

Έλεγχος ευαισθησίας ζυμομυκήτων και υφομυκήτων: EUCAST vs CLSI, τι άλλαξε το 2024-2025

Ιωσήφ Μελετιάδης, PhD, FECMM, FESCMID
Αναπληρωτής Καθηγητής Μικροβιολογίας

Μέθοδοι αναφοράς

CLSI

- M27 Yeast macro/micro broth dilution
- M44 Yeast disk diffusion
- M38 Mould macro/micro broth dilution
- M51 Mould disk diffusion

EUCAST

- E.Def 7 Yeast broth microdilution
- E.Def 9 Mould broth microdilution
- E.Def 10 Agar screening for azole/echinocandins resistance in *Aspergillus fumigatus*
- E.Def 11 Dermatophytes broth microdilution

Κλινικά όρια ευαισθησίας *Candida spp.*

		<i>EUCAST (S: ≤X; R: >Y)</i>			<i>CLSI (S: ≤X; R: >Y)</i>		
Echinocandins	AMB	≤1;	>1	(all species)			
	ANF	≤0.03;	>0.03	(alb)	≤0.25;	>0.5	(alb, krus, trop)
		≤0.06;	>0.06	(glab, krus, trop)	≤0.125;	>0.25	(glab)
		≤4;	>4	(para)(guillier IE)	≤2;	>4	(para, guillier)
	CSF	S αν ANF και MFG S			≤0.25;	>0.5	(alb, krus, trop)
MFG	≤0.016;	>0.016	(alb) ATU=0.03 mg/L	≤0.25;	>0.5	(alb, krus, trop)	
	≤0.03;	>0.03	(glab)	≤0.06;	>0.125	(glab)	
	≤2;	>2	(para)	≤2;	>4	(para, guillier)	
	IE		(trop, krus, guillier)				
Azoles	Fluco	≤2;	>4	(alb, trop, para) S Incr. Exp.	≤2;	>4	(alb, trop, para)
		≤0.001;	>16	(glab) S Incr. Exp.	≤32;	>32	(glab)
		-		(krus)			(krus poor target)
	Vori	≤0.06;	>0.25	(alb, dubl) S Incr. Exp.	≤0.125;	>0.5	(alb, trop, para)
		≤0.125;	>0.125	(trop, para) S Incr. Exp.	≤0.5;	>1	(krus)
		IE		(glab, krus, guillier)	IE		(glab)
Itra	≤0.06	>0.06	(alb, dubl)				
	≤0.125	>0.125	(para, trop)				
	IE		(glab, krus, guillier)				
Posa	≤0.06;	>0.06	(alb, trop, para)				
	IE		(glab, krus, guillier)				

Κλινικά όρια ευαισθησίας *Aspergillus spp*

	<i>EUCAST (S: ≤X; R: >Y)</i>			<i>CLSI (S: ≤X; R: >Y)</i>
Echinocandins	AMB	≤1;	>1	(fum, nig) (flav, nid, ter)
	ANF	IE		
	CSF	IE		
	MFG	IE		
	Fluco	-		
Azoles	Vori	≤1;	>2	(fum, nid) ATU=2 mg/L (fum, nig, ter)
	Itra	≤1;	>2	(fum, flav, nid, ter) ATU=2 mg/L (nig)
	Posa	≤0.125	>0.25	(fum, ter) ATU=0.25 mg/L (flav, nid, nig)
	Isa	≤1	>2	(flav, fum) ATU=2 mg/L
		≤1	>1	(ter)
		≤0.25	>0.25	(nid)
	IE		(nig)	

**Working
BPs**

S≤1

R>2

Tentative ECOFFs for dermatophytes

Table 5. Proposed WT-UL values for the proposed EUCAST CC method with a spectrophotometric 50% growth inhibition endpoint

	WT-UL (mg/L)			
	terbinafine	voriconazole	itraconazole	amorolfine
1 <i>T. rubrum</i>	0.03	0.125	(0.25) ^o	0.125
1 <i>T. indotineae</i>	0.125	1	(0.25) ^o	0.5

^oItraconazole WT-ULs are only tentative due to wide MIC distributions and are therefore presented in parentheses.

