Jurnal IPTEK Bagi Masyarakat, Vol. 5, No. 1, (2025), 1-9 e-ISSN: 2807-7253
Doi: https://doi.org/10.55537/j-ibm.v5i1.1081 p-ISSN: 2807-7261

Web-Based Binge Eating Disorder Diagnosis Expert System with Forward Chaining Method to Support Public Health Services

(Sistem Pakar Diagnosis Gangguan Binge Eating Menggunakan Metode Forward Chaining untuk Peningkatan Layanan Kesehatan Masyarakat)

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Received: February 12, 2025 | Revised: May 2, 2025 | Accepted: May 3, 2025

Abstract: *Binge Eating Disorder (BED) is an eating disorder characterized by recurring episodes of uncontrolled overeating that can lead to obesity, metabolic disorders, depression, and intense feelings of guilt. In Indonesia, limited awareness and negative stigma surrounding mental health often prevent patients from seeking professional help, resulting in delayed diagnoses. This study developed a web-based expert system for the early detection of BED using a forward chaining inference approach. The system was built based on observation and interviews with mental health professionals at RSJ Bina Karsa Tuntungan, supported by a literature review. The system diagnoses BED using 11 main symptoms, classifies its severity into five levels, and provides an educational module to encourage users to seek further medical consultation. It is expected that this expert system can support faster early detection of BED and help reduce the negative stigma surrounding mental health.*

Keywords: *binge eating disorder; early detection; expert system; forward chaining; rapid application development.*

Abstrak: *Binge Eating Disorder (BED) adalah gangguan makan yang ditandai dengan episode berulang makan berlebihan tanpa kontrol, yang dapat memicu obesitas, gangguan metabolik, depresi, dan rasa bersalah yang mendalam. Di Indonesia, rendahnya pemahaman serta stigma negatif terhadap kesehatan mental sering kali menghambat pasien untuk mencari bantuan profesional sehingga diagnosis menjadi terlambat. Penelitian ini mengembangkan sistem pakar berbasis web untuk deteksi dini BED dengan menggunakan pendekatan inferensi forward chaining. Sistem ini dibangun berdasarkan hasil observasi dan wawancara dengan tenaga medis di RSJ Bina Karsa Tuntungan serta ditunjang studi literatur. Sistem mampu mendiagnosis BED berdasarkan 11 gejala utama, mengklasifikasikan tingkat keparahan ke dalam lima kategori, serta menyediakan modul edukasi untuk mendorong pasien melakukan konsultasi lanjutan. Diharapkan sistem pakar ini dapat mendukung percepatan deteksi dini BED dan membantu mengurangi stigma negatif terhadap kesehatan mental.*

Kata kunci: *binge eating disorder; deteksi dini; forward chaining; rapid application development; sistem pakar.*

Introductions

Expert systems are a branch of artificial intelligence that model an expert's decision-making process through the integration of a knowledge base and an inference engine. The forward chaining method, which moves from known facts and symptoms toward a diagnostic conclusion, has been successfully applied in expert systems for the diagnosis of mental

disorders in children and adolescents (Dairoh et al., 2023; Satrio, Rochim, & Nugraheni, 2023) as well as in natural language processing–based mental health consultation systems (Maćkowska et al., 2024; Fardouly et al., 2022). Recent reviews affirm that enhancing expert systems with machine learning techniques further accelerates the diagnostic process and personalizes intervention recommendations for eating disorders (Ghosh et al., 2024; Benítez Andrades et al., 2023), and neuroimaging-driven approaches have demonstrated promise in patient stratification (Monaco et al., 2025).

