

Comparison of the BD Phoenix™ (PHX) Automated Microbiology System to VITEK 1 (V1) for the Identification and Antimicrobial Susceptibility Testing of Gram-Negative Organisms

D.D. FULLER*, T. DAVIS, S. PATEL, J. GOODMAN, M. MILISH, P. LINEBACK, AND L. JASPER

Wishard Health Services-Indiana University School of Medicine • Indianapolis, IN, USA

ABSTRACT

INTRODUCTION: This study compared the performance of the PHX (BD Diagnostics) to V1 (bioMérieux) for identification (ID) and antimicrobial susceptibility testing (AST) of “challenging” gram-negative bacilli.

METHODS: To date, a total of 149 isolates have been tested to include 53 *Acinetobacter* spp., 34 *Pseudomonas* spp., 13 *Escherichia coli*, 13 *Enterobacter* spp., 8 *Citrobacter* spp., 9 *Klebsiella* spp., 5 *Proteae*, 3 *Salmonella/Shigella* spp., 2 *Chryseobacterium*, *Eikenella*, *Aeromonas*, and *S. maltophilia* respectively, and 1 isolate of *Achromobacter*, *Alcaligenes faecalis*, and *Yersinia* spp. Discrepant ID/No ID results were resolved using conventional methods. AST included Amikacin (AN), Gentamicin (GN), Tobramycin (TN), Ceftazidime (CTZ), Cefepime (CPM), Aztreonam (AZ), Ciprofloxacin (CIP), Levofloxacin (LEV), Meropenem (MER) and/or TMP-SMX (SXT). A ≥ 2 fold dilution difference in MIC values resulting in major (ME) or very major error (VME) was resolved using the VITEK 2 AST system and/or E-Test.

RESULTS: Both the PHX and V1 correctly identified 147/149 (98.7%) isolates. PHX category agreement (CA) was >99% for all antibiotics, and CA for V1 was >98% for all antibiotics. The PHX had 2 VME, 1 each with AN and GN, while V1 had 4 VME: 2 with CTZ, and 1 with GN and MER. PHX had a total of 5 ME: 1 each with CIP, AZ, CTZ, TN, and CPM, while V1 had 6 ME: 2 with CIP and AZ, and 1 each with SXT and CPM. **Conclusions:** PHX and V1 performed equally for ID of these microbes. PHX and V1 had comparable results for AST although PHX had fewer VME and ME than V1.



INTRODUCTION

Several excellent instrument systems are available for identification and antimicrobial susceptibility testing of clinically significant bacteria. However, testing of some gram-negative bacilli has been a challenge for automated systems. Many of these bacteria are associated with life-threatening infections in burn and intensive care units where identification and accurate susceptibility testing is critical. The purpose of this study was to evaluate the performance of the BD Phoenix™ Automated Microbial System (BD Diagnostics, Sparks, MD) as compared to VITEK Systems (bioMérieux, Inc. Durham, NC) for “challenging” gram-negative bacilli.

METHODS

ACCEPTANCE CRITERIA. Identification and antimicrobial susceptibility testing (AST) was performed on 149 gram-negative isolates using both the Phoenix and VITEK systems. Inclusion criteria consisted of fresh isolates recovered from specimens collected by orders from the attending clinician of either an adult or pediatric patient, or from frozen stock isolates that represented a routine clinical mix from patients at this site (Wishard Hospital, Indianapolis, IN). No specimen was collected for the sole purpose of this study and multiple isolates of the same species from the same patient and the same anatomical site were excluded.

ISOLATE TESTING. Inoculum suspensions for the Phoenix system and the VITEK system were set up on the same day using fresh (18-24 hour) subculture plates. Frozen isolates were subcultured at least 2 times prior to testing. All isolates were tested on each system according to manufacturer's recommendations.

DISCREPANT TESTING. The identification results from the Phoenix system were compared to the VITEK 1 for genus and species agreement. If required by the VITEK system, additional biochemical testing was performed for confirmatory identification. For discrepant results, the isolate was retested (in duplicate) in parallel in both systems. After retesting, if the discrepancy remained, the isolate was tested with the VITEK 2. Whichever of the discrepant identifications that agreed with the confirmatory testing method was considered the correct identification. If the confirmatory test result did not agree with either of the original discrepant identifications, the results were rejected from the study.

