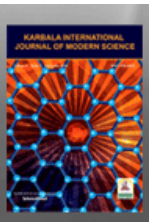

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A Note on the Combination of the New Similarity Formula with Feedback to Better Handle Complaints of In Vitro Fertilization (IVF) Patients

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Abstract

In Vitro Fertilization (IVF) patients frequently experience anxiety and report it right away to their fertility doctors. But because the fertility specialists took their time to respond, IVF patients eventually became more anxious. The research's findings demonstrated that using the standard feasibility value of 80% along with the Chris Case-Based Reasoning (CCBR) similarity formula led to an accurate system recommendation (100%) with a higher precision value (83.15%). The F value of the ANOVA test was 9.902 with a significance level of 0.007

Keywords

Accuracy, Feedback, CBR, CCBR, IVF

RESEARCH PAPER

A Note on the Combination of the New Similarity Formula with Feedback to Better Handle Complaints of In Vitro Fertilization (IVF) Patients

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Abstract

In Vitro Fertilization (IVF) patients frequently experience anxiety and report it right away to their fertility doctors. But because the fertility specialists took their time to respond, IVF patients eventually became more anxious. The research's findings demonstrated that using the standard feasibility value of 80% along with the Chris Case-Based Reasoning (CCBR) similarity formula led to an accurate system recommendation (100%) with a higher precision value (83.15%). The F value of the ANOVA test was 9.902 with a significance level of 0.007 < 0.005, according to the results. As a result, some of the IVF patients' feedback greatly impacted the smart system. The research's findings also suggested a more effective smart system strategy to address the grievances of IVF patients.

Keywords: Accuracy, Feedback, CBR, CCBR, IVF

1. Introduction

The high degree of anxiety [1,2] motivates In Vitro Fertilization (IVF) patients to speak up about any new or unexpected symptoms as soon as possible [3–5]. Due to their heavy workloads or medical issues, however, fertility doctors are unable to respond to IVF patients' inquiries right away, which increases anxiety and increases the risk of IVF failure [1,2].

Despite being widely used in health-smart systems, the case-based reasoning (CBR) model still has significant drawbacks. The first is that the updated CBR similarity values for accuracy and precision were lower [6,7]. The second CBR model's viability standards [8,9] for judging the caliber of system recommendations were not yet established. The third CBR model lacked a recommendation for a quality control system [6–9].

The four stages of the CBR model are retrieved, reuse, revise, and retain [8,9]. A new problem was first entered into the system, which then chose the most comparable previous example to answer the new problem (retrieve). If the answer satisfies the standards, it can be used immediately by system users (reuse); otherwise, it needs to be revised and corrected (revise). The solution is then added to the database as a new case (retain).

According to the research's findings [3,4], the smart system designed to address IVF patients' problems was significantly impacted by the input provided by patients. The research findings [5] also demonstrated that the Chris Case-Based Reasoning (CCBR) formula, a modified version of the CBR similarity formula, produced suggestions with higher accuracy and precision values. The shortcomings of the CBR model were improved using the findings of the research [3–5] to create such high-quality system recommendations [10].

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2. Material and methods

This research integrated the results of the three previous studies on modifying the CBR model to gain a better smart system model [3–5,11].

2.1. Feedback from the IVF patients as smart system users

The patients' active role as system users and their feedback after using the system [12] are important factors that affect the system's quality [10,13].

The first research [3,4] proved:

1. The cross-checking [14,15] results of some research data indicated that IVF patients need a smart system [3,4].
2. The results of the ANOVA test and coefficient test stated that the feedback from IVF patients significantly affected the quality of the smart system [3,4].

2.2. Feasibility standards to determine the quality of system recommendations

According to the findings of earlier studies, 80% feasibility was the optimal standard [16]: to assess the quality of the information, this standard was utilized. The information's accuracy is deemed to grow if the value is greater than 80%. Information is deemed to be getting more and more erroneous if the value is less than 80% [17–19].

The second research [5] proved that the truth of the recommendation for the feasibility standard was ≥80% [17] after testing a smart system (the case-based smart system stored 159 old cases of IVF patients) using input data from the 97 new problems. Based on the validation results of the 2 fertility doctors on the 97 system recommendations, the facts were obtained as follows: recommendations generated by the smart system with a similarity value of ≥80 were 100% accurate [16,17].

