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Comparison of Vitek 2C antifungal susceptibility testing with broth microdilution testing for Candida species

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Abstract

Background: The reference method for antifungal susceptibility testing is broth microdilution according to Clinical and Laboratory Standard Institute (CLSI) guidelines. However, the fully automated system, Vitek 2C system may reduce the workload and observer bias associated with manual broth microdilution. This study aimed to compare the results of YS08 card with the results of the broth microdilution (BMD) method.

Methods: A total of 50 clinical Candida isolates were included in the study. The susceptibility testing was done by Vitek 2C using the YS08 card. Broth microdilution was done according to CLSI guidelines M27M44S-Ed3.

Results: For C. albicans, the categorical agreement was 85.8%, 71.5%, 85.8%, and 100% for fluconazole, voriconazole, caspofungin, and micafungin, respectively. The minor errors (MiE) of 14.2% for fluconazole and caspofungin, 28.5% for voriconazole, were detected in C. albicans. In C. glabrata, the categorical agreement (CA) was 100% for micafungin, voriconazole, but 63.7% for caspofungin. An MiE of 36.3% was detected for caspofungin. C. parapsilosis showed a 100% CA for fluconazole, caspofungin, and micafungin, and 85.8% for voriconazole. There were 14.2% of MiEs for voriconazole. In C. tropicalis, 100 % CA was observed for fluconazole, micafungin, and caspofungin, and 88.9% for voriconazole. Moreover, 11.1% (1/9) of MiEs was observed for voriconazole. In C. auris, there was a 100% CA for caspofungin and micafungin, 77.8% for fluconazole, and 66.7% for amphotericin B. There was a major error of 22.2% for fluconazole and 33.3% for amphotericin B.

Conclusion: The majority of Vitek 2C showed comparable results with the broth microdilution (BMD) method. Only minor errors (MiEs) were observed in the tested Candida species.

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Introduction

Candida infections are one of the most common causes of invasive fungal infections in hospitals, leading to high morbidity and mortality, particularly in patients in intensive care units (1,2). In recent years, azole-resistant non-Candida albicans and multidrug-resistant Candida auris have emerged as important pathogens, resulting in treatment failures (2,3). Hence antifungal susceptibility testing (AFST) is important to monitor the development of resistance in these species. We need a faster and more reliable method for AFST. According to the Clinical and Laboratory Standard Institute (CLSI) guidelines, the reference method for AFST is Broth microdilution (BMD). However, the fully automated system, Vitek 2C system may reduce the workload and observer bias associated with manual BMD. It has also been updated for AFST of Candida species and interpreted as per the latest CLSI guidelines. The aim of this study was to compare the antifungal susceptibility results of Candida spp. with Vitek 2 AST-YS08 card and standard BMD method.

Methods

A total of 50 isolates of Candida spp. from blood cultures were included in the study from January 2022 to December 2022. Identification was done by the Vitek 2C system using the YST card (bioMérieux, Marcy l'Etoile, France). The antifungal susceptibility testing was done both by Vitek 2C using the YS08 (bioMérieux, Marcy l'Etoile, France) card, and BMD was done according to the CLSI guidelines M27M44S-Ed3 (4). The CLSI quality control isolate Candida parapsilosis ATCC 22019 was used as a control for each run.

The following drugs were tested, and the range of the concentration was 0.125-64 µg/L for fluconazole, and 0.03-16 µg/L for voriconazole, caspofungin, micafungin, and amphotericin B. The antifungal powders were procured from Sigma-Aldrich, United States. The test was done in duplicate. Discrepant results were repeated by both Vitek 2C and BMD. The BMD plates were incubated at 35 ○C for 24 hrs. The results were interpreted as per CLSI guidelines M27M44S-Ed3 (5). Vitek 2C does not display MIC for C. auris. The results of MIC were extrapolated in Vitek 2C by choosing any non-Candida albicans. The breakpoints recommended by the CDC were used for C. auris (6).

Discrepancies among MIC endpoints of more than two dilutions (Two wells) were used to calculate the essential agreement (EA) between the MICs determined with the Vitek 2 system and by the reference BMD (2). Categorical agreement (CA) was defined as the percentage of isolates classified in the same category by the reference procedures and the test method (7). Very major errors (VME) were defined when the isolate was considered resistant by the reference procedure but susceptible by the VITEK 2 system. Major errors (ME) occurred when the isolate was susceptible by the reference method but resistant by the VITEK 2 system, and minor error (MiE) were identified when the results by one of the methods included susceptible or resistant and susceptible-dose dependent/intermediate by the other method (8).

