

Implementation Of Forward Chaining Method In Expert System For Dengue Hemorrhagic Fever Diagnosis (Case Study In One Of General Practitioner And Dental Clinics In Bandung)

Vina Nur'alpiah¹, Feri Alpiyasin², Haris Supriatna³, Adi Suwarno⁴

STMIK Mardira Indonesia, Bandung, Indonesia^{1,2,3,4}

Email: vinanuralpiah123@gmail.com¹, feryalpiyasin@stmik-mi.ac.id², haris.supriatna@stmik-mi.ac.id³, adisuwarno@stmik-mi.ac.id⁴

ABSTRACT

Dengue Hemorrhagic Fever (DHF) is a significant health issue in Indonesia, particularly in the city of Bandung. This condition necessitates prompt intervention and precise diagnosis to ensure patients receive timely and suitable treatment. The insufficient number of medical workers, particularly physicians, in various clinics, including the Healthy Life Clinic, constitutes a significant impediment to the early diagnosis of DHF. This project aims to develop and apply an expert system for diagnosing DHF using the forward chaining method. This approach operates by tracing data from user-inputted facts or symptoms to derive diagnostic conclusions. This expert system is designed to replicate a physician's cognitive process in evaluating symptoms and providing guidance for the early diagnosis of DHF. The study's results indicated that the created method achieved a diagnosis with high accuracy and strong consistency with the test data.

Furthermore, the system demonstrated superior performance in terms of response speed and user-friendliness. Validation tests and simulations based on actual cases managed by the clinic were conducted for testing purposes. The system's efficacy is significantly contingent upon the quality and comprehensiveness of the data input by the user. A further deficiency identified was the need for regular updates to the knowledge base to ensure the system's relevance to the latest advancements in the medical field. Despite several constraints, this expert system has demonstrated its efficacy as a practical and effective diagnostic tool, particularly for clinics with limited medical staff. The incorporation of artificial intelligence through the forward chaining method is anticipated to serve as a strategic solution for enhancing the quality of health services and expediting the management of DHF cases at primary healthcare facilities.

Keywords: Dengue Fever, Expert System, Forward Chaining, Diagnosis, Healthy Life Clinic

INTRODUCTION

Dengue Hemorrhagic Fever (DHF) is a significant public health issue, particularly in tropical nations such as Indonesia. Dengue Hemorrhagic Fever (DHF) is induced by the dengue virus, which is conveyed via the bite of the *Aedes aegypti* mosquito, known to proliferate in habitats containing clean water. Data from the Ministry of Health of the Republic of Indonesia indicate that instances of Dengue Hemorrhagic Fever (DHF) exhibit significant annual changes and frequently result in Extraordinary Events (KLB), particularly during the rainy season. In a densely populated urban environment like Bandung, factors such as the tropical climate, population mobility, and limited awareness of DHF prevention contribute to the elevated incidence of this disease. (Bahroni, Rahadi, Wanti, Hartono & Purwanto, 2022; Fitri, Ramadania, Wibowo, Lesmana & Imron, 2022; Fitri, Yunita, Imron, Sahenda & Raharjo, 2023)

A primary problem in managing DHF is the need for a precise and prompt early diagnosis process. The early symptoms of DHF can sometimes resemble those of other viral illnesses, such as influenza, necessitating precise diagnostic accuracy from medical professionals. Symptoms, including abrupt high temperature, myalgia, nausea, dermal rashes, and diminished platelet counts, may differ among patients. In this instance, the participation of physicians is crucial for identifying and determining the appropriate

therapeutic measures. Nonetheless, in other healthcare institutions, such as the Healthy Life Clinic in Bandung, the scarcity of physicians frequently hinders the provision of prompt and precise diagnostic services. This condition may result in treatment delays that could exacerbate the patient's condition. (Tahir, Hendriyanto, Faizah, Anshory & Harun, 2024; Ainun, Samsir & Subagio, 2025; Hamdani, Hatta, Septiarini, Puspitasari & Andriyani, 2021)

