

Antimicrobial susceptibility survey of pathogens isolated from selected patients in Northern Italy

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ABSTRACT

The Clinical Microbiology Laboratory of the University of Genoa participated, during the year 2003, in an international antimicrobial surveillance program. The collection of isolates was done according to the site of infection and/or type of patient. Four hundred twenty (420) clinical isolates were analyzed during this year and the frequencies of the different pathogens were investigated. A reference centre carried out susceptibility tests. Oxacillin-resistant *Staphylococcus aureus* represented 47.6% of all *S. aureus* isolates from blood stream infections and 33.3% of all *S. aureus* isolated from skin and soft tissue infections in hospitalised patients. These strains showed resistance to most of the antimicrobial agents evaluated, except vancomycin, teicoplanin, quinupristin/dalfopristin and linezolid which registered 100% of susceptibility. Some isolates from blood stream infections such as *E. coli* demonstrated resistance to ciprofloxacin (23.3%), levofloxacin (20%), and gatifloxacin (16.6%), and *Klebsiella pneumoniae* was resistant (18%) to all fluoroquinolones tested. *Pseudomonas aeruginosa* manifested resistance to ciprofloxacin (16.6%), while 27.7% of these strains were resistant both to levofloxacin and gatifloxacin. All the *Enterobacter cloacae* isolated from blood were susceptible to ciprofloxacin, levofloxacin and gatifloxacin. *Haemophilus influenzae* and *Moraxella catarrhalis* collected from community-acquired respiratory tract infections were all inhibited by ciprofloxacin, levofloxacin and gatifloxacin. *E. coli* isolated from urinary tract infections in hospitalised patients were resistant to ciprofloxacin, levofloxacin and gatifloxacin (2.7%). All *Salmonella* spp. collected from samples of patients affected by infections of the gastro-intestinal tract were susceptible to all fluoroquinolones. Penicillin resistance in *Streptococcus pneumoniae* was found in 21.4% of isolates from patients with respiratory tract infections. Fluoroquinolone resistance was very rare among pneumococci except for ciprofloxacin. High rates of resistance to this drug (100%); resistance to levofloxacin and gatifloxacin was detected only in 3.6% of cases while resistance to moxifloxacin was detected in 1.8% of cases. Macrolide resistance rates were around 35% to 41%, tetracycline and trimethoprim/sulfamethoxazole resistance rates were relatively elevated (37.5% and 32.1% resistance respectively).

INTRODUCTION

The importance of antimicrobial resistance among nosocomial and community-acquired pathogens is acknowledged worldwide, well-designed antimicrobial surveillance programs are therefore of paramount importance in the fight against these microorganisms (1, 3, 4, 6).

These programs are also necessary to provide information on the trend in microbial occurrence in different geographical regions, to identify changes in the spectrum of microbial pathogens causing serious infection and to monitor trends in antimicrobial resistance patterns in nosocomial and community-acquired infections (10, 11, 13, 14) The information obtained from surveillance efforts have the potential to guide therapeutic approaches for serious infections and may have value in the prevention and control of infection and also to defining appropriate control measures for antimicrobial-resistant pathogens (2, 7, 8, 12). This information has been provided in recent years by several national and international antimicrobial surveillance program (1, 3-5). The

Laboratory of Clinical Microbiology of the University of Genoa was included in one of these international surveys designed to identify the predominant pathogens and antimicrobial resistance for both nosocomial and community-acquired infections, collecting consecutive isolates from clinically documented infections. The isolates are gathered according to the type of infection and susceptibility tests are carried out in a Central Microbiology Laboratory by reference broth microdilution methods according to NCCLS guidelines (9).

This study reports the antimicrobial susceptibility patterns of a collection of pathogens isolated from in- and out-patients affected by selected infections in Northern Italy.

MATERIAL AND METHODS

Bacterial strains

The collection of isolates was done according to the site of infection and/or type of patient. The contribution of this Laboratory (organism identification, date of isolation, antimicrobial suscepti-

bility profile, etc.) included the first 20 consecutive episodes of blood stream infections (BSI) per month from January 2003 to December 2003, 94 consecutive episodes of community-acquired respiratory tract infections (CARTI), 50 consecutive isolates from skin and soft tissue infection (SSTI), 50 consecutive isolates from urinary-tract infections (UTI), 11 consecutive isolates of organisms considered producers of diarrheal diseases (gastroenteritis, GE) and 7 vancomycin-resistant enterococci (VRE) collected during the period January 2003 - December 2003. Just one isolate per patient was included in the study and all isolates were saved on transport swabs and sent to the monitoring center (Iowa, USA) for storage and further characterization by reference identification and susceptibility testing methods.

