

# Vitek-2 Compact Identification of *Candida* Species Isolated from Urine Samples of Diabetic Patients in Rural Indonesian Community

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## ARTICLE INFO

### Article history:

DOI:

[10.30595/pshms.v6i.1425](https://doi.org/10.30595/pshms.v6i.1425)

Submitted:

Sept 25, 2024

Accepted:

Dec 25, 2024

Published:

Jan 17, 2025

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### Keywords:

Diabetes Mellitus; Fungal Infection; *Candida* Spp.; Urine; Vitek-2 Compact

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## ABSTRACT

*Diabetes mellitus (DM) increases the risk of fungal infections, particularly in the urine. The genus Candida is the most common cause of fungal infections in immunocompromised patients, including those with DM. The use of automatic identification tools such as Vitek-2 Compact allows for the rapid and accurate identification of Candida species. This study aims to identify the types of pathogenic fungi present in the urine of DM patients. This descriptive study used a cross-sectional design. Fungal examination were conducted macroscopically and microscopically on 15 urine samples from DM patients cultured on Sabouraud Dextrose Agar (SDA) media. Further identification was performed using the Vitek-2 Compact system to determine the species of fungi in positive samples. Culture results revealed that 12 out of 15 urine samples (80%) showed positive fungal growth. Identification using the Vitek-2 Compact system indicated a dominance of Candida species (66,7%), with Candida guilliermondii (33,3%) being the most frequently found species. Other fungal species identified included Candida krusei (16,7%), Candida famata (16,7%), Trichosporon asahii (16,7%), and Kodamaea ohmeri (16,7%). This study found a high prevalence of Candida infections in the urine of diabetic patients, with Candida guilliermondii being the most frequently identified species. The use of the Vitek-2 Compact system proved to be an effective method for the rapid and accurate identification of fungal species, highlighting its importance in clinical diagnostics. These findings emphasize the need for routine fungal screening in diabetic patients, as well as the importance of early and targeted antifungal therapy to prevent the complications associated with fungal infections, particularly in rural settings where healthcare resources may be limited.*

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## 1. INTRODUCTION

Diabetes mellitus (DM) represents a significant global health challenge characterized by hyperglycemia resulting from pancreatic beta cell dysfunction. The prevalence of DM has exhibited a consistent global rise, with Indonesia reporting one of the highest incidence rates [1]. Complications associated with DM encompass neuropathy, nephropathy, retinopathy, and cardiovascular issues. Moreover, DM heightens susceptibility to fungal

infections [2]. The hyperglycemic milieu engendered by DM provides an optimal habitat for various fungi, particularly *Candida spp.* and *Aspergillus* [3]. These opportunistic pathogens can precipitate severe infections in diverse organs, including the kidneys, liver, brain, and joints [4]. Fungal infections among diabetics frequently present with symptoms such as pruritus, burning, or pain in the urinary tract, significantly impacting quality of life [5]. The main objective of this research is to identify the fungal pathogens present in diabetes mellitus patients at the Sokaraja 1 Community Healthcare Center in Banyumas Regency.

The study will focus on characterizing the study population, determining the prevalence of fungal infections, identifying the specific fungal pathogens involved, and assessing the overall fungal burden in the urine of diabetic patients. Prior investigations consistently demonstrate a heightened prevalence of fungal infections in diabetic patients compared to non-diabetics [3]. Research in Nepal has unveiled a significant correlation between DM and fungal infections. Similarly, Indonesian studies have underscored an elevated incidence of urinary fungal infections in diabetics with uncontrolled blood glucose levels [5]. Notwithstanding the substantial prevalence of DM in the Banyumas Regency, a lack of research exists about the presence of fungi in the urine of diabetic patients in this locality. Underpinning the novelty of this research, it is imperative to note that antecedent studies, such as those conducted in Nigeria and in Indonesia, have discerned a spectrum of fungal species in the urine of diabetic patients.

Akinjogunla et al. found *Candida albicans* to be the most prevalent fungal pathogen in their study, followed by *C. glabrata*, *C. tropicalis*, *C. krusei*, *C. parapsilosis*, and *C. dubliniensis* [6]. Patricia et al. similarly reported the presence of *Candida albicans* in a subset of their diabetic patient samples [4]. Nonetheless, these studies were conducted in disparate regions with potentially divergent demographic and clinical characteristics. Consequently, further research is warranted to expound upon the prevalence and typology of fungal infections in diabetic patients in the Banyumas Regency. Timely detection, prudent management, and efficacious treatment are pivotal in addressing fungal infections in individuals with DM. Urine analysis can serve as a valuable diagnostic modality for delineating fungal infections, particularly when symptoms may be inconspicuous or absent [7]. Given the high incidence of DM cases in the Banyumas Regency, further research is indispensable to elucidate the attributes of fungal infection in the urine of diabetic patients in this locale. This information will be instrumental in formulating targeted preventive and therapeutic approaches.

