GSC Advanced Research and Reviews

eISSN: 2582-4597 CODEN (USA): GARRC2

Cross Ref DOI: 10.30574/gscarr

Journal homepage: https://gsconlinepress.com/journals/gscarr/

(RESEARCH ARTICLE)

Check for updates

Epidemiological profile of fungemia isolates at Mohammed VI university hospital, Marrakech

Nisrine Oudrhiri * and Awatif el Hakkouni

Department of Biology, Mohammed VI University Hospital, Faculty of Medicine and Pharmacy, Cadi Ayyad University, Marrakech, MAR.

GSC Advanced Research and Reviews, 2025, 25(02), 332-338

Publication history: Received 11 October 2025; revised on 19 November 2025; accepted on 21 November 2025

Article DOI: https://doi.org/10.30574/gscarr.2025.25.2.0359

Abstract

Invasive fungal infections (IFIs) are a major global health problem, especially among hospitalized and immunocompromised patients. Traditionally, critically ill ICU patients—those with invasive procedures, long hospital stays, abdominal surgery, neutropenia, or severe trauma—are the most affected. The global incidence of IFIs is rising, with over 300 million individuals affected and an estimated 1.5 million deaths annually Fungemia is defined as at least one positive blood culture for yeast or non-Aspergillus mold associated with clinical signs of infection. Yeasts are the main cause of fungemia, with Candida spp. being the most frequent agent. Increasingly, non-albicans Candida species—such as *Nakaseomyces glabratus, C. tropicalis,* and *C. parapsilosis*—are surpassing C. albicans in prevalence. The objective of our study is to determine the frequency of fungemia and describe its epidemiological characteristics at CHU Mohamed VI in Marrakech.

Keywords: Invasive fungal infections (IFIs); Fungemia; Candida spp.; Non-albicans Candida (NAC)

1. Introduction

Invasive fungal infections (IFIs) represent a major global health concern, particularly in hospitalized and immunocompromised populations [1]. Traditionally, the most frequently affected patients were the critically ill patients in intensive care units (ICUs), particularly in individuals undergoing intensive medical treatments, such as invasive procedures, prolonged stays, abdominal surgery, neutropenia or treatment for major trauma.[2]

The incidence of IFIs has increased worldwide. [3] There are over 300 million individuals affected by fungal infections. Recent multi-national analysis has estimated that fungal infections are killing 1.5 million cases annually [4].

Fungemia was defined as at least one positive blood culture for a strain of yeast or mold (non-Aspergillus) species associated with symptoms of fungal infection. Yeasts are the leading cause of fungemia, and Candida spp. is the most common agent, with a reported incidence of 0.15–1.5% in hospitalized patients with underlying malignancies [5]. However, non-albicans Candida (NAC) species, including *Nakaseomyces glabratus, C. tropicalis,* and *C. Parapsilosis* have shown an alarming increase in prevalence, surpassing C. albicans in some settings.[6]

The aim of our study is to assess the frequency of fungemia and describe it sepidemiology at the CHU Mohamed VI of Marrakech.

* Corresponding author: Nisrine Oudrhiri.

2. Material and methods

This is a retrospective study conducted within the Parasitology and Mycology Department of the Arrazi Hospital at CHU Mohamed VI in Marrakech over a period of 3 years and 3 months, from January 2022 to March 2025.

We included all patients with positive blood cultures for fungal blood stream infections. They were all hospitalized in the departments of Arrazi Hospital, CHU Mohamed VI in Marrakech.

We excluded from the study patients with negative blood cultures or bacterial positive blood cultures .

Data was collected from the database of the Parasitology-Mycology Department and from the medical records of patients admitted to the various departments of Arrazi Hospital, CHU Mohamed VI in Marrakech.

We used Microsoft Excel 2016 for statistical data analysis.

Samples taken via venipuncture were collected, when possible, before starting antifungal therapy and inoculated into Mycosis® bottles (Becton Dickinson), incubated for 10 days at 35 ± 2°C in the BACTEC 9050 automated system.

Each bottle detected as positive by the system was processed immediately. A direct microscopic examination was performed to detect fungal elements, and systematic subcultures were carried out on Sabouraud-Chloramphenicol medium incubated at 35 ± 2°C, regardless of the direct examination results.

Yeast identification was performed using the VITEK2 COMPACT system (BioMérieux) The antifungal susceptibility of isolates from fungemia cases was assessed using the dilution method on VITEK2 COMPACT, testing five antifungals (Fluconazole, Voriconazole, Caspofungin, Micafungin, 5- Fluorocytosine, and Amphotericin B).

