An Ontology-based Knowledge Sharing Portal for Subfertility in Humans

Yogarajah Thenuka
Computing & Information Systems
Sabaragamuwa University of Sri Lanka
Ratnapura, Sri Lanka
thenuka94@gmail.com

Shanmuganathan Vasanthapriyan
Computing & Information Systems
Sabaragamuwa University of Sri Lanka
Ratnapura, Sri Lanka
priyan@appsc.sab.ac.lk

Kuhaneswaran Banujan
Computing & Information Systems
Sabaragamuwa University of Sri Lanka
Ratnapura, Sri Lanka
bhakuha@apssc.sab.ac.lk

***Abstract* — Subfertility is called failure to conceive after unprotected and regular sexual intercourse for 12 months. Subfertility depends on male and female factors. Males need to check first and after that females need to check for subfertility factors. Decision making is critical in the treatment method of subfertility. So, ontology modeling will help in decision making to diagnose causes and treatment methods easily. It is designed and developed to support doctors, medical students, and researchers. The ontology model is designed by using the Delphi method. Data collected with the discussion of one doctor and four medical students. The ontology model is evaluated and validated by tools OOPS! Evaluation editor, DL query & SPARQL Query, and ontology experts. Future work is planned to develop a decision support system for the subfertility of the female.**

Keywords — subfertility, fertility treatment, ontology

I. INTRODUCTION

Management of subfertility needs a common definition of subfertility and infertility. Subfertility is a failure to conceive after regular and unprotected intercourse for 12 months. In basic, the Age of the female depends on fertility but not on the male's age. Doctors check for the causes of subfertility and treat them. If the patient didn't conceive anymore then they have infertility. The female factor is a vast area than the malefactor. So, Males need to check for the causes very first, and after that only females need to check [1].

Subfertility in humans is a large area and critical in the gynecological field, doctors couldn't take actual decisions without past histories, treatments, tests, and also medical students facing a lot of doubts when learning the subfertility area. So, this domain was selected to develop a knowledge-sharing model for the domain experts. Ontologies are one of the powerful mechanisms used for the representation of knowledge and decision making in the semantic web [2]. Domain knowledge is depicted using ontology which is machine interpretable. It can be used for establishing a common conceptualization to facilitate store, share, retrieve, decision making, and representing knowledge. The ontology model has classes, individuals, and relationships between them. Relationships are depicted using object properties and data properties. Restrictions are used to increase the accuracy of depicting relationships [3].

Quality of ontology closely depends on its validity which will prevent the application from using inconsistent, incorrect, redundant information, enhancing the quality of information. Thus, validation and evaluation of ontology is a key factor. But there was no exact methodology to evaluate this ontology. It depends on the purpose, aspect of which ontology trying to validate [4].

Human's subfertility ontology developed using Protégé Ontology Editor 5.5. . Web Ontology Language (OWL) is used to implement all concepts and relationships in the subfertility domain. Evaluation of the developed ontology is evaluated using the FACT++ reasoned of Protégé ontology editor 5.5. By using the reasoned, DL queries used to check the correctness of the ontology also SPARQL query is used for evaluation using Jena API. The ontology model validates by ontology experts and the domain validated by domain experts [5].

Research questions are considered as the research gaps for the selected topic or the analysis of the selected topic. Many research questions need to be analyzed on the topic of "An Ontology-based Knowledge Sharing Portal for Subfertility in Humans". The following research questions lead to this research.

- **RQ1:** What is the current status of knowledge dissemination in the context of subfertility?
- **RQ2:** How ontology modeling can be used to the decision-making related to subfertility and in future works?
- **RQ3:** How the evaluation process of the designed ontology model can be carried out?

This paper is about the presentation of an ontology model for decision making in the treatment method of the human subfertility domain.

II. OBJECTIVES

The main objective of this research is to design an ontology model for the treatment method of human subfertility and evaluation & validation of developed ontology. This research aims to contribute to treatment method in the human's subfertility in hospitals by developing an ontology-driven solution that organizes, describes, and helps to decision making clearly in the domain and medical students also can get knowledge by developing an ontology-driven solution that describes all the diagnosing causes and treatment method from top to the base level. This would help the researchers to reuse the ontology and for future works.

III. METHODOLOGY

Some methods were used to design ontology modelings such as Grüninger and Fox's methodology [6] and the Delphi method [7] in the literature review. We have selected the Delphi method to get more accuracy and agility. Fig. 1 describes the methodology of developing an ontology model of human subfertility.

