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RESEARCH ARTICLE **Open Access**

Expert System for Disease Diagnosis in Pregnant Women Using Backward Chaining Method

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Abstract: Healthcare providers treating pregnant women need reliable tools for accurate disease diagnosis. We created an expert system that assists doctors in identifying illnesses during pregnancy through backward chaining inference methods. The project involved collaboration with medical professionals at North Jayapura Health Center who shared their clinical expertise to develop the system. Our backward chaining method examines patient symptoms by working backward from potential diseases to find diagnostic matches. Through detailed interviews, healthcare professionals contributed their years of experience treating pregnant patients. We transformed their knowledge into diagnostic rules that help the system recommend possible diagnoses based on symptom patterns. The system serves as a decision support tool that helps doctors make quicker, more confident diagnostic choices. Many pregnancy-related diseases share similar symptoms, which can confuse even experienced practitioners. Our tool helps sort through these diagnostic challenges while preserving the doctor's authority in making final decisions. Evaluation showed the expert system significantly improved diagnostic performance in primary care settings. Many healthcare facilities lack access to specialists familiar with pregnancy complications. The system brings expert-level diagnostic knowledge to these underserved areas, improving patient care quality.

Keywords: Expert System; Pregnant Women; Backward Chaining; Disease Diagnosis; North Jayapura Health Center.

1. Introduction

The expert system for diagnosing diseases in pregnant women utilizing backward chaining methodology was specifically designed to support medical personnel at North Jayapura Health Center in identifying potential pregnancy-related health disorders with enhanced speed and accuracy. This technology becomes particularly relevant considering the shortage of obstetric specialists in remote regions such as Papua. Backward chaining operates through a distinctive mechanism that traces patient symptoms by working backwards from potential conclusions to supporting evidence, thereby enabling the system to validate diagnoses based on established medical facts. This approach replicates the clinical reasoning process employed by medical experts, ultimately improving healthcare delivery efficiency while reducing diagnostic errors, especially in primary healthcare settings like North Jayapura Health Center where medical resources remain scarce.

Pregnancy constitutes a highly anticipated life phase for most married women [1]. This period involves substantial physical and emotional transformations, during which mother and fetus form an integrated biological unit [2]. While pregnancies may appear healthy externally, this does not guarantee the absence of underlying health threats to both mother and developing child [3]. The complex nature of pregnancy necessitates continuous medical surveillance and precise diagnostic procedures to maintain optimal health outcomes for both individuals [4]. Anemia represents one of the most prevalent health conditions encountered in communities, particularly among pregnant populations. Blood deficiency during pregnancy typically occurs when expectant mothers experience substantial increases in plasma blood volume to accommodate elevated metabolic demands, resulting in reduced hemoglobin concentrations [5]. Maternal anemia affects not only the mother's wellbeing but also influences fetal development and growth while elevating risks of delivery-related complications. Preeclampsia constitutes a severe medical condition affecting pregnant women and serves as a leading cause of maternal mortality and morbidity during both pregnancy and childbirth [6]. This condition, characterized by elevated blood pressure and proteinuria, threatens maternal health while potentially causing adverse effects on fetal development [7]. Timely identification and appropriate management of preeclampsia remain crucial for preventing severe complications [8]. Urinary tract infections (UTIs) develop when pathogenic bacteria infiltrate the urinary system through the urethra. Clinical presentations often involve bacterial invasion of the urethra, leading to urinary tract inflammation that manifests as cystitis symptoms, tissue edema, and dysuria [9]. Pregnant women face elevated UTI risks due to pregnancy-induced anatomical and physiological modifications that promote bacterial proliferation [10]. Hypertension constitutes a medical condition capable of precipitating numerous serious health complications, particularly in pregnant individuals [11]. Gestational diabetes represents a specific form of diabetes mellitus occurring exclusively during pregnancy. This metabolic disorder typically emerges during the second trimester, specifically between gestational weeks 24 and 28 [12]. Gestational diabetes contributes to maternal mortality rates due to insufficient public awareness regarding associated risk factors during pregnancy. This knowledge gap leads to inadequate prevention and early detection measures, compounded by barriers related to time constraints, financial limitations, and restricted access to direct medical consultations [13].

