SENTRY Antimicrobial Surveillance Program Report: Latin American and Brazilian Results for 1997 through 2001

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The alarming emergence and spread of antimicrobial resistance among common bacteria threatens the effectiveness of therapy for many infections. Surveillance of antimicrobial resistance is essential to identify the major problems and guide adequate control measures. Several resistance surveillance programs have been implemented in North America and Europe in the last decade; however, very few programs have assessed antimicrobial resistance in Latin American countries. The SENTRY Antimicrobial Surveillance Program was initiated in 1997 and represents the most comprehensive surveillance program in place at the present time worldwide. The SENTRY Program collects consecutive isolates from clinically documented infections in more than 80 medical centers worldwide (10 in Latin America). The isolates are collected according to the type of infection (objectives) and susceptibility tested in a central microbiology laboratory by reference broth microdilution methods according to NCCLS guidelines. The Program also incorporated molecular typing (ribotyping and PFGE) and resistance mechanism analysis of selected isolates. In this report we present a very broad analysis of the data generated by testing almost 20,000 bacterial isolates against more than 30 antimicrobial agents. The susceptibility results (MIC_{50}, MIC_{90} and % susceptible) are presented in 11 tables according to the organism and site of infection. The data from Brazil, as well as the data from isolates collected in 2001, are analyzed separately. This report allows the evaluation of the activities numerous antimicrobial agents against clinical isolates collected in Latin American countries.

Key Words: SENTRY, antimicrobial resistance, nosocomial infection, surveillance, Latin America.

The importance of antimicrobial resistance among nosocomial and community-acquired pathogens is acknowledged worldwide. Well-designed antimicrobial surveillance programs are essential in the fight against these cases of resistance [1]. These programs provide important information on the trend in microbial occurrence in different geographical regions and antimicrobial resistance patterns in nosocomial and community-acquired infections. Such information has the potential to guide therapeutic approaches for serious infections, pending directions from local susceptibility testing, and may have value in the prevention and control of infection. However, in order to be effective, surveillance data should be analyzed, tabulated and rapidly presented to the medical community and infection control workers.

The SENTRY Antimicrobial Surveillance Program (SENTRY) was initiated in 1997 and was designed to monitor the spectrum of microbial pathogens and antimicrobial resistance trends for both nosocomial and community-acquired infections on a global scale, by using validated reference quality identification and susceptibility testing methods in designated central laboratories [1-4]. Rapid communication and dissemination of information

Received on 13 July 2003; revised 29 january 2004.
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The Brazilian Journal of Infectious Diseases 2004;8(1):25-79

is a guiding principal of the SENTRY Program. This report is a summary of the data collected in the Latin American region during the first five years of the SENTRY Program (1997 through 2001).

Material and Methods

Study design

The SENTRY Program was established to monitor the important pathogens and antimicrobial resistance patterns of nosocomial and community-acquired infections via a broad network of sentinel hospitals distributed by geographic location and size. The collection of isolates was done according to the site of infection and/or type of patient. The types of infections that are monitored include bloodstream infections or true bacteremia (BSI, objective A), community-acquired respiratory tract infections (CARTI, objective B), lower respiratory tract infections in hospitalized patients (LRTI, objective C), skin and soft tissue infections in hospitalized patients (SSTI, objective D), urinary tract infections in hospitalized patients (UTI, objective E), gastroenteritis (objective G), β-haemolytic streptococci from community-acquired infections (objective H), and assessment of pathogens and resistance patterns among infected patients in the intensive care unit (ICU, objective I). Objectives G, H and I were introduced into the program in 2001.

Each participating center contributed results (organism identification, date of isolation, antimicrobial susceptibility profile, etc.) for the first 20 consecutive episodes of BSI per month from January 1997 to December 2001, 100 consecutive episodes of LRTI and CARTI per year from 1997 to 2001, 50 consecutive isolates from SSTI per year from 1997 to 2000, and 50 consecutive isolates from UTI per year from 1997 to 1999 and in 2001, 25 consecutive isolates of organisms considered producers of diarrheal diseases (gastroenteritis) collected in 2001, 25 consecutive β-haemolytic streptococci isolated from community-acquired infections in 2001, and 50 consecutive and clinically relevant bacterial isolates from patients hospitalized in the ICU in 2001. 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. We evaluated all the isolates that were recovered and the data collected from January 1997 to December 2001.

Participating centers

The laboratories were distributed in various cites of six countries: Sao Paulo, Rio de Janeiro, Florianopolis, Porto Alegre, and Brasilia, Brazil; Buenos Aires and San Isidro, Argentina; Santiago (two centers), Chile; Medellin, Colombia; Mexico City, Mexico; and Montevideo, Uruguay. In 1998, the center located in Montevideo was replaced by a center in Caracas, Venezuela; and in 1999 the Brazilian center located in Rio de Janeiro was replaced by another Brazilian center in Porto Alegre, which is also located in the South region of Brazil. In 2001, the center located in Mendellin, Colombia was replaced by a center located in Brasilia, Brazil. The selection of participant centers was based on the principle that they should be representative in their respective geographic region.

Species identification

All isolates were identified at the participating institution by the routine methodology in use at each laboratory. On receipt at the monitoring center, isolates were subcultured on blood agar to ensure viability and purity. Species identification was confirmed by standardized methods or performed by using the Vitek System (bioMérieux, Hazelwood, MO) or API (bioMérieux, Hazelwood, MO). Isolates were frozen at -70°C until they were processed.

