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## Predictive Analytics of Dental and Oral Health Using Dempster Shafer Parameters at Pelita Bunda Clinic

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### ABSTRACT

*This study aims to provide a precise and analytical approach to predicting dental and oral health. This condition will be achieved by utilizing the Dempster-Shafer parameters at the Pelita Bunda Clinic. Maintaining dental and oral health is crucial for overall well-being. Nevertheless, making treatment decisions is frequently challenging due to aspects that need clarification and cannot be measured. The Dempster-Shafer method is a highly efficient approach for handling situations with uncertainty. This strategy can employ data in the form of hypotheses and leverage probability theory to amalgamate and analyze unclear information. The study demonstrates the effectiveness of the analytical prediction approach for dental and oral health utilizing the Dempster-Shafer parameters at Pelita Bunda Clinic in forecasting patients' dental and oral health state. Employing this approach can assist dentists in making treatment decisions with greater accuracy and efficiency.*

*Keywords: Predictive Analytics, Dental and Oral Health, Dempster-Shafer*

## INTRODUCTION

Information technology is a system utilized for data processing and generating high-quality information. Information technology is crucial in driving contemporary advancements, particularly in healthcare. In the current digital age, information technology has become an essential component of nearly every facet of life, including providing health services. Information technology has enhanced the efficiency of data administration, facilitated more advanced analysis, and permitted more accurate decision-making in the health field. Information technology facilitates convenient access to medical information, enhances health monitoring capabilities, and enhances communication between patients and healthcare providers. (Bu'ulolo & Sianturi, 2020; Sari, Fitri & Hidayatullah, 2021; Indra, 2020)

Ensuring optimal dental and oral health is a straightforward yet crucial endeavor. Inadequate oral and dental hygiene can lead to the proliferation of bacteria and germs, further harming various organs inside the body. Dental and oral health issues, such as dental caries, periodontal disease, and oral infections, can impact an individual's general well-being. Hence, it is imperative to implement suitable prevention and treatment measures to uphold optimal oral health. Engaging in daily routines such as consistently cleaning teeth, employing dental floss, and routinely visiting the dentist for check-ups are uncomplicated measures that can effectively avert dental and oral health issues. (Rimi, Arif, Akter, Rahman, Islam & Habib, 2022; Nugraheni, Nuraini, Tonggiroh & Nurhayati, 2023; Gunawan, 2022)

Forecasts play a crucial role in the healthcare industry as they enable physicians and healthcare professionals to assess the likelihood of a patient developing a particular illness. By making precise prognoses, physicians can administer suitable therapy and expedite the process of recovery. Furthermore, projections can contribute to illness prevention by offering insights into risk variables and recommending preventive measures. Precise forecasts can enhance the quality of healthcare services by offering a more robust foundation for medical decision-making. Precise prognostications aid in identifying ailments, the strategic development of treatment plans, and the overall management of patient well-being. (Sidik, Fadlurrahman & Winanti, 2020; Djong & Widjaja, 2023; Paramadini, Aldo, Fathoni, Nur & Adi, 2024)

Based on the author's interviews at the Pelita Bunda Clinic and observations of dental and oral health services, it is clear that the clinic is currently facing significant challenges. The absence of a computerized system for recording patient data and making decisions is leading to various issues, including challenges in making treatment decisions due to unknown and unmeasurable aspects. This situation underscores the urgent need to deploy a system that can enhance data management and facilitate decision-making with more efficiency. The implementation of a computerized system is not just a suggestion, but a necessity to overcome these challenges and improve the quality of dental and oral health services.