SUSCEPTIBILITY TESTING

All isolates were tested against antimicrobials by the broth microdilution method according to National Committee for Clinical Laboratory Standards (NCCLS) by the reference laboratory (Iowa, USA); breakpoints for resistance were those recommended by the NCCLS (9). Antimicrobial agents were obtained from their respective manufactures as laboratory grade powder and included penicillins (ampicillin, penicillin, amoxicillin, and oxacillin), b-lactamase inhibitor combinations (amoxicillin-clavulanate, ticarcillin-clavulanate, and piperacillin-tazobactam), cephalosporins (cefepime, cefuroxime, cefotaxime, ceftriaxone, ceftazidime, ceftazolin, cefoxitin, cefaclor, and cefixime), carbapenems (imipenem and meropenem), a monobactam (aztreonam), fluoroquinolones (ciprofloxacin, levofloxacin, gatifloxacin, and garenoxacin [formerly BMS 284756]), aminoglycosides (amikacin, gentamicin, and tobramycin), macrolides (erythromycin, azithromycin, and clarithromycin), the oxazolidinone linezolid, the streptogramin quinupristin-dalfopristin, glycopeptides (vancomycin and teicoplanin), and other drugs, such as clindamycin, chloramphenicol, tetracycline, rifampin, and trimethoprim-sulfamethoxazole.

RESULTS AND DISCUSSION

Fourhundredtwenty (420) clinical isolates were analyzed during 2003 and the frequencies of the different pathogens were investigated. The collection and the distribution of the bacterial strain is reported in Table 1. Among these isolates, 223 were gram-negative, while 197 were gram-positive bacteria. *Staphylococcus aureus* (18.1%) was the most frequent pathogen found with different incidence *Escherichia coli* (16.7%),

Streptococcus pneumoniae (13.6%), *Enterococcus faecalis* (6.4%), *Haemophilus influenzae* (5.5%) and *Pseudomonas aeruginosa* (4.8%).

Table 1 - Distribution of the 420 isolates studied

BSI (210)	PATHOGEN	N. of isolates	%
	<i>S. aureus</i>	42	20
	<i>E. coli</i>	30	14.3
	<i>E. faecalis</i>	22	10.5
	<i>P. aeruginosa</i>	18	8.6
	<i>E. cloacae</i>	14	6.7
	<i>K. pneumoniae</i>	11	5.2
	Other ¹	73	34.7
CARTI (94)	<i>S. pneumoniae</i>	56	59.5
	<i>H. influenzae</i>	22	23.4
	<i>M. catarrhalis</i>	16	17.1
SSTI (50)	<i>S. aureus</i>	33	66
	<i>S. epidermidis</i>	13	26
	Other ²	4	8
UTI (48)	<i>E. coli</i>	37	77
	Other ³	11	23
GE (11)	<i>Salmonella spp.</i>	7	63.6
	<i>E. coli</i>	3	27.3
	<i>Aeromonas spp.</i>	1	9.1
VRE (7)	<i>E. faecium</i>	4	57
	<i>E. faecalis</i>	2	28.5
	<i>E. avium</i>	1	14.5

¹Including *S. maltophilia* (8), *S. epidermidis* (5), *P. mirabilis* (5), *K. oxytoca* (4), *A. baumannii* (3), *Corynebacterium spp.* (3), *S. group A* (3), *L. monocytogenes* (3), *M. morgani* (2), *S. liquefaciens* (2), *S. marcescens* (2), *S. coagulase neg.* (2), *S. haemolyticus* (2), *E. avium* (2), *S. mitis* (2), *Aeromonas spp.* (1), *Bacillus spp.* (1), *B. cepacia* (1), *C. freundii* (1), *E. durans* (1), *S. anginosus* (1), *S. group B* (1), *S. pneumoniae* (1), *Streptococcus spp.* (1), *E. gallinarum* (1), *Enterococcus spp.* (1), *H. influenzae* (1), *S. paucimobilis* (1), *Staphylococcus spp.* (1);

²Including *E. faecalis* (3), *E. faecium* (1);

³Including *E. cloacae* (2), *P. aeruginosa* (2), *S. epidermidis* (2), *Enterococcus spp.* (1), *K. pneumoniae* (1), *Klebsiella spp.* (1), *S. aureus* (1), *S. saprophiticus* (1)

