

Side by Side by Side Evaluation of Dade Microscan Walkaway 96, BD Phoenix and bioMérieux Vitek 2 for Antimicrobial Susceptibility Testing of a Challenge Set of Clinical Strains

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ABSTRACT (REVISED)

■ **BACKGROUND:** The objective of this study was to simultaneously evaluate three automated antimicrobial susceptibility (AST) instruments against a challenge set of bacterial strains with specific resistance determinants collected from routine, referred and stock reference cultures.

METHODS: Simultaneous testing of 65 challenge strains was performed on three automated instruments using colonies from a single inoculum plate, and each manufacturer's directions for inoculation and reading. These included VRE (29), MRSA (14), Imipenem resistant *Pseudomonas aeruginosa* (10), ESBL's (9), and other (3). A scoring system for the AST results was used. Organisms not included in the instrument databases were not scored.

RESULTS: The ESBL screen in all three systems was correctly detected in 67 – 89% of isolates tested. For MRSA detection, all three instruments were correct for 86% of strains. Imipenem testing against *P. aeruginosa* was more problematic, with 40 – 90% of isolates giving the correct results. Seven of ten strains failed to grow in two instruments, resulting in the low percentage. The results for vancomycin testing against *Enterococcus* spp. were accurate, with 86 – 95% of all isolates being correctly identified as VRE. The 3 miscellaneous isolates tested produced accurate results with the exception of 2 of the 3 instruments reporting a Trimethoprim/sulfamethoxazole (SXT) resistant strain of *Stenotrophomonas maltophilia* as susceptible.

The total points scored for each instrument was as follows: Phoenix scored 187/228 (82%), Vitek 2 scored 220/260 (85%), and MicroScan scored 239/260 (92%).

CONCLUSIONS: The three systems detected the large majority of resistance determinants in this defined set of challenge isolates. The mucoid nature of certain strains of *P. aeruginosa* was more problematic for Vitek 2 and Phoenix (failure to grow). A very major error was observed with SXT and *S. maltophilia*. Each instrument has strengths and weaknesses that need to be addressed according to laboratory requirements.

INTRODUCTION

Prompt diagnosis and accurate antimicrobial susceptibility information is of utmost importance in the management of patients in an acute care facility. Effective treatment of infections can greatly decrease the morbidity and mortality in patients with severe infections. Over the last few decades, automated identification and susceptibility testing methods have become the mainstay of clinical microbiological laboratories. Rapid antimicrobial susceptibility testing of drug resistant organisms is important for infection control purposes and for early treatment of these infections. We compared three automated instruments to determine their efficacy in detecting these important resistant determinants.

OBJECTIVE

The objective of this study was to assess the reliability of the antimicrobial susceptibility testing (AST) results of the Dade Microscan Walkaway 96, the BD Phoenix and the bioMérieux Vitek 2 against a challenge set of clinical isolates with specific resistance determinants by performing a side by side by side evaluation. Sixty-five (65) clinical isolates were tested using the same inoculum and tested simultaneously by each instrument.

MATERIALS & METHODS

Strains, culture conditions and inoculum preparation

Sixty-five (65) routine strains from our clinical laboratory were tested: 29 VRE, 14 MRSA, 10 Imipenem resistant *P. aeruginosa*, 9 ESBL producers, and 3 miscellaneous strains. Each isolate was subcultured onto Trypticase Soy Agar with 5% defibrinated sheep blood and incubated at 35°C for 18-20 h in ambient air. Isolates were set up to the NUMIC11 and PMIC13 Combo panel for the MicroScan, NMIC/ID-5 and PMIC/ID-6 for the Phoenix and AST-N020 and AST-GP55 cards for the Vitek 2. All panels and cards were set up and processed according to the manufacturers' recommendations. Results for all isolates were compared to NCCLS reference broth micro-dilution observations.

Quality Control

30 day QC and then weekly QC was performed according to each manufacturer's recommendations.

Reporting of Susceptibility Results

The routine antimicrobial susceptibility testing panels and cards for gram-negative and positive organisms were used, but the only

antibiotic scored was the drug relevant to the organisms' antimicrobial resistance determinant. A score was given to each susceptibility result based on MIC and breakpoint category. A score of 4 was awarded if all instruments results were within 1 dilution of the reference minimum inhibitory concentration (MIC) and had the same category. A score of 3 was awarded if the result was within 1 dilution of reference MIC but had a minor category change (i.e. a difference between S and I, or I and R) or if the result was within 2 dilutions of the reference MIC, with no category difference. A score of 2 was awarded if the result was within 2 dilutions of the reference MIC with a minor category change. A score of 1 was awarded for a major error (the instrument's category was R (resistant) and the reference category was S (sensitive)). A score of 0 was awarded for a very major error where the instrument called the isolate susceptible and the reference called the isolate resistant.

Any major and very major discrepancies were repeated on all instruments and if the discrepancy was resolved no further action was taken.