Binge Eating Disorder (BED) is characterized by recurrent episodes of excessive food intake over a short period accompanied by a sense of loss of control, contributing to obesity, metabolic disturbances, mood disorders, and reduced quality of life (Keski Rahkonen, 2021; Monaco et al., 2025). Meta-analytic evidence places the global prevalence of BED at approximately 2.6%, with the highest incidence among adolescent and young adult females (Cooney et al., 2024; Aird et al., 2025). BED often co-occurs with conditions such as polycystic ovary syndrome (Cooney et al., 2024) and functional dyspepsia (Félix Téllez et al., 2025), and studies have reported elevated rates in urban youth populations in coastal Karnataka, India (Varadarajulu et al., 2025).

Despite its considerable prevalence, most individuals with BED experience delayed or no diagnosis due to low public awareness and the pervasive stigma surrounding eating disorders (Côté et al., 2025; Riise et al., 2025). Quantitative comparisons of stigma indicate that BED sufferers face greater social stigma than those with anorexia nervosa or bulimia nervosa (Aird et al., 2025), while qualitative research highlights how stigma and a lack of interactive educational modules deter help-seeking behaviors (Riise et al., 2025; Schweda et al., 2025). This situation is exacerbated by persistence of BED without natural remission in many cases and limited mental health services in remote areas (Obleada et al., 2025; Graham, 2024).

A range of digital and economic interventions have been explored to enhance community mental health services for BED. Early intervention programs such as the FREED Network have demonstrated improved clinical outcomes when applied at the first episode (Allen et al., 2025), and cost-effectiveness analyses confirm that cognitive-behavioral therapy for adolescents with BED represents good value (Pardey et al., 2025). Machine learning approaches enriched with contextual knowledge have achieved high accuracy in detecting BED from social media posts (Benítez Andrades et al., 2023), while physiologically based models using OGTT curves show promise for precise classification in high-weight individuals (Procopio et al., 2025; Rania et al., 2025). Guided online interventions also bridge treatment gaps and broaden access to mental health education (Graham, 2024; Forrer et al., 2025; Gagné Pomerleau et al., 2025). Accordingly, the development of a web-based expert system for diagnosing Binge Eating Disorder using forward chaining, supplemented with interactive educational modules, is expected to accelerate early detection, raise public awareness, and substantially improve community-level mental health services.

Methods

Time and Location of the Activity

This activity was conducted from January to April 2025 at Bina Karsa Mental Hospital (RSJ Bina Karsa Tuntungan) in Medan, North Sumatra. The hospital was chosen as the research site because it is a referral mental health institution that provides services for various psychiatric conditions, including Binge Eating Disorder (BED).

Characteristics of the Partner

The main partner involved in this activity was a psychiatrist with expertise in treating eating disorders, assisted by several healthcare staff at RSJ Bina Karsa Tuntungan. The psychiatrist contributed clinical knowledge about BED symptoms, diagnostic criteria, and levels of severity, which became the basis for the expert system's knowledge base and

diagnostic rules.

Activity Design

The activity design consisted of three main phases: pre-activity, implementation, and post-activity. In the pre-activity phase, direct observations and in-depth interviews were carried out at the hospital to map the diagnostic process and collect information about common BED symptoms. Literature review was also conducted to strengthen the system's knowledge base with information from credible references related to BED diagnosis. During the implementation phase, the expert system was developed as a web-based application. The system's design included defining a set of symptoms, constructing diagnostic rules, and developing an inference mechanism using the Forward Chaining method to simulate an expert's logical reasoning from input symptoms to diagnostic conclusions. In the post-activity phase, the system was tested directly with the support of the psychiatrist to ensure that the outputs matched the real diagnostic procedures in the hospital.

Tools, Materials, and Media

The tools and materials used included computers with adequate specifications, a local server to store the system and patient data, and software for web development and interface design. Educational materials about BED were also prepared as part of the system's output to help patients understand their condition and encourage them to seek further professional treatment.

Evaluation Techniques and Data Collection Methods

The evaluation of this activity was carried out by comparing the diagnostic results generated by the system with the psychiatrist's manual diagnosis to assess consistency and accuracy. Data collection methods included direct observation at the hospital, interviews with the psychiatrist, and a literature study to enrich the knowledge base used by the system. Feedback from the psychiatrist and health staff was also gathered to assess the usability and effectiveness of the system and to identify areas for improvement.

