

The Antimicrobial Resistance of Candida: A 5-Year Retrospective Analysis at a Tertiary Hospital in Jordan

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- Non-albicans species were the main cause of blood infections, with a notable *C. krusei* minority and pronounced resistance to echinocandins. While in high vaginal swabs (HVS), *C. albicans* formed most of the positive samples with a notable minority of *C. glabrata*, resistance rates to fluconazole were low in both.

BACKGROUND

Candida infections are a global health concern with rising antimicrobial resistance (AMR). This study aimed to detail the circulating candida species and AMR patterns in Amman, Jordan.

METHODS

- An observational epidemiological study based on data collected from the electronic Microbiology Lab records at Jordan University Hospital (JUH) covering the period of June 2017 to June 2022.

3581 Microbiology lab records with a positive candida isolate.

934 records with incomplete data were removed:

- 596 missing sensitivity results.
- 27 missing (in vs. outpatient).
- 311 missing sample source.

2647 records remained

Source	Inpatients	Outpatients
Blood	137	2
Genital tract	31	402
Respiratory tract	697	132
Urinary tract	763	382
Skin and soft tissue	74	15
Central nervous system	6	0
Gastrointestinal tract	7	1

Identification of candida species was done through the examination of colony color and morphology on the chromogenic agar media (CHROMID® Candida, bioMérieux). For uncharacterized colonies, the automated system (VITEK® 2, bioMérieux) with the identification card (YST ID card, VITEK® 2, bioMérieux) and YS08 AST card for sensitivity testing. The Clinical & Laboratory Standards Institute (CLSI) Breakpoints were used.