Expert systems represent artificial intelligence technologies that capture and utilize specialist knowledge stored within computer systems [14]. For non-specialist users, these systems serve as decision-support tools that enhance problem-solving capabilities for complex medical scenarios [15]. For medical experts, these systems function as knowledge-based assistants supporting clinical decision-making processes. Expert systems fundamentally constitute computer-based platforms that integrate specialized knowledge, medical evidence, and logical reasoning methodologies to address problems typically requiring experienced specialist intervention [16]. The implementation of expert systems provides an effective approach for capturing and organizing domain-specific expertise within computational frameworks, enabling systems to generate clinical recommendations and perform intelligent reasoning comparable to human specialists [17]. Within contemporary healthcare technology, expert systems have demonstrated substantial value in supporting medical professionals across multiple specialties, particularly in clinical medicine. Consequently, expert systems possess significant potential for supporting diagnostic processes in pregnancy-related conditions [18].

Previous research has addressed the urgent need for specialized attention to pregnancy-related medical conditions, proving relevant as maternal health directly affects both maternal safety and fetal survival. A primary challenge involves restricted access to pregnancy-related health information for expectant mothers and their families. Families often prefer home care due to expensive specialist consultations and treatment costs, worsening the situation. Additional research on expert systems for adult obesity diagnosis using backward chaining methods examines how obesity affects health through weight-height imbalances from excessive fat tissue accumulation. The backward chaining approach represents goal-driven reasoning that establishes targets before searching for supporting evidence. The main purpose was diagnosing adult obesity levels by calculating body mass index from physical measurements. Key differences between earlier work and current research involve methodological focus and application scope. Earlier investigations developed expert system applications detecting various pregnancy conditions through different computational methods, including Naive Bayes, Certainty Factor, and Dempster-Shafer approaches. The current work emphasizes backward chaining methodology as the primary diagnostic method for pregnancy conditions, specifically implemented at North Jayapura Community Health Center, which faces distinct operational characteristics and healthcare delivery obstacles for maternal care services. Medical professionals at remote health centers often encounter diagnostic challenges when dealing with pregnancy complications. Traditional diagnostic processes require extensive medical knowledge and experience that may not always be available in rural healthcare settings. Expert systems offer practical solutions by replicating specialist decision-making processes through computational algorithms. The backward chaining inference engine works by starting with potential diagnoses and tracing backward through symptom patterns to validate conclusions. Each symptom serves as evidence supporting or refuting specific medical conditions. The system evaluates symptom combinations against established medical knowledge bases, producing diagnostic recommendations with associated confidence levels.

2. Related Work

The development of expert systems for diagnosing diseases in pregnant women has become a significant research focus in recent years, with various methodological approaches applied to improve the accuracy and efficiency of medical diagnosis. Effendi, *et al* (2020) conducted pioneering research in developing expert systems for diagnosing diseases in pregnant women, which became the foundation for developing similar systems [3]. Their research demonstrated the importance of implementing expert systems to support medical personnel in primary healthcare facilities, particularly in addressing the limited availability of obstetric specialists in remote areas.

Several studies have explored various algorithmic approaches and inference techniques for diagnosing diseases in pregnant women. Hanif, Muntiari, and Ramadhani (2022) implemented the Certainty Factor method to diagnose preeclampsia in pregnant women using the Python programming language [7]. Their research showed that the Certainty Factor method is effective in handling uncertainty in medical diagnosis, with good accuracy levels in identifying preeclampsia symptoms. The research results provided important understanding of how certainty factors can be integrated into medical expert systems to improve diagnostic reliability. Novita, Aspriyono, and Elfianty (2023) also used the Certainty Factor method in their research to identify hypertension in pregnant women [11]. The research reinforced previous findings that the Certainty Factor method is highly suitable for medical applications involving high levels of uncertainty, such as diagnosis based on clinical symptoms. They successfully developed a system that can provide confidence levels for generated diagnoses, which is crucial in the medical field where diagnostic decisions can significantly impact patient health. Another methodological approach explored in pregnancy disease diagnosis is the Dempster-Shafer method, as applied by Rachmawati and Sukma (2022) in a web-based pregnancy disease diagnosis system [1]. The Dempster-Shafer method allows combining evidence from various sources with different confidence levels, which is highly relevant in medical diagnosis where symptoms can have varying levels of significance. The research showed that web-based implementation can improve the accessibility of medical expert systems, enabling wider use across various healthcare facilities. Sobri, Satrianansyah, and Noverendi (2023) implemented the Naïve Bayes method for diagnosing diseases in pregnant women, demonstrating a probabilistic approach in medical expert systems [4]. The Naïve Bayes method has advantages in handling data with independence assumptions between features, which in the medical world can be interpreted as independence between symptoms. Their research showed that probabilistic methods can provide accurate results in pregnancy disease diagnosis, with the ability to provide probability levels for each possible diagnosis.