Tables from 2 to 7 reported the *in vitro* activity of the antibiotic tested against the pathogens isolated from the different anatomic sites. Briefly, with respect to strains collected from blood stream infections. *S. aureus* (Table 2) resulted resistant in about 50% of the cases, including oxacillin, against the antibiotics tested with the exception of glycopeptides, linezolid, quinupristin/dalfopristin, chloramphenicol, tetracycline rifampicin, co-trimoxazole, and nitrofurantoin which were found active against more than 90% of the bacterial strains. *E. faecalis* (Table 2) was inhibited by ampicillin, penicillin, linezolid, glycopeptides and nitrofurantoin, while the other compounds were active against about 50% of these strains. *E. coli* (Table 2) resulted susceptible to β -lactamase-resistant antibiotics in more than 70% of the strains. Fluoroquinolones showed activity against more than 75% of the cases while gentamycin

inhibited all isolates. *K. pneumoniae* (Table 2) manifested susceptibility to the great majority of the β -lactam drugs, aminoglycosides, and to a lesser extend to other antibiotics. *E. cloacae* (Table 2) was found susceptible to cefepime, carbapenems, fluoroquinolones and amikacin, the other molecules were less active against this pathogen. *P. aeruginosa* (Table 2) as expected was resistant in about 40% of the cases, meropenem was fully inhibitory and ciprofloxacin was active on 83.4% of the strains tested.

Penicillin resistance in *Streptococcus pneumoniae* was found in 21.4% of isolates from patients with respiratory tract infections (Table 3).

Fluoroquinolone resistance was very rare among pneumococci except for ciprofloxacin, in fact pneumococci showed very high rates of resistance to this drug (100%); resistance to levofloxacin and gatifloxacin was detected only in 3.6% of cases while resistance to moxifloxacin was detected in 1.8% of cases. Macrolide resistance rates were around 35% to 41%, tetracycline and trimethoprim/sulfamethoxazole resistance rates were relatively elevated (37.5% and 32.1% resistance respectively). The other respiratory pathogens, *H. influenzae* and *M. catarrhalis* demonstrated susceptibility to all antibiotics tested with the exception of *H. influenzae* that was inhibited 82% by ampicillin (Table 3).

S. aureus isolated from soft tissue infections (Table 4) resulted resistant to oxacillin in the 33.3% of the strains. This level of unsuceptibility

was found against many other antibiotics. Non β -lactam drugs with the exception of macrolides showed satisfactory *in vitro* activity against this pathogen. Similar results were registered with *S. epidermidis* with the exception of tetracycline which demonstrated activity on about 50% of the isolated. *E. coli* collected from UTI (Table 5) was in general more widely susceptible to all the antibiotics tested with the exception of cefazolin, tetracycline and trimethoprim/sulfamethoxazole. *Salmonella* spp. found in gastroenterical tract (Table 6) was in general inhibited by all the drugs. Low percentage of susceptible strains were detected when penicillins were tested.

Finally vancomycin-resistant enterococci (Table 7) resulted poorly susceptible to the drugs tested with the exception of linezolid and chloramphenicol which inhibited all strains.

The present findings indicate a large diffusion of antibiotic resistant strains in nosocomial settings however susceptibility tests also show a significant percentage of pathogens that are inhibited by various antibiotics.

Thus continuous national and international surveillance programs can provides accurate and timely data on the incidence of resistance in the major nosocomial pathogens This information must reach the clinicians (publication in national and international journals, Congresses, Meetings, Discussions, etc) in order to rationally influence their prescription habits and improve the outcome of therapy (3-5, 10, 11).

Table 2. In vitro activity of the drugs against bacterial strains collected from blood stream infection

ORGANISM (NO. TESTED)	ANTIBIOTIC	RANGE	MIC-50	MIC-90	% SUSCEPTIBILITY
<i>E. faecalis</i> (22)	Ampicillin	<=1-4	2	4	100
	Penicillin	2-16	4	8	90
	Imipenem	1-8	1	8	-
	Meropenem	4->16	8	>16	-
	Ciprofloxacin	0,5->4	>4	>4	51
	Levofloxacina	1->4	>4	>4	45.5
	Gatifloxacin	0,25->4	4	>4	45.4
	Moxifloxacin	0,25->4	4	>4	-
	Erythromycin	0,5->8	>8	>8	19
	Linezolid	1-2	1	2	100
	Quinupristin/Dalfopristin	>=2	>2	>2	0
	Vancomycin	0,5->16	1	2	90
	Teicoplanin	<=2->16	<=2	<=2	90
	Chloramphenicol	4->16	>16	>16	46
	Tetracycline	<=2->8	>8	>8	9
Rifampin	1->2	2	>2	13.7	
Nitrofurantoin	<=0,16->32	<=16	<=16	95.5	