RESULTS CONTINUED

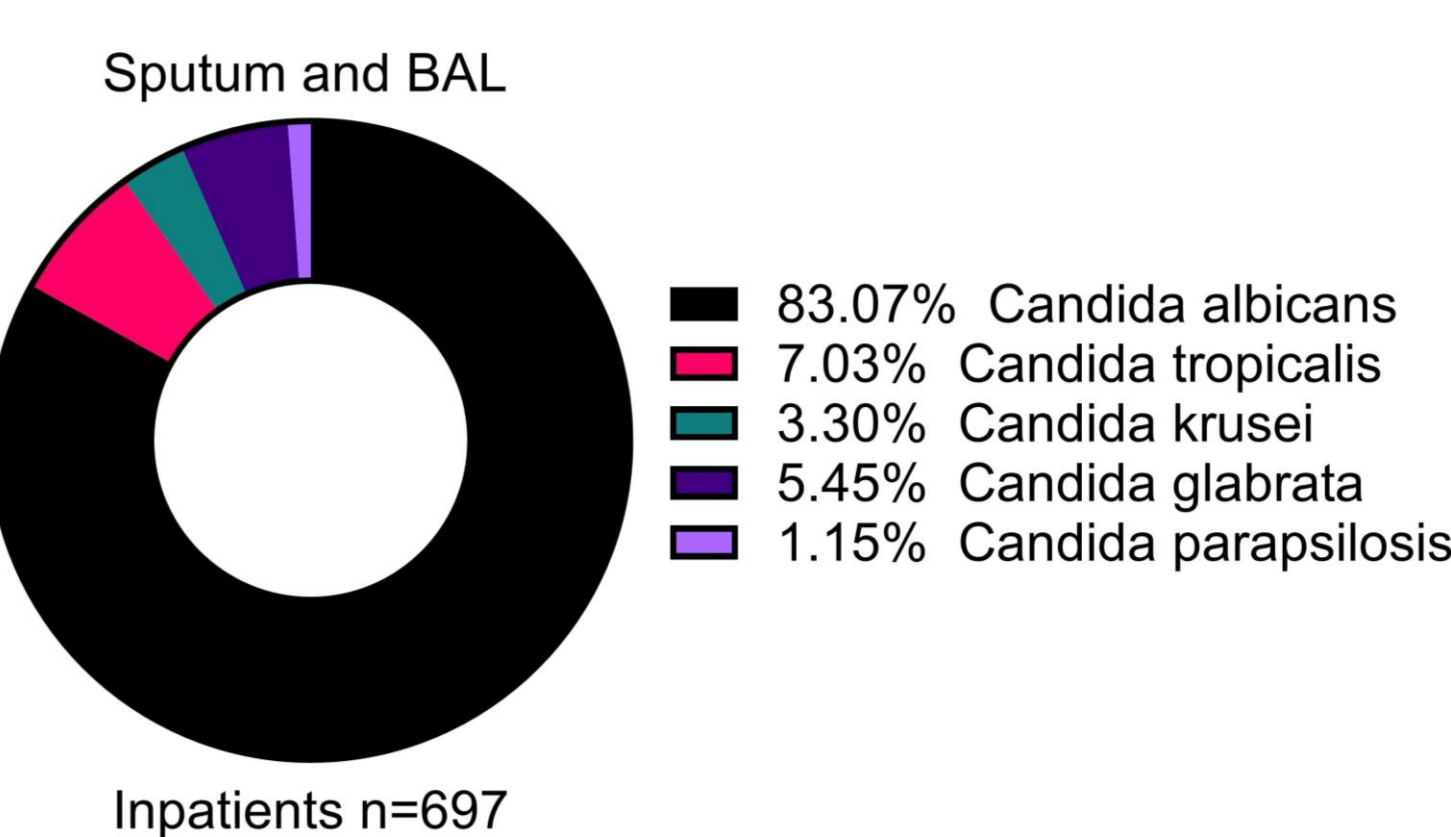