With the advancement of information technology, one potential approach to address this issue is the implementation of an expert system. An expert system is a subset of artificial intelligence (AI) designed to replicate the cognitive processes of an expert in addressing a specific issue or problem. An expert system in a medical context can facilitate the disease diagnostic process by evaluating patient symptoms and offering recommendations for suitable medical interventions. This system operates on a knowledge base derived from field specialists and logical rules that guide decision-making. (Wanti, Prasetya & Somantri, 2023; Henderi, Al Khudhorie, Maulani, Millah & Devana, 2022; Elkana & Kuswanto, 2023)

The inference approach of an expert system is crucial for deriving conclusions from user-inputted symptoms. Forward chaining is a prevalent inference approach that progresses from existing data or facts to derive conclusions. This approach will analyze the symptoms

presented by the patient, correlate them with the rules in the knowledge base, and generate potential diagnoses and treatment recommendations for dengue fever. The forward chaining method's advantage is its capacity to process data directly and yield rapid results, particularly when symptoms are identified from the outset. (Kiswanto, Irijanto, Risman & Imbiri, 2024; Palilingan & Tomatala, 2022)

The application of the forward chaining method in an expert system for dengue fever diagnosis at the Healthy Life Clinic is pertinent, given the scarcity of medical personnel. This system aims to assist non-physician medical staff in conducting preliminary assessments of patients suspected of having dengue fever before obtaining a physician's confirmation. This expert approach facilitates a more rapid and precise diagnostic process, expediting patient care and diminishing the likelihood of severe complications. (Puja, 2021; Putra, Rafli, Arinal & Resky, 2023; Rizki, Triyadi, Zikriah & Sidiq, 2025)

This work is to develop and execute an expert system utilizing the forward chaining method for the early detection of dengue fever in a general and dental clinic in Bandung. This study involves collecting dengue fever symptom data from reputable medical sources and consulting with general practitioners who are recognized authorities in the field. The data is structured as if-then logic rules that the system utilizes during the inference phase. The system utilizes web-

based programming software for easy access by medical workers at the clinic. The system is designed to display diagnostic results in real time and provide recommendations for initiating therapy based on established medical standards.

The outcomes of the system installation indicate that the developed expert system may deliver an initial diagnosis of dengue fever with a considerable degree of accuracy. The system yields consistent outcomes when evaluated with diverse symptom data and demonstrates commendable performance in terms of speed and responsiveness. In controlled trials at the Healthy Life Clinic, the system accelerated the patient evaluation process by up to 40% compared to manual assessments conducted by healthcare professionals. Furthermore, the technique enhances the trust of non-physician medical professionals in conducting initial screenings of patients exhibiting dengue symptoms.

This system possesses numerous limitations. One factor is the reliance on comprehensive and precise input data. If the entered symptom data is inappropriate or incomplete, the system cannot yield good diagnostic outcomes. The system requires continuous updates to the knowledge base to remain current with the latest advancements in dengue diagnosis and treatment. The participation of physicians and medical professionals as experts is crucial for maintaining the system's validity and reliability throughout time.

This study highlights the importance of integrating technology into medical practice, particularly in small clinics or areas with limited human resources. Expert systems are designed not to supplant physicians but to enhance the efficiency and quality of healthcare services. Implementing an appropriate system helps alleviate the workload of medical staff, decrease patient waiting times, and expedite treatment procedures. This condition is particularly significant in the context of dengue fever when time is a critical determinant of treatment efficacy.

The implementation of the forward-chaining method in an expert system for dengue fever diagnosis at the Healthy Life Clinic yielded favorable outcomes. This approach not only delivers a precise and rapid initial diagnosis but also significantly enhances the quality of healthcare services, particularly in scenarios where there is a scarcity of physicians. This technology, with additional development and refinement, has the potential for broader application across diverse healthcare facilities, including clinics and hospitals.

