

Antimicrobial Susceptibility Testing for Ten 5-Fluoroquinolones Using the BD Phoenix™ Automated Microbiology System

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ABSTRACT

■ **OBJECTIVES:** In a performance evaluation of the Phoenix System (BD Diagnostic Systems, Sparks, MD, USA) for identification (ID) and antimicrobial susceptibility testing (AST), 10 5-Fluoroquinolones were under investigation. Individual drug results were compared to the NCCLS reference broth micro-dilution method, and are presented for both gram-positive and gram-negative bacteria, derived from fresh clinical single patient isolates.

METHODS: A total of 365 gram-positive strains (235 staphylococci, 130 enterococci) and 384 gram-negative strains (295 *Enterobacteriaceae*, 89 Nonfermenters) were tested. For AST, the following 5-Fluoroquinolones were evaluated in parallel with the NCCLS reference broth micro-dilution method: Pefloxacin, Norfloxacin, Ciprofloxacin, Ofloxacin, Lomefloxacin, Levofloxacin, Trovafloxacin, Gatifloxacin, Grepafloxacin and Moxifloxacin. Discrepant results were repeated in duplicate, all data were evaluated as defined by the ASM guidelines; additionally the distribution of the minimal inhibitory concentration (MIC) values were documented for each individual drug.

RESULTS: The essential agreement (EA), category agreement (CA), very major error rate (VME) and major error rate (ME) for all 5-Fluoroquinolones combined was 96.7%, 98.0%, 1.3% and 0.1% for gram-positive isolates, and 97.9%, 99.2%, 0.0% and 0.04% for gram-negative isolates, respectively. The observed resistance rates for gram-positive cocci and gram-negative rods were: Norfloxacin 36.8%, 16.5%, Ciprofloxacin 38.6%, 18.1%, Ofloxacin 38.2%, 18.2%, Lomefloxacin 38.6%, 20.2%, Levofloxacin 29.1%, 15.6%, Trovafloxacin 12.2%, 17.8%, Gatifloxacin 3.9%, 12.2% Grepafloxacin 37.7%, 16.0%, Moxifloxacin 2.2%, 14.4%, respectively, and Pefloxacin 41.5% for gram-positive cocci.

CONCLUSIONS: The Phoenix System provides highly reliable AST results for 5-Fluoroquinolones in both gram-positive and gram-negative isolates. The MIC distribution differed substantially between old and newer Quinolones for gram-positive strains, whereas for gram-negative strains only slight differences were seen.

INTRODUCTION AND PURPOSE

Reliable automated susceptibility testing of clinically relevant bacterial isolates is very important for routine microbiology laboratories, thus improving patient care. The Phoenix system is a fully automated system to provide accurate ID and AST results.

In a European clinical evaluation we compared the system to standard broth micro-dilution method (SBM) for AST according to NCCLS guidelines¹. During this trial, 9 different drug classes and several miscellaneous drugs were investigated. Since therapy with 5-Fluoroquinolones is often applied in outpatients as well as in hospitalized patients, it is of special interest to compare the different drugs of this drug-class for frequently encountered bacterial isolates in a routine laboratory. We determined EA, CA, VME, ME, and minor error rate (mE). Additionally, we compared the minimal inhibitory concentration (MIC) values of the different drugs for *Enterobacteriaceae*, Nonfermenters, Staphylococci, and Enterococci.

METHODS

Bacterial Isolates

A total of 749 clinical isolates were tested which were comprised of 384 gram-negative rods (295 *Enterobacteriaceae*, 89 Non-fermenters) and 365 gram-positive cocci (235 Staphylococci, 130 Enterococci).

Antimicrobials

For AST, the following 5-Fluoroquinolones were evaluated in comparison to the NCCLS recommended SBM method: Pefloxacin, Norfloxacin, Ciprofloxacin, Ofloxacin, Lomefloxacin, Levofloxacin, Trovafloxacin, Gatifloxacin, Grepafloxacin, and Moxifloxacin. Discrepant results were repeated in duplicate, all data were evaluated as defined by the ASM guidelines².

Quality Control

Enterococcus faecalis ATCC 29212, *Staphylococcus aureus* ATCC 29213, *E. faecalis* ATCC 14506, *E. faecalis* ATCC 49533, *E. faecalis* ATCC 10741, *Escherichia coli* ATCC 25922, *Pseudomonas aeruginosa* ATCC 27853, *Pseudomonas aeruginosa* ATCC 35032.