Μεθοδολογικές αλλαγές στην EUCAST

- **E.Def 7.4 Yeast broth microdilution**
 - Έλεγχος ευαισθησίας στην ρεζαφουγκίνη με προσθήκη Tween20 στο θρεπτικό υλικό
- **E.Def 9.4 Mould broth microdilution**
 - Φωτομετρικός προσδιορισμός MIC *A. fumigatus*
- **E.Def 10.2 Agar screening for azole/echinocandins resistance in *Aspergillus fumigatus***
 - Έλεγχος στελεχών *Trichophyton* spp

Έλεγχος ευαισθησίας στην ρεζαφουγκίνη

Χωρίς Tween 20

Με 0,002% Tween 20

Species centre	MIC (mg/L)												
	0.002	0.004	0.008	0.016	0.031	0.063	0.125	0.25	0.5	1	2	4	>4
<i>C. albicans</i>													
Laboratory 1			5	33	41	17	7						
Laboratory 2			1	44	48	7							
Laboratory 3	5	12	77	6									
Laboratory 4	1	47	47	5									
All	6	59	130	88	89	24	7						
<i>C. glabrata</i>													
Laboratory 1					24	58	29	1					
Laboratory 2					4	69	27						
Laboratory 3				16	72	11	1						
Laboratory 4				32	69								
All				48	169	138	57	1					
<i>C. krusei</i>													
Laboratory 1					17	40	41	1					
Laboratory 2					29	59	12						
Laboratory 3				7	25	68							
Laboratory 4				4	51	46	2						
All				11	122	213	55	1					
<i>C. parapsilosis</i>													
Laboratory 1						1		1	52	35	8	1	
Laboratory 2									1	87	12		
Laboratory 3									29	67	4		
Laboratory 4								5	44	51			
All						1		6	126	240	24	1	
<i>C. tropicalis</i>													
Laboratory 1	1	1			17	29	42	11	1				
Laboratory 2					7	51	41	1					
Laboratory 3	1	2		30	55	12							
Laboratory 4			2	41	44	13							
All	2	5		71	123	105	83	12	1				

Species	MIC (mg/L)*																	
	0.0002	0.0005	0.001	0.002	0.004	0.008	0.016	0.03	0.06	0.125	0.25	0.5	1	2	4	8	>8	
<i>C. albicans</i>																		
Centre 1				11	12	2												
Centre 2		1	10	12	2				<u>1</u>									
Centre 3		1	21	3														
Centre 4	1	5	15	4	1													
Centre 5		2	13	7	3													
Centre 6			1	18	5	3												
Total	1	9	71	56	13	3			<u>1</u>									
<i>C. glabrata</i>																		
Centre 1					12	13												
Centre 2						22	1	<u>1</u>					<u>1</u>					
Centre 3						10	15											
Centre 4					2	8	16											
Centre 5						11	12	2										
Centre 6						22	5											
Total					2	41	100	8	<u>1</u>				<u>1</u>					
<i>C. krusei</i>																		
Centre 1						4	19	1	<u>1</u>									
Centre 2						1	3	20	<u>1</u>									
Centre 3							25											
Centre 4							15	13										
Centre 5							11	10	4									
Centre 6							1	24	1									
Total						1	59	86	6	<u>2</u>								
<i>C. parapsilosis</i>																		
Centre 1																6	11	8
Centre 2																16	6	2
Centre 3																		<u>1</u>
Centre 4													7	11	7			
Centre 5													5	14	7			
Centre 6													1	5	15	2	2	
Total													2	24	60	76	30	10
<i>C. tropicalis</i>																		
Centre 1							7	14	4									
Centre 2							1	18	6									
Centre 3							1	18	6									
Centre 4								9	16	1								
Centre 5								3	18	4								
Centre 6								1	4	21	1							
Total							4	54	62	32	1							

Παρασκευή 0,002% Tween 20

- **Prepare 4 mL of a 10% Tween 20 solution:**

- a. Place an empty tube on a balance and adjust to zero.
- b. Transfer 400 μL Tween 20 using a tip with a wide orifice or a syringe). Note the weight transferred (density 1.1 g/mL, 400 μl = 0.44 g Tween 20).
- c. Add the following amount of sterile water, correcting for imprecise pipetting according to weight and density as follows.

$$\text{Volume of water to add (mL)} = 3.6 \text{ mL} \times \frac{\text{Weight of the Pipetted Tween (g)}}{0.44 \text{ (g)}}$$

- **Prepare Tween 20 supplemented double concentrated medium (Tween 0.004%):**

- a. add 400 μL 10% Tween 20 to 1 L medium.
- b. Mix thoroughly.