Results

The isolates of Candida included seven Candida albicans, nine Candida tropicalis, fourteen Candida parapsilosis, eleven Candida glabrata, and nine Candida auris. For C. albicans, the categorical agreement was 85.8%, 71.5%, 85.8%, and 100% for fluconazole, voriconazole, caspofungin, and micafungin, respectively. The MiE of 14.2% was detected for fluconazole and caspofungin, as well as 28.5% for voriconazole, in C. albicans. In C. glabrata, the CA was 100% for micafungin and voriconazole, while 63.7% for caspofungin. An MiE of 36.3% for caspofungin were detected. C. parapsilosis showed 100% CA for fluconazole, caspofungin, micafungin and 85.8% for voriconazole. There were 14.2% of MiEs for voriconazole. In C. tropicalis, a 100% CA was observed for fluconazole, micafungin, and caspofungin, and 88.9% for voriconazole. Also, an MiE of 11.1% (1/9) was observed for voriconazole. In C. auris, there was a 100% CA observed for caspofungin and micafungin, 77.8% for fluconazole, and 66.7% for amphotericin B. There was an ME of 22.2% for fluconazole and 33.3% for amphotericin B.

The susceptibility pattern of the Candida spp. by BMD and Vitek 2C is shown in Table 1. The agreement between the results of Vitek 2C antifungal susceptibility testing with broth microdilution was high for all tested Candida spp. (Table 2).

Discussion

Antifungal susceptibility testing will help clinicians start appropriate treatment for invasive Candidal infections. The standard method for AFST is BMD, which is time-consuming and difficult to perform (9). The Vitek 2 YS08 card has been updated for AFST according to the CLSI guidelines. It is easy to perform and the time consumed is shorter compared to BMD (1). In the present study, AFST was done for 50 isolates of Candida spp. against fluconazole, voriconazole, caspofungin, and micafungin. Many studies have compared Vitek 2 results with CLSI BMD at 24 hrs and 48 hrs of incubation (9,10,11). In the present study, the BMD plates were read at 24hrs as per CLSI guidelines (6). In the present study, the EA for fluconazole, caspofungin and micafungin was 100% across all tested Candida spp., while it was lower for voriconazole in C. albicans and C.

parapsilosis. The comparison of the EA, CA, and various errors from different studies is shown in Table 3.

There was an MiE of 14.2% in case of C. albicans and ME of 22.2% in case of C. auris for fluconazole. Vitek 2 does not show the MIC for fluconazole in C. glabrata as the modified fluconazole formulation has not been validated for the species. Hence, this drug was not compared in the present study for C. glabrata (1). In the present study, we reported MiE for voriconazole for the Candida spp. Other studies have reported both minor and major errors for voriconazole (Table 3). For voriconazole, there are no breakpoints for C. glabrata in CLSI (5) and for C. auris in CDC (4). In the case of C. glabrata, there is insufficient data to correlate between in vitro susceptibility testing and clinical outcomes for voriconazole (5).

Minor errors (MiEs) were observed with caspofungin in C. albicans and C. glabrata in the present study. In other studies, there were both minor and major errors for caspofungin (Table 3). In the case of C. glabrata, micafungin results are more reliable in YS08 than caspofungin as there is a high chance of false resistance (12). Eight isolates of C. glabrata were resistant and one isolate had intermediate susceptibility to caspofungin in our study. According to the CLSI guidelines, caspofungin resistance should be confirmed with additional testing such as micafungin/anidulafungin and DNA sequence analysis of FKS genes (5). In the current study, no minor or major errors were observed with micafungin for other Candida spp., while there was an ME with micafungin in a study from Korea (1). The breakpoints for C. parapsilosis are applicable only in regions with a low prevalence of cryptic species (5).

In the case of C. auris, the EA was low for amphotericin B and there was an ME of 33.3%. Hence, automated systems should be used with caution and results should be confirmed with BMD while doing AFST for C. auris (13). There are only two studies that assessed the clinical performance of YS08 cards compared with BMD using clinical isolates from the world (1,14,15). Two studies had compared YS08 with sensititer (12,16). To the best of our knowledge, this is probably the second study from India.