The challenge was the foundation for developing an analytical forecasting system utilizing the Dempster-Shafer method. The Dempster-Shafer method is a technique in probability theory that enables the amalgamation of data from multiple sources and the management of uncertainty. This approach utilizes belief functions and rational reasoning to address ambiguity in medical decision-making. The highest confidence or density value signifies the diagnostic with the greatest likelihood of dental and oral disease in dental and oral health. This approach enables dentists to integrate diverse sources of data and information, which could be more frequently ambiguous or lacking in completeness, leading to more resilient and dependable conclusions. (Utomo, Fitri & Winarsih, 2020; Altuntas, Erdogan & Dereli, 2020; Waruwu & Simangunsong, 2020)

The Dempster-Shafer method provides a reliable way of addressing ambiguity in diagnosing and treating medical conditions. This strategy employs hypotheses and applies probability theory to aggregate and analyze uncertain information. By employing this approach, dentists can integrate a range of facts and risk factors to formulate treatment options that are more precise and effective. The Dempster-Shafer-based predictive analytical system can offer robust assistance to dentists in managing diverse dental and oral health problems at the Pelita Bunda Clinic. This innovative system holds the potential to revolutionize patient care, offering a more profound understanding of the patient's state of health and paving the way for more effective treatment strategies. (Alfaiz, Fitri & Nathasia, 2020; Tang, Gu, Rao & Lu, 2021; Fu, Chen, Liu, Son & Yang, 2022)

To address current issues, this project intends to establish a predictive analytical approach for dental and oral health utilizing the Dempster-Shafer parameters at the Pelita Bunda Clinic. Introducing an advanced computerized system aims to enhance the speed, accuracy, and efficiency of recording patient data, analysis, and decision-making. This system is anticipated to facilitate improved patient data management, thereby enabling more efficient monitoring and evaluation of dental and oral health. Implementing this system would enhance the quality of health services and offer patients a more efficient and transparent experience. (Damayanti, Marfu'ah, Salamah & Husna, 2022; Lubis & Gaol, 2022)

Predictive dental and oral health analytics at Pelita Bunda Clinic can yield numerous advantages. Initially, this method can enhance diagnostic precision by considering many risk factors and existing evidence. Furthermore, this device can assist dentists in formulating more precise and focused treatment strategies. Furthermore, the utilization of a computerized system enables a more expeditious execution of the decision-making process, hence enhancing the reaction time for patient treatment. Furthermore, this technology can decrease the administrative burden on dentists, allowing them to allocate more attention to patient care.

The aim of this study is to develop an analytical predicting technique for dental and oral health, harnessing the Dempster-Shafer parameters at the Pelita Bunda Clinic. This research also seeks to evaluate the effectiveness of this approach in predicting the dental and oral health status of patients and aiding dentists in treatment decisions. This research is poised to make a significant stride in enhancing the standard of dental and oral healthcare services at the Pelita Bunda Clinic. Moreover, it is anticipated that this research will open doors for the application of similar techniques in clinics and other healthcare establishments, thereby extending the benefits to a larger population, and potentially transforming the landscape of dental and oral health management.

## **METHOD**

This research employs the Dempster-Shafer Theory as a data analysis tool to address uncertainty and integrate evidence from many sources about patients' dental and oral health at the Pelita Bunda Clinic. The initial phase of this study involves identifying hypotheses that may be associated with the patient's dental and oral health state. This hypothesis encompasses a range of potential causes and health issues derived from medical record data and interviews conducted with dentists and patients.

After identifying the hypothesis, the subsequent step involves amalgamating the evidence. This is done using the belief function and plausibility function, which are key components of the Dempster-Shafer Theory. The belief function is used to merge information from different theories, while the plausibility function quantifies the degree to which the evidence does not contradict that hypothesis. The confidence function, another integral part

of the theory, is utilized to evaluate the degree to which the existing evidence substantiates a specific hypothesis. By amalgamating these diverse sources of knowledge, we can tackle ambiguity and offer a more all-encompassing depiction of a patient's oral health status.

The ultimate phase entails the process of making decisions. According to the Dempster-Shafer analysis, treatment decisions are established by selecting the hypothesis with the highest confidence value. This rating represents the highest degree of confidence backed by the collective evidence. This technique enables dentists at Pelita Bunda Clinic to enhance the precision and effectiveness of their treatment decisions. This condition is achieved by taking into account the multiple elements and uncertainties associated with the diagnosis and treatment of oral health. This approach enhances the precision of diagnosis and facilitates the development of more suitable treatment strategies, enhancing the quality of healthcare services provided at the clinic.