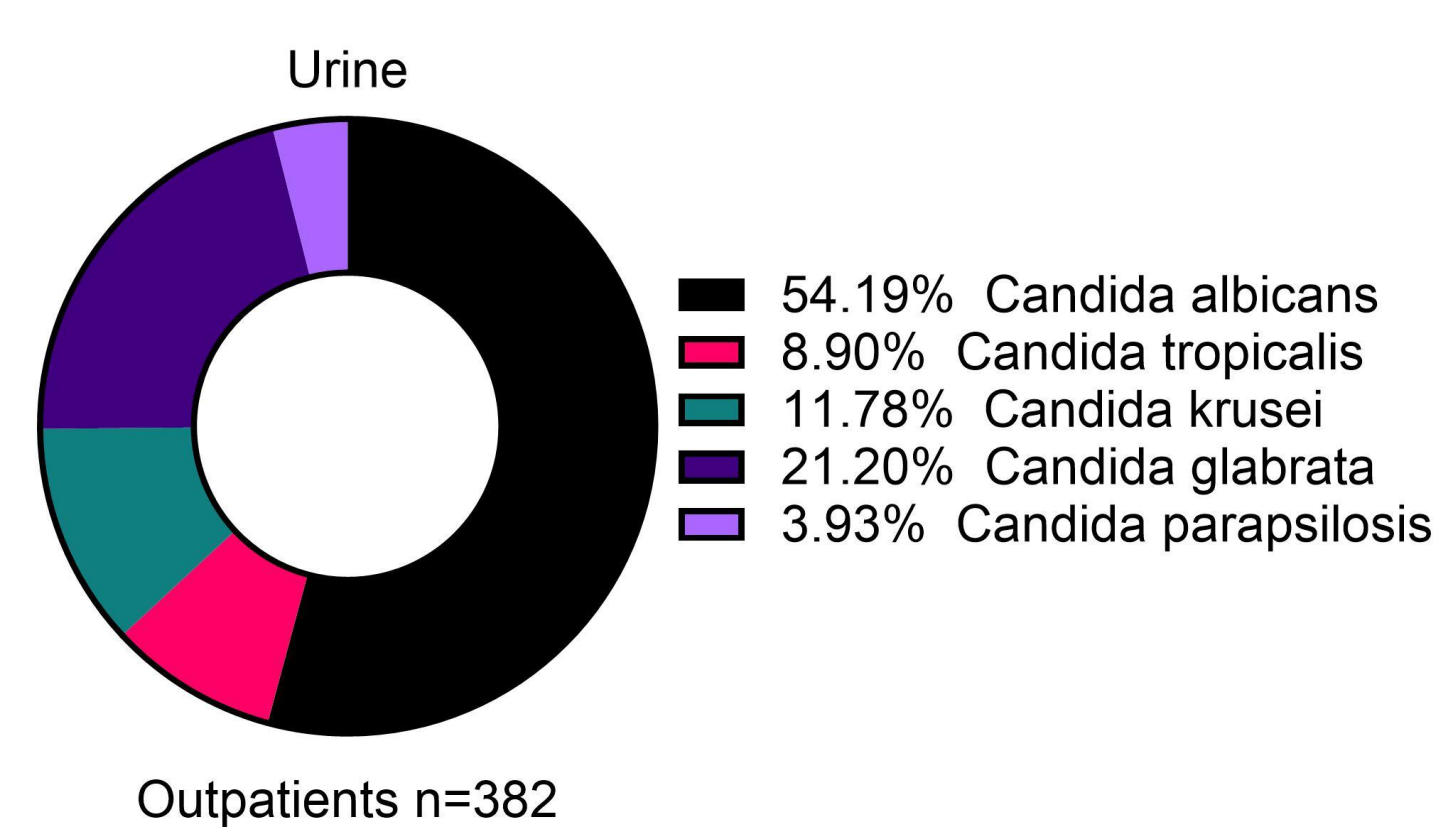
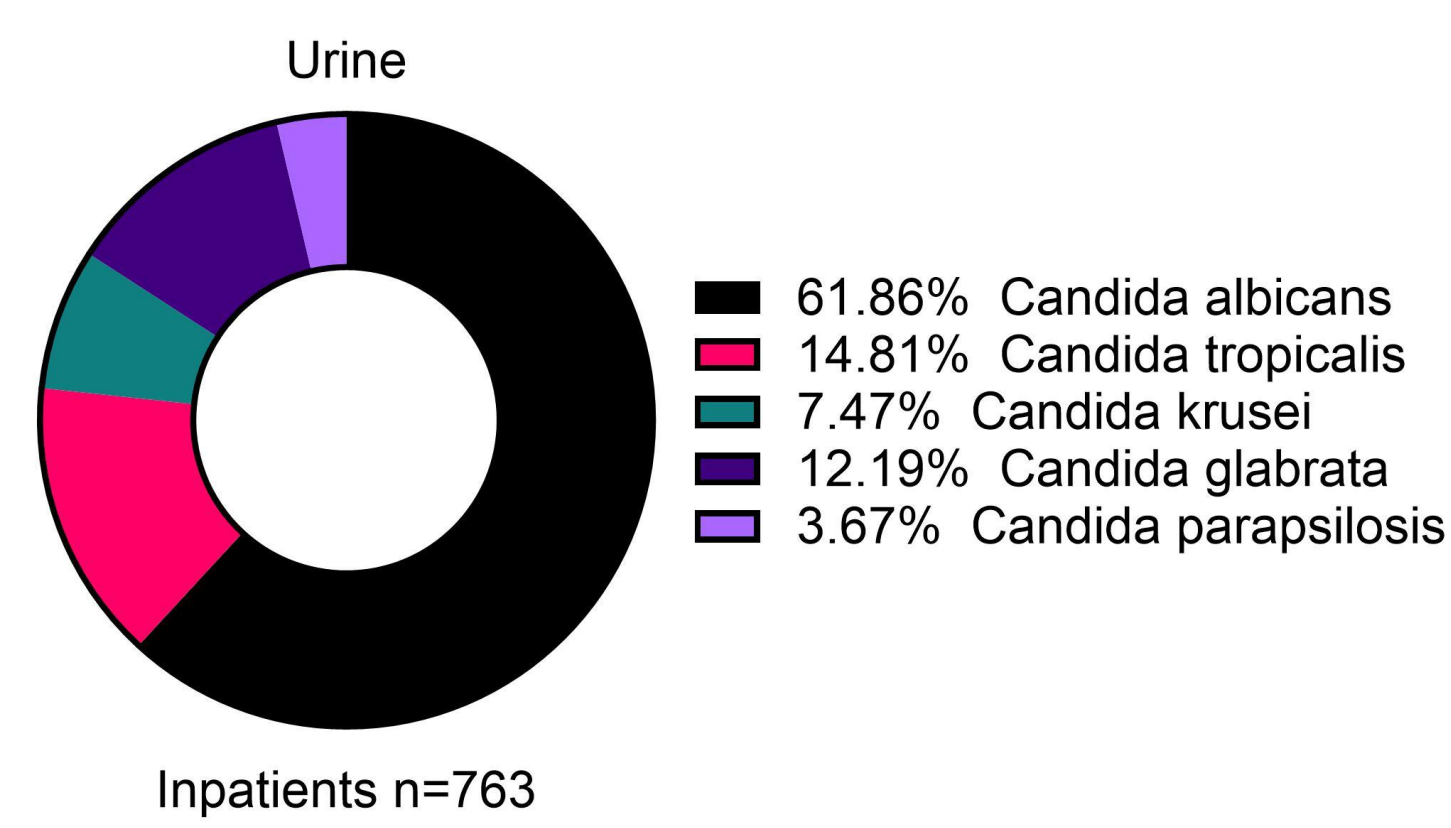