Conclusion

The majority of Vitek 2C antifungal susceptibility testing results were consistent with those obtained using BMD. There were MiE in the tested Candida spp. except for C. auris, which showed ME for fluconazole and amphotericin B. Thus, the Vitek 2 system provides reliable results in a shorter time, aiding clinicians in initiating timely and appropriate antifungal therapy.

Table 1. Susceptibility pattern of *Candida* spp. by BMD and Vitek 2C

Organism	Antifungal drugs	Methods	No. of isolates			
			Susceptible	Susceptible dose-dependent	Intermediate	Resistant
C. Albicans, n=7	Fluconazole	BMD	6	1	-	-
		Vitek 2C	6	-	-	1
	Voriconazole	BMD	5	-	2	-
		Vitek 2C	6	-	-	1
	Caspofungin	BMD	7	-	-	-
		Vitek 2C	6	-	1	-
	Micafungin	BMD	7	-	-	-
		Vitek 2C	7	-	-	-
C. Tropicalis, n=9	Fluconazole	BMD	8	-	-	1
		Vitek 2C	8	-	-	1
	Voriconazole	BMD	8	-	1	-
		Vitek 2C	7	-	2	-
	Caspofungin	BMD	9	-	-	-
		Vitek 2C	9	-	-	-
	Micafungin	BMD	9	-	-	-
		Vitek 2C	9	-	-	-
C. Parapsilosis, n=14	Fluconazole	BMD	13	-	-	1
		Vitek 2C	13	-	-	1
	Voriconazole	BMD	12	-	2	-
		Vitek 2C	11	-	3	-
	Caspofungin	BMD	14	-	-	-
		Vitek 2C	14	-	-	-
	Micafungin	BMD	14	-	-	-
		Vitek 2C	14	-	-	-
C. Glabrata, n=11	Caspofungin	BMD	2	-	1	8
		Vitek 2C	1	-	3	7
	Micafungin	BMD	11	-	-	-
		Vitek 2C	11	-	-	-
C. Auris, n=9	Fluconazole	BMD	4	-	-	5
		Vitek 2C	2	-	-	7
	Caspofungin	BMD	9	-	-	-
		Vitek 2C	9	-	-	-
	Micafungin	BMD	9	-	-	-
		Vitek 2C	9	-	-	-
	Amphotericin B	BMD	4	-	-	5
		Vitek 2C	1	-	-	8

Table 2. Comparison of results of Vitek 2C antifungal susceptibility testing with BMD

Organism	Antifungal drugs	No. of isolates (%)				
		EA*	CA†	VME‡	ME§	MiE‖
C. Albicans, n=7	Fluconazole	7 (100)	6 (85.8)	0	0	1 (14.2)
	Voriconazole	6 (85.7)	5 (71.5)	0	0	2 (28.5)
	Caspofungin	7 (100)	6 (85.8)	0	0	1 (14.2)
	Micafungin	7 (100)	7 (100)	0	0	0
C. Tropicalis, n=9	Fluconazole	9 (100)	9 (100)	0	0	0
	Voriconazole	9 (100)	8 (88.9)	0	0	1 (11.1)
	Caspofungin	9 (100)	9 (100)	0	0	0
	Micafungin	9 (100)	9 (100)	0	0	0
C. Parapsilosis, n=14	Fluconazole	14 (100)	9 (100)	0	0	0
	Voriconazole	13 (92.8)	12 (85.8)	0	0	2 (14.2)
	Caspofungin	14 (100)	14 (100)	0	0	0
	Micafungin	14 (100)	14 (100)	0	0	0
C. Glabrata, n=11	Caspofungin	11 (100)	7 (63.7)	0	0	4 (36.3)
	Micafungin	11 (100)	11 (100)	0	0	0
C. Auris, n=9	Fluconazole	9 (100)	7 (77.8)	0	2 (22.2)	0
	Caspofungin	9 (100)	9 (100)	0	0	0
	Micafungin	9 (100)	9 (100)	0	0	0
	Amphotericin B	6 (66.7)	6 (66.7)	0	3 (33.3)	0

*EA: Essential Agreement, †CA: Categorical Agreement, ‡VME: Very Major Error, §ME: Major Error, ||MiE: Minor Error