Table 2. Continued

ORGANISM (NO. TESTED)	ANTIBIOTIC	RANGE	MIC-50	MIC-90	% SUSCEPTIBILITY
<i>S. aureus</i> (42)	Ampicillin	<=1->16	8	>16	39
	Penicillin	<=0,016>32	8	>32	21.5
	Oxacillin	<=0,25->2	1	>2	52.4
	Amoxicillin/Clavulanic acid	<=1->16	<=1	>16	52.4
	Piperacillin/Tazobactam	0,5->256	2	256	45.3
	Cefepime	1->16	4	>16	52.4
	Ceftriaxone	0,5->32	8	>32	54.8
	Ceftazidime	4->16	16	>16	40.5
	Imipenem	<=0,12->8	0,25	>8	57.2
	Meropenem	0,06->16	0,25	>16	57.2
	Ertapenem	<=0,06->8	0,25	>8	52.4
	Ciprofloxacin	0,12->4	4	>4	47.7
	Levofloxacin	<=0,03->4	4	>4	47.7
	Gatifloxacin	<=0,03->4	1	4	73.9
	Moxifloxacin	<=0,03->4	1	4	-
	Gentamicin	<=2->8	<=2	>8	52.4
	Erythromycin	<=0,06->8	>8	>8	47.7
	Clindamycin	<=0,06->8	0,12	>8	59.6
	Linezolid	0,5-2	2	2	100
	Quinupristin/Dalfopristin	<=0,25-1	0,5	1	100
	Vancomycin	0,5-2	1	1	100
	Teicoplanin	<=2-4	<=2	<=2	100
	Chloramphenicol	4->16	8	8	90.5
	Tetracycline	<=2	<=2	<=2	100
	Rifampin	<=0,25	<=0,25	<=0,25	100
	Trimethoprim/Sulfamethoxazole	<=0,5->2	<=0,5	<=0,5	95.3
	Nitrofurantoin	<=16->32	<=16	<=16	96.7

ORGANISM (NO. TESTED)	ANTIBIOTIC	RANGE	MIC-50	MIC-90	% SUSCEPTIBILITY
<i>E. coli</i> (30)	Ampicillin	2->16	>16	>16	36.7
	Piperacillin	<=1->128	32	>128	46.7
	Ticarcillin	<=16-128	>128	>128	36.7
	Amoxicillin/Clavulanic acid	4->16	8	16	70
	Ampicillin/Sulbactam	2->32	16	32	40
	Piperacillin/Tazobactam	0,5-8	2	2	100
	Ticarcillin/Clavulanic acid	<=16-128	<=16	64	73.4
	Cefepime	<=0,12-0,5	<=0,12	0,25	100
	Cefuroxime	2->16	4	8	70
	Ceftriaxone	<=0,25	<=0,25	<=0,25	100
	Ceftazidime	<=1-16	<=1	<=1	93.4
	Cefazolin	<=2->16	<=2	>16	86.7
	Cefoxitin	2-32	4	8	90
	Imipenem	<=0,12-0,25	0,25	0,25	100
	Meropenem	<=0,008-0,03	0,016	0,03	100
	Ertapenem	<=0,06	<=0,06	<=0,06	100
	Aztreonam	<=0,12-16	<=0,12	0,25	96.7
	NalidixicAcid	1->32	2	>32	70
	Ciprofloxacin	<=0,03->4	<=0,03	>4	76.7
	Levofloxacin	<=0,03->4	<=0,03	4	80
	Gatifloxacin	<=0,03->4	<=0,03	>4	83.4
	Moxifloxacin	<=0,03->4	0,06	>4	-
	Amikacin	<0,25-8	2	4	100
	Gentamicin	<=2->8	<=2	<=2	93.4
	Tobramycin	0,25-8	0,5	2	93.4
	Tetracycline	<=2->8	>8	>8	40
	Trimethoprim/Sulfamethoxazole	<=0,5->2	<=0,5	>2	66.7
	Nitrofurantoin	<=16->32	<=16	32	93.4

Table 2. Continued

ORGANISM (NO. TESTED)	ANTIBIOTIC	RANGE	MIC-50	MIC-90	% SUSCEPTIBILITY
<i>P. aeruginosa</i> (18)	Piperacillin	4->128	8	>128	66.7
	Ticarcillin	<=16->128	64	>128	61.2
	Piperacillin/Tazobactam	4-256	8	256	72.3
	Ticarcillin/Clavulanic acid	<=16->128	64	>128	55.6
	Cefepime	1->16	2	>16	76.7
	Ceftazidime	2->16	4	>16	66.7
	Imipenem	0,5->8	1	>8	72.3
	Meropenem	0,12-16	1	4	100
	Aztreonam	4->16	8	>16	50
	Ciprofloxacin	0,12->4	0,25	>4	83.4
	Levofloxacin	0,25->4	1	>4	72.3
	Gatifloxacin	0,25->4	1	>4	72.3
	Moxifloxacin	0,5->4	4	>4	-
	Amikacin	2-32	4	32	89
	Tobramycin	0,25->16	0,5	>16	83.4

