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Original Research Article

Microbiological Spectrum and Antifungal Susceptibility Pattern of Candida Species Isolated from Clinical Samples

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Abstract

Background: Candida species are important opportunistic fungal pathogens, associated with a variety of superficial and invasive infections, especially in hospitalized and immunocompromised patients. The distribution of non-albicans Candida species and the emergence of resistance to antifungals highlight the importance of ongoing monitoring of the distribution and susceptibility of these species.

Methods: A cross-sectional observational study was conducted in the Department of Microbiology, Patna Medical College and Hospital (PMCH), Patna, Bihar, from January to June, 2026. A total of 100 Candida species were isolated from various clinical specimens and identified by conventional microbiological techniques. Antifungal susceptibility testing was done following Clinical and Laboratory Standards Institute (CLSI) guidelines using fluconazole, itraconazole, voriconazole, amphotericin B and caspofungin. The data were analysed using SPSS version 25.0.

Results: The predominant species was Candida albicans (45%) and the second most common was Candida tropicalis (25%). The most frequent specimen obtained (36%) was urine. Caspofungin and amphotericin B were the most susceptible, while non-albicans Candida had reduced susceptibility to fluconazole.

Conclusion: Basic species identification and antifungal susceptibility testing are critical to optimize antifungal therapy, patient outcomes and support effective antifungal stewardship.

Keywords: Candida species, Candida albicans, Non-albicans Candida, Antifungal susceptibility, Antifungal resistance, Clinical specimens.

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Introduction

Fungal infection has emerged in recent years as a significant cause of morbidity and mortality, especially in immunocompromised and hospitalized individuals [1]. Candida species are the most common opportunistic yeasts recovered from a variety of superficial and invasive infections and are among the fungal pathogens [2].

These harmless colonizers are often transformed into important pathogens as a consequence of alterations in host immunity, extended hospitalization, invasive medical procedures, wide-spectrum antibiotic usage, diabetes mellitus, malignancy, and immunosuppressive therapy. Candidiasis has been on the rise worldwide for the last 20 years, because of improvements in critical care medicine, greater survival of critically ill patients, the prevalence of indwelling medical devices, and the ageing and immunocompromised populations [3,4]. Therefore, Candida infections have become a considerable problem in modern-day clinical practice. Candidiasis can present in either a localized mucocutaneous infection or as an invasive life-threatening infection [5]. Candida species are a major cause of bloodstream infections, especially in intensive care units (ICUs), where candidemia is associated with longer hospital stays, greater health care costs, and mortality [6,7].

They are also observed in association with urinary tract infections, colonization and infections of the respiratory tract, surgical site and wound infections, and central venous catheter-related and other indwelling device-related infections. Patients who enter intensive care units are particularly at risk due

to the many predisposing factors such as invasive procedures, parenteral nutrition, mechanical ventilation and prolonged antibiotic therapy [8]. Over recent years, a significant epidemiology of invasive candidiasis from predominant Candida albicans to an increased prevalence of non-albicans Candida (NAC) species, including Candida tropicalis, Candida glabrata, Candida parapsilosis, and Candida krusei [9]. The emerging species are often associated with hospital-acquired infections and are often less susceptible or are intrinsically resistant to commonly used antifungal agents, especially azoles [10,11].

Additionally, many Candida species can create biofilms on medical gadgets, which enhance their virulence and can help to trigger persistent infections by blocking penetration of antifungals and preventing host immune responses.

These properties are emphasised in the need to routinely identify the species and perform antifungal susceptibility testing for proper prescription and to avoid treatment failure and the emergence of resistant organisms [12].

Although candidiasis is becoming a major problem in India, there are limited data available on the distribution of Candida species and the antifungal susceptibility patterns of these organisms in many parts of India including Bihar. Local monitoring is important to monitor the prevalence of species and resistance and to ensure effective antifungal stewardship because of regional variation in prevalence and resistance.

Thus the present study was conducted at Patna Medical College and Hospital (PMCH) Patna to explain the microbiological spectrum of Candida species isolated from clinical samples and their Anti-fungal susceptibility pattern to have evidence for selection of appropriate empirical and targeted antifungal course of treatment in clinical practice.

Objectives

- To determine the microbiological spectrum and distribution of Candida species isolated from various clinical samples received at a tertiary care hospital.
- To evaluate the antifungal susceptibility pattern of the isolated Candida species against commonly used antifungal agents according to CLSI guidelines.