Table 3. Comparison with other similar studies

Study	*C. albicans*				*C. tropicalis*				*C. parapsilosis*				*C. glabrata*				*C. auris*		
Pfaller MA, USA, 2007 (10)	n-198				n-238				n-43				n-83				-		
		flu*	vor†	cas‡	mic§	flu*	vor†	cas‡	mic§	flu*	vor†	cas‡	mic§	flu*	vor†	cas‡	mic§	flu*	cas‡	mic§
	EA	97	NT‖	NT‖	NT‖	100	NT‖	NT‖	NT‖	93.3	NT‖	NT‖	NT‖	98.8	NT‖	NT‖	NT‖	NT‖	NT‖	NT‖
	CA	99	NT‖	NT‖	NT‖	100	NT‖	NT‖	NT‖	97	NT‖	NT‖	NT‖	89.2	NT‖	NT‖	NT‖	NT‖	NT‖	NT‖
	VME	0	NT‖	NT‖	NT‖	0	NT‖	NT‖	NT‖	0	NT‖	NT‖	NT‖	0	NT‖	NT‖	NT‖	NT‖	NT‖	NT‖
	ME	0	NT‖	NT‖	NT‖	0	NT‖	NT‖	NT‖	0	NT‖	NT‖	NT‖	0	NT‖	NT‖	NT‖	NT‖	NT‖	NT‖
	MiE	1	NT‖	NT‖	NT‖	0	NT‖	NT‖	NT‖	2.3	NT‖	NT‖	NT‖	10.8	NT‖	NT‖	NT‖	NT‖	NT‖	NT‖
Bourgeois N, France, 2009 (11)	n-84				n-17				n-22				n-56				-		
	EA	98.8	100	NT‖	NT‖	100	100	NT‖	NT‖	95.4	100	NT‖	NT‖	94.6	89.3	NT‖	NT‖	NT‖	NT‖	NT‖
	CA	100	98.8	NT‖	NT‖	100	100	NT‖	NT‖	100	100	NT‖	NT‖	78.6	87.5	NT‖	NT‖	NT‖	NT‖	NT‖
	VME	0	0	NT‖	NT‖	0	0	NT‖	NT‖	0	0	NT‖	NT‖	0	0	NT‖	NT‖	NT‖	NT‖	NT‖
	ME	0	0	NT‖	NT‖	0	0	NT‖	NT‖	0	0	NT‖	NT‖	1	0	NT‖	NT‖	NT‖	NT‖	NT‖
	MiE	0	1	NT‖	NT‖	0	0	NT‖	NT‖	0	0	NT‖	NT‖	11	5	NT‖	NT‖	NT‖	NT‖	NT‖
Cejudo MA, Spain, 2010 (8)	n-97				n-21				n-8				n-29				-		
	EA	92.8	95.8	NT‖	NT‖	85.7	95.2	NT‖	NT‖	100	100	NT‖	NT‖	72.4	89.6	NT‖	NT‖	NT‖	NT‖	NT‖
	CA	85.6	97	NT‖	NT‖	80.9	95.2	NT‖	NT‖	100	100	NT‖	NT‖	69	96.5	NT‖	NT‖	NT‖	NT‖	NT‖
	VME	2	1	NT‖	NT‖	0	4.8	NT‖	NT‖	0	0	NT‖	NT‖	3.5	0	NT‖	NT‖	NT‖	NT‖	NT‖
	ME	0	0	NT‖	NT‖	0	0	NT‖	NT‖	0	0	NT‖	NT‖	0	0	NT‖	NT‖	NT‖	NT‖	NT‖
	MiE	12.4	2	NT‖	NT‖	19.1	0	NT‖	NT‖	0	0	NT‖	NT‖	27.5	3.5	NT‖	NT‖	NT‖	NT‖	NT‖
Borghi E, Italy, 2010 (9)		n-324				n-37				n-142				n-74				-		
	EA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	CA	100	100	NT‖	NT‖	94.6	100	NT‖	NT‖	97.2	98.8	NT‖	NT‖	51.4	90.5	NT‖	NT‖	NT‖	NT‖	NT‖
	VME	0	0	NT‖	NT‖	0	0	NT‖	NT‖	0	0	NT‖	NT‖	12.2	0	NT‖	NT‖	NT‖	NT‖	NT‖
	ME	0	0	NT‖	NT‖	0	0	NT‖	NT‖	0	0	NT‖	NT‖	0	4	NT‖	NT‖	NT‖	NT‖	NT‖
	MiE	0	0	NT‖	NT‖	2.8	0	NT‖	NT‖	5.4	1.4	NT‖	NT‖	36.6	0	NT‖	NT‖	NT‖	NT‖	NT‖
Rajmane SV, India, 2018 (14)	n-12				n-10				n-2				n-2				-		
	EA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
	CA	100	100	NT‖	NT‖	100	100	NT‖	NT‖	100	100	NT‖	NT‖	100	100	NT‖	NT‖	NT‖	NT‖	NT‖
	VME	0	0	NT‖	NT‖	0	0	NT‖	NT‖	0	0	NT‖	NT‖	0	0	NT‖	NT‖	NT‖	NT‖	NT‖
	ME	0	0	NT‖	NT‖	0	0	NT‖	NT‖	0	0	NT‖	NT‖	0	0	NT‖	NT‖	NT‖	NT‖	NT‖
	EA	0	0	NT‖	NT‖	0	0	NT‖	NT‖	0	0	NT‖	NT‖	0	0	NT‖	NT‖	NT‖	NT‖	NT‖
Lee H, Korea, 2022 (1)	n-24				n-21				n-19				n-20				n-45		
	EA	83.3	91.7	95.8	95.8	76.3	100	100	100	89.5	100	100	100	NT‖	NT‖	45	100	42	44	44
	CA	79.2	91.7	95.8	95.8	66.7	100	100	100	84.2	100	94.7	100	NT‖	NT‖	15	100	-	-	-
	VME	12.5	4.2	4.2	4.2	0	0	0	0	5.3	0	0	0	NT‖	NT‖	0	0	-	-	-
	ME	0	4.2	0	0	0	0	0	0	0	0	0	0	NT‖	NT‖	10	0	-	-	-
	MiE	0	0	0	0	33.3	0	0	0	10.5	0	10.5	0	NT‖	NT‖	75	0	-	-	-
The present study	n-7				n-9				n-14				n-11				n-9		
	EA	100	85.7	100	100	100	100	100	100	100	92.8	100	100	NT‖	NT‖	100	100	100	100	100
	CA	85.8	71.5	85.8	100	100	88.9	100	100	100	85.8	100	100	NT‖	NT‖	63.7	100	77.8	-	-
	VME	0	0	0	0	0	0	0	0	0	0	0	0	NT‖	NT‖	0	0	-	-	-
	ME	0	0	0	0	0	0	0	0	0	0	0	0	NT‖	NT‖	0	0	22.2	-	-
	MiE	14.2	28.5	14.2	0	0	11.1	0	0	0	14.2	0	0	NT‖	NT‖	36.3	0	-	-	-

