

Evaluation of the New Automated Phoenix™ System for Detection of Special Resistance Mechanisms

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REVISED ABSTRACT

■ **OBJECTIVES:** The performance of the Phoenix system with regard to antimicrobial susceptibility testing (AST) for oxacillin of staphylococci, vancomycin of enterococci, and detection of extended spectrum beta-lactamases (ESBL) of *Escherichia coli* and *Klebsiella* spp. was evaluated.

METHODS: A total of 278 staphylococci (117 *Staphylococcus aureus*, 161 coagulase negative staphylococci [CNS]) were tested. The results were compared to the reference broth micro-dilution method, oxacillin screen agar, and *mecA*-gene detection. 163 enterococci were tested for vancomycin resistance, the results were compared to broth micro-dilution method, and vancomycin screen agar. A total of 203 *E. coli* and *Klebsiella* spp. were tested and the results were compared to broth micro-dilution method and ESBL screening test. Discrepant results were repeated in duplicate, all AST methods were performed according to NCCLS standards (1).

RESULTS: Out of the 278 staphylococci, 149 were oxacillin resistant according to the reference broth micro-dilution method. The Phoenix system correctly detected 145 out of 149 oxacillin resistant strains, resulting in 98% sensitivity, and 96.9% specificity. Out of 163 enterococci 28 were resistant and 4 strains intermediate susceptible to vancomycin. Sensitivity and specificity of the Phoenix system was 100% and 99.2%, respectively. For ESBL-detection the Phoenix System correctly detected 50/51 ESBL-positive strains. Sensitivity and specificity was 98% and 100% respectively.

CONCLUSIONS: The new automated Phoenix system showed excellent performance to detect critical resistance mechanisms.

INTRODUCTION

The increasing emergence of clinical isolates with special resistance mechanisms like oxacillin resistant staphylococci, vancomycin resistant enterococci and ESBL phenotypes of the family *Enterobacteriaceae* remains a major reason for resistance problems especially in intensive care units (1). Therefore detection of these resistance mechanisms is a difficult task facing microbiologists (3,4,5).

In this study the ability of the automated Phoenix System (BD Diagnostic Systems, Maryland, USA) to detect these resistance mechanisms was evaluated.

METHODS AND MATERIALS

Bacterial isolates

A total of 278 staphylococci were tested, comprising 117 isolates of *S. aureus* with 54 oxacillin resistant strains and 161 isolates of CNS with 95 oxacillin resistant strains. 163 enterococci were tested for vancomycin resistance, 28 isolates were vancomycin resistant, 4 isolates intermediate sensitive. The following species were included: 111 *Enterococcus faecalis* and 52 *E. faecium*. A total of 102 *E. coli*, 69 *K. pneumoniae*, and 32 *K. oxytoca* were tested for ESBL-detection, 51 being ESBL positive strains. In this culture collection clinical strains and challenge strains were included (Centers for Disease Control (CDC), French National Reference Center (SFM), BD internal collection) (Table 1).

Identification

All isolates were identified with the Phoenix system and with alternate methods like VITEK®, VITEK®2, API 32 Staph, and API 32 Strep (bioMérieux Lyon, France). Additionally, coagulase test and clumping factor were performed for staphylococci and the esculin test for enterococci.

Antimicrobial susceptibility testing

Staphylococci: Oxacillin resistance was determined with the Phoenix instrument according to the manufacturer's instructions. The broth micro-dilution method according to NCCLS standards was used as the reference method (2), additionally the oxacillin screen agar was used for *S. aureus*, and the *mecA*-gene was determined with PCR for staphylococcal isolates from Heidelberg and for the challenge strains.

Enterococci: Vancomycin resistance was determined with the Phoenix instrument and with the reference broth micro-dilution method. All strains had been characterized at a molecular level.

***E. coli*, *Klebsiella ssp*:** ESBL detection was performed with the Phoenix instrument and with the reference broth micro-dilution method according to NCCLS recommendation, the ESBLs of the challenge strains had been characterized at a molecular level.