3. Results

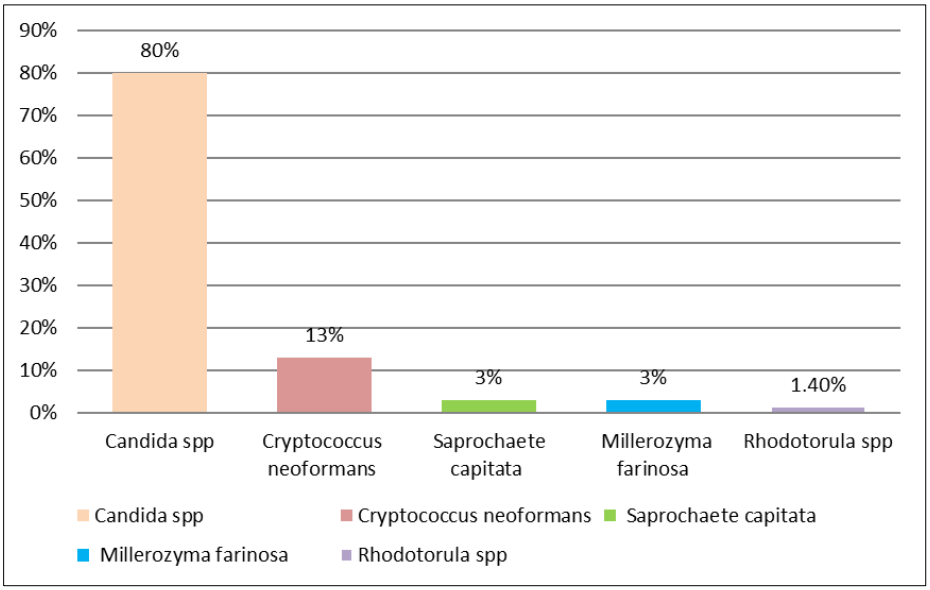

Figure 1 Proportion of Candida and Other Yeast species

The total number of blood cultures reviewed during the study period was 2395 blood cultures. A total of 69 fungal-positive blood cultures were identified during the study period representing a positivity rate of 2,88% .The average age was 33 years, with a range from 1 to 80 years.The sex ratio (M/F) was 1,39.

Fungemia cases were primarily reported in the following hospital departments: Hematology (35%), Intensive care unit (30%), Pediatric hemato-oncology (15%) Infectious diseases (12.5%), Cardiovascular surgery (5%) and Oncology (2.5%).

The total number of yeasts determined were Candida spp. 80%. and 20% were other yeasts, such as Cryptococcus neoformans (13%) Saprochaete capitata (3%) Millerozyma farinosa (3%) and Rhodotorula spp(1,4%). **(Graph 1)**

Candida tropicalis was the most frequently isolated species (25%), followed by Candida albicans (23%), Candida parapsilosis (17,4%) Nakaseomyces glabratus(5,8%) Candida lusitaniae (3%) Candida famata (1,4%) Candida utilis (1,4%) Candida kruseii (1,4%) And Candida laurentii (1,4%). (Graph 2)