Table 3. Resistance among candida isolates from urine samples in inpatients

Species	<i>C. albicans</i> (n=472)	<i>C. tropicalis</i> (n=113)	<i>C. krusei</i> (n=57)	<i>C. glabrata</i> (n=93)	<i>C. parapsilosis</i> (n=28)
Antifungal					
Amphotericin B	3.4%	0.9%	3.6%	1.1%	0.0%
Caspofungin	2.6%	6.3%	10.9%	19.5%	14.8%
Micafungin	0.9%	2.8%	4.2%	0.0%	0.0%
Fluconazole	2.4%	2.8%	NA	NA	24.0%
Voriconazole	0.4%	0.9%	0.0%	NA	0.0%
Flucytosine	1.7%	0.0%	94.7%	2.2%	0.0%

Table 4. Resistance among candida isolates from urine samples in outpatients.

Species	<i>C. albicans</i> (n=207)	<i>C. tropicalis</i> (n=34)	<i>C. krusei</i> (n=45)	<i>C. glabrata</i> (n=81)	<i>C. parapsilosis</i> (n=15)
Antifungal					
Amphotericin B	2.9%	5.9%	6.7%	9.9%	0.0%
Caspofungin	1.0%	9.1%	0.0%	26.9%	0.0%
Micafungin	0.0%	0.0%	0.0%	3.2%	0.0%
Fluconazole	1.5%	0.0%	NA	NA	40.0%
Voriconazole	0.0%	0.0%	0.0%	NA	0.0%
Flucytosine	1.4%	0.0%	100.0%	6.2%	0.0%

Table 5. Resistance among candida isolates from sputum and Bronchoalveolar lavage samples inpatients.

Species	<i>C. albicans</i> (n=579)	<i>C. tropicalis</i> (n=49)	<i>C. krusei</i> (n=23)	<i>C. glabrata</i> (n=38)	<i>C. parapsilosis</i> (n=8)
Antifungal					
Amphotericin B	2.1%	0.0%	4.3%	7.9%	0.0%
Caspofungin	2.8%	2.0%	21.7%	13.2%	37.5%
Micafungin	0.5%	0.0%	10.0%	4.5%	0.0%
Fluconazole	3.9%	4.2%	NA	NA	14.3%
Voriconazole	0.4%	0.0%	0.0%	NA	0.0%
Flucytosine	5.0%	4.1%	95.7%	0.0%	0.0%

CONCLUSIONS

- The data set in this study is one of the largest in Jordan in recent years and provides an updated view of the growing AMR in the region and globally.
- It emphasizes the growing trend of **non-albicans candidemia** associated with **higher AMR**, especially to **echinocandins**. Additionally, *C. krusei* formed (9.5%) of blood samples, which is higher than most reports in the region and globally.
- *C. albicans* formed most of the HVS positive samples, with a notable minority of *C. glabrata*. Importantly, the **resistance rate to fluconazole was low in both**.
- *C. albicans* formed most isolates in both inpatients and outpatients urine samples. The AMR to fluconazole and flucytosine used as treatments to candiduria was low.
- When considering all isolates from **urine samples**, statistical testing indicated **no significant differences in the AMR rates between inpatient and outpatient isolates**.
- Use of the Vitek 2 system in identifying candida species and their AMR in this study should be taken in consideration.
- Studying mechanisms of AMR to echinocandins in candidemia is recommended in surveillance and molecular studies.

ADDITIONAL KEY INFORMATION

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The authors declare no competing interests.