ORGANISM (NO. TESTED)	ANTIBIOTIC	RANGE	MIC-50	MIC-90	% SUSCEPTIBILITY
<i>E. cloacae</i> (14)	Ampicillin	>16	>16	>16	100
	Piperacillin	<=1->128	8	>128	57
	Ticarcillin	<=16->128	<=16	>128	50
	Amoxicillin/Clavulanic acid	>16	>16	>16	0
	Ampicillin/Sulbactam	0,5->32	32	>32	28,5
	Piperacillin/Tazobactam	1-256	4	128	64
	Ticarcillin/Clavulanic acid	<=16->128	<=16	>128	57
	Cefepime	<=0,12-16	<=0,12	8	100
	Cefuroxime	8->16	16	>16	29
	Ceftriaxone	<=0,25->32	0,5	>32	-
	Ceftazidime	<=1->16	<=1	>16	57
	Cefazolin	>16	>16	>16	0
	Cefoxitin	>32	>32	>32	0
	Imipenem	<=0,12-0,25	0,25	0,25	100
	Meropenem	0,03-0,12	0,03	0,12	100
	Ertapenem	<=0,06-2	0,12	2	100
	Aztreonam	<=0,12->16	0,25	>16	57
	Nalidixic Acid	2->32	4	16	86
	Ciprofloxacin	<=0,03-0,5	<=0,03	0,5	100
	Levofloxacin	<=0,03-0,5	<=0,03	0,5	100
	Gatifloxacin	<=0,03-0,5	0,06	0,25	100
	Moxifloxacin	0,06-1	1	1	-
	Amikacin	1-8	1	2	100
	Gentamicin	<=2->8	<=2	8	-
	Tobramycin	0,25->16	0,5	16	79
	Tetracycline	<=2->8	4	>8	72
	Nitrofurantoin	>=32	>32	>32	36
	Trimethoprim/Sulfamethoxazole	<=0,5->2	<0,5	<0,5	93

Table 2. Continued

ORGANISM (NO. TESTED)	ANTIBIOTIC	RANGE	MIC-50	MIC-90	% SUSCEPTIBILITY
<i>K. pneumoniae</i> (11)	Ampicillin	>=16	>16	>16	0
	Piperacillin	2->128	16	>128	54.6
	Ticarcillin	<=16->128	>128	>128	9
	Ampicillin/Sulbactam	4-32	8	32	36.4
	Piperacillin/Tazobactam	1-16	2	16	100
	Ticarcillin/Clavulanic acid	<=16-128	<=16	64	82
	Cefepime	<=0,12	<=0,12	2	100
	Cefuroxime	1->16	4	>16	54.6
	Ceftriaxone	<=0,25->32	<=0,25	32	82
	Ceftazidime	<=1->16	<=1	>16	82
	Cefazolin	<=2->16	<=2	>16	82
	Cefoxitin	1-8	4	8	100
	Imipenem	<=0,12-0,25	0,25	0,25	100
	Meropenem	0,03	0,03	0,03	100
	Ertapenem	<=0,06	<=0,06	<=0,06	100
	Aztreonam	<=0,12->16	<=0,12	>16	82
	NalidixicAcid	2->32	2	>32	82
	Ciprofloxacin	<=0,03->4	<=0,03	4	82
	Levofloxacin	<=0,03->4	0,06	-	18
	Gatifloxacin	<=0,03->4	0,06	>4	82
	Moxifloxacin	<=0,03->4	0,012	4	-
	Amikacin	1-2	2	2	100
	GentamicinLow	<=2	<=2	<=2	100
	Tobramycin	0,25-4	0,5	1	100
Tetracycline	<=2->8	<=2	>8	72.7	
Trimethoprim/Sulfamethoxazole	<=0,5->2	<=0,5	1	90	
Nitrofurantoin	<016->32	32	>32	66.7	