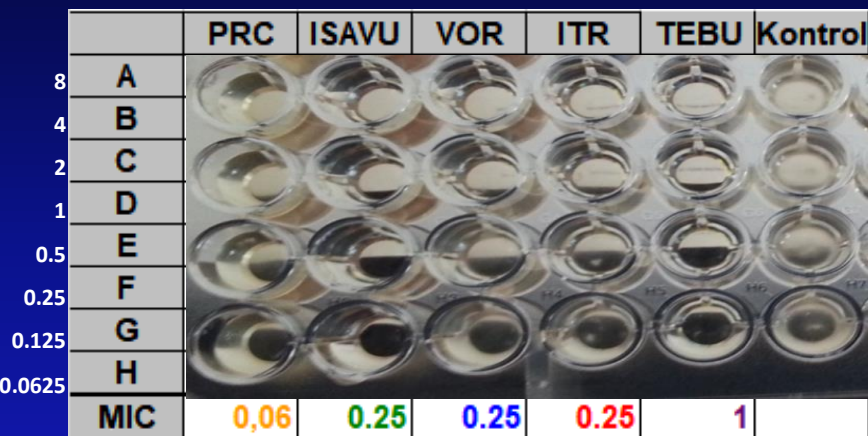
-

- **Filter sterilise using a 0.22- μm pore size filter.**

- **Store at 4 $^{\circ}\text{C}$ or lower for up to 6 months.**

Φωτομετρικός προσδιορισμός MIC για *A. fumigatus*

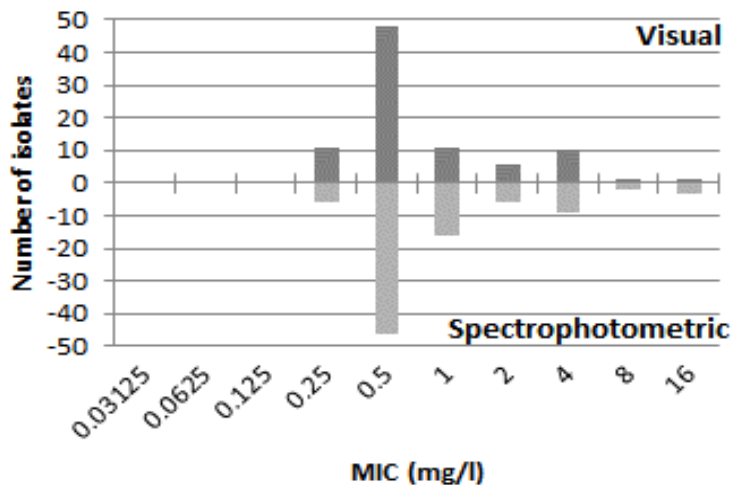
Απορρόφηση στα 490nm



Ποσοστά ανάπτυξης

	PRC	ISAVU	VOR	ITR	TEBU	Kontrol
A	0%	0%	0%	2%	0%	100%
B	-1%	-1%	0%	0%	0%	100%
C	-1%	-1%	-1%	-1%	1%	100%
D	0%	1%	0%	-1%	5%	100%
E	-1%	0%	0%	0%	105%	100%
F	-2%	9%	8%	4%	139%	100%
G	1%	92%	134%	68%	123%	100%
H	112%	117%	123%	128%	123%	100%
MIC	0,0625	0,25	0,25	0,25	1	

Voriconazole



Endpoints:

<10% απορρόφηση OD₄₉₀

**New
E. Def 9.4**

Συμφωνία:

92-99% με την οπτική ανάγνωση

Σφάλματα:

0% πολύ μεγάλα (VME), <3% μεγάλα (ME)
<6% μικρά (MiE)

Φωτομετρικός προσδιορισμός MIC για *A. fumigatus*

Original article

Spectrophotometric reading of EUCAST antifungal susceptibility testing of *Aspergillus fumigatus*

J. Meletiadis ^{1,2,*}, K. Leth Mortensen ^{3,4}, P.E. Verweij ^{5,6}, J.W. Mouton ², M.C. Arendrup ^{3,4,7}

Spectrophotometric detection of azole-resistant *Aspergillus fumigatus* with the EUCAST broth microdilution method: is it time for automated MIC reading of EUCAST antifungal susceptibility testing of *Aspergillus* species?

Joseph Meletiadis ^{1,2,*}, Ioanna Efstathiou¹, Hein A. L. van der Lee³, Karen M. T. Astvad⁴, Paul E. Verweij ^{3,5} and Maiken Cavling Arendrup ^{4,6,7}