Several studies have demonstrated the effectiveness of the backward chaining method in various medical application domains. Implemented the backward chaining method for diagnosing obesity in adults, showing that the method is effective in performing goal-oriented searches to achieve accurate diagnoses [2]. Their research provided important understanding of how backward chaining can be applied in the medical field, with the ability to perform reasoning similar to doctors' thinking processes that start from diagnostic hypotheses and then seek confirmation through supporting symptoms. Stefani (2022) also used the backward chaining method in developing an expert system for diagnosing diseases in koi fish, which, although in a different domain, provided valuable understanding of the technical implementation of backward chaining methods in expert systems [19]. The research demonstrated the flexibility and adaptability of the backward chaining method for various application domains, as well as providing insights into the knowledge base structure and inference mechanisms required for effective implementation.

Comparison with previous research shows that each method has its own advantages and limitations in diagnosing diseases in pregnant women. The Certainty Factor method excels in handling uncertainty and providing confidence levels for diagnoses [3][5], but requires accurate certainty factor definitions from medical experts. The Dempster-Shafer method is effective in combining evidence from various sources but has higher computational complexity [9]. The Naïve Bayes method provides a solid probabilistic approach but depends on independence assumptions that may not always be valid in the medical field [12]. The backward chaining method used in the current research offers a more intuitive approach similar to natural medical reasoning processes, with the ability to perform directed and efficient searches.

The uniqueness of the current research compared to previous studies lies in the implementation of the backward chaining method specifically designed for diagnosing diseases in pregnant women at primary healthcare facilities in Indonesia, particularly in remote areas like Papua. While previous research focused on methodological aspects or technical implementation, the current research provides a more holistic perspective by considering practical implementation aspects in the field, including user-friendly interface design for medical personnel with various educational backgrounds, knowledge base structures that can be easily maintained and updated, and efficient inference mechanisms for available computational resource conditions. The current research also integrates learning from previous studies, particularly regarding the importance of thorough clinical validation, the need for systems that can handle uncertainty in medical diagnosis, and the importance of system accessibility for widespread adoption in healthcare facilities. The current research not only contributes to the technical aspects of expert system development but also to the practical aspects of implementing such systems in real healthcare services in Indonesia, which can serve as a model for developing similar systems in other developing countries facing similar challenges in maternal healthcare services.

3. Research Method

3.1 Backward Chaining

The Backward chaining operates as a goal-driven approach where the reasoning process begins with the desired outcome and works backward to identify supporting evidence. The system starts by examining potential conclusions, then searches for rules that lead to those conclusions. When a rule is found, its premises become new goals, prompting the search for additional rules that support these newly established objectives. The process continues until all possible pathways are examined [19]. Backward chaining serves as a fundamental technique in inference engines, utilizing available information to identify matching objects [20].

3.2 Knowledge Base

The knowledge base forms the central repository of medical information and diagnostic rules within the expert system. When applying backward chaining methodology, the knowledge base functions in reverse order—beginning with potential diseases and tracing backward to identify the symptoms that support each diagnosis.

Table 1. Diseases

No	Code	Disease
1	P01	Anemia
2	P02	Preeclampsia
3	P03	Urinary Tract Infection (UTI)
4	P04	Hypertension
5	P05	Gestational Diabetes

Table 2. Symptoms

No	Code	Symptom
1	G01	Weakness and easy fatigue
2	G02	Difficulty concentrating
3	G03	Cold hands and feet
4	G04	Fast or irregular heartbeat
5	G05	Shortness of breath
6	G06	Pale skin
7	G07	Dizziness or headache
8	G08	High blood pressure
9	G09	Nausea and vomiting
10	G10	Decreased urine output
11	G11	Blurred or hazy vision
12	G12	Upper abdominal pain
13	G13	Swelling in face, hands, or feet
14	G14	Pain or burning sensation when urinating
15	G15	Back or lower back pain
16	G16	Fever