2.3. Modified CBR similarity formula

Such modifications [5] were made by changing how the equation formula worked in calculating the similarity values adopted from the similarity theory developed by Dekang Lin [20,21]:

1. The greater the similarities, the more similar its values, while the greater the differences, the more different its values.
2. To find out the level of similarities and differences between A and B, assessments must be included from different points of view, and each point of view is calculated for the similarity level.
3. The best similarity value is the average value of all equation values from different points of view.

The CCBR similarity formula has two points of view to calculate the similarity (average) value [5].

The similarity formulas are as follows:

1. CBR similarity formula [8,9].

$$\textbf{Similarity}\,(\mathbf{N},\mathbf{O}) = \frac{\sum_{i=1}^{n} \mathbf{S_i} * \mathbf{W_i}}{\sum_{i=1}^{n} \mathbf{W_i}} \tag{1}$$

Description:

- N = new problem.
- O = old case.
- W = weight value.
- S = similarity value between N and O.
- $S = \begin{cases} 1, N = O \\ 0, N \neq O \end{cases}$
- $\forall W_i \neq 0$.

2. CCBR similarity formula [5].

$$\textbf{Similarity}\,(\mathbf{N},\mathbf{O}) = \frac{\left(\frac{\sum_{i=1}^{n} S_i . W_i}{\sum_{i=1}^{n} W_i}\right) + \left(\frac{\sum_{i=1}^{n} S_i . W'_i}{\sum_{i=1}^{n} W'_i}\right)}{2} \tag{2}$$

Description:

- N = new problem.
- O = old case.
- W = weight value.
- W' = weight value.
- S = similarity value between N and O or between O and N.
- $S = \begin{cases} 1, N = O \text{ or } O = N \\ 0, N \neq O \text{ or } O \neq N \end{cases}$
- $\forall W_i \neq 0$ and $\forall W'_i \neq 0$.

3. Theory

The CBR model discovers solutions by mimicking how people think, i.e., by recalling instances of a similar kind that occurred in the past and adapting them to deal with the current problems [8,9]. The scenarios that are most comparable to the new challenges are identified using the CBR similarity formula [9,22]. However, the system's recommendations that were generated had low accuracy and

precision values [6,7]. How the CBR model worked is shown in Fig. 1.

4. Result

There were three CBR model modifications, as follows:

1. Applying the CCBR similarity formula at the retrieving stage [5].
2. Implementing a feasibility standard of ≥80% [5,23] to assess:
   - Quality of the system recommendation. If the similarity value is ≥ 80%, the system recommendation has good quality, so it can be directly given to IVF patients. However, if the similarity value is < 80, the system recommendation must be repaired first by a fertility doctor [16].
   - Feedback quality of IVF patients as a system user, based on the value interpretations. Feedback in the "excellent" and "good" criteria indicates that IVF patients are satisfied with the system recommendation. However, if the feedback meets the "fair," "poor," and "very poor" criteria, IVF patients are dissatisfied, so the system recommendation must be immediately checked by a fertility doctor, and the