## 2. RESEARCH METHOD

A cross-sectional, descriptive study, performed during a two-month period (from Juli 2024-Agustus 2024). Fifteen diabetic patients took part in the study, meeting the following inclusion criteria: 1) Regular attendance at the Prolanis program at Sokaraja 1 Healthcare Center, Banyumas, as per medical records, and 2) Voluntary participation in the study by providing written informed consent. Exclusion criteria included: 1) Use of antibiotics or antifungal medications, 2) Pregnancy or menstruation, 3) Ongoing treatment for urinary tract infections (UTIs), and 4) Unwillingness to participate as evidenced by not providing written informed consent. A standardized questionnaire was employed to collect demographic and clinical data from the participants. A midstream urine sample, ranging from 20 to 30 ml, was obtained in a sterile container and homogenized. The urine samples underwent culture on *Sabouraud dextrose agar* (SDA) and were then placed in an incubator at 37°C for 1 to 3 days, during which fungal growth was observed both macroscopically and microscopically using 10% KOH and LPCB staining techniques.

Fungal species were subsequently identified using the Vitek-2 Compact system. Descriptive statistics were used to summarize the demographic and clinical characteristics of the study population. The prevalence of urinary tract fungal infections was determined, and the distribution of fungal species was analyzed.

## 3. RESULTS AND DISCUSSIONS

After inoculating 15 urine samples onto *Sabouraud Dextrose Agar* (SDA) media, a macroscopic examination revealed positive growth in 12 samples, representing an 80.0% positivity rate. The positive cultures exhibited characteristic mold with a sour odor and white, yeast-like colonies. Conversely, 3 samples, constituting 20.0% of the total, demonstrated no fungal growth. Subsequent analysis of the 12 fungal-positive samples using the Vitek-2 Compact system resulted in the identification of 6 fungal isolates. The dominant fungal species identified in this study were *Candida* species, accounting for 66.7% of the total isolates. Among *Candida* species, *C. guilliermondii* was the most prevalent, followed by *C. krusei* and *C. famata*, each representing 16.7% of the isolates. Additionally, *Trichosporon asahii* and *Kodamaea ohmeri* were also detected, with a prevalence of 16.7% each.

Based on **Table 1** out of the 12 samples that were found to have fungal presence, only 6 samples were successfully identified using the Vitek-2 Compact system. This limitation arose due to the presence of dimorphic fungi, which possess the unique ability to transition between yeast and hyphal forms based on environmental conditions [8]. The capacity of these fungi to alter their shape presents challenges in their automated identification using the Vitek-2 Compact system, which is designed to identify microorganisms based on their growth patterns under relatively stable conditions [9].

**Table 1.** The frequency of fungal species isolated from urine specimens of diabetic patients

Fungal species	Total	
	Frequency	Percentage
<i>Candida guilliermondii</i>	2	33.3
<i>Candida krusei</i>	1	16.7
<i>Candida famata</i>	1	16.7
<i>Trichosporon asahii</i>	1	16.7
<i>Kodamaea ohmeri</i>	1	16.7
total	6	100

The finding that the genus *Candida* dominates fungal isolates is consistent with previous studies. Similar to a study conducted in Uyo, Nigeria, where *Candida spp.* accounted for 35.3% of the 51 urine samples [6]. A similar study at the Islamic General Hospital in Klaten found that among 30 urine samples from diabetic patients, 6 samples were positive for *Candida albicans* (20%) [10]. This can be explained by the high adaptability of *Candida* to glucose-rich environments, such as the urine of diabetic patients. *Candida* species possess enzymes that enable them to efficiently utilize glucose as an energy source. The identification of several *Candida* species indicates the diversity of fungal types that can infect the urinary tract of diabetic patients. *Candida krusei* is a type of yeast that is resistant to antifungal drugs [11]. It can cause serious infections like candidemia, which can lead to complications such as sepsis and organ abscesses.

Nurses should carefully watch for signs of systemic infection and make sure that patients complete their antibiotic treatment to overcome drug resistance [12]. *Candida guilliermondii* is often found in the environment and can cause infections in people with weakened immune systems. This type of infection can be life-threatening, especially when associated with the use of catheters. Nurses should use very clean techniques and isolate patients if needed to prevent the spread of infections. *Candida famata* normally causes surface infections, but it can spread in patients with severely weakened immune systems. Nurses should focus on good wound care and quickly identify risk factors, such as catheter use, to prevent widespread infection [13]. *Trichosporon asahii* can be hard to tell apart from *Candida* and can cause serious invasive infections, especially in patients with low levels of certain white blood cells. Nurses should regularly monitor blood counts and isolate patients to prevent the spread of infection [14].