RESULTS

Tables 1-4

Show the EA, CA, VME and ME of the different 5-Fluoroquinolones comparing the Phoenix system to SBM.

Figures 1-4

Show the comparison of the MIC values of the 5-Fluoroquinolones (without Norfloxacin and Trovafloxacin) for both methods for the different organism groups.

Table 1: *Staphylococci*

Drug	n	S	I	R	%				
					EA	CA	VME	ME	mE
Pefloxacin	228	128	8	92	98.2	98.7	1.1	0.0	0.9
Norfloxacin	232	139	3	90	93.5	99.6	0.0	0.0	0.4
Ciprofloxacin	233	141	3	89	98.7	99.6	1.1	0.0	0.0
Ofloxacin	233	144		89	98.7	99.1	1.1	0.0	0.4
Lomefloxacin	233	136	7	90	97.0	99.6	0.0	0.0	0.4
Levofloxacin	228	141	25	62	97.8	97.8	1.6	0.0	1.8
Trovafloxacin	233	206	15	12	97.0	97.9	0.0	0.0	2.1
Gatifloxacin	228	171	48	9	97.8	100.0	0.0	0.0	0.0
Grepafloxacin	228	141	1	86	96.1	96.9	1.2	0.7	2.2
Moxifloxacin	227	208	14	5	98.2	98.7	0.0	0.5	0.9
					97.3	98.8	0.8	0.1	0.9