AST evaluation was only performed for isolates with concordance/resolved identification results. Category concordance was evaluated after application of the Phoenix Expert System and the VITEK Expert System with only antibiotics that are tested in both systems.

If the AST results were discrepant, retests were performed in parallel in both systems and the respective Expert system applied for Category Concordance determination for the repeat results. If the AST results remained discrepant, the isolate was tested using the VITEK 2 as previously described and E-Test when available.

Discrepancies for AST were defined as:

- **Very Major Error (VME) = VITEK and Phoenix discrepant.** The arbitrated result is Resistant, and VME for the test system (Phoenix or VITEK) that is Sensitive.
- **Major Error (ME) = VITEK and Phoenix discrepant.** The arbitrated result is Sensitive. ME for the test system (Phoenix or VITEK) that is Resistant.

QUALITY CONTROL. Quality control strains were tested in all systems as recommended by each manufacturer.

RESULTS

Table 1 represents the number of bacterial isolates evaluated with both systems. Both the Phoenix and VITEK 1 correctly identified 147/149 (98.7%) isolates. Twenty-five isolates identified by VITEK required additional testing to confirm the species identification. Category agreement (CA) was >99% for Phoenix and >98% for VITEK 1 for all antibiotics evaluated. Table 2 represents the concentration range for each drug tested and AST discrepant results (VME and ME) for both Phoenix and VITEK 1. Briefly, Phoenix had 2 VME and 5 ME, while VITEK 1 had 4 VME and 6 ME.

Table 1. Identification Results

Organism	N	Correct ID	Incorrect ID
<i>Achromobacter species</i>	1	1	
<i>Acinetobacter baumannii</i>	52	50	2(VITEK)
<i>Acinetobacter lwoffii</i>	3	3	
<i>Aeromonas caviae</i>	2	2	
<i>Alcaligenes faecalis</i>	1	1	
<i>Chryseobacterium gleum</i>	2	1	1(Phoenix)
<i>Citrobacter farmeri</i>	2	2	
<i>Citrobacter freundii</i>	4	4	
<i>Citrobacter koseri</i>	2	2	
<i>Eikenella corrodens</i>	2	2	
<i>Enterobacter aerogenes</i>	1	1	
<i>Enterobacter cloacae</i>	12	12	
<i>Escherichia coli</i> *	13	12	1(Phoenix)
<i>Klebsiella oxytoca</i>	2	2	
<i>Klebsiella pneumoniae</i> *	7	7	
<i>Providencia stuartii</i>	3	3	
<i>Serratia marcescens</i>	2	2	
<i>Pseudomonas aeruginosa</i>	32	32	
<i>Pseudomonas putida</i>	2	2	
<i>Salmonella/Shigella</i> spp.	3	3	
<i>S. maltophilia</i>	2	2	
<i>Yersinia frederiksenii</i>	1	1	
TOTAL	151	149	4

* Two *E. coli* and one *K. pneumoniae* were ESBL

Table 2. Antibiotic Concentrations and Discrepant Results

Antibiotic	Phoenix Conc. Range (µg/mL)	VITEK Conc. Range (µg/mL)	Phoenix Discrepant	VITEK Discrepant
Amikacin	4-32	2-32	1 VME	
Aztreonam	0.25-32	8-32	1 ME	2 ME
Cefepime	2-64	4-32	1 ME	1 ME
Ceftazidime	1-128	8-32	1 ME	2 VME
Ciprofloxacin	0.25-2	0.5-4	1 ME	2 ME
Gentamicin	0.5-8	0.5-16	1 VME	1 VME
Meropenem	1-8	2-16		1 VME
SXT	0.5/9.5-2/38	10-320		1 ME
Tobramycin	0.25-32	0.5-16	1 ME	
Total Combined			2 VME 5 ME	4 VME 6 ME

CONCLUSION

- The Phoenix and VITEK 1 performed equally for identification of these gram-negative bacilli (147/149) although VITEK required additional testing for 17% of the organisms. This additional testing often resulted in a delay of up to 24 hours before a definitive identification could be obtained (13/25). Additionally, Phoenix and VITEK had comparable results for AST although Phoenix exhibited fewer VME and ME than VITEK. Many of these microorganisms were recovered from burn unit or intensive care unit patients, grossly encapsulated or showed unusually resistant AST results, therefore rapid and accurate reporting is imperative for these "problematic" pathogens.