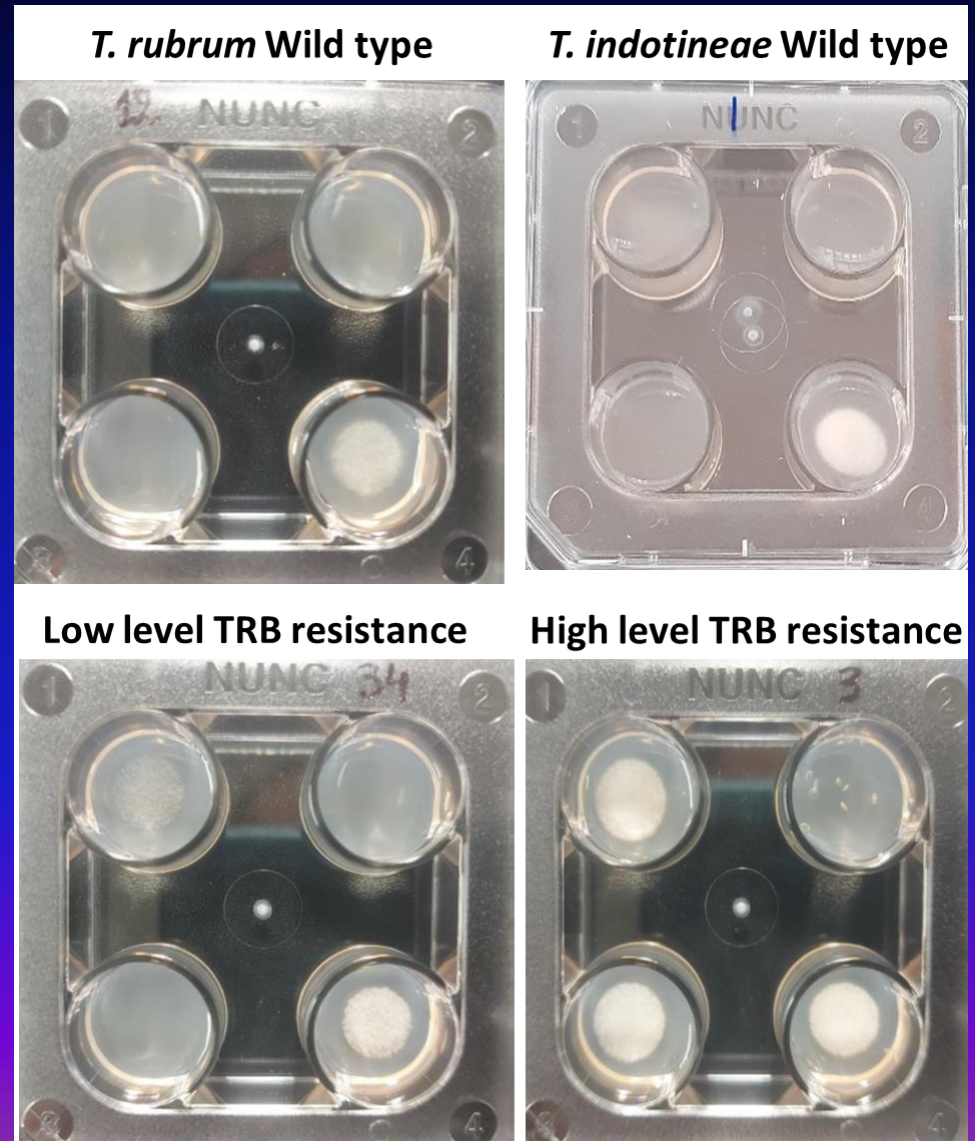
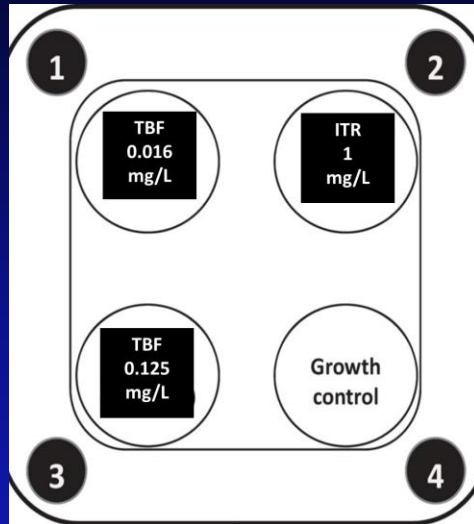
Azole and Amphotericin B MIC Values against *Aspergillus fumigatus*: High Agreement between Spectrophotometric and Visual Readings Using the EUCAST EDef 9.3.2 Procedure

Julia Serrano-Lobo,^{a,b} Ana Gómez,^{a,b} Waldo Sánchez-Yebra,^c Miguel Fajardo,^d Belén Lorenzo,^a Ferrán Sánchez-Reus,^f Inmaculada Vidal,^g Marina Fernández-Torres,^h Isabel Sánchez-Romero,ⁱ Carlos Ruiz de Alegría-Puig,^j José Luis del Pozo,^k Patricia Muñoz,^{a,b,l,m} Pilar Escribano,^{a,b} Jesús Guinea,^{a,b,l} on behalf of the ASPEIN Study Group

Spectrophotometric azole and amphotericin B MIC readings against *Aspergillus fumigatus sensu lato* using the EUCAST 9.3.2 methodology. Are ≥ 90 and $\geq 95\%$ fungal growth inhibition endpoints equally suitable?