Figure 1

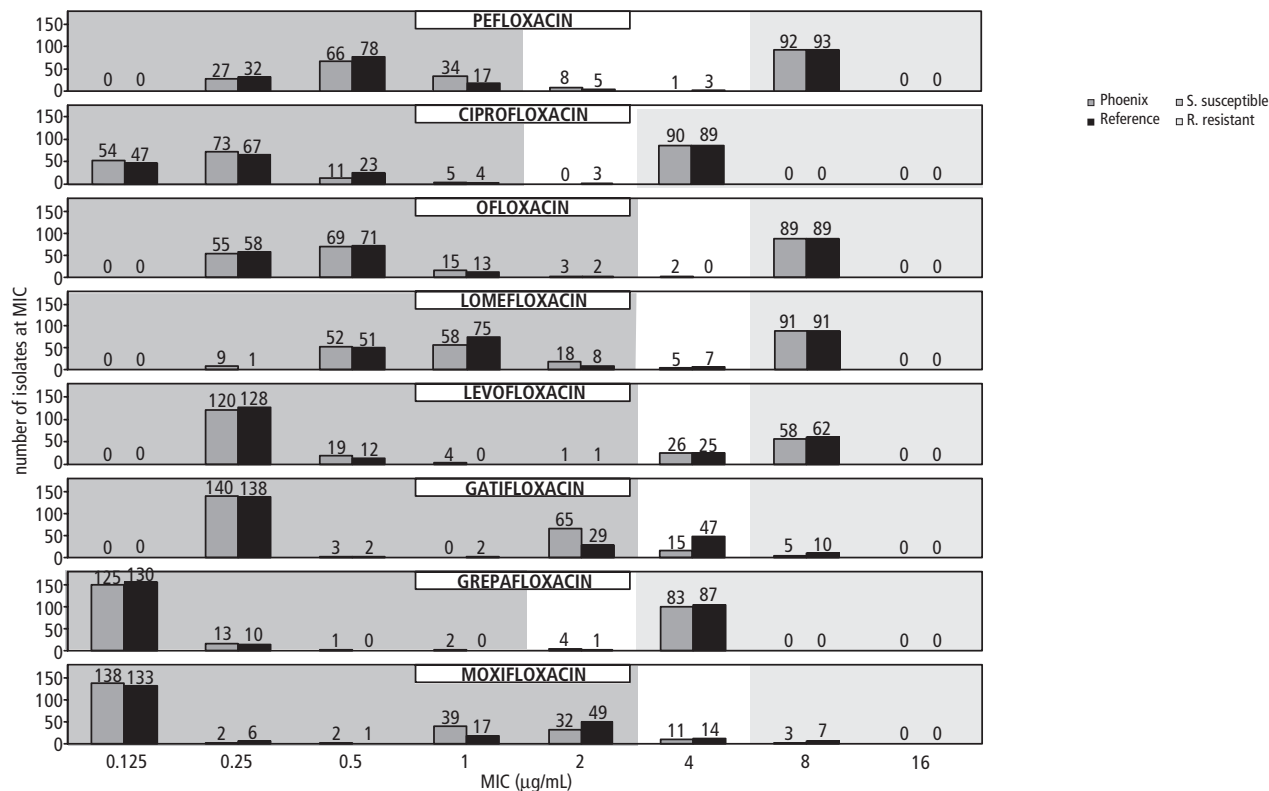


Table 2: Enterococci

Drug	n	S	I	R	EA	CA	VME	ME	mE
Pefloxacin	129	1	72	56	92.2	92.2	1.8	0.0	7.0
Norfloxacin	129	70	16	43	98.4	99.2	0.0	0.0	0.8
Ciprofloxacin	130	56	23	51	94.6	94.6	5.9	0.0	3.1
Levofloxacin	129	83	4	42	99.2	100.0	0.0	0.0	0.0
Trovafloxacin	129	85	12	32	89.1	90.7	6.3	0.0	7.8
					94.7	95.4	2.7	0.0	3.7

Table 3: Enterobacteriaceae

Drug	n	S	I	R	EA	CA	VME	ME	mE
Norfloxacin	293	250	10	33	98.3	99.7	0.0	0.0	0.3
Ciprofloxacin	294	246	9	39	99.0	99.3	0.0	0.0	0.7
Ofloxacin	294	247	8	39	99.3	99.7	0.0	0.0	0.3
Lomefloxacin	294	235	15	44	99.0	99.0	0.0	0.0	1.0
Levofloxacin	294	254	8	32	99.0	99.7	0.0	0.0	0.3
Trovafloxacin	294	246	8	40	99.0	99.3	0.0	0.0	0.7
Gatifloxacin	294	251	7	36	97.6	99.0	0.0	0.0	1.0
Grepafoxacin	294	241	6	47	98.6	99.7	0.0	0.4	0.0
Moxifloxacin	285	234	10	41	95.8	99.3	0.0	0.0	0.7
					98.4	99.4	0.0	0.05	0.6

Figure 2

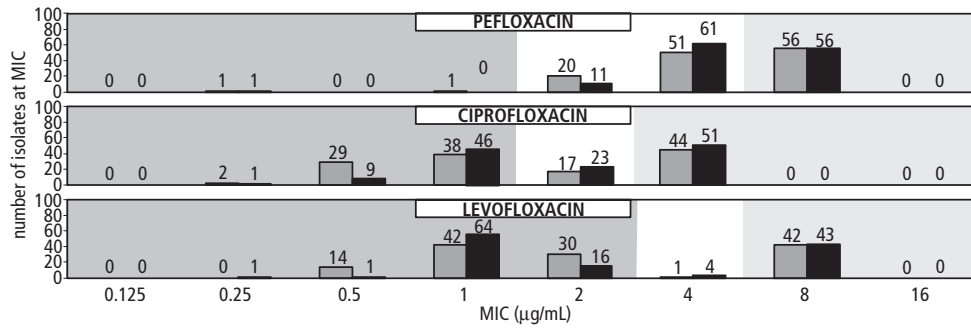
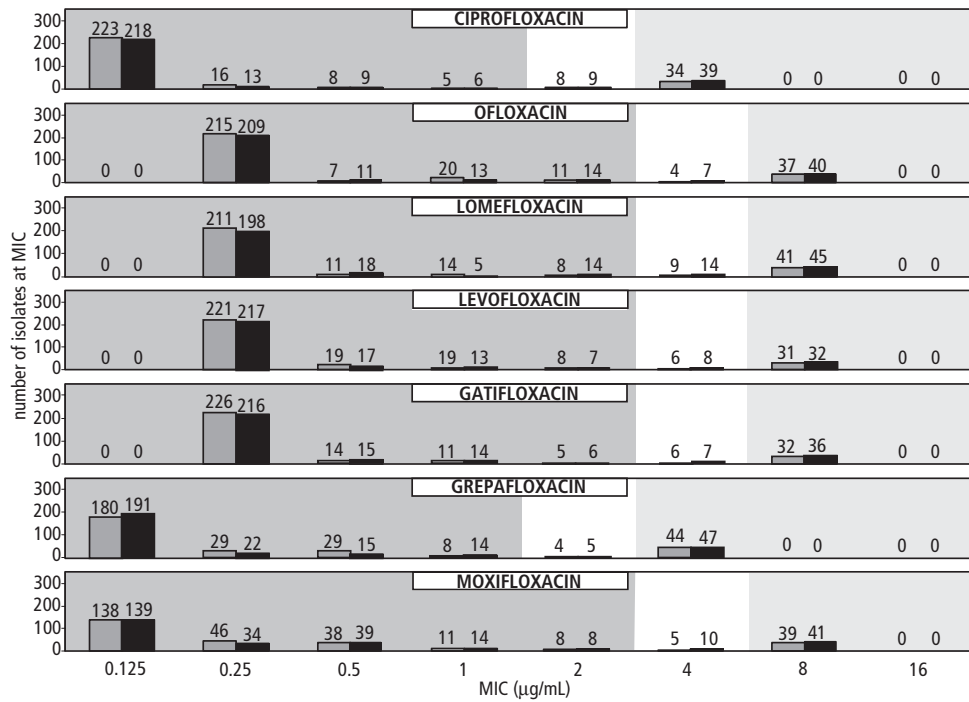