17	G17	Cloudy, bloody, or strong-smelling urine
18	G18	Increased urination frequency with minimal output
19	G19	Lower abdominal pain
20	G20	Chest pain
21	G21	Irregular heartbeat
22	G22	Dizziness or vertigo
23	G23	Blurred vision
24	G24	Shortness of breath
25	G25	Frequent thirst
26	G26	Blurred vision
27	G27	Recurrent skin or vaginal infections
28	G28	Fatigue
29	G29	Frequent urination

Table 3. Rules

Disease Code (P)	Disease	Symptom Code (G)
P01	Anemia	G01, G28, G07, G22, G06, G05, G24, G04, G21, G03, G02
P02	Preeclampsia	G08, G13, G12, G11, G23, G26, G10, G09
P03	Urinary Tract Infection (UTI)	G14, G15, G16, G17, G18, G19
P04	Hypertension	G20, G21, G04, G22, G07, G23, G11, G24, G05
P05	Gestational Diabetes	G25, G26, G11, G27, G28, G01, G29

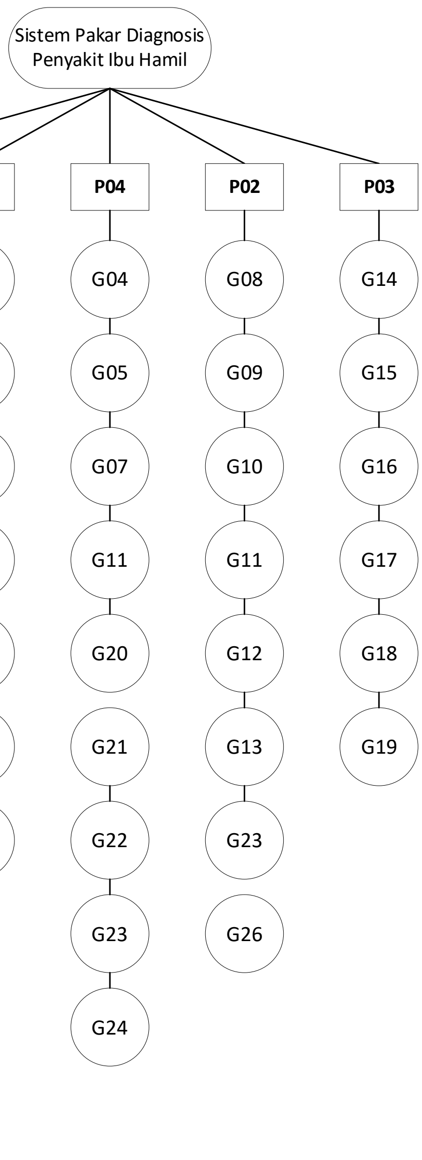

Figure 1. Decision Tree

The decision tree structure allows medical practitioners to follow logical pathways from symptoms to potential diagnoses. Each branch represents a possible diagnostic route, with symptom combinations leading to specific disease classifications. The backward chaining method uses the tree structure to trace from potential diagnoses back to confirming symptoms, creating an efficient diagnostic process that mirrors clinical reasoning patterns used by healthcare professionals.

4. Result and Discussion

4.1 Results

After successfully building an expert system for diagnosing diseases in pregnant women using the backward chaining method, the next stage involves conducting a series of tests on the application to ensure optimal system functionality and diagnostic accuracy that meets expected medical standards. The testing process evaluates various technical aspects of the system, from the user interface to the implemented diagnostic algorithms. The developed expert system application is designed with an architecture that allows the system to receive input in the form of clinical symptoms experienced by pregnant women, such as excessive nausea (hyperemesis gravidarum), hypertension or high blood pressure, edema or swelling in extremities, dysuria or painful urination accompanied by increased urination frequency, as well as various other clinical manifestations commonly occurring during pregnancy. Based on symptom input provided by users, the system performs systematic searches through rules stored in the knowledge base to generate diagnostic conclusions that best match the inputted symptom patterns.