## **RESULTS AND DISCUSSION**

### **System Analysis and Design**

#### **1. Current System Analysis**

The established protocol at the Pelita Bunda Clinic allows patients to seek dental and oral health examinations directly at the clinic. Patients desiring a dental and oral health examination should directly enroll with the attending nurse. Registered patients receive a queue number from the attending nurse. Physicians conduct examinations on registered patients to determine the appropriate course of therapy. Nurses assist physicians in conducting patient examinations.

#### **2. Problem**

The issues that arise in the operational system of the Pelita Bunda Clinic are as follows: Dental and oral health diagnoses are now conducted by completing a paper-based questionnaire based on the symptoms reported. Employees are required to personally document the patient's diagnosis findings for the purpose of creating a medical record. Errors or incorrect assessments of illnesses in patients result from imprecise computations.

#### **3. Alternative Problem Solving**

An alternative approach to problem-solving for the challenges Pelita Bunda Clinic encounters is outlined below. It is developing and utilizing a computerized system that diagnoses dental and oral health conditions by categorizing symptoms according to diseases determined through the Dempster-Shafer approach. Revise the existing method by including calculations into the categorized symptoms to enhance accuracy. This condition can be achieved by utilizing the Dempster Shafer parameters.

#### **4. Analysis and Design**

##### **a. Usecase Diagrams**



Figure 1. Usecase Diagram

b. Database Design



Figure 2. Database Design

c. Interface Design



Figure 3. Interface Design

**System Implementation**

During the implementation stage, the interface design process persists to guarantee the system's user-friendliness for dentists. The interface will facilitate patient data input and generate dental and oral health projections using Dempster-Shafer analysis. Before implementation in a clinical setting, the accuracy and user-friendliness of the results obtained from this implementation will be thoroughly evaluated.

1. Login Page Display



Figure 4. Login page display

2. Registration Page Display



Figure 5. Registration page display

3. Display Diagnostics Page



Figure 6. Diagnostic page display

4. Logout Page Display



Figure 7. Logout page display

## CONCLUSION AND RECOMMENDATION

The research findings indicate that the analytical predictive method for dental and oral health, utilizing the Dempster-Shafer parameters at the Pelita Bunda Clinic, is an effective tool for predicting a patient's dental and oral health. Employing this approach can assist dentists in making treatment decisions with greater accuracy and efficiency. This approach effectively addresses ambiguity in medical data and serves as a solid foundation for improved decision-making. The proposal posits that advancing illness and symptom classifications can facilitate

the development of predictive analytics for dental and oral health. Therefore, this method can enhance the accuracy of disease diagnoses, further improving therapy's effectiveness and efficiency. Additional research is advised to investigate the use of this technique in different clinics and broader populations to verify the applicability of the findings and enhance the overall standard of oral healthcare.