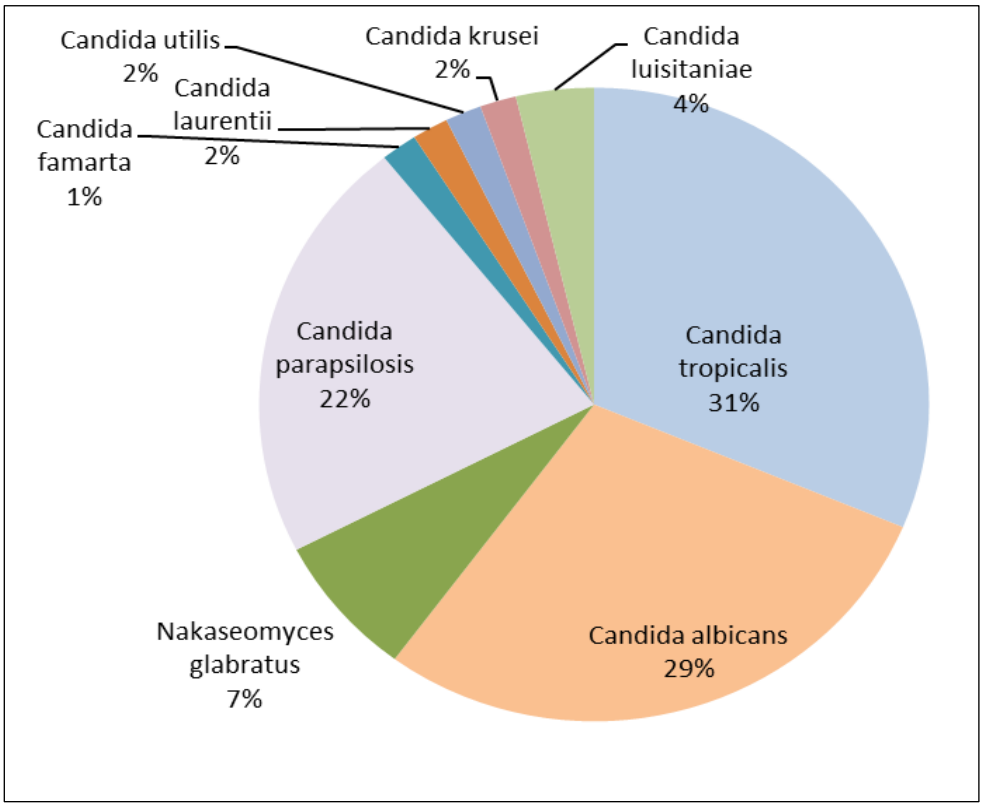

Figure 2 Species distribution of Candida isolates

The proportion of candidemia caused by C. albicans versus non-albicans Candida was 23% vs 57%, respectively.

During the study period, two cases of mixed fungemia were identified (representing a rate of 0.08% of all fungemias). The first case involved Candida tropicalis and Candida krusei, while the second case involved Candida laurentii and Rhodotorula glutinis.

All isolated strains were 100% susceptible to amphotericin B, 94% susceptible to flucytosine, 94% susceptible to fluconazole and 83% to echinocandins.

4. Discussion

Fungal bloodstream infections (BSIs) are a serious public health issue, with increasing incidence among immunocompromised and hospitalized patients. They are associated with high morbidity and mortality rates averaging around 35 % and ranging from 30 to 40 % in the largest series [7][8]

During the study period, Fungal BSIs represented 2,88% of all positive blood cultures, which aligns with the rates reported in recent literature, typically ranging between 2% and 6% acrossvarious hospital settings . [9][10]

In our study, non-albicans Candida species were more frequently isolated from blood cultures than Candida albicans. This finding aligns with previous reports from Asia and North Africa, where species such as Candida tropicalis, Candida parapsilosis, and Nakaseomyces glabratus have been reported to predominate in bloodstream infections [11][12]. However, other studies—particularly from North America—have shown a continued predominance of Candida albicans [13].

The distribution of Candida species may vary depending on factors such as patient populations, local epidemiology, and antifungal prescription practices [14]. For instance, Candida glabrata is the second most commonly reported species in the United States, Northern Europe, and Australia, whereas C. parapsilosisis the most prevalent non-albicansspecies in Latin America, Southern Europe, and Asia [15][16].

The rising incidence of bloodstream infections caused by non-albicans Candida species is concerning, as these species differ from Candida albicans in their epidemiology and antifungal susceptibility patterns, and may exhibit both inherent and acquiredr esistance to antifungal agents.[17][18]

While candidemia remains the most common form of fungemia, our findings confirm that otherfungal pathogens can also be isolated. Specifically, we identified cases caused by Cryptococcus spp., Saprochaete capitata, Millerozyma farinosa, and Rhodotorula spp. Although these fungi account for a small proportion of fungemia cases, they are associated with significant morbidity and mortality [19]. These infections are likely under-recognized and under-reported in routine clinical practice due to diagnostic limitations and potential misidentification .

Among non-Candida yeasts, Cryptococcus species are the most common fungalpathogens responsible for community-acquired invasive fungal diseases, particularly in immunocompromised individuals. [20].In our study, Cryptococcus neoformans was isolated in 13% of fungemia cases, representing a relatively high proportion compared to previously reported data in the literature[21][22]. This difference may be attributed to the high proportion of immunocompromised patients in our population.

Rhodotorula, a yeast belonging to the Basidiomycota phylum, is a common environmental organism [23]. However, bloodstream infections caused by Rhodotorula are extremely rare and are primarily associated with underlying immunosuppression [24][25][26]. The presence of a central venous catheter is considered the main risk factor. Recent studies have reported the incidence of Rhodotorula fungemia ranging from 0.5% to 2.3% in the United States and Europe [27].