RESULTS

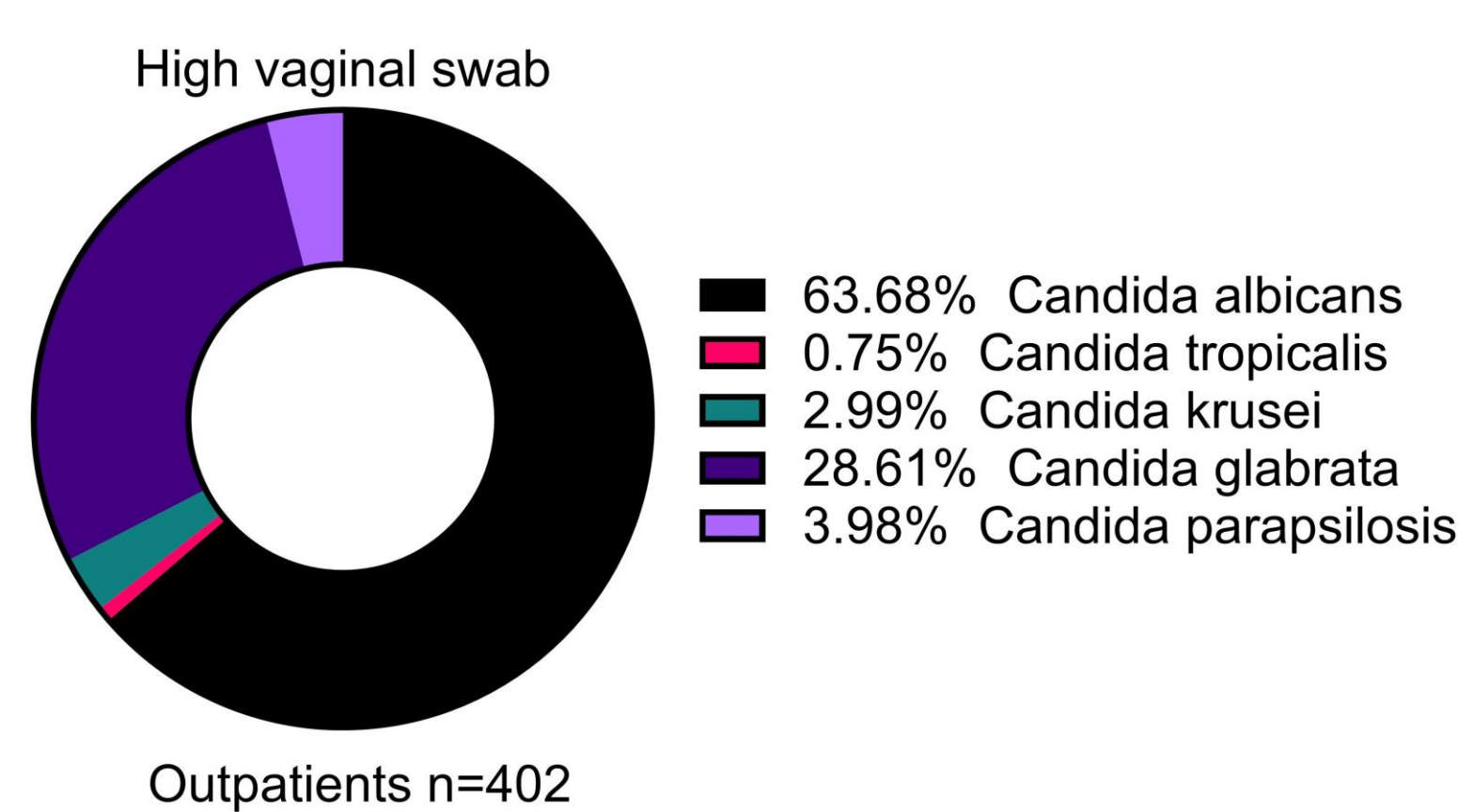
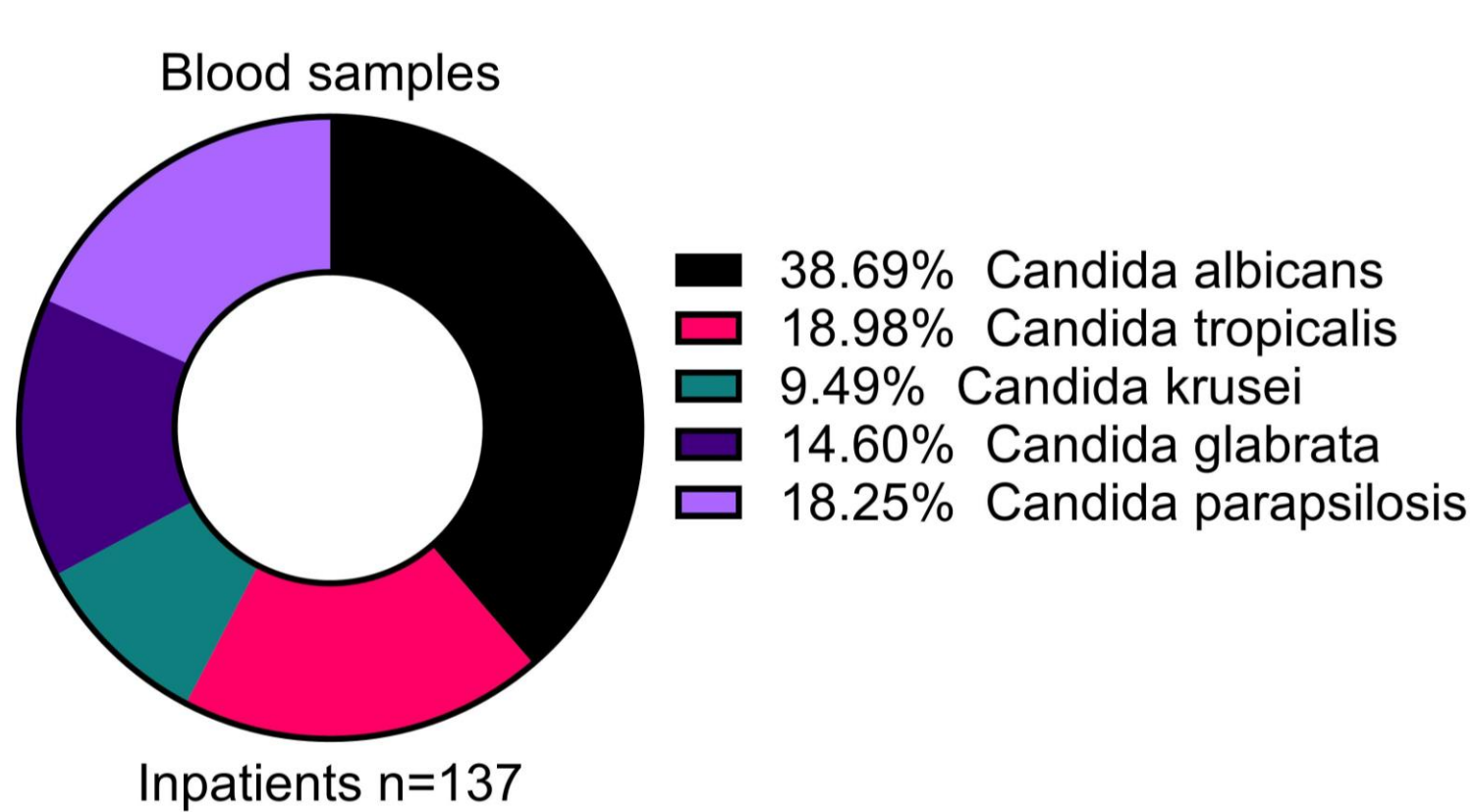