## REFERENCES

- Alfaiz, M., Fitri, I., & Nathasia, N. D. (2020). Expert System of Early Detection of Arthritis with Web-Based Certainte Fector Method: Expert System of Early Detection of Arthritis with Web-Based Certainte Fector Method. *Jurnal Mantik*, 3(4), 400-411.
- Altuntas, S., Erdogan, Z., & Dereli, T. (2020). A clustering-based approach for the evaluation of candidate emerging technologies. *Scientometrics*, 124, 1157-1177.
- Bu'ulolo, E., & Sianturi, F. A. (2020). Diagnose Expert System Dental Disease In Humans Method Using Dempster Shafer. *Journal of Computer Networks, Architecture and High Performance Computing*, 2(2), 227-230.
- Damayanti, A. Y., Marfu'ah, N., Salamah, S., & Husna, F. (2022, September). Relationship between Vitamin A and Vitamin C intake on Dental Caries. In *U-Go Healthy 2020: Proceedings of the U-Go Healthy International Conference, U-Go Healthy 2020*, 29 March 2020, Pacitan, East Java, Indonesia (p. 190). European Alliance for Innovation.
- Djong, A. M., & Widjaja, M. (2023, December). A Web-Based Expert System for Diagnosing Cervical Cancer Using Dempster-Shafer Method. In *2023 7th International Conference on New Media Studies (CONMEDIA)* (pp. 243-249). IEEE.
- Fu, Y., Chen, X., Liu, Y., Son, C., & Yang, Y. (2022). Gearbox fault diagnosis based on multi-sensor and multi-channel decision-level fusion based on SDP. *Applied Sciences*, 12(15), 7535.
- Gunawan, A. (2022). Application of the Certainty Factor Method in the Dental Disease Expert System using the Addie Model. *Journal of Computer Scine and Information Technology*, 148-152.
- Indra, D. (2020). Effect of Web-Based Early Diagnosis of Dental and Oral Diseases with Validity Level of Dentist Final Diagnosis in Public Health Center, Makassar, Indonesia. *Indian Journal of Forensic Medicine & Toxicology*, 14(2), 1728-1735.
- Lubis, A. I., & Gaol, N. Y. L. (2022). Application of Certainty Factor Method in Intelligent System for Diagnosis of Periodontal Disease in Cigarette AddictsApplication of Certainty Factor Method in Intelligent System for Diagnosis of Periodontal Disease in Cigarette Addicts. *Sinkron: jurnal dan penelitian teknik informatika*, 6(4), 2272-2279.
- Nugraheni, M., Nuraini, R., Tonggiroh, M., & Nurhayati, S. (2023). Expert System for Diagnosing Learning Disorders in Children Using the Dempster-Shafer Theory Approach. *Sinkron: jurnal dan penelitian teknik informatika*, 8(4), 2513-2525.
- Paramadini, A. W., Aldo, D., Fathoni, M. Y., Nur, Y. S. R., & Adi, D. Q. (2024). EXPERT SYSTEM WITH DEMPSTER-SHAFER METHOD FOR EARLY IDENTIFICATION OF DISEASES DUE TO COMPLICATIONS SYSTEMIC INFLAMMATORY RESPONSE SYNDROME. *Jurnal Teknik Informatika (Jutif)*, 5(3), 891-901.

- Rimi, I. F., Arif, M. A. I., Akter, S., Rahman, M. R., Islam, A. S., & Habib, M. T. (2022). Machine learning techniques for dental disease prediction. *Iran Journal of Computer Science*, 5(3), 187-195.
- Sari, A. K., Fitri, I., & Hidayatullah, D. (2021). IMPLEMENTATION OF DEMPSTER SHAFER IN EXPERT SYSTEM IN EARLY DIAGNOSIS OF DENTAL AND MOUTH DISEASES IN CHILDREN. *Jurnal Ipteks Terapan*, 15(1), 14-19.
- Sidik, R., Fadlurrahman, M. A., & Winanti, M. B. (2020, July). Development of expert system for dental and oral diseases diagnose in certainty condition. In *IOP Conference Series: Materials Science and Engineering* (Vol. 879, No. 1, p. 012033). IOP Publishing.
- Tang, X., Gu, X., Rao, L., & Lu, J. (2021). A single fault detection method of gearbox based on random forest hybrid classifier and improved Dempster-Shafer information fusion. *Computers & Electrical Engineering*, 92, 107101.
- Utomo, H. P., Fitri, I., & Winarsih, W. (2020). Expert System of Diagnosis of Human Dental Diseases Using The Naïve Bayes Method: Expert System of Diagnosis of Human Dental Diseases Using The Naïve Bayes Method. *Jurnal Mantik*, 3(4), 373-382.
- Waruwu, S. K., & Simangunsong, A. (2020). Application of Certainty Factor Method For Diagnosis Expert System Skin Diseases In Humans. *Journal of Computer Networks, Architecture and High Performance Computing*, 2(2), 191-194.