flu*-fluconazole, vor†-voriconazole, cas‡-caspofungin, mic§-micafungin, NT‖ -Not tested

Shaded areas indicate errors in the studies

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Ethical statement

Since this study included isolates from samples routinely sent to the Department of Microbiology and did not involve any patient details or clinical trial, ethical approval was not applicable.

Conflicts of interest

The authors declare no conflict of interest.

Author contributions

SS: designed the concept, conducted the literature review, wrote the manuscript, analyzed the results, and edited the manuscript. NARS: handled the technical aspects and reviewed the manuscript. UP: contributed to the concept design and reviewed the manuscript.

References

1. Lee H, Choi SH, Oh J, Koo J, Lee HJ, Cho SI, et al. Comparison of Six Antifungal Susceptibilities of 11 Candida Species Using the VITEK2 AST-YS08 Card and Broth Microdilution Method. Microbiol Spectr. 2022;10:e0125321. [View at Publisher] [DOI] [PMID] [Google Scholar]
2. Peterson JF, Pfaller MA, Diekema DJ, Rinaldi MG, Riebe KM, Ledeboer NA. Multicenter comparison of the Vitek 2 antifungal susceptibility test with the CLSI broth microdilution reference method for testing caspofungin, micafungin, and posaconazole against Candida spp. J Clin Microbiol. 2011;49:1765-71. [View at Publisher] [DOI] [PMID] [Google Scholar]
3. Melhem MS, Bertoletti A, Lucca HR, Silva RB, Meneghin FA, Szeszs MW. Use of the VITEK 2 system to identify and test the antifungal susceptibility of clinically relevant yeast species. Braz J Microbiol. 2014;44:1257-66. [View at Publisher] [DOI] [PMID] [Google Scholar]
4. CDC Candida auris: information for laboratorians and health professionals. Atlanta, Georgia: US Department of Health and Human Services, CDC; 2020. https://www.cdc.gov/fungal/candida-auris/health-professionals.html [View at Publisher]