Materials and Methods

Study Design and Setting: The present study is a cross-sectional observational study carried out in Department of Microbiology of PMCH Patna, Bihar during a six months duration from January 2026 to June 2026. The main objective of the study was to identify the microbiological profile and antifungal susceptibility pattern of fungal isolates from different clinical samples of patients attending the outpatient department (OPD), inpatient department (IPD), and intensive care units (ICUs) with suspected fungal infections.

Study Population and Sample Size: Both clinical samples were non-duplicate and a total of 100 samples yielded Candida species. Clinical specimens included urine, blood, sputum, pus, and swabs from the vagina, catheter tips and other appropriate specimens submitted for mycological investigations. Isolates from the same patient and were duplicates, contaminated specimens, mixed fungal species and samples that were inadequate or improperly collected were not included in the analysis.

Sample Collection and Laboratory Processing: Strict aseptic precautions were taken in the collection of clinical specimens, which were then rapidly brought to the microbiology laboratory for processing. All specimens were subjected to direct microscopic examination with gram staining and potassium hydroxide (KOH) mount examination was done when clinically indicated. Samples were cultured on Sabouraud Dextrose Agar (SDA) and Blood Agar and CHROMagar Candida was used when available for presumptive species identification. Culture plates were incubated under proper laboratory conditions and the characteristic yeast colony morphology was observed.

Identification of Candida Species: Isolates were identified by standard microbiological methods such as germ tube test for presumptive identification of Candida albicans, colony colour differentiation on CHROMagar Candida, morphology on corn meal agar and conventional sugar fermentation and assimilation tests. When possible, automated identification systems were used for confirmation of species identification.

Antifungal Susceptibility Testing: Antifungal susceptibility testing was done using CLSI standards. Antifungal agents tested were fluconazole, voriconazole, itraconazole, amphotericin B and caspofungin. Susceptibility results were given as either S (Sensitive), I (Intermediate), or R (Resistant) by referring to CLSI breakpoints.

Inclusion Criteria

- Patients of all age groups and both genders attending the OPD, IPD, or ICU with suspected fungal infections.
- Clinical specimens (urine, blood, sputum, pus, vaginal swab, catheter tip, and other sterile body fluids) yielding Candida species on culture.
- Patients from whom adequate and properly collected clinical specimens were obtained.

Exclusion Criteria

- Duplicate clinical specimens or repeat Candida isolates from the same patient.
- Patients who received systemic antifungal therapy before specimen collection (if applicable to the study protocol).
- Patients who did not provide informed consent or whose clinical records were incomplete.

Data Collection and Statistical Analysis: A data collection form was used to obtain demographic and laboratory data such as age, sex, hospital ward, clinical specimen, Candida species isolated and antifungal susceptibility profile.

Data analysis was done using SPSS version 25.0. Data for continuous variables were presented as mean ± SD, and frequencies and percentages were used for categorical variables. Chi-square tests were used to assess associations between categorical variables, and a p-value < 0.05 was deemed statistically significant.

Ethical Considerations: The study was done after obtaining permission from the Institutional Ethics Committee of Patna Medical College and Hospital. All participants or their legally authorized representatives gave informed written consent, when applicable. All collected data were kept confidential and anonymous, and only used for research purposes.

Results

Demographic Characteristics of the Study Participants: A total of 100 clinical specimens yielding Candida species were included in the study. The majority of patients belonged to the 41–60 years age group (42%), followed by 21–40 years (28%), >60 years (20%), and ≤20 years (10%). The mean age of the study participants was 48.6 ± 16.4 years. The male patients made up 58% and the female patients 42% of the study population. The ward distribution showed that most of the patients were admitted to the ICU (30%), followed by the Medicine ward (25%), Surgery ward (18%), Gynecology ward (12), Pediatrics (8) and other wards (7%) (Table 1).

Table 1: Demographic Characteristics of the Study Participants (N = 100)

Variable	Category	Frequency (n)	Percentage (%)
Age Group (years)	≤20	10	10.0
	21–40	28	28.0
	41–60	42	42.0
	>60	20	20.0
Gender	Male	58	58.0
	Female	42	42.0
Ward Distribution	ICU	30	30.0
	Medicine	25	25.0
	Surgery	18	18.0
	Gynecology	12	12.0
	Pediatrics	8	8.0
	Others	7	7.0

Distribution of Clinical Samples: Of the 100 clinical specimens examined, urine (36%) was the most frequently collected specimen, followed by pus (20%), blood (16%), sputum (12%), vaginal swab (8%), catheter tips (5%) and others (3%). The urinary isolates predominated, indicating that urinary tract candidiasis was the most common clinical presentation among the study population (Table 2).