In the scratch, data collected by the discussion between one doctor, four medical students, a researcher, and also from the books [8] which are provided by them. Other than that, we checked all the data collections from the below experts were correct or not using trustable sources received from the experts. All the details were categorized under appropriate classes, and individuals were integrated. All the categorized and integrated details were given to doctors and medical

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students. Domain experts evaluated those details after that revised again in an iterative manner and rectified all the corrections.

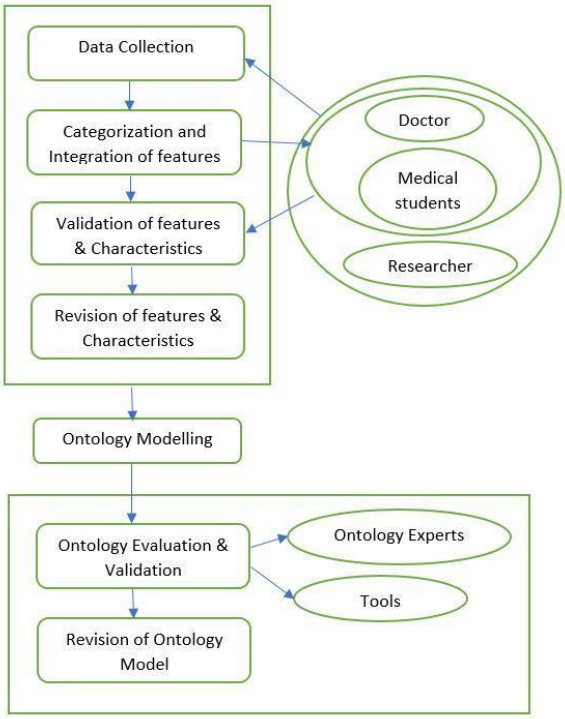

Fig 1. Methodology for Ontology Modelling

By using the ontology modeling knowledge, Ontology is designed using Protégé Ontology Editor 5.5. After that, the Ontology model is evaluated by OOPS! Evaluation Editor. All the pitfalls were identified and also rectified by the researcher, FaCT++ reasoned is used for reasoning and DL Query used to check the correctness of the ontology modeling and relationships. SPARQL Queries also used to check the ontology model. Finally, two ontology experts validated the ontology model, and corrections were rectified.

IV. RESULTS AND DISCUSSION

Human's subfertility treatment method ontology models developed ontology using Protégé Ontology editor 5.5. Developed Ontology's part of the Ontograf shown in Fig 2.

The evaluation and validation have been done separately. FaCT++ reasoner is used to validate the correctness and quality of developed ontology. OOPS! The ontology editor used to find the critical, important, minor pitfalls and all the critical errors were rectified. Figure 3 shows the OOPS! Evaluation results of developed ontology.

Ontology is validated by DL Query using the FaCT++ reasoner. Some of the DL queries and the answers are shown in Table 1 by the collection of competency questions created by the researcher.