*Kodamaea ohmeri* is a harmful organism that can infect people with weakened immune systems. This infection often happens in hospitals. Nurses need to give strong antifungal treatment and use detailed infection prevention techniques to stop the spread of infection [15]. Based on **Table 2**, the study assessed the connection between the presence of fungal infections in the urine of diabetic individuals and various demographic and laboratory data. The incidence of fungal infections in the urine of diabetics in this population is associated with factors such as age (elderly category), gender (female), occupation, educational status, type of diabetes, duration of diabetes, and blood glucose levels. Besides that, in this case, nurses need to increase awareness of the potential for fungal infections in patients with diabetes mellitus, especially in more vulnerable groups such as the elderly, women, and those who have had diabetes for a long time or have poor blood sugar control. Nurses must educate diabetes patients about the importance of maintaining blood sugar levels within the normal range to prevent infection [16].

Comprehensive health education needs to emphasize the extra importance of maintaining the cleanliness of the genital area for diabetes mellitus patients [17]. In addition to providing appropriate medical care, nurses can also be good listeners, helping patients express their concerns and feelings regarding the risk of infection. By creating a strong therapeutic relationship, nurses can help patients become more confident in facing their health challenges. When patients feel supported and understood, they are more likely to adhere to their treatment plan, improve their quality of life, and reduce stress levels. Emotional support can also help patients develop healthy coping mechanisms to face their health challenges. Comprehensive care planning is crucial for successfully managing diabetes mellitus and preventing complications. Nurses play a vital role in creating and implementing care plans as they are at the forefront of providing nursing care. By working closely with doctors and nutritionists, nurses can develop personalized treatment plans for each patient [16].

These treatment plans encompass not only managing blood sugar levels but also address other factors such as nutrition, physical activity, and infection prevention.

**Table 2.** Characteristics of the study population

Characteristics	No of samples collected	No of subjects (positive)
<b>Age (yrs)</b>		
46-55	3	3
56-65	5	4

Characteristics	No of samples collected	No of subjects (positive)
> 65	7	5
<b>Gender</b>		
Male	3	2
Female	12	10
<b>Marital status</b>		
Single	0	0
Married	15	12
<b>Occupation</b>		
Working	1	0
Unemployment	14	12
<b>Educational status</b>		
Elementary	8	7
Junior	4	2
Senior	2	2
University	1	1
<b>Type of Diabetes</b>		
Type 1	0	0
Type 2	15	12
<b>Duration of Diabetes</b>		
≤ 5 yrs	6	5
> 5 yrs	9	7
<b>Blood glucose levels</b>		
Controlled	5	4
Uncontrolled	10	8

#### 4. CONCLUSIONS AND RECOMMENDATION

The study found that a significant proportion of diabetic patients in a rural Indonesian community have fungal infections in their urine. Specifically, 80% of urine samples from diabetic individuals exhibited fungal growth, with *Candida* species dominating (66.7%). Among these, *Candida guilliermondii* was the most commonly identified species (33.3%), followed by other *Candida* species such as *Candida krusei* (16.7%) and *Candida famata* (16.7%). Additionally, *Trichosporon asahii* (16.7%) and *Kodamaea ohmeri* (16.7%) were also detected. The affected individuals were predominantly elderly, unemployed women with limited education and poorly controlled blood glucose levels. Genital itching was the most common symptom reported by the patients. These findings highlight the high prevalence of fungal infections among diabetic patients in rural communities, particularly the dominance of *Candida* species, with *Candida guilliermondii* being the most prevalent.

It also underscores the vulnerability of elderly, poorly controlled diabetic patients who may have limited access to healthcare. Based on the results, it is crucial for diabetic patients in rural areas to undergo regular health screenings, particularly for fungal infections, to allow for early detection and intervention. Healthcare providers should focus on improving blood glucose control through better management strategies, as elevated glucose levels create favorable conditions for fungal growth. Educational programs should be implemented to raise awareness among diabetic patients, particularly those in vulnerable groups such as the elderly, about the risks associated with fungal infections and the importance of maintaining stable glucose levels. Given the prevalence of multiple fungal species, including less common ones like *Trichosporon asahii* and *Kodamaea ohmeri*, healthcare systems should ensure the availability of advanced diagnostic tools, such as the Vitek-2 Compact system, for accurate identification of fungal pathogens.

Moreover, healthcare agencies should collaborate with local educational institutions to promote routine fungal screenings in diabetes management. Further research with larger sample sizes and the use of molecular techniques should be prioritized to better understand the diversity of fungal pathogens in diabetic patients. Longitudinal studies will provide valuable insights into the progression of fungal infections and their virulence factors, helping to refine treatment strategies. These operational and realistic recommendations aim to address the immediate needs of diabetic patients in rural areas and improve the overall management of diabetes and its complications.

#### Acknowledgements

This research was conducted at Sokaraja 1 Community Health Center, Banyumas Regency, with support from the Microbiology and Biochemistry Laboratory at Universitas Muhammadiyah Purwokerto, and the Banyumas Regional Hospital Laboratory. The researcher expresses gratitude to the staff for their valuable

assistance, to the patients who participated in this study, and to the academic mentors for their invaluable guidance throughout the research process.

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