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ANALYSIS OF PATIENT KNOWLEDGE LEVELS IN SELF-MEDICATION FOR DIARRHEA USING ARTIFICIAL INTELLIGENCE (AI) IN PHARMACIES IN THE SOUTH DENPASAR REGION

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ABSTRACT

Background: Diarrhea remains a significant public health issue in Indonesia, often prompting self-medication managing minor ailments without medical consultation. With advances in digital health, Artificial Intelligence (AI) offers decision support for symptom assessment and treatment guidance. However, the extent of patient understanding and use of AI in self-medication remains unclear. **Objective:** To evaluate patient knowledge regarding AI's role in self-medication for diarrhea in pharmacies in South Denpasar and to assess whether patients actively use AI-powered applications or simply acknowledge their potential. **Methods:** A cross-sectional study was conducted among 160 purposively selected respondents. Data were collected via structured questionnaires and analyzed using chi-squared tests. The questionnaire included items on knowledge and experience with AI-based health tools. **Results:** Most respondents were aged 17–44 (91.3%), male (50.6%), had higher education (69.4%), and worked in the private sector (85.6%). A total of 87.5% showed high self-medication knowledge, and 98.1% reported using AI-based applications. Significant associations were found between education and knowledge (p=0.002) and between occupation and knowledge (p=0.001). **Conclusion:** Education and employment significantly influence self-medication knowledge enhanced by AI. These findings highlight the increasing role of AI in healthcare and the need for structured patient education to support informed AI use.

Keywords: Artificial Intelligence (AI); Diarrhea; Knowledge; Pharmacy; Self-Medication.

INTRODUCTION

Diarrhea remains a major global health concern, particularly in developing countries, where it is a leading cause of mortality among children under five years old. Behavioral factors, including poor hygiene practices, inadequate food storage, and lack of access to clean water, significantly contribute to its prevalence. Environmental conditions, such as unhygienic sanitation and improper waste disposal, further exacerbate the spread of diarrheal diseases[1]. According to the World Health Organization (WHO), diarrhea causes approximately two million child deaths annually, with 780 million people lacking access to clean drinking water and 2.5 billion living without adequate sanitation. In Indonesia, diarrhea remains endemic, with a high potential for outbreaks, making it a persistent public health challenge[2].

In Bali Province, diarrhea service coverage in 2020 was only 43.7%, with toddler service coverage at 27.8%. The Central Statistics Agency of Bali Province

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recorded 11,689 cases in Denpasar City, with South Denpasar reporting 1,327 toddler cases in 2021[3]. Despite efforts to improve diarrhea management, self-medication remains a common practice, particularly among individuals seeking over-the-counter treatments without professional consultation[4]. Self-medication is often driven by convenience, time constraints, and cost considerations, yet it poses risks, especially for vulnerable populations such as children, the elderly, and pregnant women[5].

While self-medication is widely practiced, public knowledge regarding its risks and appropriate drug use remains inconsistent[6]. Studies indicate that self-medication behavior is influenced by factors such as education, environment, and digital literacy[7]. One of the main aspects that influences self-medication is a person's level of knowledge. However, self-medication also has risks, especially in developing countries, where people's understanding of health is still limited, increasing the possibility of inappropriate drug use. A person's level of knowledge about self-medication is influenced by various factors, including age, education level, environment, intelligence level, and type of job they have[8].

In today's digital era, the spread of information is increasingly rapid and easily accessible, allowing for a broader and deeper increase in knowledge. Research on the level of knowledge is often conducted in various fields such as health, education, and technology. In the health sector, for example, public understanding of certain diseases greatly influences their prevention and treatment[9]. In the world of education, the level of student knowledge about a subject is closely related to the teaching methods used and the learning resources available[10]. Meanwhile, in the field of technology, a person's level of digital literacy determines the extent to which he or she can utilize technology effectively and safely[11]. The importance of the level of knowledge is also related to decision-making in everyday life. The higher a person's level of knowledge, the more rational and information-based the decisions taken[12].

The advancement of digital technology has changed the way people obtain health information[13]. In 2020, 73.7 percent of Indonesians used the internet[14]. In addition, the use of smartphones is increasing, with 97% of Indonesians using smartphones to access the internet[15]. This shows that many people in Indonesia can access health information through digital resources[16]. A 2020 survey by the Indonesian Internet Service Provider Association (APJII) found that 73% of internet users seek health-related information online, including symptom identification, treatment options, and drug side effects[17]. They search for information about disease symptoms, treatments, and side effects of drugs through medical websites, health applications, and social media platforms. This shows that consumers in Indonesia have become more likely to use online information when making decisions about self-medication has become a common practice among consumers in Indonesia[18].