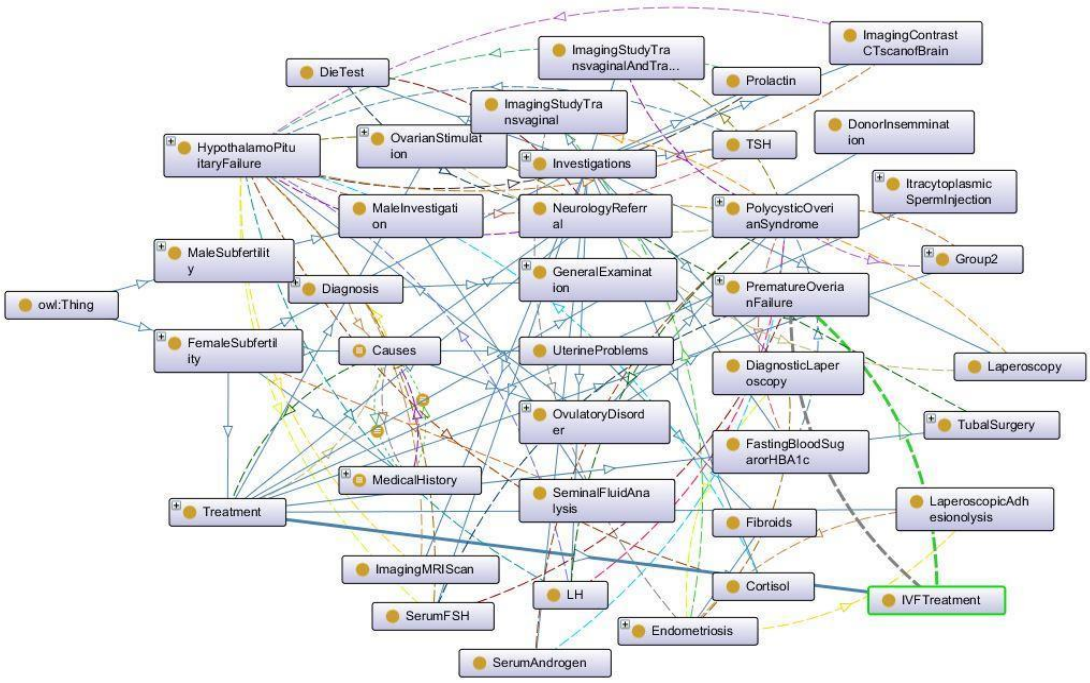

Fig 2. Part of the ontology's ontograf

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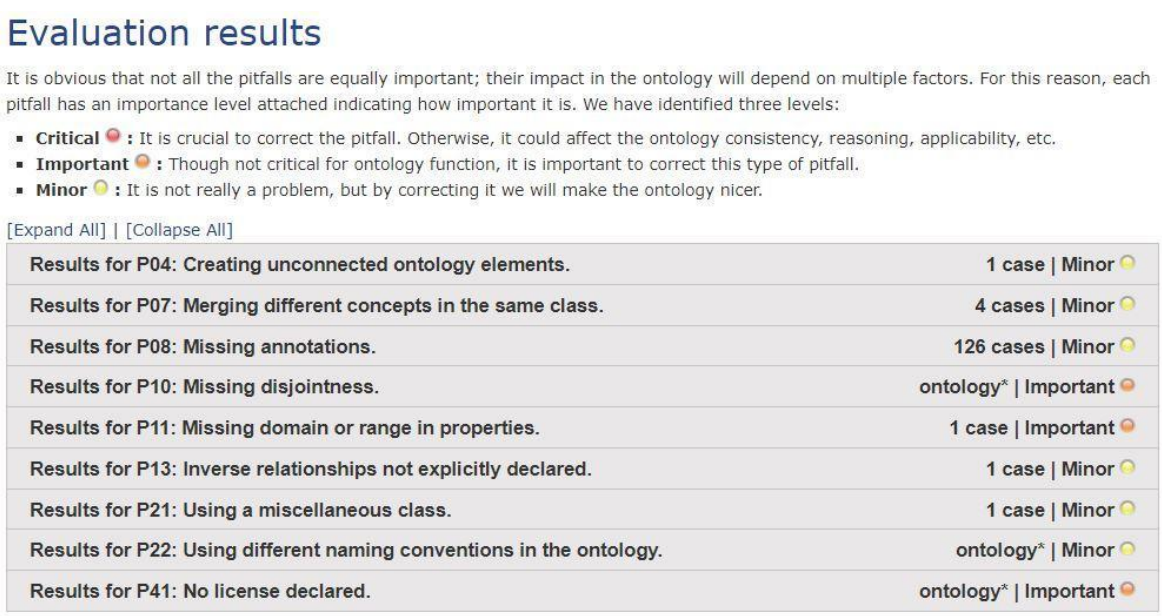

Fig 3. OOPS! Evaluation Results.

TABLE I. Dl Queries and Answers

Competency Questions	DL Query	Answers
What are the treatment method for Tubal Disorder Cause?	TubalSurgery and hasSurgeries only TubalSurgery	Labaroscopic_Tubal_Surgery Surgery_for_hydrosalpinges Tubal_catheterisation_or_cannulation Tubal_microsurgery
What are the medical history that helps to find Tubal Disorder?	TubalDisorder and is select some MedicalHistory	Scar_Tissue Pelvic_Inflammatory_Disease History_of_Gonorhea_or_Chlamydia

V. CONCLUSION

Female subfertility is a vast area than male subfertility so males need to check first. That is the norm in the medical field. If they don't have any causes then doctors can move to female subfertility. Doctors and medical students have many confusions about decision making. So, this ontology modeling will help in decision making in diagnosing causes and treatment methods.

Human's Subfertility domain ontology designing is a tedious task. The female subfertility domain is more tedious than male subfertility designing. This research is about the decision-making of the partners who have a problem and go further diagnosis and treatment using this ontology model.

Human subfertility ontology can help in the gynecological department and also researchers can use this ontology model for their further research. In the future, we are going to develop a decision support system that helps to make decisions in their field to doctors and medical students easily.

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