Results

This expert system for diagnosing Binge Eating Disorder (BED) produces a web-based application that uses a Forward Chaining inference method to detect the severity level of BED based on user input. The main output includes a knowledge base consisting of symptoms, severity levels, and clear diagnostic rules.

Table 1 presents the classification of BED severity levels that guide the system's conclusions.

Table 1. BED Severity Levels

No	Code	Severity Level
1	R1	Mild
2	R2	Moderate
3	R3	Severe
4	R4	Extreme
5	R5	Normal

This classification is supported by the list of symptoms that form the system's knowledge base. Table 2 shows the main symptoms used for diagnosis.

Table 2. BED Symptom List

No	Code	Symptom Description
1	G001	Eating much faster than usual
2	G002	Eating large amounts in a short time
3	G003	Eating until feeling uncomfortably full
4	G004	Eating large portions even when not hungry
5	G005	Eating secretly due to shame
6	G006	Feeling disgusted or guilty after eating
7	G007	Difficulty maintaining diet and weight loss
8	G008	Hoarding food
9	G009	Easily upset about food or body image
10	G010	Feeling anxious, hopeless, or low self-esteem
11	G011	Binge episodes occur at least once a week for three months

The connection between these symptoms and the severity levels is defined in the diagnostic rules in Table 3.

Table 3. Diagnostic Rules

No	Rule (Symptom Relationship)	Severity Level
1	IF G001 AND G002 THEN G003	R1
2	IF G001 AND G002 AND G004 THEN G005	R2
3	IF G001 AND G006 AND G007 THEN G011	R3
4	IF G001 AND G006 AND G008 AND G009 THEN G010	R4
5	IF G001 AND G006 AND G008 THEN G011	R5

To explain how the system processes user input into diagnostic results, the Forward Chaining Inference Engine is visualized in Figure 1 below. This diagram illustrates how facts are processed step by step to reach diagnostic goals.

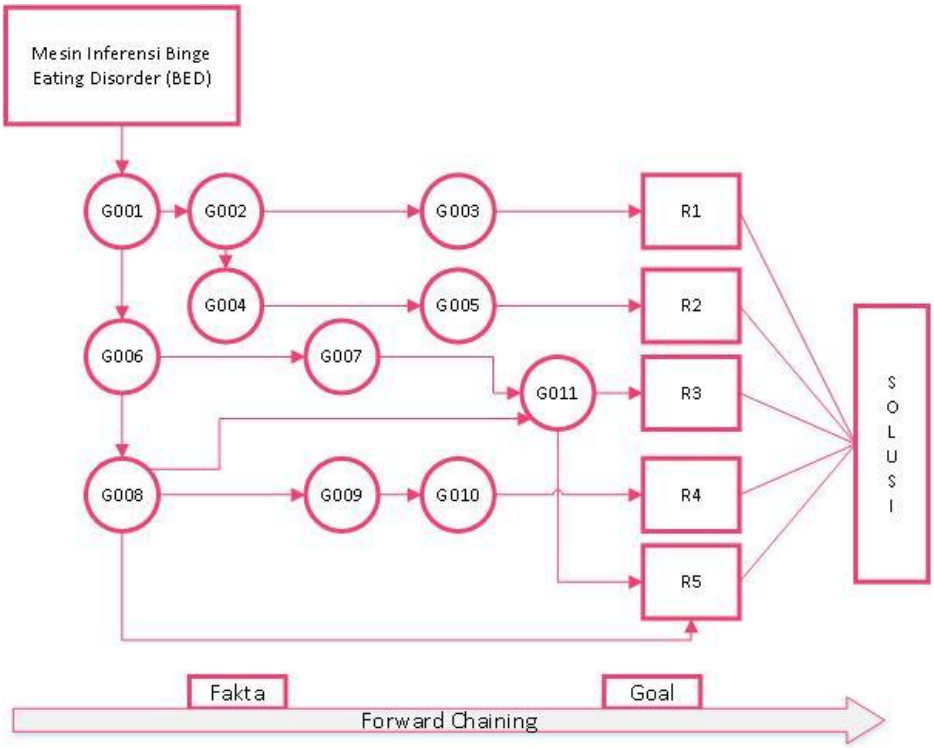

Figure 1. Forward Chaining Inference Engine

Next, the Use Case Diagram in Figure 2 explains how users and administrators interact with the system during the consultation process.