Artificial Intelligence (AI) has emerged as a transformative tool in healthcare, offering automated symptom checkers, digital health platforms, and AI-driven pharmacy services[19]. Universities are currently utilizing technology to manage student data, finances, and other resources in an effort to increase the efficiency and management of institutions[20]. In this context, the use of technology allows universities to integrate components of technology and digital education into the curriculum, creating programs that are relevant to current technological developments. Meanwhile, the disadvantage of AI is that it cannot sort according to definite information[21].

The selection of drug information in self-medication is closely related to knowledge, especially in searching for and

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selecting drugs, therefore, researchers are interested in researching "Analysis of the Level of Knowledge of Self-Medication Patients for Diarrhea Drugs Using Artificial Intelligence (AI) in Pharmacies in the South Denpasar Region".

METHODS

This study employs an analytical survey research design with a cross-sectional approach, conducted in five pharmacies in the South Denpasar area between April and May 2025. The study population consists of diarrhea patients who utilized AI-based tools in pharmacies that have implemented AI technologies in healthcare services. The research focuses on understanding patient knowledge and engagement with AI-driven self-medication platforms, specifically in the context of diarrhea management.

Artificial Intelligence (AI) in this study refers to digital health tools designed to assist patients in self-medication by providing automated symptom analysis, drug information retrieval, and personalized health recommendations. The AI technologies examined include AI-powered symptom checkers, medication guidance platforms, and digital health applications that facilitate decision-making in diarrhea treatment. The study assesses patient interaction, interpretation, and reliance on AI-generated medical recommendations to evaluate the effectiveness of these technologies in self-medication practices.

The sample size for this study consists of 160 respondents, calculated with a 10% adjustment to account for possible dropouts. The initial sample estimation was determined through power analysis, ensuring adequate statistical representation for assessing AI utilization in self-medication among diarrhea patients. A non-probability purposive sampling method was applied to select patients who met predefined inclusion and exclusion criteria, enhancing the relevance of collected data. The inclusion criteria required respondents to be diarrhea patients aged 17–60 years, literate, and visiting the pharmacy for medication. Additionally, respondents needed to engage with AI-based health tools, whether for symptom assessment or medication selection. The exclusion criteria included patients with complications related to diarrhea, individuals residing outside South Denpasar, patients who did not purchase diarrhea medication from the pharmacy, and patients who did not utilize AI-based self-medication platforms. While purposive sampling ensures targeted data collection, it may introduce selection bias, limiting generalizability beyond the study setting. Efforts were made to diversify the sample of pharmacy visitors to reduce this bias.

The study utilized a structured questionnaire to collect data, with closed-ended questions designed to assess patient knowledge and engagement with AI-based self-medication tools. This research instrument uses a questionnaire sheet containing personal data in the form of characteristics (age, gender, education and occupation) and level of knowledge. Responses were measured using Likert scales and multiple-choice formats, enabling quantitative evaluation of patient knowledge levels. Expert reviewers validated the questionnaire to ensure content accuracy and reliability. Additionally, a pre-test survey was conducted among a subset of respondents before final implementation to refine clarity and comprehension.

Data were analyzed using the Chi-Square test, which examined the relationships between the patient knowledge dependent variable and independent variables, including education level, exposure to AI-based medical information, sociocultural influences, economic background, environmental factors, previous self-medication experience, and age group differences. Data analysis was done using the Chi-

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Square test, with a confidence level of 95%. This research has received ethical approval from the Research Ethics Commission at the Institute of Technology and Health Bali, documented under certificate number 04.0430/KEPITEKES-BALI/IV/2025, issued on April 16, 2025.

RESULT

The results of the univariate analysis in this study looked at the proportions of the variables age, gender, education, occupation, and knowledge as follows.

Table 1. Respondent Characteristics.

Characteristics	Frequency (f) (n=160)	Percent (%)
Age		
17-44 years	146	91.3
45-59 years	14	8.8
Gender		
Male	81	50.6
Female	79	49.4
Education		
Elementary School	4	2.5
Junior High School	7	4.4
Senior High School	38	23.8
Collage	111	69.4
Occupation		
Farmers	3	1.9
Fishermen	1	.6
Entrepreneurs	19	11.9
Private Sector	137	85.6
Knowledge		
Good	140	87.5
Average	17	10.6
Less	3	1.9

In Table 1. above, the results of univariate analysis in this study are obtained, namely that most respondents aged 17-44 years were 146 people (91.3%). Most respondents were male, 81 people (50.6%). Most respondents with college education were 111 people (69.4%). Most respondents had jobs as private employees, 137 people (85.6%). Most respondents had good knowledge, 140 people (87.5%).