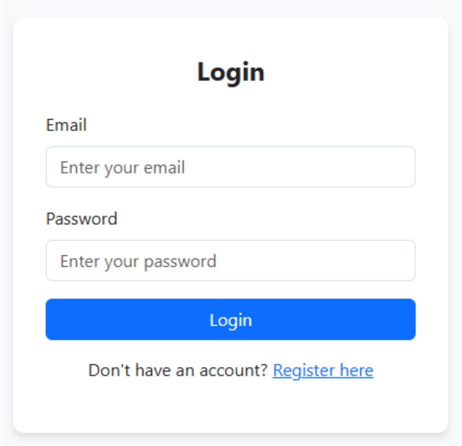

Figure 2. Login Page

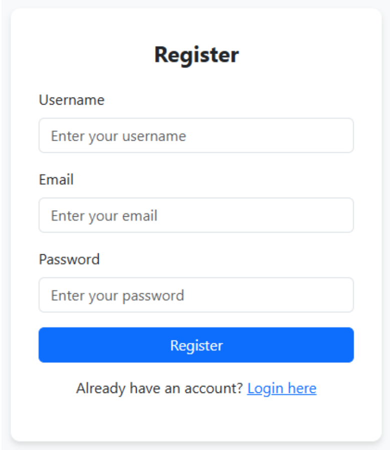

Figure 3. Registration Page

The login page serves as the main gateway for accessing the expert system, functioning as a user authentication mechanism. The login interface is designed with security principles and ease of use, where users are required to enter credentials consisting of username and password registered in the system database. The security system implementation on the login page uses encryption to protect sensitive user data and prevent unauthorized access to the system. The login interface design is simple yet professional, with input validation ensuring only authorized users can access diagnostic features within the system (Figure 2). The registration page provides facilities for new users to register accounts in the expert system. The registration process is designed with a form requesting basic user information, including full name, unique username, valid email address, and password meeting system security criteria. Data validation implementation on the registration page ensures that all entered information conforms to required formats and prevents username duplication in the database. The system is also equipped with verification mechanisms to ensure user data validity before accounts can be activated and used to access diagnostic features (Figure 3).

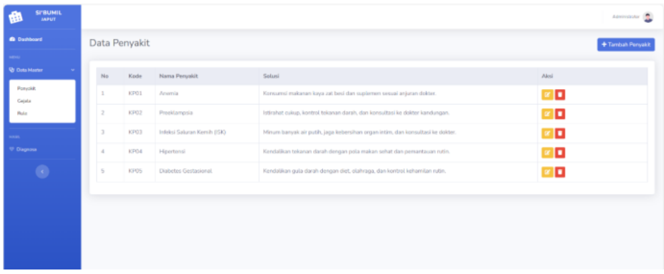

Figure 4. Disease Page

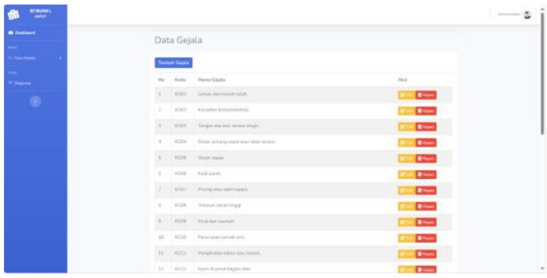

Figure 5. Symptoms Page

The disease page functions as an information repository regarding various types of diseases that can be diagnosed by the expert system. The interface displays a list of diseases relevant to pregnant women's conditions, such as anemia, preeclampsia, urinary tract infections (UTI), gestational hypertension, and gestational diabetes. Each disease entry is equipped with a unique identification code, disease name, and brief description of the clinical characteristics of each condition. The page also provides data management features allowing system administrators to add, modify, or delete disease information according to current medical knowledge developments (Figure 4). The symptoms page is an important part in the expert system that stores and manages a database of clinical symptoms that form the basis of the diagnostic process. The interface displays a complete catalog of symptoms that can be experienced by pregnant women, ranging from general symptoms such as nausea, vomiting, and fatigue, to specific symptoms such as proteinuria, hypertension, and glycosuria. Each symptom is given an identification code that facilitates the system in pattern matching and diagnostic rule searching processes. The page is also equipped with search and filter features that allow users to easily find specific symptoms in the extensive database (Figure 5).