5. CLSI. Performance Standards for Antifungal Susceptibility Testing of Yeasts. 3rd ed. CLSI supplement M27M44S. Clinical and Laboratory Standards Institute; 2022. [View at Publisher]
6. CLSI. Reference Method for Broth Dilution Antifungal Susceptibility Testing of Yeasts, 4th Edition. CLSI standard M27.Wayne,PA:Clinical and Laboratory Standards Institute; 2017. [View at Publisher]
7. Cuenca-Estrella M, Gomez-Lopez A, Alastruey-Izquierdo A, Bernal-Martinez L, Cuesta I, Buitrago MJ, et al. Comparison of the Vitek 2 antifungal susceptibility system with the clinical and laboratory standards institute (CLSI) and European Committee on Antimicrobial Susceptibility Testing (EUCAST) Broth Microdilution Reference Methods and with the Sensititre YeastOne and Etest techniques for in vitro detection of antifungal resistance in yeast isolates. J Clin Microbiol. 2010;48:1782-6. [View at Publisher] [DOI] [PMID] [Google Scholar]
8. Cejudo MA, Gallego AG, Lacasa EC, Aller AI, Romero A, García JP, et al. Evaluation of the VITEK 2 system to test the susceptibility of Candida spp., Trichosporon asahii and Cryptococcus neoformans to amphotericin B, flucytosine, fluconazole and voriconazole: a comparison with the M27-A3 reference method. Med Mycol. 2010;48:710-9. [View at Publisher] [DOI] [PMID] [Google Scholar]
9. Borghi E, Iatta R, Sciota R, Biassoni C, Cuna T, Montagna MT, Morace G. Comparative evaluation of the Vitek 2 yeast susceptibility test and CLSI broth microdilution reference method for testing antifungal susceptibility of invasive fungal isolates in Italy: the GISIA3 study. J Clin Microbiol. 2010;48:3153-7. [View at Publisher] [DOI] [PMID] [Google Scholar]
10. Pfaller MA, Diekema DJ, Procop GW, Rinaldi MG. Multicenter comparison of the VITEK 2 yeast susceptibility test with the CLSI broth microdilution reference method for testing fluconazole against Candida spp. J Clin Microbiol. 2007;45:796-802. [View at Publisher] [DOI] [PMID] [Google Scholar]
11. Bourgeois N, Dehandschoewercker L, Bertout S, Bousquet PJ, Rispail P, Lachaud L. Antifungal susceptibility of 205 Candida spp. isolated primarily during invasive Candidiasis and comparison of the Vitek 2 system with the CLSI broth microdilution and Etest methods. J Clin Microbiol. 2010;48:154-61. [View at Publisher] [DOI] [PMID] [Google Scholar]
12. Lim HJ, Shin JH, Kim MN, Yong D, Byun SA, Choi MJ, et al. Evaluation of two commercial broth microdilution methods using different interpretive criteria for the detection of molecularmechanisms of acquired azole and echinocandin resistance in four commonCandida species. Antimicrob Agents Chemother 2020;64:e00740-20. [View at Publisher] [DOI] [PMID] [Google Scholar]
13. Welsh RM, Sexton DJ, Forsberg K, Vallabhaneni S, Litvintseva A. Insights into the Unique Nature of the East Asian Clade of the Emerging Pathogenic Yeast Candida auris. J Clin Microbiol. 2019;57:e00007-19. [View at Publisher] [DOI] [PMID] [Google Scholar]
14. Rajmane SV, Mohite TS. Comparison of the VITEK 2 Yeast Antifungal Susceptibility Testing with CLSI Broth Microdilution Reference Method for Testing Four Antifungal Drugs against Candida species Isolated from Blood Samples. JKIMSU. 2018;7:40-6. [View at Publisher] [Google Scholar]
15. Pfaller MA, Diekema DJ, Procop GW, Rinaldi MG. Comparison of the Vitek 2 yeast susceptibility system with CLSI microdilution for antifungal susceptibility testing of fluconazole and voriconazole against Candida spp., using new clinical breakpoints and epidemiological cutoff values. Diagn Microbiol Infect Dis. 2013;77:37-40. [View at Publisher] [DOI] [PMID] [Google Scholar]
16. Wong KY, Gardam D, Boan P. Comparison of Vitek 2 YS08 with Sensititre YeastOne for Candida susceptibility testing. Pathology. 2019;51:668-9. [View at Publisher] [DOI] [PMID] [Google Scholar]

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