the health services that will be given to them [14]. This shows that detection of the risk of preeclampsia is important for pregnant women so that the handling is faster and more appropriate.

3.3. The effectiveness of information systems

The results of the effectiveness of the information system test obtained a value of 4.24 (84.8%) in terms of usability, speed, suitability, ease, accuracy, and trust. It shows in table 3 below:

Table 3. Scores of information system effectiveness.

| No | Effectiveness variable | ScoreAverage | Percentage (%) |
|----|------------------------|--------------|----------------|
| 1  | Purpose                | 4.38         | 87.6           |
| 2  | Speed                  | 4.28         | 85.6           |
| 3  | Compliance             | 4.20         | 84             |
| 4  | Ease                   | 4.35         | 87             |
| 5  | Accuracy               | 4.20         | 84             |
| 6  | Trust                  | 4            | 80             |
|    | Mean                   | 4.24         | 84.8           |

The results of the effectiveness of the information system test obtained a value of 4.24 (84.8%) in terms of usability, speed, suitability, ease, accuracy, and trust. So it can be concluded that the information system of early detection of preeclampsia using rule-based systems (PE Care) in the care of pregnant women is very effective. The highest score is in terms of later use below it in terms of convenience. This shows that midwives feel helped by the existence of this information system. In addition, midwives find it easy to use
this system because the data filling instructions are available properly. In addition, the length of work of a midwife also has a positive influence on one's performance, the longer a person's work period, the more experienced he will be in carrying out his duties [24].

The lowest score of information system effectiveness is in terms of the trust. Based on research Librado (2017) states that perceptions of usability have a positive significant effect on beliefs, attitudes and behavioral intentions [16]. According to Abbas (2018), trust refers to the belief of a health profession in carrying out its performance on health service technology. Trust reflects a belief system that results in behavioral changes. A system will build trust in the mind of an individual if it can perform the expected and bring about changes and is able to motivate individuals to have a positive evaluation of the use of the system. A positive attitude is the possibility of a collection of beliefs about the system. The more positive the individual's intention towards the use of health service technology, the higher the likelihood that technology users will carry out this behavior [18]. Information system is a solution of the many problems that exist in health services such as lack of available resources, length of reporting process, length of administrative process, incomplete data available, delays in diagnosing and handling, far distance to get to health services, high costs transportation to health services and others [19-27].

4. Conclusion
Based on the results of the study it can be concluded that the rule-based system information system is effective in the detection and diagnosis of preeclampsia. This is evidenced by the results of the study that the rule-based system information system can improve the completeness of preeclampsia risk factor data by 35.66%, increase the speed of detection of preeclampsia in pregnant women by 35.60% and be able to increase the speed of diagnosing preeclampsia by 7.21% compared to manual systems. Information system for early detection of preeclampsia using a rule-based system (PE Care) has a very high effectiveness that is equal to 4.24 (84.8%) which is seen in terms of usability, speed, suitability, ease, accuracy, and trust.

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