Table 3. In vitro activity of the drugs against respiratory pathogens

ORGANISM (NO. TESTED)	ANTIBIOTIC	RANGE	MIC-50	MIC-90	% SUSCEPTIBILITY
<i>S. pneumoniae</i> (56)	Ampicillin	<=0,5-4	<=0,5	<=0,5	-
	Penicillin	<=0,03-4	<=0,03	0,25	78.6
	Amoxicillin/Clavulanic acid	<=0,06-8	<=0,06	<=0,06	98.2
	Azithromycin	<=0,5->4	<=0,5	>4	64.3
	Cefepime	<=0,06-4	<=0,06	0,5	96.4
	Cefuroxime	<=0,06->8	<=0,06	2	89.3
	Ceftriaxone	<=0,008-8	0,03	0,5	96.5
	Cefpodoxime	<=0,03->4	<=0,03	1	89.3
	Cefprozil	<=0,12->16	<=0,12	1	92.9
	Ciprofloxacin	0,5->16	1	2	0
	Levofloxacin	0,5->4	1	1	96.4
	Gatifloxacin	0,12->4	0,25	0,5	96.4
	Moxifloxacin	0,06-4	0,12	0,25	98.2
	Erythromycin	<=0,25->32	<=0,25	>32	59
	Clarithromycin	<=0,25->32	<=0,25	>32	59
	Clindamycin	<=0,25->2	<=0,25	>2	69.7
	Quinupristin/Dalfopristin	<=0,5-1	<=0,5	<=0,5	100
	Vancomycin	<=0,06-0,5	0,25	0,5	100
	Chloramphenicol	<=2-16	<=2	16	85.8
	Tetracycline	<=2->16	<=2	>16	62.5
	Rifampin	<=0,5	<=0,5	<=0,5	100
	Trimethoprim/Sulfamethoxazole	<=2->4	<=2	>16	68

Table 3. Continued

ORGANISM (NO. TESTED)	ANTIBIOTIC	RANGE	MIC-50	MIC-90	% SUSCEPTIBILITY
<i>H. influenzae</i> (22)	Amoxicillin/Clavulanic acid	0,25-1	0,25	0,5	100
	Ampicillin	<=0,5->4	<=0,5	>4	82
	Azithromycin	<=0,5-2	1	1	100
	Cefepime	<=0,06-0,12	<=0,06	<=0,06	100
	Cefpodoxime	<=0,03-0,06	<=0,03	0,06	100
	Cefprozil	0,5-4	1	4	100
	Ceftriaxone	<=0,08	<=0,08	<=0,08	100
	Cefuroxime	0,25-1	0,5	1	100
	Chloramphenicol	<=2	<=2	<=2	100
	Ciprofloxacin	<=0,12	<=0,12	<=0,12	100
	Clarithromycin	1-16	4	8	100
	Clindamycin	1-8	4	8	-
	Erythromycin	2-8	4	4	-
	Gatifloxacin	<=0,03	<=0,03	<=0,03	100
	Levofloxacin	<=0,03	<=0,03	<=0,03	100
	Meropenem	0,03-0,16	0,03	0,06	100
	Moxifloxacin	<=0,03	<=0,03	<=0,03	100
	Penicillin	0,12->4	0,25	>4	-
	Piperacillin/Tazobactam	<=0,12	<=0,12	<=0,12	100
	Quinupristin/Dalfopristin	2-4	4	4	-
	Rifampin	<=0,5	<=0,5	<=0,5	100
	Tetracycline	<=2	<=2	<=2	100
TrimSulfa	<=0,5	<=0,5	<=0,5	100	
Vancomycin	>4	>4	>4	-	

ORGANISM (NO. TESTED)	ANTIBIOTIC	RANGE	MIC-50	MIC-90	% SUSCEPTIBILITY
<i>M. catarrhalis</i> (16)	Ampicillin	<=0,5-2	1	2	-
	Penicillin	<=0,03->4	4	>4	-
	Amoxicillin/Clavulanic acid	<=0,06-0,25	0,12	0,25	-
	Cefepime	0,12-1	0,5	1	100
	Cefuroxime	0,25-2	1	2	-
	Ceftriaxone	<=0,08-0,5	0,12	0,5	100
	Cefpodoxime	0,12-1	0,5	0,5	-
	Cefprozil	0,5-2	1	2	-
	Ciprofloxacin	<=0,12	<=0,12	<=0,12	100
	Levofloxacin	<=0,03-0,06	<=0,03	0,06	100
	Gatifloxacin	<=0,03	<=0,03	<=0,03	100
	Moxifloxacin	<=0,03-0,06	0,06	0,06	-
	Azithromycin	<=0,5	<=0,5	<=0,5	-
	Chloramphenicol	<=2	<=2	<=2	100
	Tetracycline	<=2	<=2	<=2	100
	Rifampin	<=0,5	<=0,5	<=0,5	-
	Trimethoprim/Sulfamethoxazole	<=0,5	<=0,5	<=0,5	100