Julia Serrano-Lobo ^{1,2}, Ana Gómez ^{1,2}, Patricia Muñoz ^{1,2,3,4}, Pilar Escribano ^{1,2,*} and Jesús Guinea on behalf of the ASPEIN study group ^{1,2,3,*}

Agar screening for *Trichophyton* spp



- Multicenter study (5 centers)
- 42 *Trichophyton* isolates
 - 17 terbinafine-resistant / 25 WT
 - 42 itraconazole WT

- **Terbinafine**
94%-100% Sensitivity, 100% Specificity
- **Itraconazole**
100% Specificity

Νέες οδηγίες EUCAST

- ✓ **Rationale Document on rezafungin v1.0**

Dosages, pharmacokinetics/pharmacodynamics plus breakpoints of rezafungin as well as MIC distributions and ECOFFs for *Candida* spp

- ✓ **What to do when there are no breakpoints**

Guidance for rare yeasts

- ✓ **Warning concerning antifungal susceptibility testing of amphotericin B**

Problems detected with several commercially available products

Rationale Document on rezafungin

Rationale for EUCAST clinical breakpoints

Agent	Rezafungin	
Current version	2.0	13 January 2025 (ECOFFs vs <i>C. auris</i>)
Previous versions	1.0	09 February 2024

3a. MIC distributions* (numbers) and epidemiological cut-off (ECOFF) values (mg/L)

5. Pharmacokinetics (PK)

6. Pharmacodynamics (PD)

7. Monte Carlo simulations and PK/PD breakpoints

8. Clinical data

9. Clinical breakpoints

PK/PD breakpoints

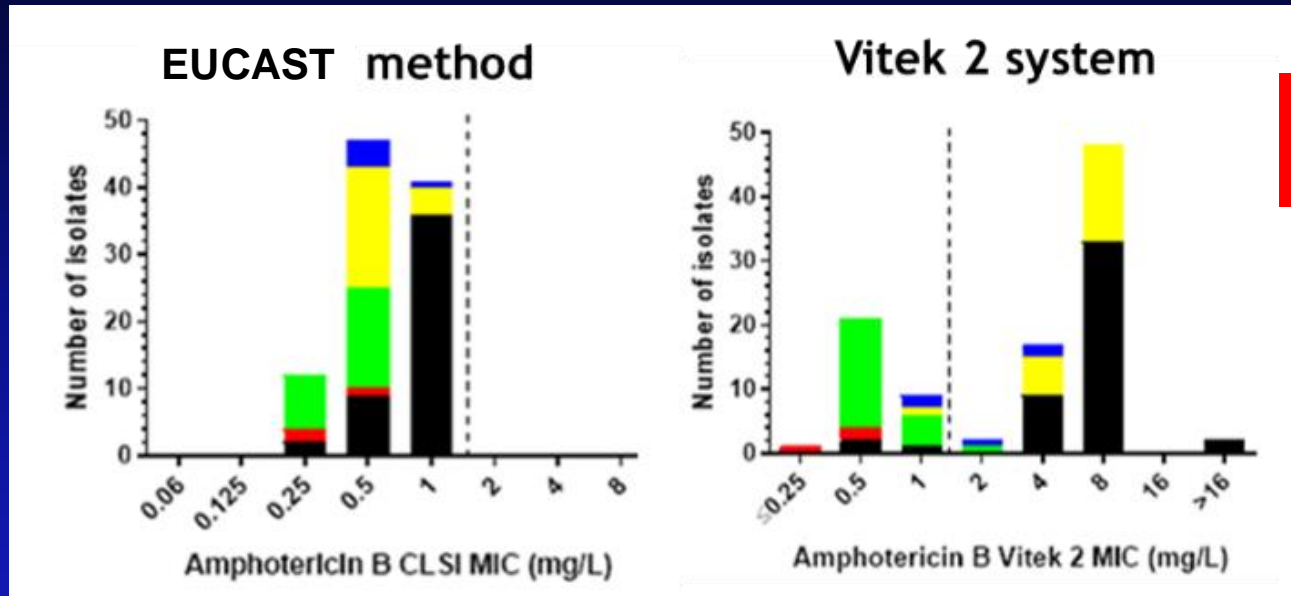
PK/PD breakpoints have been determined using PK/PD data and are independent of MIC distributions of specific species. They are for use only as a guide for organisms that do not have specific breakpoints. PK/PD breakpoints have been termed “non-species-related breakpoints” but this has led to confusion and it has become clear that PK/PD breakpoints for some agents may differ for different organisms. A non-species-specific PK/PD breakpoints cannot be defined for rezafungin as the activity of rezafungin is species specific. (See Table 7. Monte Carlo simulations and PK/PD breakpoints).