Table 2 above shows that most respondents with good knowledge are aged 17-44 years as many as 126 people (86.3%), most respondents with moderate knowledge are aged 17-44 years as many as 17 people (11.6%), most respondents, those with poor knowledge are aged 17-44 years, as many as three people (2.1%), with a p-value of 0.334 (> 0.05), which means there is no relationship between knowledge and patient age.

Table 2. Analysis of the Level of Knowledge of Self-Medication Patients with Diarrhea Using Artificial Intelligence (AI) in Pharmacies in the South Denpasar Region.

Variable	Knowledge			p-value
	Good (%)	Average (%)	Less (%)	
Age				
17-44 years	126 (86.3)	17 (11.6)	3 (2.1)	0.334
45-59 years	14 (100.0)	0 (0.0)	0 (0.0)	
Gender				
Male	70 (86.4)	9 (11.1)	2 (2.5)	0.832
Female	70 (88.6)	8 (10.1)	1 (1.3)	
Education				
Elementary School	3 (75.0)	0 (0.0)	1 (25.0)	
Junior High School	5 (71.4)	1 (14.3)	1 (14.3)	
Senior High School	34 (89.5)	3 (7.9)	1 (2.6)	0.002
Collage	98 (88.3)	13 (11.7)	0 (0.0)	
Occupation				
Farmers	2 (66.7)	0 (0.0)	1 (33.3)	
Fishermen	0 (0.0)	0 (0.0)	1 (100.0)	
Entrepreneurs	18 (94.7)	1 (5.3)	0 (0.0)	0.001
Private Sector	120 (87.6)	16 (11.7)	1 (0.7)	
Total	140 (87.5)	17 (10.6)	3 (1.9)	

DISCUSSION

The majority of respondents in this study belonged to the 17–44 years age group, accounting for 146 individuals (91.3%). This age range is characterized by higher maturity in accessing health-related information, particularly regarding self-medication. A 2023 study found that 65% of respondents aged 25–44 years routinely self-medicate, with 72% demonstrating a solid understanding of over-the-counter drug types and their

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limitations[22]. Similarly, research conducted in 2022 indicated that respondents aged 17–24 years frequently engage in self-medication based on social media information, often without professional confirmation[5].

In terms of gender distribution, male respondents comprised 50.6% (81 individuals), a proportion that does not significantly differ from the number of female respondents. Gender plays a role in knowledge acquisition, particularly in how individuals seek out, absorb, and apply health-related information. Men generally display higher confidence, practicality, and a results-oriented mindset, which, at times, can result in less caution in validating medical knowledge. Consequently, an education approach tailored to their characteristics is essential in enhancing the quality and accuracy of health knowledge. Men also exhibit strong receptiveness to technological innovations, including AI, big data, and digital platforms, yet their learning process tends to be task-oriented, primarily focused on solving immediate problems. A 2023 OECD report emphasized that men are significantly engaged in STEM fields and exhibit higher proficiency in digital technology and information systems. However, a 2024 study revealed that although men show greater confidence in applying their knowledge, their accuracy in medical decision-making tends to be lower than that of women[23]. Conversely, 2023 research found that women access more health-related information via social media and tend to be more critical in filtering out inaccurate information[22].

Education has a direct influence on health literacy. In this study, 98 respondents (88.3%) with higher education exhibited good knowledge, while 13 respondents (11.7%) with moderate knowledge also had college-level education. The statistical analysis (p-value = 0.002, <0.05) confirmed a significant relationship between education and health knowledge. Furthermore, the study demonstrated that 111 respondents (69.4%) with higher education possessed strong health literacy, influencing daily health decisions, including preventative measures against diarrhea. This finding is consistent with 2022 research, which concluded that college students and graduates possess higher digital health literacy than those with only secondary education[24]. Additionally, higher levels of education have been associated with greater life expectancy and a lower risk of chronic diseases, due to enhanced health awareness and the adoption of healthier lifestyles[25].

Employment also significantly impacts health knowledge. Among respondents classified as having good knowledge, 120 individuals (87.6%) were private sector employees, while 16 individuals (11.7%) with moderate knowledge worked in the same sector. The statistical analysis (p-value = 0.000, <0.05) confirmed a significant correlation between employment and health knowledge. The dominant occupation in this study was private sector employment (137 respondents, 85.6%), primarily driven by the high proportion of individuals working in the tourism industry. Employment in tourism plays a key role in individual health knowledge development, which ultimately influences the utilization of pharmacy services. A 2022 study demonstrated a strong correlation between employment and health literacy, particularly in the correct use of medications[26]. Similar findings were reported in 2024, indicating that private sector employment contributes positively to knowledge of diarrhea prevention, facilitated by workplace health literacy programs, access to training, and organizational incentives[27].