Table 1. Resistance among candida isolates from blood samples in inpatients.

Species	<i>C. albicans</i> (n=53)	<i>C. tropicalis</i> (n=26)	<i>C. krusei</i> (n=13)	<i>C. glabrata</i> (n=20)	<i>C. parapsilosis</i> (n=25)
Antifungal					
Amphotericin B	1.9%	4.0%	7.7%	0.0%	8.3%
Caspofungin	1.9%	7.7%	23.1%	30.0%	32.0%
Micafungin	0.0%	0.0%	0.0%	6.3%	5.9%
Fluconazole	1.9%	9.1%	NA	NA	0.0%
Voriconazole	0.0%	0.0%	0.0%	NA	0.0%
Flucytosine	0.0%	4.0%	92.3%	0.0%	0.0%

Table 2. Resistance among candida isolates from high vaginal swabs in outpatients.

Species	<i>C. albicans</i> (n=256)	<i>C. tropicalis</i> (n=3)	<i>C. krusei</i> (n=12)	<i>C. glabrata</i> (n=115)	<i>C. parapsilosis</i> (n=16)
Antifungal					
Amphotericin B	2.3%	0.0%	0.0%	1.8%	0.0%
Caspofungin	2.0%	0.0%	0.0%	20.4%	6.3%
Micafungin	0.0%	0.0%	0.0%	0.0%	0.0%
Fluconazole	2.0%	33.3%	NA	NA	93.8%
Voriconazole	0.0%	0.0%	0.0%	NA	0.0%
Flucytosine	0.4%	0.0%	100.0%	1.7%	0.0%