Organism group	MIC breakpoints (mg/L)		Notes
	S ≤	R >	
<i>C. albicans</i>	0.008	0.008	
<i>C. dubliniensis</i>	0.016	0.016	
<i>C. glabrata</i>	0.016	0.016	
<i>C. krusei</i>	0.03	0.03	
<i>C. parapsilosis</i>	4	4	
<i>C. tropicalis</i>	0.03	0.03	
<i>C. auris</i>	IE	IE	

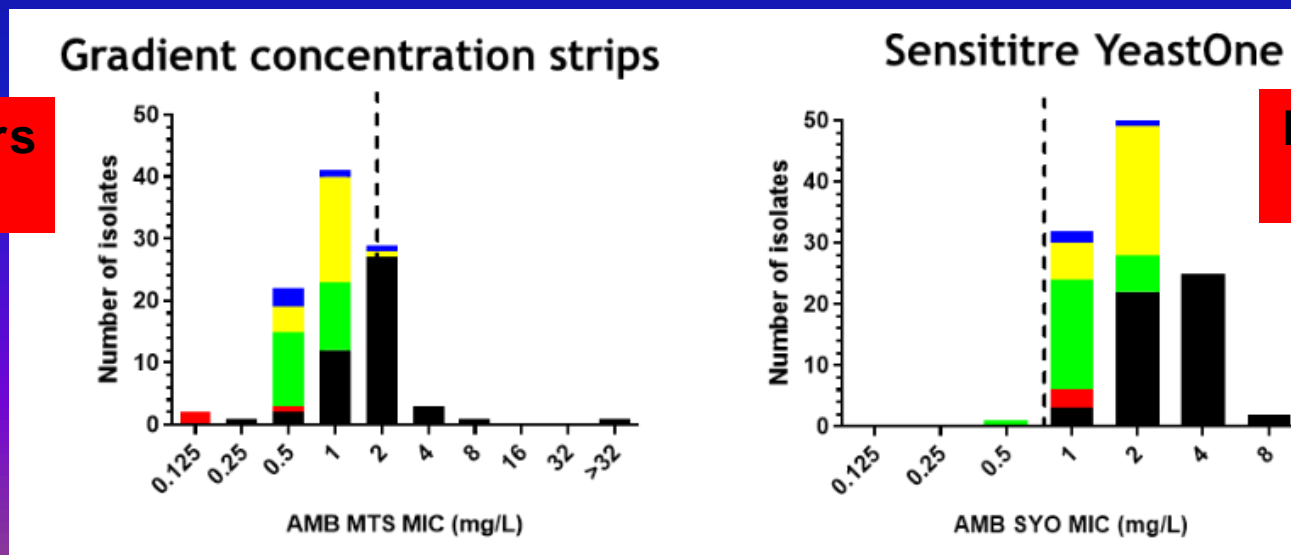
Species-related

Warning!

Amphotericin B and commercial tests



**Major errors
69%**



**Major errors
34%**

**Major errors
89%**

Species without BPs

	Amphotericin B	Anidulafungin	Fluconazole	Voriconazole
<i>Arxula (Blastobotrys)</i>				
<i>A. adenivorans, (B. adenivorans)</i>	≤ 1	≤ 0.5	R	R
<i>Candida</i>				
<i>C. bovina</i>	≤ 1		≤ 16	
<i>C. fermentati</i>	≤ 1	≤ 1?	≤ 16	≤ 0.125
<i>C. guilliermondii</i>	≤ 1	≤ 1?	≤ 16	≤ 0.125
<i>C. inconspicua</i>	≤ 1	≤ 0.06	R	≤ 1?
<i>C. intermedia</i>	≤ 1	≤ 0.125^	≤ 2	≤ 0.03
<i>C. kefyr</i>	≤ 1	≤ 0.125^	≤ 2	≤ 0.03
<i>C. lipolytica</i>	≤ 1	≤ 0.5	R	≤ 0.125
<i>C. lusitaniae</i>	R	≤ 0.125^	≤ 2	≤ 0.03
<i>C. magnoliae</i>	≤ 1	≤ 0.5	R	
<i>C. metapsilosis</i>	≤ 1	≤ 0.5	≤ 2	≤ 0.03
<i>C. nivariensis</i>	≤ 1	≤ 0.06	≤ 16	≤ 0.125
<i>C. norvegensis</i>	≤ 1	≤ 0.06	R	≤ 1?
<i>C. orthopsilosis</i>	≤ 1	≤ 0.5	≤ 2	≤ 0.03
<i>C. palmiroleophila</i>	≤ 1	≤ 0.125^	≤ 16	≤ 0.125
<i>C. pararugosa</i>	≤ 1	≤ 0.5	≤ 16	
<i>C. pelliculosa</i>	≤ 1	≤ 0.06	≤ 16	≤ 0.125
<i>C. utilis</i>	≤ 1	≤ 0.06	≤ 2	≤ 0.125
<i>Cryptococcus</i>	≤ 1	R		
<i>C. neoformans</i>	≤ 1	R	≤ 16*	≤ 0.5
<i>Geotrichum</i>	≤ 1	R		
<i>G. candidum</i>	≤ 1	R	R	≤ 1? "
<i>L. elongisporus</i>	≤ 1	≤ 0.06	≤ 2	≤ 0.03
<i>Magnusiomyces</i>	≤ 1	R		
<i>M. capitatus, M. clavatus</i>	≤ 1	R	R	≤ 1? "
<i>Pichia kluyveri</i>	≤ 1	≤ 0.06	R	≤ 1?
<i>Rhodotorula</i>	≤ 1	R		
<i>R. mucilaginosa</i>	≤ 1	R	R	R
<i>Saccharomyces cerevisiae</i>	≤ 1	≤ 0.5	≤ 16	≤ 0.125
<i>Trichosporon</i>	R *	R		
<i>T. asahii</i>	R *	R	≤ 16"	
<i>T. dermatis</i>	R *	R	≤ 16'	≤ 0.125 '