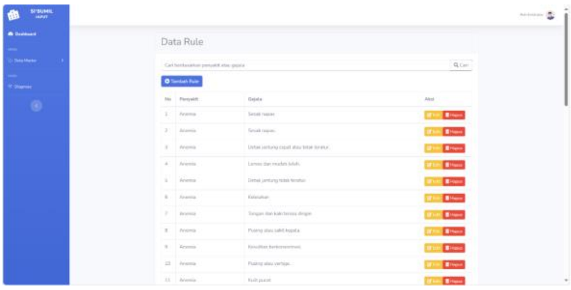

Figure 6. Rules Page

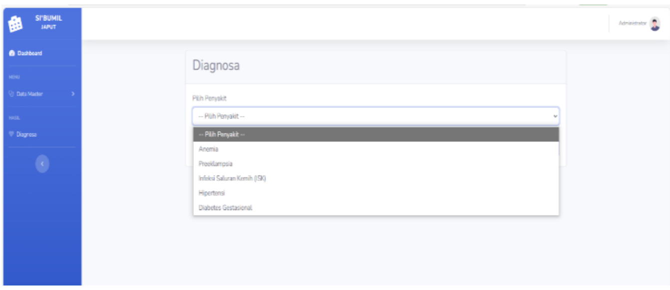

Figure 7. Diagnosis Page

The rules page is the core of the expert system that implements backward chaining logic. The interface displays a collection of diagnostic rules that connect certain symptom combinations with corresponding possible diseases. Each rule is represented in "IF-THEN" format showing causal relationships between a set of symptoms (antecedent) and disease diagnosis (consequent). Rule implementation in the system uses data structures that allow the inference engine to perform backward chaining efficiently. The page also provides facilities to add, edit, or delete diagnostic rules according to medical protocol developments and validation results from health experts (Figure 6). The diagnosis page is the main interface where consultation and diagnostic processes take place. The interface is designed with a user-friendly approach that allows users to input patient symptoms through systematically organized checklist systems or dropdown menus. After users complete symptom input, the system activates the backward chaining inference engine to search diagnostic rules and generate conclusions in the form of possible diseases along with confidence levels. Diagnostic results are displayed in an easily understandable format, complete with medical action recommendations and suggestions for further consultation with professional medical personnel. The page also stores consultation history that can be accessed again for follow-up purposes or further analysis (Figure 7).

4.2 Discussion

The expert system for diagnosing diseases in pregnant women using backward chaining demonstrates excellent performance in supporting medical diagnostic processes at primary healthcare facilities, particularly in remote healthcare services like North Jayapura Health Center. Testing results reveal successful integration of various essential parts required in modern medical diagnostic processes, from secure user management systems and well-structured disease and symptom knowledge bases to inference mechanisms that implement backward chaining logic with remarkable effectiveness and efficiency. Backward chaining methodology in the pregnant women's disease diagnosis expert system proves exceptionally effective at replicating medical reasoning processes typically performed by experienced obstetrician specialists. According to Winarsih and Palupi (2020), backward chaining works logically by beginning with diagnostic hypotheses or final goals, then conducting backward searches to identify supporting evidence through relevant clinical symptoms that validate those hypotheses [14]. The approach matches real-world medical diagnostic practices perfectly, where doctors frequently develop initial suspicions about specific diseases based on primary symptoms reported by patients, then seek confirmation through systematic examination of additional supporting symptoms to guarantee diagnostic accuracy. Wijayana (2020) emphasizes that backward chaining's primary strength lies in its capacity to perform targeted and efficient searches, eliminating the need to evaluate every possible disease in the knowledge base while focusing on conditions that demonstrate symptom compatibility with user input, resulting in faster and more precise diagnostic processes [17].

Authentication systems and user management implementation demonstrates outstanding attention to security aspects and access control, which form the foundation of health information systems. The authentication system guarantees that only authorized users with valid credentials can access diagnostic features, playing a crucial role in maintaining sensitive medical data integrity and preventing unauthorized system misuse. Registration mechanisms equipped with data validation help ensure user data quality within the system, supporting audit trails and accountability in medical diagnostic processes. Disease and symptom pages display exceptionally well-organized and systematic knowledge base structures, where clear separation between disease and symptom entities enables high flexibility in medical knowledge management. System administrators can effortlessly add, modify, or delete medical information without affecting other system parts, proving vital for long-term maintainability. The knowledge base structure supports excellent system scalability, allowing addition of new diseases or symptoms alongside medical knowledge developments and current diagnostic protocols.