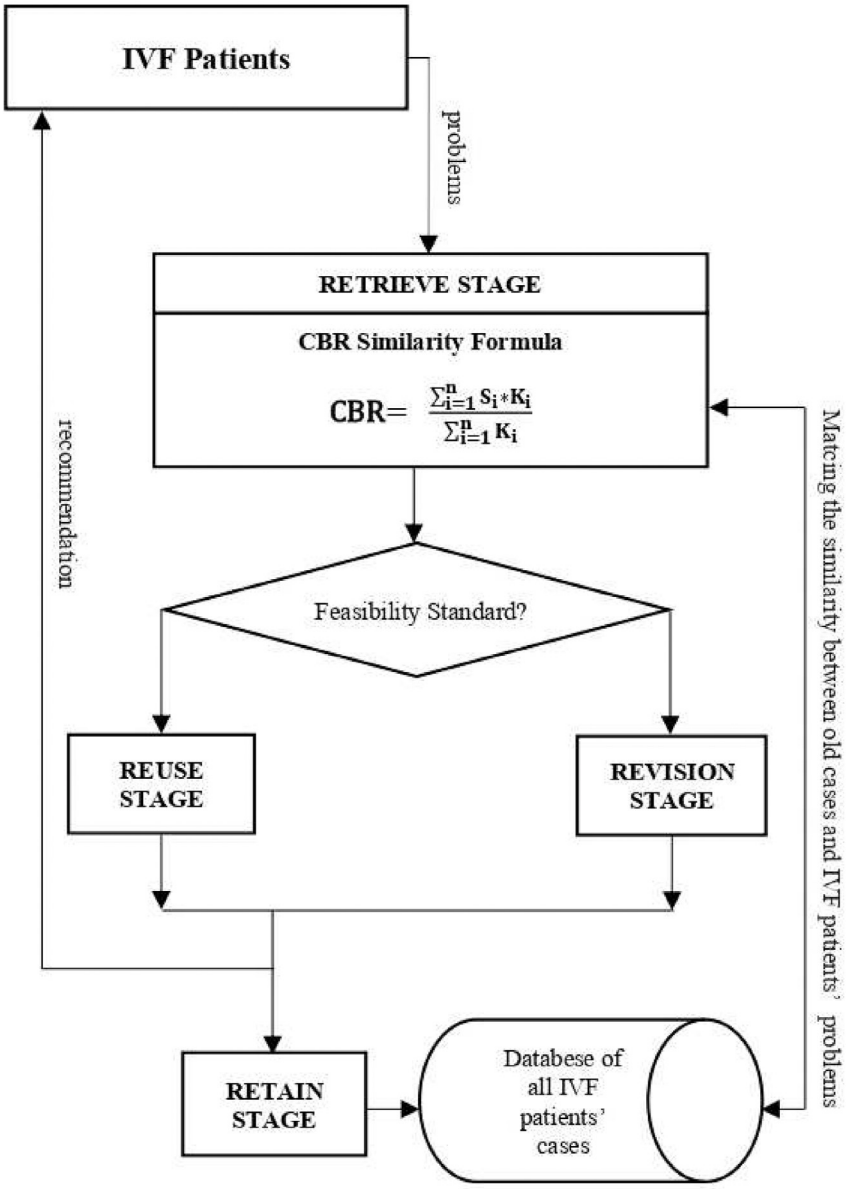

Fig. 1. CBR model.

results should be immediately informed to the IVF patients [24].

3. The feedback of the system users [3,4] is a quality controller for system recommendations [12,13] capturing IVF patients' satisfaction after implementing recommendations from the system. Giving feedback using a Likert scale is divided into five criteria: excellent, good, fair, poor, and very poor [25].
4. Fig. 2 shows the results of the CBR model modification.

5. Discussion

5.1. Performance comparison

The results of the research [5] are shown in Table 1. Proved that the CCBR similarity formula was applicable because the system recommendations with a similarity value of ≥80% are 100% accurate, while those with a similarity value of <80% are 82.14% accurate.

The graph shown in Fig. 3 strengthened the results presented in Table 1. The results of confusion

Table 1. Comparison of the number of recommendations considered valid and invalid by fertility doctors.

Similarity Value	CBR Similarity Formula		CCBR Similarity Formula	
	Valid	Not Valid	Valid	Not Valid
≥80%	26.70%	73.30%	100.00%	0.00%
<80%	16.85%	83.15%	82.14%	17.86%

metric measurements proved that the precision (83.15%) and accuracy (32.99%) values of the CCBR similarity formula were respectively better than those of the CBR similarity formula.

5.2. Feedback

The results of the ANOVA test [4] obtained an F value of 9.902 with a significance level of 0.007 < 0.005, while those of the coefficient test [4] obtained a t-value of 3.147 with a significance value of 0.007 < 0.05. The results of the ANOVA and coefficient tests stated that the feedback from the IVF patients significantly affected the smart system's ability to handle the complaints from the IVF patients.