Figure 3

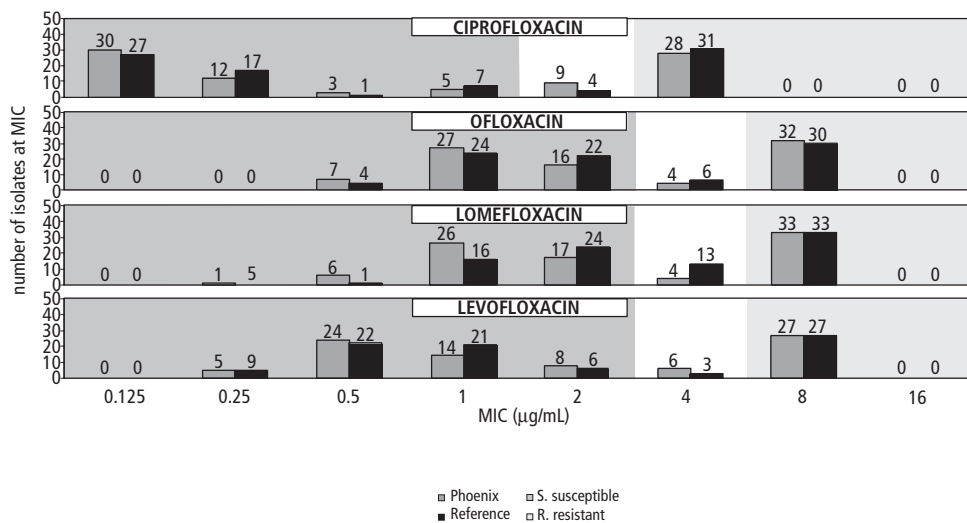


Phoenix S. susceptible
 Reference R. resistant

Table 4: Nonfermenters

Drug	n	S	I	R	%				
					EA	CA	VME	ME	mE
Norfloxacin	88	51	7	30	96.6	98.9	0.0	0.0	1.1
Ciprofloxacin	87	52	5	30	96.6	98.9	0.0	0.0	1.1
Ofloxacin	86	50	6	30	96.5	97.7	0.0	0.0	2.3
Lomefloxacin	87	41	13	33	96.6	98.9	0.0	0.0	1.1
Levofloxacin	84	54	3	27	89.3	95.2	0.0	0.0	4.8
Trovafloxacin	88	57	3	28	96.6	98.9	0.0	0.0	1.1
					95.4	98.1	0.0	0.0	1.9

Figure 4



CONCLUSIONS

The Phoenix system showed excellent results for EA, CA, VME, and ME for 5-Fluoroquinolones when compared to the reference method. The MIC distribution was comparable in both systems.

For gram-negative isolates the MIC values showed only slight differences between older and newer Quinolones. Ciprofloxacin and Grepafloxacin had the lowest MIC values for *Enterobacteriaceae*, and Ciprofloxacin for Nonfermenters, respectively. For Staphylococci the new Quinolones Moxifloxacin and Gatifloxacin showed lower MIC values than Ofloxacin and Ciprofloxacin.

References

- 1 National Committee for Clinical Laboratory Standards 2000. Methods for diluting antimicrobial tests that grow aerobically, 5th ed. Approved standard M7-A5. National Committee for Clinical Laboratory Standards, Wayne, Pa.
- 2 Mulder, R. H., Farnham, S. M. Evaluating Antimicrobial Susceptibility Test Systems. In Clinical Microbiology Procedures Handbook. ASM Press, Washington, D.C.