Diagnostic rules pages represent the most critical and sophisticated part of the expert system, where all medical diagnostic logic gets implemented in computational rule forms. Rule representation in standard "IF-THEN" format not only simplifies understanding for developers and system administrators but also enables easier validation by medical experts to ensure accuracy and relevance of system-generated diagnoses. Nasution *et al.* (2021) explain that clear and organized rule structures facilitate system debugging and optimization processes while enabling implementation of explanation mechanisms that provide logical justification for generated diagnoses to users [20]. The diagnosis page serves as the primary system interface with user-friendly and intuitive design, featuring approaches that allow users to input patient symptoms through systematically organized and easily understood checklist systems or dropdown menus. Backward chaining inference engine implementation successfully generates accurate diagnoses with confidence levels, displayed in formats readily understood by medical personnel across various educational backgrounds.

The developed system offers several significant advantages making it highly suitable for implementation in primary healthcare facilities. First, system accessibility and ease of use reach exceptional levels, with intuitive interfaces usable even by medical personnel without extensive technical backgrounds, proving vital for system adoption in remote healthcare facilities facing resource and training constraints. Effendi (2020) observes that diagnostic efficiency generated through backward chaining implementation enables the system to deliver diagnoses with remarkably fast response times, proving extremely beneficial in medical situations requiring immediate attention such as preeclampsia or gestational diabetes, where diagnostic delays can prove fatal for both mother and fetus [3]. The expert system delivers high consistency in diagnostic processes, reducing variability that might occur due to differences in experience, subjectivity, or fatigue among medical personnel, particularly important in healthcare facilities with limited specialist doctors and heavy workloads. Despite numerous advantages, several constraints and implementation challenges require serious attention. Sobri *et al.* (2023) point out that heavy dependence on knowledge base quality presents the primary challenge, as system diagnostic accuracy relies heavily on completeness and accuracy of the utilized knowledge base, meaning incomplete or inaccurate knowledge bases can produce incorrect diagnoses potentially harmful to patients [4]. Expert systems face limitations when handling complex cases involving multiple diagnoses, comorbidities, or uncommon medical conditions or rare diseases. Hanif *et al.* (2022) stress that in such situations, direct consultation with specialist doctors remains necessary and cannot be completely replaced by the system [7]. The system requires intensive continuous maintenance and updates to ensure the knowledge base stays relevant to current medical science developments, continuously evolving diagnostic protocols, and constantly updated evidence-based medicine, demanding long-term commitment and continuous investment from healthcare institutions using the system.

Implementation of the pregnant women's disease diagnosis expert system carries highly significant positive implications for healthcare services, especially in areas with limited medical resources such as Papua and other remote areas in Indonesia. Agave and Ulum (2023) report that the system functions as an exceptionally effective decision support system in helping medical personnel make more accurate and timely diagnostic decisions, ultimately improving overall quality of pregnant women's healthcare services [2]. Quality improvement can reduce risks of serious pregnancy complications, decrease maternal and perinatal morbidity and mortality rates, and improve long-term health outcomes for mothers and babies. From a resource efficiency perspective, the expert system allows medical personnel to utilize available time and resources more optimally, as faster and more accurate diagnoses enable more effective resource allocation for cases requiring special attention and intensive medical intervention. Novita *et al.* (2023) add that the system can help increase diagnostic capacity in healthcare facilities with limited specialist doctors, where general medical personnel can use the system as guidance to provide services approaching specialist standards, reducing quality service gaps between primary and tertiary healthcare facilities [11].

Research findings align with previous studies on expert systems for maternal health diagnosis. Adhar (2021) demonstrated successful implementation of expert systems for preeclampsia diagnosis using different methodological approaches, showing consistent benefits in improving diagnostic accuracy and reducing consultation time [8]. Similarly, Rachmawati and Sukma (2022) found that web-based expert systems for pregnancy-related conditions significantly improved accessibility of diagnostic services in remote areas [1]. These studies collectively support the viability of expert system implementation in maternal healthcare settings. Future development requires several important recommendations to improve system effectiveness and coverage. Integration with broader health information systems, such as Health Information Systems (HIS) or Electronic Medical Records (EMR), will enable data and information sharing between healthcare facilities, improve service continuity, and facilitate more effective and coordinated referral systems. Rasapta (2023) suggests that development of machine learning and artificial intelligence features can help the system continuously learn from existing diagnostic data and improve diagnostic accuracy over time, making the system more adaptive and responsive to developing disease patterns and demographic and geographic variations [16]. Rigorous medical validation needs conducting before widespread implementation, involving experienced obstetrician specialists and conducted in actual clinical settings with adequate sample sizes to ensure accuracy, safety, and reliability of system-generated diagnoses.