This study also creates opportunities for the development of analogous expert systems for diagnosing other diseases with complex symptomatology that require prompt intervention. An expert method for diagnosing pneumonia, malaria, or other developing infectious diseases. The integration of this system with electronic medical records, clinic management systems, or

telemedicine platforms can enhance its advantages within Indonesia's digital healthcare ecosystem.

Consequently, the imperative to address DHF swiftly and precisely, alongside the implementation of technology such as expert systems utilizing the forward chaining method, may serve as an innovative remedy to mitigate deficiencies in medical services. This study aims to offer scientific and practical contributions to health information technology and serve as a reference for the future development of analogous systems.

METHOD

This research employs software engineering techniques, utilizing quantitative and descriptive methodologies, to develop and execute an expert system for detecting Dengue Hemorrhagic Fever (DHF) through the forward-chaining strategy. This research was conducted at the Healthy Life Clinic, a medical and dental facility in Bandung City, which has a limited number of physicians available for initial diagnostic services to patients. The primary aim of this study is to develop an expert system capable of autonomously analyzing clinical symptoms reported by patients and delivering preliminary diagnostic outcomes, along with pertinent medicinal recommendations.

The preliminary phase of this investigation commenced with the data collection method.

Data were collected through literature reviews, interviews with general practitioners practicing at related clinics, and documentation of typical DHF symptoms obtained from trusted medical sources, including the Ministry of Health and scientific journals. A list of the primary and ancillary symptoms of DHF was produced from these data for reference in the system inference process. The symptoms used as metrics in the system include abrupt high fever, myalgia, arthralgia, erythematous skin lesions, epistaxis, cephalalgia, and thrombocytopenia.

Following the symptom identification phase, the system-building stage is executed utilizing the forward chaining method, a reasoning approach that progresses from initial data or facts to conclusions. This system is built utilizing a web-based programming language to facilitate easy access for doctors via desktops or mobile devices. The system's rule base is structured as if-then rules derived from patterns of correlations between symptoms and potential diagnoses of dengue fever. Upon inputting symptom data, the algorithm correlates it with existing rules and generates a definitive result.

Additionally, the system undergoes evaluation through a Black-Box testing scenario and a validity assessment by comparing the system's diagnostic outcomes with those of the physician. System review is conducted by assessing accuracy, speed, and usability through direct testing by healthcare professionals. The

test results are utilized to enhance the system, enabling it to deliver progressively pertinent and responsive diagnostic outcomes that aid the medical process in the clinic.

RESULTS and DISCUSSION

The implementation findings of an expert system utilizing the forward chaining method for the early diagnosis of Dengue Hemorrhagic Fever (DHF) indicate that this system operates efficiently in facilitating the medical decision-making process at the Healthy Life Clinic in Bandung City. The system created can analyze user-entered symptoms with considerable accuracy, yielding a first diagnosis consistent with medical references and expert physician judgments. Testing was conducted using several case scenarios of patients exhibiting distinct DHF symptoms, which were subsequently compared with the diagnostic outcomes from general practitioners at the clinic.

The system generates output that aligns with physicians' manual diagnoses, suggesting that the rule base developed using the forward chaining method effectively represents the symptom patterns typically observed in DHF cases. Key symptoms, including abrupt high fever, myalgia and arthralgia, nausea, erythematous lesions, and thrombocytopenia, serve as critical indicators for the system's conclusions. In 90% of the total test cases (30 cases), the system produced diagnostic results that matched the physician's diagnosis. This result indicates that the system's accuracy is elevated and suitable for use as an early diagnostic tool.

The system's fast performance is among its most outstanding features. The system employs forward chaining processing, deriving inferences directly from symptom input without necessitating a comprehensive search of the current knowledge store. This result enables the system to deliver results instantaneously, with an average processing duration of approximately 1.8 seconds per diagnosis. This timeliness is a significant benefit for clinics experiencing severe workloads or a scarcity of medical staff, as the diagnostic process is expedited and can promptly transition to appropriate medical intervention. The simplicity of use is a key determinant of the system's efficacy in deployment. The clinic's web-based interface enables medical practitioners to easily input patient data and symptoms without requiring specialized training. A trial involving five medical workers revealed that all responders (100%) found the system to be comprehensible and user-friendly, even for those with limited information technology expertise. This system is accessible via multiple platforms, including PCs, tablets, and cellphones, hence offering considerable flexibility of use.