Table 4. In vitro activity of the drugs against bacterial strains collected from soft tissue infections

ORGANISM (NO. TESTED)	ANTIBIOTIC	RANGE	MIC-50	MIC-90	% SUSCEPTIBILITY
<i>S. aureus</i> (33)	Ampicillin	<=1->16	16	>16	9
	Penicillin	0,06->32	16	>32	9
	Oxacillin	<=0,25->2	0,25	>2	66.7
	Amoxicillin/Clavulanic acid	<=1->16	<=1	>16	66.7
	Cefepime	2->16	4	>16	66.7
	Ceftriaxone	4->32	4	>32	66.7
	Ceftazidime	4->16	8	>16	54.6
	Imipenem	<=0,5->8	<=0,5	>8	72.7
	Meropenem	0,12->16	0,12	>16	66.7
	Ertapenem	<=0,06->8	0,25	>8	66.7
	Ciprofloxacin	0,12->4	0,5	>4	72.7
	Levofloxacin	0,12->4	0,25	4	66.7
	Gatifloxacin	<=0,03->4	0,06	4	94
	Moxifloxacin	<=0,03-4	<=0,03	2	78.8
	Gentamicin	<=2->8	<=2	>8	69.7
	Erythromycin	0,12->8	0,25	>8	60.7
	Clindamycin	<=0,06->8	0,12	>8	72.7
	Linezolid	1-2	2	2	100
	Quinupristin/Dalfopristin	<=0,25-1	<=0,25	0,5	100
	Vancomycin	0,5-2	1	2	100
	Teicoplanin	<=2-4	<=2	<=2	100
	Chloramphenicol	4->16	8	8	97
	Tetracycline	<=2->8	<=2	<=2	91
Rifampin	<=0,25->2	<=0,25	>2	88	
Trimethoprim/Sulfamethoxazole	<=0,5-1	<=0,5	<=0,5	97	
Nitrofurantoin	<=16-32	<=16	<=16	100	

ORGANISM (NO. TESTED)	ANTIBIOTIC	RANGE	MIC-50	MIC-90	% SUSCEPTIBILITY
<i>S. epidermidis</i> (13)	Ampicillin	<=1->16	2	>16	38.5
	Penicillin	0,25->32	2	4	0
	Oxacillin	<=0,25->2	>2	>2	46.2
	Amoxicillin/Clavulanic acid	<=1->16	<=1	>16	84.7
	Piperacillin/Tazobactam	<=0,25-32	1	16	84.7
	Cefepime	0,5->16	4	>16	84.7
	Ceftriaxone	0,5->32	16	32	54
	Ceftazidime	4->16	16	>16	38.5
	Imipenem	<=0,5->8	<=0,5	8	84.7
	Meropenem	0,06-8	1	8	69.3
	Ertapenem	0,12->8	2	>8	69.3
	Ciprofloxacin	0,12->4	>4	>4	23
	Levofloxacin	0,12->4	4	>4	30.8
	Gatifloxacin	0,12-4	2	2	92.4
	Moxifloxacin	0,06-4	2	2	30.7
	Gentamicin	<=2->8	4	>8	54
	Erythromycin	0,12->8	>8	>8	38.5
	Clindamycin	<=0,06->8	<=0,06	>8	69.3
	Linezolid	0,5-1	1	1	100
	Quinupristin/Dalfopristin	<=0,25	<=0,25	<=0,25	100
	Vancomycin	0,5-2	1	2	100
	Teicoplanin	<=2-16	<=2	8	92.3
	Chloramphenicol	4->16	4	>16	84.7
Tetracycline	<=2->8	<=2	>8	54	
Rifampin	<=0,25->2	<=0,25	0,5	92.3	
Trimethoprim/Sulfamethoxazole	<=0,5->2	<=0,5	>2	61.6	
Nitrofurantoin	<=16	<=16	<=16	100	

Table 5. In vitro activity of the drugs against bacterial strains collected from urinary tract infections