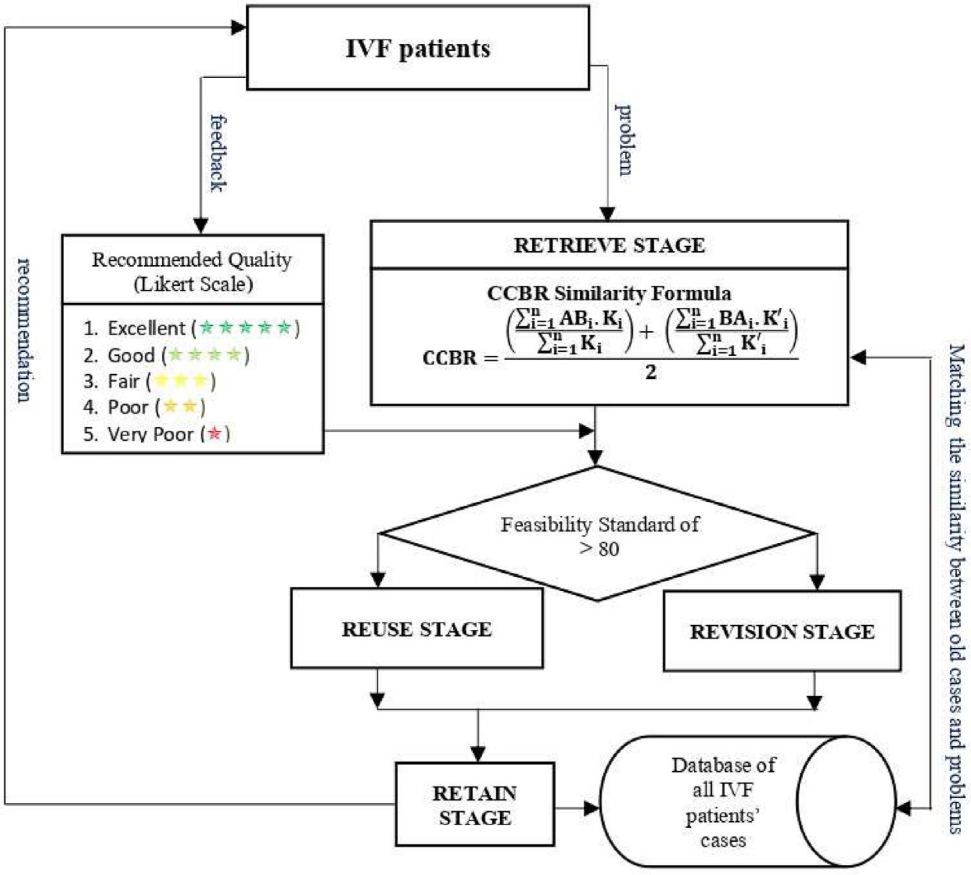

Fig. 2. Result of CBR model modification.

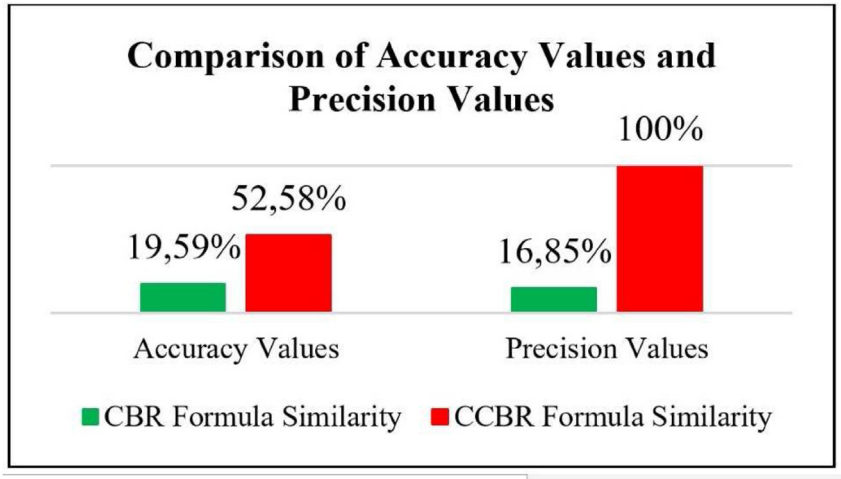

Fig. 3. Comparison after measuring by confusion metrics.

6. Conclusion

The results of the CBR model modifications are considered a better model for the smart system:

1. To effectively handle their problems, IVF patients require a smart system, which will help them feel less anxious.
2. A smart IVF patient management system has successfully assisted fertility doctors and provided precise system recommendations.
3. The suggested hybrid smart system software model enables multiple devices to access it [26].

Data availability

The dataset is available at https://repo.stmik-wp.ac.id/index.php/download/file/UkVQTzE2ODM1MTI4NjIjDEwMS03MzAxIzhla21oOHVlMXNj.

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Conflict of interest

This research has no conflicts of interest.

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