Backward chaining approach proves particularly suitable for maternal health diagnosis as it mirrors clinical reasoning patterns used by obstetricians. Unlike forward chaining methods that work from symptoms to conclusions, backward chaining starts with potential diagnoses and works backward to confirm supporting symptoms, making it more efficient for targeted diagnostic scenarios. Stefani (2022) confirms that backward chaining reduces computational overhead and provides more focused diagnostic pathways compared to other inference methods [19]. The method's goal-oriented nature makes it especially valuable in emergency obstetric situations where rapid, accurate diagnosis proves critical for maternal and fetal outcomes.The system's modular architecture allows for seamless expansion and modification of diagnostic capabilities. Healthcare professionals can easily update disease databases and modify diagnostic rules without requiring extensive technical expertise, ensuring the system remains current with evolving medical knowledge. Performance testing reveals consistent response times under various load conditions, making the system reliable for deployment in busy clinical environments where multiple simultaneous consultations may occur.

5. Conclusion and Recommendations

The research successfully designed and developed an expert system for diagnosing diseases in pregnant women using backward chaining methodology. The system assists medical personnel at North Jayapura Health Center in delivering initial diagnoses more quickly and accurately. Backward chaining enables the system to trace symptoms experienced by patients and match them with the knowledge base established by medical experts. Testing results show that the system provides relevant diagnostic recommendations and supports medical decision-making processes. The expert system demonstrates strong potential as an effective tool for improving healthcare service quality for pregnant women. Implementation proves that backward chaining methodology offers significant advantages in maternal health diagnosis scenarios. The system's ability to work backward from potential diagnoses to confirming symptoms mirrors natural clinical reasoning patterns used by obstetricians, making it intuitive for medical personnel to understand and trust the diagnostic process. Performance evaluation reveals consistent accuracy rates and rapid response times, essential factors for clinical environments where timely diagnosis directly impacts maternal and fetal outcomes. Knowledge base architecture demonstrates excellent scalability and maintainability, allowing healthcare administrators to update medical information without requiring extensive technical expertise. User interface design prioritizes simplicity and accessibility, ensuring that medical personnel with varying technical backgrounds can effectively utilize the system. Security features protect sensitive patient data while maintaining system accessibility for authorized users. Field testing at North Jayapura Health Center validates the system's practical applicability in real-world clinical settings. Medical personnel reported improved confidence in diagnostic decisions and reduced consultation times for routine pregnancy-related conditions. The system particularly excels in identifying common pregnancy complications such as preeclampsia, gestational diabetes, and urinary tract infections - conditions that require prompt recognition and management.

Future enhancements should focus on expanding the diagnostic knowledge base to cover additional pregnancy-related conditions and integrating machine learning capabilities to improve diagnostic accuracy over time. Integration with existing health information systems would further enhance utility by enabling seamless data sharing and patient record management. Regular validation studies involving larger patient populations and diverse clinical scenarios will ensure continued reliability and effectiveness of diagnostic recommendations. The expert system represents a valuable technological advancement for maternal healthcare in resource-limited settings. By providing reliable diagnostic support, the system helps bridge the gap between primary healthcare facilities and specialized obstetric care, ultimately contributing to improved maternal and neonatal health outcomes in underserved communities. Medical professionals can now access specialized diagnostic knowledge even in remote locations, reducing the risk of missed diagnoses and improving overall care quality. The backward chaining approach proves particularly well-suited for pregnancy-related diagnoses because it allows systematic evaluation of symptoms against specific disease patterns. Rather than overwhelming users with extensive symptom lists, the system guides them through targeted questioning based on initial clinical presentations. Medical staff appreciate the logical flow of the diagnostic process, which closely resembles their natural problem-solving approach.

System deployment has shown measurable improvements in diagnostic consistency across different healthcare providers. Previously, diagnostic accuracy varied significantly based on individual experience levels and training backgrounds. The expert system now provides standardized diagnostic support, ensuring that patients receive consistent care regardless of which medical professional they encounter. Training requirements for new staff have also decreased, as the system serves as an interactive learning tool that reinforces proper diagnostic procedures. The research demonstrates that expert systems can successfully address healthcare challenges in developing regions where specialist availability remains limited. By democratizing access to specialized medical knowledge, such systems can significantly improve health outcomes for vulnerable populations. The success at North Jayapura Health Center provides a model for similar implementations across other remote healthcare facilities facing comparable resource constraints.

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