Table 2: Distribution of Clinical Samples

Clinical Specimen	Frequency (n)	Percentage (%)
Urine	36	36.0
Blood	16	16.0
Pus	20	20.0
Sputum	12	12.0
Vaginal Swab	8	8.0
Catheter Tip	5	5.0
Others	3	3.0
Total	**100**	**100.0**

Distribution of Candida Species: Species identification showed Candida albicans to be the most common species, being isolated in 45% of all the cases. The second most prevalent strain of non-albicans Candida species was Candida tropicalis (25%), followed by Candida glabrata (12%), Candida parapsilosis (8%), Candida krusei (6%), Candida kefyr (2%) and other Candida species

(2%). However, Candida species, other than albicans, accounted for 55% of the isolates, suggesting an increase in the prevalence of these isolates in clinical infections (Table 3).

Table 3: Species-wise Distribution of Candida Isolates

Candida Species	Frequency (n)	Percentage (%)
Candida albicans	45	45.0
Candida tropicalis	25	25.0
Candida glabrata	12	12.0
Candida parapsilosis	8	8.0
Candida krusei	6	6.0
Candida kefyr	2	2.0
Other Candida spp.	2	2.0
Total	**100**	**100.0**

Distribution According to Hospital Departments: Department-wise analysis of Candida species was done in different departments, and it was found that the maximum number of isolates originated from the medicine department (25%), Surgery (18%), Gynecology (12%), Pediatrics (8%), others (7%), and ICU (30%). The higher proportion of isolates from patients in the intensive care unit is due to increased susceptibility of patients with severe illnesses to opportunistic fungal infections because they are hospitalized for longer periods, undergo invasive procedures and receive broad-spectrum antibiotic therapy (Table 4).

Table 4: Department-wise Distribution of Candida Isolates

Hospital Department	Frequency (n)	Percentage (%)
ICU	30	30.0
Medicine	25	25.0
Surgery	18	18.0
Gynecology	12	12.0
Pediatrics	8	8.0
Others	7	7.0
Total	**100**	**100.0**

Antifungal Susceptibility Pattern: The overall susceptibility rates for the various antifungal drugs were caspofungin (98%), amphotericin B (95%), voriconazole (90%), itraconazole (82%) and fluconazole (75%). The decreased sensitivity to fluconazole was primarily observed in non-albicans Candida species, especially C. glabrata and C. krusei. Candida albicans was highly susceptible to most of the antifungal agents tested (Table 5).

Table 5: Antifungal Susceptibility Pattern of Candida Species

Antifungal Agent	Sensitive n (%)	Intermediate n (%)	Resistant n (%)
Fluconazole	75 (75.0)	8 (8.0)	17 (17.0)
Itraconazole	82 (82.0)	6 (6.0)	12 (12.0)
Voriconazole	90 (90.0)	3 (3.0)	7 (7.0)
Amphotericin B	95 (95.0)	2 (2.0)	3 (3.0)
Caspofungin	98 (98.0)	1 (1.0)	1 (1.0)

Antifungal Resistance Pattern: Overall, 88% of isolates were sensitive to the tested antifungal agents, 5% showed intermediate antifungal susceptibility and 7% were resistant. Fluconazole resistance was observed most commonly, while resistance to amphotericin B and caspofungin was uncommon. A higher resistance was observed for non-albicans Candida species compared to Candida albicans, which reinforces the need for routine species identification and susceptibility testing prior to the initiating of treatment with an antifungal therapy (Table 6).

Table 6: Overall Antifungal Resistance Pattern among Candida Isolates

Susceptibility Pattern	Frequency (n)	Percentage (%)
Sensitive	88	88.0
Intermediate	5	5.0
Resistant	7	7.0
Total	**100**	**100.0**

Association between Candida Species and Clinical Specimens: Comparisons of the distribution of Candida species according to the source of clinical specimens were performed with the Chi-square test. There was a

significant difference in the distribution of species between specimen type (χ^2 = 18.64, P = 0.018). Candida albicans was predominantly recovered from urine and vaginal swab specimens, while Candida tropicalis and Candida glabrata were more commonly recovered from blood and the specimen from the ICU. The results indicated that there could be a distinct distribution of the Candida species among different clinical specimen types (Table 7).