Report

“?” Formal categorising of the susceptibility of the organism is not possible. An MIC below the indicated value suggests the organism is wild-type, but there is insufficient data allow susceptibility interpretation.

Formal categorising of the susceptibility of the organism is not possible. A cautious interpretation suggests that the agent may be considered for therapy

Formal categorising of the susceptibility of the organism is not possible. A cautious interpretation suggests that the agent may be considered for therapy for the following situations: 1) non-severe infection, 2) elevated dose, 3) oral consolidation, 4) no better option

“R”: report as R (resistant).

Αλλαγές σε ECOFFs και BPs

MIC distributions of anidulafungin and micafungin have been expanded with new datasets

Anidulafungin and Candida

- ECOFF and BP for *C. albicans* have been lowered by 1 dilution (0.03→0.016 mg/L)
- ECOFF and BP have been established for *C. dubliniensis* (0.03 mg/L)
- ECOFFs have also been set for *C. kefyr* (0.125 mg/L), *C. lusitaniae* (0.125 mg/L), and *S. cerevisiae* (0.25 mg/L).

Micafungin and Candida

- ECOFF and BP for *C. albicans* have been increased by 1 dilution (0.016→0.03 mg/L)
- ATU (0.03 mg/L) for *C. albicans* and micafungin has been removed
- BPs have been established for *C. dubliniensis* and *C. tropicalis* (0.06 mg/L).
- BP has increased for *C. parapsilosis* by 1 dilution (2→4 mg/L)
- ECOFFs have been set for *C. dubliniensis* (0.06 mg/L), *C. kefyr* (0.125 mg/L), *C. lusitaniae* (0.125 mg/L), and *S. cerevisiae* (0.5 mg/L).

Azoles and Aspergillus

ATU (2 mg/L) for itraconazole and voriconazole in the *Aspergillus* sheet has been removed
Add comment: For isolates with confirmed MIC 2 mg/L (one dilution above the breakpoint), itraconazole may be considered for treatment of chronic pulmonary aspergillosis when no alternative is available and when sufficient exposure (>2 mg/L) is ensured via TDM.

C. auris ECOFF and BP (public consultation)

www.eucast.org

Table 1. Combined MIC distributions for amphotericin B, echinocandins and flucytosine (each consisting of distributions from five centres) against *C. auris*. The mode is highlighted in bold, and the MIC₅₀ in underlined font

	N	MIC (mg/L)																	ECOFF (mg/L)	
		0.002	0.004	0.008	0.016	0.03	0.06	0.125	0.25	0.5	1	2	4	8	16	32	64	128		256
Amphotericin B	153						1	6	24	<u>55</u>	64	3								2
Anidulafungin	154		1	5	14	36	<u>28</u>	8	5	2	1	1								0.25
Micafungin	154			2	8	43	<u>71</u>	22	4	3	1									0.25
Rezafungin	149	3	6	23	<u>44</u>	50	<u>17</u>	5	2	1	1									0.125
Flucytosine	153						12	<u>66</u>	56	18										0.5

Table 2. EUCAST breakpoints for *C. auris*.

	S: ≤	R: >
Amphotericin B	0.001 ^a	2
Anidulafungin	0.25	0.25
Micafungin	0.25	0.25
Rezafungin	IE ^b	IE
Flucytosine	IE ^b	IE

Meletiadis et al submitted

^aThe entire *C. auris* wild-type population is in the I category. MICs against *C. auris* should be interpreted as resistant when above 2 mg/L. Susceptible category (≤0.001 mg/L) is to avoid misclassification of “I” as “S”.

