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Comparison of Al-assisted and manual interpretation of disc diffusion test from 12 antibiotics of Pseudomonas aeruginosa

Juliane Pöpsel¹, Angela Nowag¹, Steven Giglio^{2,3}, Rhys Hill^{2,3}, Hilmar Wisplinghoff^{1,4}, Nathalie Jazmati^{1,5}

1 Wisplinghoff Laboratories - Cologne (Germany), 2 Clever Culture Systems - Bach (Switzerland), 3 LBT Innovations - Adelaide (Australia), 4 Institute for Virology and Medical Microbiology, Witten/Herdecke University - Witten (Germany), 5 Institute for Medical Microbiology, Immunology and Hygiene, University Hospital of Cologne - Cologne (Germany)

Background

Pseudomonas spp., especially P. aeruginosa are among the most important nosocomial pathogens, mainly as causative agents of infections of wounds, in the respiratory and the urinary tract. Their high cell density enables them to form a mucus film that protects them from antibiotics and phagocytes, adding to their resistance and further complicating antimicrobial therapy. Rapid and reliable antimicrobial susceptibility testing (AST) is mandatory for targeted treatment of P. aeruginosa infections. Since automated AST does not always provide reliable results for some antibiotics, additional confirmatory manual testing of P. aeruginosa is often required in routine diagnostics.

Methods

Disc diffusion test of 19 P. aeruginosa isolates (12 antibiotics per isolate)

✤ Zone diameters (ZD) were measured by microbiologist and using AI (APAS Independence (CCS)) in a blinded manner.

Results

Table 4: Overall comparison of the performance, based on gold standard "microbiologist", respectively "microbiologist at APAS".

Study details or performance parameter	No. (%) MiBi (i) vs. APAS (ii)	No. (%) MiBi (i) vs. MiBi+APAS (iii)	No. (%) MiBi+APAS (iii) vs. APAS (ii)
No. of discs used for performance parameter calculation*	219	222	217
No. of S strain-drug pairs	51	49	51
No. of I strain-drug pairs	73	73	74
No. of R strain-drug pairs	95	100	92
CA* mE rate* ME rate* VME rate*	208/219 (94.98) 7/219 (3.2) 0 (0) 4/95 (4.21)	213/222 (95.95) 5/222 (2.25) 1/49 (2.04) 3/100 (3)	205/217 (94.47) 10/217 (4.61) 0 (0) 2/92 (2.17)
ATU	4/228 (1.75)	6/228 (2.63)	6/228 (2.63)
n/a	5/228 (2.19)	0/228 (0)	5/228 (2.19)

* Zone diameter in the ATU as well as discs that were not recognized by the APAS (n/a) were excluded for CA and error calculation.

✤ 100% CA in all 3 comparisons for Ciprofloxacin and Meropenem.

✤ Only in 5 of 228 (2.2%) discs, APAS read neither the disc nor the ZD.

In 7 of 228 (3.1%) discs, APAS did not identify the disc, presumably due



Figure 1: Types of zone diameter measurements to be compared.

Table 1: EUCAST specifications used for analysis					Table 2: Performance parameter analysed			
Antibiotic	Short	S ≥	R <	I	ATU	Analytes	Definition	
Aztreonam	ATM	50	18	18-49		Categorial Agreement (CA)	Identical interpre	
Cefepim	CPM	50	21	21-49		Minor Error (mE)	I instead of S or	
Ceftazidim	CAZ	50	17	17-49		Major Error (ME)	R instead of S	
Ceftazidim-Avi	CZA	17	17		16-17	Very Major Error (VME)	S instead of R	
Ceftolozan-Tazo	C/T	23	23					
Ciprofloxacin	CIP	50	26	26-49		mE rate	errors / all	
Imipenem	IMI	50	20	20-49		ME rate	errors / sensible	
Levofloxacin	LEV	50	18	18-49		VME rate	errors / resisten	
Meropenem	MEM	24	18	18-23		Zone diameter in the area of tech	nical uncertainty (ATI	
Piperacillin	PRL	50	18	18-49	18-19	as discs not recognized by APAS (n/a) were excluded f		
Pip-Taz	PTZ	50	18	18-49	18-19	error calculations (see below).		
Tobramicin	TN	18	18					

Analytes	Definition
Categorial Agreement (CA)	Identical interpretation
Minor Error (mE)	I instead of S or R
Major Error (ME)	R instead of S
Very Major Error (VME)	S instead of R
mE rate	errors / all
ME rate	errors / sensible
V/ME rata	errors / resistent

to poor printing, but measured the ZD.

✤ APAS marked 17 double zones, of which 7 were marked for review and only 2 were mEs compared to the microbiologist's score.







Figure 2 Pictures of different, correct measured *P. aeruginosa* types, analyzed by APAS (A) white strain, (B) green strain, (C) red strain







Table 3: Overall performance of the plate readings

Study details or performance parameter	No. (%) MiBi (i)	No. (%) APAS (ii)	No. (%) MiBi + APAS (iii)
No. of antibiotics tested	12	12	12
No. of strains tested	19	19	19
No. of total strain-drug pairs	228	228	228
No. of S strain-drug pairs	51 (22.3)	57 (25)	51 (22.37)
No. of I strain-drug pairs	73 (32.02)	78 (34.21)	74 (32.46)
No. of R strain-drug pairs	100 (43.86)	86 (37.72)	97 (42.54)
No. of ATH straip drug pairs*	1 (1 75)	2 (0 88)	6 (2 6 2)
No. of ATO Strain-urug pairs	4 (1.73)	∠ (U.00)	0 (2.03)
No. of n/a strain-drug pairs*	0(0)	5 (2.19)	U (U)

Results

* Zone diameter in the ATU as well as discs that were not recognized by the APAS (n/a, see picture 2A) were excluded for CA as well as for error calculation.



Figure 3 Pictures of different errors made by APAS (A) Unknown disc (C/T) (n=7); (B) Double zone (CZA + PRL) (n=17); (C) Not detected disc (CZA) (n=5)

Conclusion

This study shows that the APAS AMR module has a high categorial agreement with manual reading of disc diffusion test for *P. aeruginosa* and is therefore a promising tool for the automated measurement of zone diameters in the routine microbiological diagnostic. APAS AMR can flag reads contributing to VME for review, reducing the actual VME.