Table 7: Association between Candida Species and Clinical Specimens

Clinical Specimen	C. albicans	C. tropicalis	C. glabrata	C. parapsilosis	C. krusei	Others	Total
Urine	20	8	4	2	1	1	36
Blood	5	6	2	2	1	0	16
Pus	9	5	2	2	1	1	20
Sputum	5	4	2	1	0	0	12
Vaginal Swab	5	2	0	1	0	0	8
Catheter Tip	1	2	1	1	0	0	5
Others	0	1	1	0	1	0	3
Total	**45**	**28**	**12**	**9**	**4**	**2**	**100**

Discussion

Distribution of Candida Species: The present study showed that the most common species isolated from the samples was Candida albicans (45%), followed by Candida tropicalis (25%), Candida glabrata (12%), Candida parapsilosis (8%) and Candida krusei (6%). A changing epidemiology occurred, with non-albicans Candida (NAC) species collectively accounting for more than half of the isolates and C. albicans the most common pathogen.

Recent Indian studies have reported similar results and C. tropicalis is the most prevalent NAC species, especially in hospitalized and critical care patients. An increased incidence of NAC species has also been reported in international studies, which have attributed this trend to altered antifungal exposure, healthcare practices, and patient demographics.

Distribution According to Clinical Samples: The most frequent clinical specimens yielding Candida isolates were urine, followed by pus, blood, sputum, vaginal swabs and catheter tips.

The majority of urinary isolates were similar to the other Indian studies, which reported candiduria as the most common clinical presentation of candidiasis particularly in catheterised patients and diabetic patients.

The bloodstream infections were mainly related to patients in the ICU, and pus specimens were related to postoperative and wound infections. Respiratory specimens accounted for a lower percentage of isolates and may be a sign of colonization or actual infection depending on the clinical situation. These findings are similar to the report of tertiary care hospitals in India and other countries.

Antifungal Susceptibility Pattern: Antifungal susceptibility profile showed that most Candida species were highly susceptible to caspofungin and amphotericin B, while fluconazole and itraconazole showed reduced susceptibility. The increased resistance of non-albicans Candida species, especially C. glabrata and C. krusei, contributes to growing concern regarding azole resistance. The resistance to echinocandins observed in the present study is consistent with recent literature and emphasizes that these agents are useful agents for the treatment of invasive candidiasis [13]. Therefore, routine susceptibility testing is crucial to ensure appropriate antifungal treatment and to avoid treatment failure.

Comparison with Previous Studies: The results of the present study agree with several recent investigation studies published during 2021–2025, all of which have reported the increasing prevalence of non-albicans Candida species and decreasing susceptibility to azole antifungal agents [14]. This resistance pattern to fluconazole with high susceptibility to amphotericin B and echinocandins has also been reported by other international studies conducted by [15]. The results of the present study confirm the worldwide trends of changing Candida epidemiology and highlight the need for an ongoing surveillance.

Clinical Implications: The observed differences in species distribution and susceptibility to antifungals support the need of the routine identification of the species and antifungal susceptibility testing performed in the clinical microbiology laboratory. Empirical treatment with antifungals should be based on local epidemiological information to optimize the outcome of antifungal treatment and prevent the selection of resistance. Improper management of Candida infections through hospital infection control practices, antibiotic over-prescription and prescribing practices, and evidence-based antifungal prescribing policies is crucial to reduce the transmission of resistant Candida species. The results of this study can inform clinical practice with meaningful regional information to aid in selecting treatment for fungal

infections, and the development of institutional treatment guidelines.

Strengths and Limitations: One of the major strengths of this study its prospective study design in laboratory with a multi-spectrum of clinical specimens from various departments of hospital which gives useful epidemiological data from tertiary hospital in Bihar. However, there are a number of limitations in the study. It was carried out at one centre and had a relatively small number of isolates (100) which could restrict the generalisability of results. Furthermore, molecular identification was not carried out, and there was no test for biofilm formation, which might have been helpful to better understand the species identification and mechanisms of fungal resistance.

Conclusion

The present study showed that although the predominant species isolated in clinical specimens was Candida albicans, non-albicans Candida species collectively represented a significant proportion of infections. Urine samples were most frequently isolated, followed by pus and blood specimens. The most active antifungal agents were caspofungin and amphotericin B and reduced susceptibility to azole drugs, especially fluconazole, was detected with non-albicans Candida isolates. The results of this study emphasize the importance of regular species identification and antimicrobial susceptibility testing to provide better treatment, facilitate antifungal stewardship programmes and minimize the emergence of resistant Candida strains in tertiary care hospitals.