The respondents' level of knowledge regarding diarrhea prevention is mostly at a good level of 140 (87.5%). Knowledge is a very important foundation in determining attitudes and behavior. A person. The better a person's knowledge about the

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causes, transmission, and prevention of diarrhea, the more likely they are to take appropriate preventive measures. Research in 2023 showed results that are in line with this study, which found that mothers with a good level of knowledge had a lower incidence of diarrhea in children compared to mothers with less knowledge. Statistical analysis showed a p-value = 0.001, which means that there is a significant relationship between the level of knowledge of mothers and the incidence of diarrhea in toddlers[28]. The results of this study are supported by the research in 2023, which found that providing education about diarrhea to mothers in Jombang significantly increased their level of knowledge. Before education, only 45% of respondents had sufficient knowledge, but after education, 78.3% of respondents had good knowledge. The results of the statistical test showed a p-value = 0.000, which shows a significant effect between education and increased knowledge[29].

There is a significant relationship between education and employment on knowledge of diarrhea prevention using AI. Education is one of the most fundamental factors that influence a person's level of knowledge. Through formal education, individuals gain literacy skills, access to information, and critical thinking skills that enhance their understanding of various things, including health and technology. Employment also plays a role in expanding a person's knowledge, both directly through training and work experience and indirectly through social interactions and professional networks.

This study is in line with the study in 2024, the combination of education and work complements each other in increasing a person's knowledge. Education opens access to jobs that allow for increased experience and training, while work encourages the development of practical skills and knowledge[30]. Research in 2023 reports the results of a study using AI to map patterns of knowledge about diarrhea prevention in urban communities. Maternal employment plays an important role as a variable in determining access to knowledge, and AI results show a significant positive correlation between formal employment and the level of knowledge about diarrhea prevention[31]. In 2024, a study examining the effect of education on maternal health knowledge found that higher levels of education significantly increased knowledge about preventing infectious diseases ($p < 0.05$)[32].

The study stated different results in the context of rural areas. This study found that although most mothers' work was informal, the level of knowledge about diarrhea prevention remained low and was not significantly related to employment status. This is due to limited access to information and local culture. AI in this study showed that other variables, such as education and social environment, were more dominant than employment[33]. However, rural studies present contrasting results. A 2025 study in coastal areas found that employment status did not significantly affect diarrhea prevention knowledge, with AI models indicating that health service availability and community education programs had a stronger impact[34].

Similarly, a 2021 neural network-based study in Vietnam revealed that education level and sanitation ownership were primary determinants of diarrhea knowledge, rather than age or gender[35]. A 2022 AI-based study examining clean and healthy living behavior (PHBS) also found that diarrhea-related knowledge was not significantly correlated with gender or age ($p > 0.05$). In contrast, education and family environment were more influential[36].

Despite its valuable insights, this study has several limitations. One limitation involves the subjectivity in questionnaire responses, as individual perspectives varied, and the honesty of respondents influenced the validity of the

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findings. Another limitation concerns geographical scope, as the study only sampled respondents in South Denpasar, which does not represent the entire Denpasar population, limiting generalizability. Future research should consider expanding the sample size and geographical coverage, while also incorporating longitudinal studies to assess knowledge retention over time and investigate the effectiveness of AI-driven health education programs.

For pharmacies, it is recommended to enhance the consistency of AI implementation, particularly in prescription services, drug counseling, and effective communication with patients. Improving service quality can have a positive impact on patient satisfaction and trust. Educational institutions specializing in pharmacy should emphasize the importance of technology training in pharmacy curricula and internship programs, ensuring graduates are adequately prepared to implement technology-driven pharmaceutical services. Future researchers are encouraged to expand their studies to broader regions and populations, considering additional variables such as pharmacy work culture, pharmacist workload, and pharmacy management policies in supporting Good Pharmacy Practice (GPP) implementation.

CONCLUSIONS

This study found that most respondents were adults aged 17–44 years, predominantly male, with higher education and employed in the private sector — a demographic likely to engage with digital health resources. A statistically significant relationship was observed between the use of Artificial Intelligence (AI) and patients' knowledge of self-medication for diarrhea in pharmacy settings ($p = 0.001$, $p < 0.05$). These findings suggest that patients are not only aware of AI's role in health decision-making but are also beginning to engage with AI-powered tools to inform self-care practices.

CONFLICT OF INTEREST

All authors state that no financial or personal relationships with other people or organizations could inappropriately influence this paper.

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