RESULTS

Table 1

AST Results of 14 MRSA isolates tested vs. Oxacillin on Microscan Walkaway, Phoenix (BD) and Vitek 2 (bioMérieux)

RESULT	MICROSCAN		PHOENIX		VITEK 2	
Correct Result	12	86%	12	86%	12	86%
Incorrect Result	2	14%	2	14%	2	14%
No Result	0	0%	0	0%	0	0%
No Growth	0	0%	0	0%	0	0%

Phoenix and Microscan both missed 2 hyper β -lactamase producers and Vitek 2 missed one hyper β -lactamase producer and one strain with a weak *MecA* gene.

Table 2

AST Results of 9 *E. coli* ESBL-producing isolates tested vs. the ESBL Screen on Microscan Walkaway, Phoenix (BD) and Vitek 2 (bioMérieux)

RESULT	MICROSCAN		PHOENIX		VITEK 2	
Correct Result	6	67%	7	78%	8	89%
Incorrect Result	3	33%	2	22%	1	11%
No Result	0	0%	0	0%	0	0%
No Growth	0	0%	0	0%	0	0%

The 3 strains missed on the Microscan were reported as "Suspect ESBL" and would have been investigated further. Phoenix missed 2 ESBL strains and Vitek 2 missed one ESBL producer.

Table 3

AST Results of 29 *Enterococcus* spp. isolates tested vs. Vancomycin on Microscan Walkaway, Phoenix (BD) and Vitek 2 (bioMérieux)

RESULT	MICROSCAN		PHOENIX		VITEK 2	
Correct Result	27	93%	20	95%	25	86%
Incorrect Result	2	7%	1	5%	4	14%
No Result	0	0%	0	0%	0	0%
No Growth	0	0%	0	0%	0	0%
Total Scored	29	–	21	–	29	–

Only 21 isolates were scored for Phoenix; there were 4 strains of *E. gallinarum* and 4 of *E. casseliflavus* that are not in their AST database. The 6 strains that were missed on Vitek 2 (4) and Microscan (2) were all minor errors. The strain missed by Phoenix was a minor error; the isolate was susceptible to vancomycin and was called intermediate.

Table 4

AST Results of 10 *P. aeruginosa* isolates tested vs. Imipenem on Microscan Walkaway, Phoenix (BD) and Vitek 2 (bioMérieux)

RESULT	MICROSCAN		PHOENIX		VITEK 2	
Correct Result	9	90%	4	40%	5	50%
Incorrect Result	1	10%	0	0%	2	20%
No Result	0	0%	2	20%	0	0%
No Growth	0	0%	4	40%	3	30%

The incorrect result on Microscan was a minor error. Vitek 2 called one isolate intermediate instead of susceptible and the other strain was deduced to be susceptible by the "Expert System" when it was resistant. On Phoenix, there were 2 strains that gave no result; these strains had AST results, but there was no result for Imipenem given. The 7 strains of *P. aeruginosa* that did not grow on Phoenix (4) and Vitek 2 (3) were mucoid in nature, and had insufficient growth for an AST result.

Table 5
Total Antimicrobial Susceptibility Scores of 65 Challenge Isolates tested on the
Microscan Walkaway, Phoenix (BD) and Vitek 2 (bioMérieux)

RESULT	MICROSCAN		PHOENIX		VITEK 2	
	Score	% Correct	Score	% Correct	Score	% Correct
MRSA	48/56	86%	48/56	86%	48/56	86%
ESBL <i>E. coli</i>	33/36	92%	28/36	78%	32/36	89%
VRE	114/116	98%	83/84	99%	112/116	97%
Miscellaneous	8/12	67%	12/12	100%	8/12	67%
<i>P. aeruginosa</i> vs. Imp	36/40	90%	16/40	40%	20/40	50%
TOTAL	239/260	92%	187/228	82%	220/260	85%

DISCUSSION AND CONCLUSIONS

■ The three automated systems detected the large majority of commonly observed resistance determinants seen in our laboratory. To further test these systems, we examined a small number of strains where we had observed problems previously with an earlier automated AST system. The mucoid nature of *P. aeruginosa* from our cystic fibrosis patients continues to create issues for imipenem testing on Phoenix and Vitek 2. In addition, although only one strain of *S. maltophilia* was tested against SXT, two of the systems (Microscan and Phoenix) incorrectly called it susceptible. All three systems were capable of differentiating ampicillin susceptibility and resistance in *Enterococcus faecium* isolates.

Our findings with this limited set of strains with specific resistance determinants suggest that all three systems have strengths and weaknesses. We suspect that with larger numbers of isolates, the apparent differences between the three systems would become less obvious. However, each laboratory should address issues of performing “resistance” testing on these systems according to their individual requirements. In some cases, it may be necessary to test specific organisms (e.g. mucoid *P. aeruginosa*) offline to ensure acceptable performance and accuracy.

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