^bIE Insufficient evidence. EUCAST has refrained from setting clinical breakpoints for rezafungin and flucytosine against *C. auris*, as there is no available clinical experience for patients with *C. auris* treated with these agents

Arendrup et al submitted

CLSI ECVs and BPs

Table 1. Antifungal Agents for which Clinical Breakpoints or ECVs Are Published for Candida Species in CLSI Documents

Species	Azoles				Echinocandins			Polyenes
	Fluconazole	Voriconazole	Posaconazole	Itraconazole	Caspofungin	Micafungin	Anidulafungin	Amphotericin B
<i>Candida albicans</i>	BP / ECV	BP / ECV	ECV	–	BP	BP / ECV	BP / ECV	ECV
<i>Candida dubliniensis</i>	ECV	–	–	–	–	ECV	ECV	–
<i>Candida glabrata</i>	BP / ECV	ECV	ECV	ECV	BP	BP / ECV	BP / ECV	ECV
<i>Candida guilliermondii</i>	ECV	–	ECV	–	BP	BP / ECV	BP / ECV	–
<i>Candida krusei</i>	–	BP / ECV	ECV	–	BP	BP / ECV	BP / ECV	ECV
<i>Candida lusitanae</i>	ECV	–	ECV	ECV	–	ECV	ECV	–
<i>Candida parapsilosis</i> complex ^c	BP / ECV	BP / ECV	ECV	–	BP	BP / ECV	BP / ECV	ECV
<i>Candida tropicalis</i>	BP / ECV	BP / ECV	ECV	ECV	BP	BP / ECV	BP / ECV	ECV

Abbreviations: BP, clinical breakpoints; ECV, epidemiological cut-off values.

^a CLSI M60

^b CLSI M59

^c ECV established for *C. parapsilosis* species complex, which may include isolates of *C. orthopsilosis* and *C. metapsilosis*.

CLSI ECV and BP for echinocandins

<i>Candida</i> spp.	Rezafungin			Anidulafungin				Caspofungin				Micafungin			
	S	I	R	S	I	R	WT	S	I	R	WT	S	I	R	WT
<i>C. albicans</i>	≤0.25			≤0.25	0.5	≥1		≤0.25	0.5	≥1		≤0.25	0.5	≥1	
<i>C. glabrata</i>	≤0.5			≤0.12	0.25	≥0.5		≤0.12	0.25	≥0.5		≤0.06	0.12	≥0.25	
<i>C. tropicalis</i>	≤0.25			≤0.25	0.5	≥1		≤0.25	0.5	≥1		≤0.25	0.5	≥1	
<i>C. parapsilosis</i>	≤2			≤2	4	≥8		≤2	4	≥8		≤2	4	≥8	
<i>C. krusei</i>	≤0.25			≤0.25	0.5	≥1		≤0.25	0.5	≥1		≤0.25	0.5	≥1	
<i>C. guilliermondii</i>				≤2	4	≥8		≤2	4	≥8		≤2	4	≥8	
<i>C. dubliniensis</i>	≤0.12						≤0.12								≤0.12
<i>C. auris</i>	≤0.5					≥4 ^a	≤1			≥2 ^a	≤0.5			≥4 ^a	≤0.5
<i>C. duobushaemulonii</i>							≤1				≤0.25				≤0.5
<i>C. haemulonii</i>							≤0.5								
<i>C. kefyr</i>							≤0.25								≤0.12
<i>C. lusitaniae</i>							≤1				≤1				≤0.5
<i>C. metapsilosis</i>							≤0.5				≤0.25				≤1
<i>C. orthopsilosis</i>							≤2				≤1				≤1
<i>C. pelliculosa</i>															≤0.12

Abbreviations: ECV, epidemiological cutoff value, S, susceptible; I, intermediate; R, resistant

^a Tentative CDC breakpoints

Voriconazole Breakpoints for *Aspergillus fumigatus*



CLSI rationale document FR01
May 2024

Table 1. Current CLSI Voriconazole Breakpoints^{a,b}

Organism Group	Interpretive Categories and MIC Breakpoints, µg/mL		
	S	I	R
<i>A. fumigatus</i>	≤ 0.5	1	≥ 2

Abbreviations: I, intermediate; MIC, minimal inhibitory concentration; R, resistant; S, susceptible.

^a Last reviewed June 2019; first published in CLSI M61-Ed2.¹⁶

^b Interpretive breakpoints were derived from a collection of sequence-confirmed isolates of *A. fumigatus sensu stricto* and are not applicable to other members of the *A. fumigatus* species complex.



Ευχαριστώ



Π.Γ.Ν. ΑΤΤΙΚΟΝ