Millerozy mafarinosa, (formerly known as Pichia farinosa), is typically associated with catheter-related blood stream infections in immunocompromised patients [30][29]. In contrast, S. capitata (formerly Geotrichum capitatum) is classically reported in neutropenic patients with hematologic malignancies [31]. Their isolation from blood cultures should prompt clinical vigilance and the initiation of appropriat eantifungal therapy.

Antifungal resistance remains a significant clinical challenge, particularly among non-albicans Candida and emerging yeast species. In our study, we observed resistance to azole antifungals in four isolates: one Candida krusei, one Rhodotorulas pp., and two Saprochaete capitata (formerly Geotrichum capitatum). This aligns with previous reports describing C. krusei as intrinsically resistant to fluconazole [32], and Rhodotorula as naturally resistant to most azoles due to efflux mechanisms and reduced drug target affinity [33].

Resistance to echinocandins was detected in 12 isolates, including all Cryptococcus neoformans (n=9), two S. capitata, and one Rhodotorula, which is consistent with the known intrinsic resistance of these species due to the low expression or absence of β-1,3-glucan synthase, the target of echinocandins [34].

Additionally, flucytosine resistance was observed in four isolates (Rhodotorula spp., C. tropicalis, C. krusei, and C. lusitaniae), indicating possible acquired resistance or reduced susceptibility, especially in Candida species where resistance can emerge during treatment [35].

These findings emphasize the need for routine antifungal susceptibility testing and identification, particularly in high-risk patients, to ensure appropriate and effective therapy.

5. Conclusion

Fungal blood stream infections are frequently fatal opportunistic infections. Early and accurate diagnosis, particularly of antifungal-resistant cases, is crucial for effective patient management. Collaboration between clinicians and mycologists is essential to monitor changes in the distribution of Candida and non-Candida species and to reduce the emergence of multidrug resistance by avoiding unnecessary antifungal use.

Compliance with ethical standards

Disclosure of conflict of interest

Disclosure of conflict of interest There is no conflict of interest.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study by signing the Free and Informed Consent Form.

References

[1] Branda, F.; Petrosillo, N.; Ceccarelli, G.; Giovanetti, M.; De Vito, A.; Madeddu, G.; Scarpa, F.; Ciccozzi, M. Antifungal Agents in the 21st Century: Advances, Challenges, and Future Perspectives. Infect. Dis. Rep. 2025, 17, 91. https://doi.org/10.3390/idr17040091

[2] Bitar D, Lortholary O, Le Strat Y et al. Population-based analysis of invasive fungal infections, France, 2001–2010. Emerg Infect Dis 2014; 20: 1149–55. https://doi.org/10.3201/eid2007.140087

[3] Suleyman G, Alangaden GJ. Nosocomial fungal infections: epidemiology, infection control, and prevention. Infect Dis Clin North Am 2021; 35: 1027–53. https://doi.org/10.1016/j.idc.2021.08.002

[4] Bongomin F, Gago S, Oladele RO, Denning DW. Global and Multi-National Prevalence of Fungal Diseases-Estimate Precision. J Fungi (Basel). (2017) 3(4):57. doi: 10.3390/jof3040057

[5] Cornely, O.A.; Gachot, B.; Akan, H.; Bassetti, M.; Uzun, O.; Kibbler, C.; Marchetti, O.; de Burghgraeve, P.; Ramadan, S.; Pylkkanen, L.; et al. Epidemiology and Outcome of Fungemia in a Cancer Cohort of the Infectious Diseases Group (IDG) of the European Organization for Research and Treatment of Cancer (EORTC 65031). Clin. Infect. Dis. 2015, 61, 324–331.

[6] Pappas PG, Lionakis MS, Arendrup MC et al. Invasive candidiasis. Nat Rev Dis Primer 2018; 4: 18026. https://doi.org/10.1038/nrdp.2018.26

[7] Marchetti O, Billie J, Fluckiger U .Epidemiology of candidemia in Swiss Tertiary care hospitals : Secular Trends, 1991-2000 . Clinical infectious Diseases, volume 38, Issue 3, 1 February2004, Pages 311-320 . Https://doi.org/10.1086/360637

[8] Pittet D, Li N, Wenzel RP. Association of secondary and polymicrobial nosocomial bloodstream infections with higher mortality. Eur J Clin Microbiol Infect Dis. 1993;12(11):813-9.