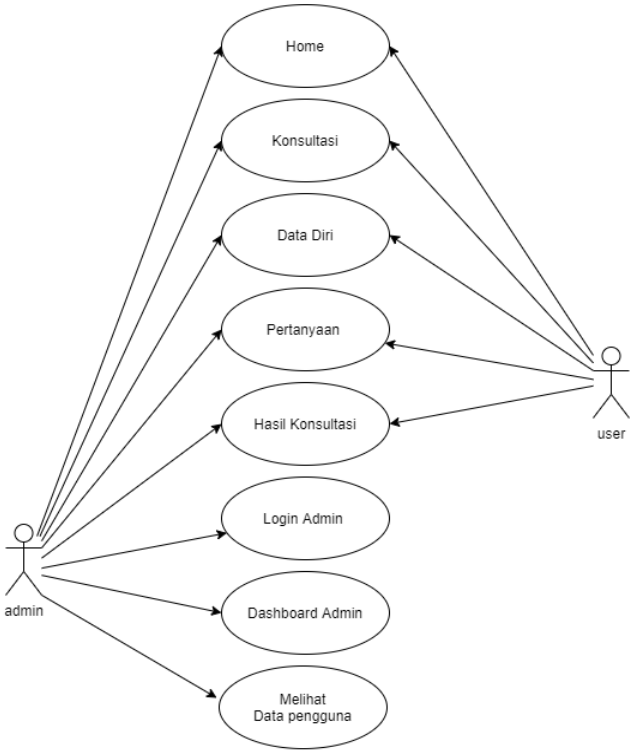

Figure 2. Use Case Diagram for BED Expert System

The main user workflow is outlined in the Activity Diagram shown in Figure 3, which describes how users navigate from login to receiving a diagnosis.

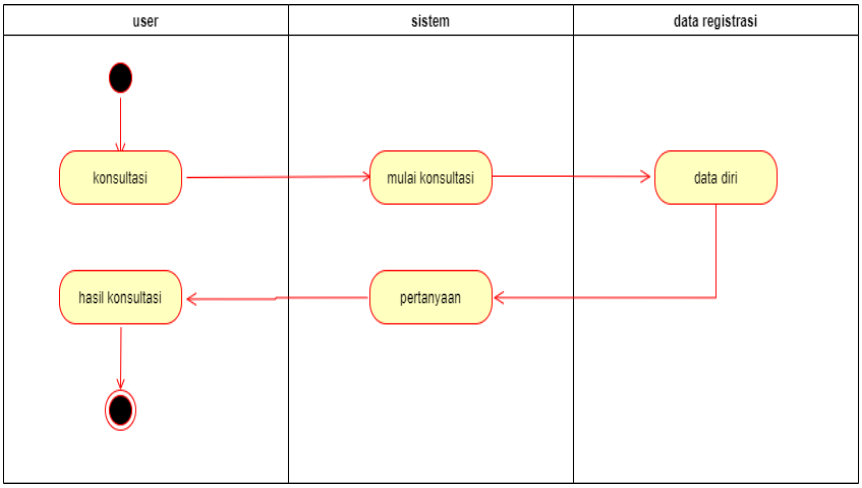

Figure 3. Activity Diagram for BED Expert System

One of the key interfaces in the system is the Consultation Page, where users answer questions related to BED symptoms. This view is shown in Figure 4. This page is crucial because it directly collects symptom data that will be matched with the knowledge base to produce a diagnosis.