Nonetheless, several shortcomings have been identified in the implementation of this system. A primary problem is the system's reliance on the completeness and precision of incoming data. The system relies on user-entered data; thus, inaccuracies or omissions in symptom reporting can lead to erroneous diagnostic outcomes. If the user omits symptoms such as red spots on the skin or a history of nosebleeds, the algorithm cannot fully correlate the likelihood of DHF. Consequently, comprehensive training for officers in accurately documenting

symptoms is essential to guarantee the system's efficacy.

This approach also raises concerns regarding the relevance of the information. The knowledge base of this expert system is static, necessitating constant modifications to align with the current medical advancements related to DHF. For instance, if there is an alteration in the criteria for diagnosing DHF or the identification of new symptoms, the rule base must be revised to ensure the system's continued relevance and precision. This condition can be addressed by establishing a system maintenance team composed of medical professionals and system developers to do regular evaluations and updates.

This study's results indicate that the forward chaining strategy is better appropriate for diseases with distinct and linear symptom patterns, such as DHF. In contrast to the backward chaining method, which progresses from hypothesis to fact, forward chaining advances from fact to conclusion. This approach is particularly pertinent in initial diagnosis, as medical professionals typically lack a hypothesis prior to gathering the primary symptoms. This approach effectively meets the clinic's requirement for prompt and rational diagnostic results derived from patient data.

This study's results provide a robust foundation for replicating the approach in other clinics with similar challenges, particularly those with a physician shortage or located in regions with limited medical access. The expert system employing the forward chaining method can be tailored to local requirements and circumstances through modifications to the knowledge base and user interface. The system can be enhanced to encompass additional disease

diagnosis by incorporating new rule bases and modules.

The expert system for dengue fever diagnosis, constructed using the forward chaining method, has demonstrated commendable outcomes in terms of diagnostic accuracy, processing speed, user-friendliness, and medical relevance. The system's efficacy is significantly contingent upon the comprehensiveness of the input data and the ongoing enhancement of medical knowledge. Consequently, the efficacy of future implementation of this system will be contingent not only upon technological factors but also on sustained collaboration between the medical team and information technology experts.

CONCLUSION

The research findings indicate that the application of the forward chaining method in an expert system for the early diagnosis of Dengue Hemorrhagic Fever (DHF) is practical and positively influences the medical service process, particularly at the Bandung Healthy Life Clinic, which has limited medical staff. The developed expert system can analyze symptom data inputted by medical professionals and generate an initial diagnosis with considerable accuracy. The system's diagnostic results exhibit strong alignment with the observations and conclusions made by physicians, indicating its suitability as a tool for facilitating rapid and precise medical decision-making.

This technology demonstrates not only outstanding accuracy but also exceptional performance in terms of speed and responsiveness. The device enables medical professionals to obtain diagnostic results in just a few seconds. This condition

is crucial in a clinic with high service demand, as it helps expedite the patient care process. The intuitive interface facilitates seamless operation for officers, eliminating the need for extensive training and enabling rapid system adaptation.

The efficacy of this method is contingent upon the completeness and precision of the input symptom data. In the presence of inadequate or erroneous data, the diagnostic results may also diverge. The system's knowledge base must be routinely updated to remain relevant to current advancements in the medical field, including modifications in diagnostic criteria or the incorporation of novel symptoms associated with DHF. Consequently, communication between the medical team and system developers is crucial for ensuring the system's durability and future quality enhancement. This forward-chaining-based expert system offers significant potential as an alternative approach to enhance the efficiency and quality of healthcare services in resource-constrained clinical facilities.

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