[9] Geremia N, Bragato B, Giovagnorio F, Zuglian G, Brugnaro P, Solinas M, Distribution and prevalence of fungemia: a five-year retrospective multicentric survey in Venetian region, Italy JAC Antimicrob Resist.2025 Mar 25;7(2):dlaf044. doi: 10.1093/jacamr/dlaf044

[10] Jorge Alberto Cortés,, Patricia Reyes, Carlos Gómez, Giancarlo Buitrago, Aura Lucía Lea Fungal bloodstream infections in tertiary care hospitals in Colombia DOI: 10.1016/j.riam.2010.12.002

[11] Zhang W, Song X, Wu H, Zheng R (2019). Epidemiology, risk factors and outcomes of Candida albicans vs. non-albicans candidaemia in adult patients in Northeast China. Epidemiology and Infection 147, e277, 1–8. https://doi.org/10.1017/

[12] D. Arrache∗, K. Madani, H. Zait, I. Achir, N. Younsi, A. Zebdi, L. Bouahri, F. Chaouche, B. Hamriou .Fongémies diagnostiquées au laboratoire de parasitologie-mycologie du CHU Mustapha d'Alger, Algérie (2004—2014) DOI:10.1016/j.mycmed.2015.06.049

[13] Jenkins EN, Gold JAW, Benedict K, et al. Population Based Active Surveillance for Culture Confirmed Candidemia — 10 Sites, United States, 2017–2021. MMWR Surveill Summ. 2025;74(4):1–15. doi:10.15585/mmwr.ss7404a1

[14] M A Pfaller, D J Diekema, Rare and Emerging Opportunistic Fungal Pathogens: Concern for Resistance beyond Candida albicans and Aspergillus fumigatus .J Clin Microbiol. 2004 Oct;42(10):4419–4431. doi: 10.1128/JCM.42.10.4419-4431.2004

[15] Pfaller MA, Diekema DJ, Turnidge JD, Castanheira M, Jones RN. Twenty Years of the SENTRY Antifungal Surveillance Program: Results for Candida Species From 1997-2016. Open Forum Infect Dis. 2019 Mar;6(Suppl 1):S79-S94

[16] Chapman B, Slavin M, Marriott D, Halliday C, Kidd S, Arthur I, Bak N, Heath CH, Kennedy K, Morrissey CO, Sorrell TC, van Hal S, Keighley C, Goeman E, Underwood N, Hajkowicz K, Hofmeyr A, Leung M, Macesic N, Botes J, Blyth C, Cooley L, George CR, Kalukottege P, Kesson A, McMullan B, Baird R, Robson J, Korman TM, Pendle S, Weeks K, Liu E, Cheong E, Chen S., Australian and New Zealand Mycoses Interest Group. Changing epidemiology of candidaemia in Australia. J Antimicrob Chemother. 2017 Apr 01;72(4):1103-1108

[17] Pappas PG, Lionakis MS, Arendrup MC, Ostrosky-Zeichner L, Kullberg BJ. Invasive candidiasis. Nat Rev Dis Primers. 2018 May 11;4:18026.

[18] Casalini G, Giacomelli A, Antinori S. The WHO fungal priority pathogens list: a crucial reappraisal to review the prioritisation. Lancet Microbe. 2024 Jul;5(7):717-724.

[19] Rogers TR, Verweij PE, Castanheira M, Dannaoui E, White PL, Arendrup MC., Subcommittee on Antifungal Susceptibility Testing (AFST) of the ESCMID European Committee for Antimicrobial Susceptibility Testing (EUCAST). Molecular mechanisms of acquired antifungal drug resistance in principal fungal pathogens and EUCAST guidance for their laboratory detection and clinical implications. J Antimicrob Chemother. 2022 Jul 28;77(8):2053-2073.