Figure 4. Consultation Page Display

Testing shows that users can easily navigate through the system: they start from the home page, fill in their data, proceed to the consultation page, answer symptom-based questions, and finally receive the diagnosis result along with recommended follow-up actions.

Discussions

BED (Binge Eating Disorder) is recognized as the most common eating disorder worldwide, yet it remains largely underdiagnosed and frequently misunderstood by the public. Studies have confirmed that only about one-third of people can correctly identify BED symptoms, with stigma levels often exceeding those for other eating disorders such as anorexia nervosa and bulimia nervosa (Côté et al., 2025; Aird et al., 2025). This stigma contributes significantly to delays in seeking professional help, prolonging the disorder's negative impact on both mental and physical health (Riise et al., 2025).

Globally, the prevalence of BED is estimated to range between 1.9% and 2.6% of the adult population (Keski-Rahkonen, 2021; Cooney et al., 2024). This aligns with findings that BED is particularly common among women and younger adults, with high comorbidity: approximately 79% of individuals with BED also struggle with other mental health conditions, including anxiety and depression (Forrer et al., 2025; Obleada et al., 2025). Despite this high prevalence and impact, under-recognition and persistent stigma mean that many sufferers do not receive timely treatment (Sandri et al., 2025).

In recent years, expert systems and machine learning have emerged as promising tools to improve early detection and reduce the treatment gap in mental health care. Several studies have demonstrated that expert systems using methods like Forward Chaining can support efficient and structured decision-making in diagnosing mental health disorders (Dairoh et al., 2023; Satrio et al., 2023). Furthermore, digital solutions such as web-based diagnostic tools can be integrated with educational modules to raise awareness and encourage help-seeking behavior (Ghosh et al., 2024; Allen et al., 2025).

The expert system developed in this study builds on this technological potential by incorporating 11 well-defined symptoms into a Forward Chaining inference engine. The rule-based model classifies the severity of BED into five levels, from mild to extreme, and generates preliminary recommendations to guide the user toward appropriate next steps. This aligns with findings from Procopio et al. (2025) and Rania et al. (2025), who emphasize that combining domain knowledge with automated analysis can enhance diagnostic precision for eating disorders. In addition, the user-friendly web interface ensures that the system is accessible to a broad community, potentially addressing the barriers caused by stigma and limited awareness.

Validation by qualified mental health professionals remains crucial to ensuring diagnostic accuracy and patient safety (Fardouly et al., 2022). Nevertheless, this system demonstrates that integrating expert system methods with clear knowledge bases and forward

chaining can contribute meaningfully to the early detection of BED, bridging the gap between sufferers and professional care (Graham, 2024).

Conclusion

The expert system developed to diagnose Binge Eating Disorder (BED) at RSJ Bina Karsa Tuntungan uses the Forward Chaining method to support patients by referring to knowledge from psychiatric specialists. This system is designed not only to provide education about BED and its symptoms but also to generate an initial diagnosis and indicate the level of confidence regarding the detected disorder. This information is expected to encourage patients to seek further consultation with mental health professionals.

In addition to being able to identify BED at five levels of severity based on 11 established symptoms, the system is equipped with initial treatment recommendations to guide patients after diagnosis. Furthermore, the user-friendly interface increases accessibility, enabling broader public use and supporting early detection and stigma reduction in the community.

Acknowledgment

The authors would like to express their sincere gratitude to RSJ Bina Karsa Tuntungan for providing access and support during the research. Special thanks are extended to Dr. Nurul Utami, M.Kes., M.Ked (KJ)., Sp.KJ. and Dr. Dahlia Rosalli Tarungan, M.Ked (KJ)., Sp.KJ. for their valuable time and insights which greatly contributed to the development of this study.

Conflict of Interest Statement

The authors declare that there is no conflict of interest regarding the publication of this paper.

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