RESULTS AND DISCUSSION

The results of the performance of the Phoenix instrument in detecting the special resistance mechanisms with regard to oxacillin, vancomycin and ESBLs are shown in Table 2.

The sensitivities in detecting these resistance mechanisms were 98%, 100% and 98% for oxacillin, vancomycin and ESBLs,

respectively. The respective specificity results for these were 96.9%, 99.2% and 100%. Concerning oxacillin resistance only three CNS strains failed to be detected by the instrument.

Altogether the Phoenix instrument detected the resistant strains with high reliability.

Table 1
Number of Strains Tested (n=644)

Staphylococci	n	Oxacillin R (n)
<i>S. aureus</i>	117	54
<i>S. capitis</i>	17	6
<i>S. carnosus</i>	1	1
<i>S. chromogenes</i>	1	1
<i>S. cohnii</i>	2	2
<i>S. epidermidis</i>	66	40
<i>S. gallinarum</i>	8	4
<i>S. haemolyticus</i>	26	23
<i>S. hominis</i>	16	4
<i>S. hyicus</i>	1	0
<i>S. intermedius</i>	1	1
<i>S. lugdunensis</i>	5	5
<i>S. pasteurii</i>	1	0
<i>S. saprophyticus</i>	5	5
<i>S. schleiferi</i>	1	0
<i>S. simulans</i>	4	0
<i>S. warneri</i>	8	4
<i>S. xylosus</i>	1	0
Staphylococci total	278	149
Enterococci	n	Vancomycin R/I (n)
<i>E. faecium</i>	52	23
<i>E. faecalis</i>	111	9
Enterococci total	163	32
Enterobacteriaceae	n	ESBL pos
<i>E. coli</i>	102	19
<i>K. pneumoniae</i>	69	24
<i>K. oxytoca</i>	32	8
Enterobacteriaceae total	203	51

Table 2
Performance of the Phoenix (PHX) System in Detecting Special Resistance Mechanisms

Parameters	<i>n</i>	both pos	both neg	PHX pos/ Ref/neg	PHX neg/ Ref pos.	Sensitivity (%)	Specificity (%)
Oxacillin-resistance	278	146	125	4	3	98.0	96.9
Vancomycin-resistance	163	32	130	1	0	100.0	99.2
ESBL	203	50	152	0	1	98.0	100.0

CONCLUSIONS

■ Detection of oxacillin resistance in staphylococci, vancomycin resistance in enterococci and ESBL-detection in *E. coli*, *K. pneumoniae* and *K. oxytoca* by the Phoenix instrument was highly reliable.

REFERENCES

1. **Livermore D.M. and F. J. Brown** 2001. Detection of β -lactamase-mediated resistance. *J. Antimicrob. Chemother.* **48**, Suppl. S1, 59-64.
2. **National Committee for Clinical Laboratory Standards.** 1999. Performance Standards for Antimicrobial Susceptibility testing; 9th informational suppl. National Committee for Clinical Laboratory Standards, Wayne, PA.
3. **Sanders C. C., M. Peyret, E. Smith Moland, C. Shubert, K. S. Thomson, JM. Boeufgras, and W. E. Sanders Jr.** 2000. Ability of the VITEK2 Advanced Expert System to identify β -lactam phenotypes in isolates of *Enterobacteriaceae* and *Pseudomonas aeruginosa*. *J. Clin. Microbiol.* **38**:570-574.
4. **Tenover F.C., M. J. Mohammed, T. S. Gorton and Z. F. Dembek** 1999. Detection and reporting of organisms producing extended-spectrum beta-lactamases: Survey of laboratories in Connecticut. *J. Clin. Microbiol.* **37**: 4065-4070.
5. **Okabe T., K. Oana., Y. Kawakami, M. Yamaguchi, Y. Takahashi, T. Okir Honda and T. Katsuyama** 2000. Limitations of Vitek GPS-418 cards in exact detection of vancomycin resistant Enterococci with vanB genotype. *J. Clin. Microbiol.* **38**: 2409-2411.