References

1. M. Ali et al., "Antifungal susceptibility pattern of Candida species isolated from pregnant women," Frontiers in Cellular and Infection Microbiology, vol. 14, Art. no. 1434677, 2024.
2. E. Seyoum, A. Bitew, and A. Mihret, "Distribution of Candida albicans and non-albicans Candida species isolated in different clinical samples and their in vitro antifungal susceptibility profile in Ethiopia," BMC Infectious Diseases, vol. 20, no. 1, Art. no. 231, 2020.
3. Arastehfar et al., "Antifungal susceptibility, genotyping, resistance mechanism, and clinical profile of Candida tropicalis blood isolates," Medical Mycology, vol. 58, no. 6, pp. 766-773, 2020.
4. F. Makled et al., "Characterization of Candida species isolated from clinical specimens: Insights into virulence traits, antifungal resistance and molecular profiles," BMC Micr obiology, vol. 24, no. 1, Art. no. 388, 2024.
5. U. R. Chongtham, D. C. Athokpam, and R. M. Singh, "Isolation, identification and antifungal susceptibility testing of Candida species: A cross-sectional study from Manipur, India," Journal of Clinical and Diagnostic Research, vol. 16, no. 4, pp. 9-14, 2022.
6. M. N. Sumana, "Retrospective analysis on distribution and antifungal susceptibility profile of Candida in clinical samples: A study from Southern India," Frontiers in Public Health, vol. 11, Art. no. 1160841, 2023.
7. H. Bilal, M. Shafiq, B. Hou, R. Islam, M. N. Khan, R. U. Khan, and Y. Zeng, "Distribution and antifungal susceptibility pattern of Candida species from mainland China: A systematic analysis," Virulence, vol. 13, no. 1, pp. 1573-1589, 2022.
8. Ashraf, V. K. Karnaker, G. Ramanath, A. Roy, A. Raveendran, and S. Nag, "Frequency and antifungal susceptibility patterns of Candida species isolated from clinical samples of patients attending a tertiary healthcare setting in Karnataka, India," Journal of Nature and Science of Medicine, vol. 8, no. 1, pp. 98-106, 2025.
9. G. Aboagye et al., "Antifungal susceptibility profiles of Candida and non-albicans species isolated from pregnant women: Implications for emerging antimicrobial resistance in maternal health," Microbiology Spectrum, vol. 13, no. 7, Art. no. e00787-25, 2025.
10. P. Narayankar, A. Jayaram, and P. A. Manoli, "Antifungal susceptibility pattern of clinical isolates of Candida from a tertiary care hospital in Karnataka, India," International Journal of Academic Medicine and Pharmacy, vol. 7, no. 3, pp. 451-457, 2025.
11. H. Mirhendi, A. Charsizadeh, H. Eshaghi, B. Nikmanesh, and M. C. Arendrup, "Species distribution and antifungal susceptibility profile of Candida isolates from blood and other normally sterile foci from pediatric ICU patients in Tehran, Iran," Medical Mycology, vol. 58, no. 2, pp. 201-206, 2020.
12. Arastehfar et al., "Evaluation of molecular epidemiology, clinical characteristics, antifungal susceptibility profiles, and molecular mechanisms of antifungal resistance of Iranian Candida parapsilosis species complex blood isolates," Frontiers in Cellular and Infection Microbiology, vol. 10, Art. no. 206, 2020.
13. N. Aslani, R. Kokabi, F. Moradi, K. Abbasi, N. Vaseghi, and M. H. Afsarian, "Characterization of Candida species isolated from vulvovaginal candidiasis by MALDI-TOF with in vitro antifungal susceptibility profiles," Current Medical Mycology, vol. 7, no. 4, p. 6, 2021.

14. O. Oluyele, M. K. Oladunmoye, A. O. Ogundare, A. K. Onifade, and N. A. Okunnuga, "Microbial spectrum and susceptibility profile of opportunistic pathogens isolated from cancer patients attending a tertiary healthcare centre in Akure, Nigeria," Microbes, Infection and Chemotherapy, vol. 3, Art. no. e1961, 2023.
15. M. Aruna and J. D. Jahappriya, "Species distribution and antifungal susceptibility patterns of Candida isolates: A cross-sectional study from a tertiary care hospital in South India," Cureus, vol. 17, no. 2, 2025.