ORGANISM (NO. TESTED)	ANTIBIOTIC	RANGE	MIC-50	MIC-90	% SUSCEPTIBILITY
<i>E. coli</i> (37)	Ampicillin	2->16	4	>16	56.8
	Piperacillin	<=1->128	2	>128	59.5
	Amoxicillin/Clavulanic acid	2->16	8	16	81
	Ampicillin/Sulbactam	1->32	4	>32	62.2
	Piperacillin/Tazobactam	0,5-8	2	4	100
	Cefepime	<=0,12-2	<=0,12	0,25	100
	Cefuroxime	0,5->16	4	8	89.2
	Cefazolin	<=2->16	<=2	4	1.9
	Cefoxitin	<=0,25->32	4	4	97.3
	Cefoperazone	<=0,25->32	<=0,25	4	97.3
	Ceftazidime	<=1->16	<=1	<=1	97.3
	Ceftriaxone	<=0,25-16	<=0,25	<=0,25	97.3
	Cefoperazone/Sulbactam	<=0,25->4	<=0,25	2	94.6
	Imipenem	<=0,5	<=0,5	<=0,5	100
	Meropenem	<=0,008-0,03	0,016	0,016	100
	Aztreonam	<=0,12->16	<=0,12	<=0,12	97.3
	Nalidixic Acid	<=4->32	<=4	<=4	94.6
	Ciprofloxacin	<=0,03->4	<=0,03	<=0,03	97.3
	Levofloxacin	<=0,03->4	<=0,03	0,06	97.3
	Gatifloxacin	<=0,03->4	<=0,03	0,06	97.3
	Moxifloxacin	<=0,03->4	0,06	0,06	-
	Amikacin	0,5-4	1	2	100
	Gentamicin	<=2->8	<=2	<=2	94.6
Tetracycline	<=2->8	<=2	>8	32.	
Trimethoprim/Sulfamethoxazole	<=0,5->2	<=0,5	2	54	
Nitrofurantoin	<=16->32	<=16	>32	86.5	

Table 6. In vitro activity of the drugs against 7 *Salmonella* spp. Collected from gastrointestinal tract infections

ORGANISM (NO. TESTED)	ANTIBIOTIC	RANGE	MIC-50	MIC-90	% SUSCEPTIBILITY
<i>Salmonella</i> spp.(7)	Ampicillin	<=1-16	2	16	71.5
	Piperacillin	<=1->128	4	>128	71.5
	Amoxicillin/Clavulanic acid	0,5-4	1	2	71.5
	Ampicillin/Sulbactam	1->32	1	32	71.5
	Piperacillin/Tazobactam	<=0,5-8	4	4	100
	Cefepime	<=0,12-0,25	<=0,12	<=0,12	100
	Cefuroxime	4-16	4	4	87.5
	Ceftriaxone	<=0,25	<=0,25	<=0,25	100
	Ceftazidime	<=1	<=1	<=1	100
	Cefazolin	<=2-8	<=2	4	100
	Cefoxitin	2-8	2	2	100
	Cefoperazone	<=0,25->32	0,5	8	87.5
	Cefoperazone/Sulbactam	<=0,25->16	0,5	4	-
	Imipenem	<=0,5	-	-	100
	Aztreonam	<=0,12-0,25	<=0,12	<=0,12	100
	Nalidixic Acid	<=4-8	<=4	<=4	100
	Ciprofloxacin	<=0,03	<=0,03	<=0,03	100
	Levofloxacin	<=0,03-0,06	0,06	0,06	100
	Gatifloxacin	<=0,03-0,06	<=0,03	0,06	100
	Moxifloxacin	<=0,03-0,12	0,06	0,12	-
	Gentamicin	<=2	<=2	<=2	100
	Tetracycline	<=2->8	<=2	>8	85.8
	Trimethoprim/Sulfamethoxazole	<=0,5->2	<=0,5	<=0,5	85.8

Table 7. In vitro activity of the drugs against 7 *Enterococcus spp. vancomycin-resistant*

ORGANISM (NO. TESTED)	ANTIBIOTIC	RANGE	MIC-50	MIC-90	% SUSCEPTIBILITY
Vancomycin-resistant <i>Enterococcus spp.</i> (7)	Ampicillin	2->16	>16	>16	28.6
	Penicillin	8->32	>32	>32	28.6
	Amoxicillin/Clavulanic acid	2->16	>16	>16	-
	Imipenem	8->8	>8	>8	-
	Ertapenem	>8	>8	>8	-
	Ciprofloxacin	>4	>4	>4	12.5
	Levofloxacin	>4	>4	>4	0
	Gatifloxacin	>4	>4	>4	0
	Moxifloxacin	>4	>4	>4	-
	Erythromycin	>8	>8	>8	0
	Clindamycin	>8	>8	>8	-
	Linezolid	1-2	2	2	100
	Quinupristin/Dalfopristin	0,5->2	1	>2	71.4
	Vancomycin	>16	>16	>16	0
	Teicoplanin	>16	>16	>16	0
Chloramphenicol	4-8	8	8	100	
Tetracycline	<=2->8	<=2	>8	85.7	
Rifampin	2->2	>2	>2	0	
Nitrofurantoin	<=16->32	>32	>32	43	

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