[20] Lin S-Y, Lu P-L, Tan BH, et al.; on behalf of the Asia Fungal Working Group (AFWG). The epidemiology of non-Candida yeast isolated from blood: The Asia Surveillance Study. Mycoses. 2019;62:112–120. https://doi.org/10.1111/myc.12852

[21] Marisa H Miceli, José A Díaz, Samuel A Lee. Emerging opportunistic yeast infections. Lancet Infect Dis 2011; 11: 142–51

[22] Vargas-Espíndola, L.A.; Cuervo-Maldonado, S.I.; Enciso-Olivera, J.L.; Gómez-Rincón, J.C.; Jiménez-Cetina, L.; Sánchez-Pedraza, R.; García-Guzmán, K.; López-Mora, M.J.; Álvarez-Moreno, C.A.; Cortés, J.A.; et al. Fungemia in Hospitalized Adult Patients with Hematological Malignancies: Epidemiology and Risk Factors. J. Fungi 2023, 9, 400. https://doi.org/10.3390/jof9040400

[23] Distribution and prevalence of fungemia: a five-year retrospective multicentric survey in Venetian region, Italy / Nicholas Geremia 1,2,✉, Beatrice Bragato 3, Federico Giovagnorio 4, Gianluca Zuglian 5,6, Pierluigi Brugnaro 7, Maria Solinas 8, Paola Stano 9, Sandro Panese 10,11, Saverio Giuseppe Parisi 12 JAC Antimicrob Resist . 2025 Mar 25;7(2):dlaf044. doi: 10.1093/jacamr/dlaf044

[24] Epidemiology of Rhodotorula: an emerging pathogen F Wirth, Z. Goldani Interdiscip Perspect Infect Dis, 2012: 1-7, 2012

[25] Molecular identification, antifungal susceptibility profile, and biofilm formation of clinical and environmental Rhodotorula species isolates JM Nunes, FC Bizerra, RC Ferreira Antimicrob Agents Chemother, 57: 382-9, 2013

[26] A systematic review of 128 cases from literature FF Tuon, SF Costa Rev Iberoam Micol, 25: 135-40, 2008

[27] Central venous catheter-associated fungemia due to Rhodotorula spp.: a systematic review FF Tuon, de Almeida GM Duboc, SF Costa Med Mycol, 45: 441-7, 2007

[28] An unusual case of Rhodotorula mucilaginosa fungaemia in a cancer patient Valentino Granero Elvio Peyronel Nicoletta Mensa Nicola Liuzzi Cristina Costa Maria Rita Cavallo DOI: 10.4081/mm.2017.6827

[29] Infect Chemother. 2018 Jun 20;50(4):362–366. doi: 10.3947/ic.2018.50.4.362 Successful Treatment of Catheter Related Blood Stream Infection By Millerozyma farinosa with Micafungin: A Case ReportSun In Hong 1, Young Sun Suh 1, Hyun-Ok Kim 1, In-Gyu Bae 2, Jong Hee Shin 3, Oh-Hyun Cho

[30] Catheter-related blood stream infection caused by Millerozyma farinosa in an immunocompetent patient: a case report and a brief review of the literature Eva Maria Giada Mollaschi*, 1, Elizabeth Nagy Iskandar*, 4, Maria Carmela Esposto2, Anna Prigitano2, Giovanni Rigano3, Giorgio Rotola3, Giacomo Caneva4, Caterina Cavanna1

[31] A case of Saprochaete capitata pulmonary infection in a neutropenic HIV-infected patient Soumia Nachate, Saloua Abbassi, Hajar Elfouar, Yousra Zouine 2,4, Najat Cherif Idrissi El Ganouni, Noura Tassi, Awatif El Hakkouni,Access Microbiol . 2022 Aug 25;4(8):acmi000450. doi: 10.1099/acmi.0.000450

[32] Azole Antifungal Resistance in Candida albicans and Emerging Non-albicans Candida Species Sarah G. Whaley Elizabeth L. Berkow Jeffrey M. Rybak Andrew T. Nishimoto1Katherine S. Barker1P. David RogersFront. Microbiol., 12 January 2017| doi.org/10.3389/fmicb.2016.02173

[33] Alicia Gomez-Lopez 1, Emilia Mellado, Juan L Rodriguez-Tudela, Manuel Cuenca-EstrellaJ Susceptibility profile of 29 clinical isolates of Rhodotorula spp. and literature review Antimicrob Chemother 2005 Mar;55(3):312-6. doi: 10.1093/jac/dki020. Epub 2005 Feb 4.

[34] Louise A Walker 1, Neil AR Gow 1, Carol A Munro 1,∗Fungal echinocandin resistanceFungal Genet Biol2010 Feb;47(2):117–126. doi: 10.1016/j.fgb.2009.09.003

[35] Candidiasis and Mechanisms of Antifungal Resistance Somanon Bhattacharya,Sutthichai Sae-Tia,BettinaC.FriesAntibiotics 2020, 9(6),312; https://doi.org/10.3390/antibiotics9060312