Susceptibility testing

Antimicrobial susceptibility testing of isolates was performed by reference broth microdilution methods,

as described by the National Committee for Clinical Laboratory Standards (NCCLS) [5]. Microdilution trays were purchased from TREK Diagnostics (Cleveland, OH), MicroScan® (West Sacramento, CA), and PML Microbiologicals (Wilsonville, OR). Antimicrobial agents were obtained from their respective manufactures as laboratory grade powder and included cephalosporins (cefepime, cefuroxime, cefotaxime, ceftriaxone, ceftazidime, cefazolin, cefoxitin, cefaclor, and cefixime), penicillins (ampicillin, penicillin, amoxicillin, and oxacillin), β-lactamase inhibitor combinations (amoxicillin-clavulanate, ticarcillin-clavulanate, and piperacillin-tazobactam), 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), glycopeptides (vancomycin and teicoplanin), the oxazolidinone linezolid, the streptogramin quinupristin-dalfopristin, and other drugs, such as clindamycin, chloramphenicol, tetracycline, rifampin, and trimethoprim-sulfamethoxazole. Quality control was performed by testing *E. coli* American Type Culture Collection (ATCC) 25922, *Pseudomonas aeruginosa* ATCC 27853, and other strains, as recommended by the NCCLS [5,6]. Interpretive criteria for each antimicrobial tested were those published by the NCCLS [5,6].

Results

Almost 20,000 clinical isolates were analyzed during this period, and the frequencies of the different pathogens were investigated (Table 1). The antimicrobial susceptibility data for the year 2001 were analyzed separately (Tables 2-5), while the data for the entire 5-year period was also compiled (Tables 6-11).

In addition, data collected in the participating Brazilian centers were analyzed separately from the data of the entire Latin American region (including Brazil). Minimum antimicrobial concentrations that inhibits 50% and 90% of the organism collection (MIC_{50} and MIC_{90}, respectively) were presented only for the data of the entire region. Isolates collected from bloodstream infections and from lower respiratory tract infections (mainly pneumonia) in hospitalized patients were also analyzed separately (Tables 3, 5, 7 and 9).

Two groups of pathogens, streptococci and extended-spectrum (ESBL)-producing strains, were analyzed separately due to their importance in community-acquired and nosocomial-acquired infections, respectively. Table 10 presents the antimicrobial susceptibility of streptococcal species, while Table 11 presents the antimicrobial susceptibility of ESBL-producing *E. coli* and *Klebsiella pneumoniae*.

Discussion

We made a comprehensive analysis of the Latin American SENTRY Program data collected during the first five years of this global program. During this period, SENTRY has provided valuable information worldwide [2-4, 7-9]. The rapid publication of regional susceptibility data concerning a large number of antimicrobial agents, indexed by the site of infection, allowed the detection of considerable geographical variation of the *in vitro* activity of several antimicrobial agents and made evident the emergence of important resistance patterns. These data have been used to guide empirical therapy and the local implementation of control or intervention measures. In addition, SENTRY Program data has guided the implementation of more focused, local surveillance studies, which have been designed based on local resistance problems detected by SENTRY Program results [10,11].

The SENTRY Program has shown that resistance among Gram-negative bacteria seems to be much higher in Latin America when compared to other regions of the world, especially North America and Europe [1,2]. On the other hand, some resistance problems related to Gram-positive cocci, such as glycopeptide-resistance among enterococci, and high-level penicillin-

Table 1. Occurrence of the major pathogens isolated in Latin America during the period of January 1997 to December 2001 according to SENTRY objectives[a]

Pathogen	Objective[a] (no. of isolates)						
	BSI (9,059)	**CARTI (2,409)**	**LRTI (3,346)**	**SSTI (1,780)**	**UTI (1,961)**	**ICU (470)**	**Total[b] (19,547)**
Staphylococcus aureus	1,921	—	760	584	29	102	3,396
Escherichia coli	1,620	—	128	233	1,121	55	3,164
Pseudomonas aeruginosa	589	—	862	210	147	85	1,893
Streptococcus pneumoniae	352	1,046	158	—		4	1,560
Klebsiella pneumoniae	840	—	328	103	203	43	1,517
CoNS[c]	1,221	—	41	99	20	16	1,397
Haemophilus influenzae	26	1,006	143	—	—	1	1,176
Enterobacter spp.	517	—	165	100	77	38	897
Acinetobacter spp.	380	—	299	73	35	39	826
Enterococcus spp.	280	—	58	137	79	29	583
β-haemolytic streptococci[d]	187	—	18	31	8	1	443
Moraxella catarrhalis	3	347	29	—	—	—	379
Proteus spp.	92	—	42	72	112	10	328
Serratia spp.	157	—	89	30	28	16	320
Salmonella spp.[e]	179	—	2	6	5	—	308
Shigella spp.[e]	9	—	—	—	—	—	209
Stenotrophomonas maltophilia	86	—	60	7	—	13	166
Citrobacter spp.	51	—	24	21	34	6	136
Viridans group streptococci	98	—	19	5	1	1	124
Morganella morganii	32	—	10	15	19	4	80

a. The collection of isolates was done according to the site of infection and/or type of patient. The monitored infections included bloodstream infections or true bacteremias (BSI, objective A), community-acquired respiratory tract infections (CARTI, objective B), lower respiratory tract infections in hospitalized patients (LRTI, objective C), skin and soft tissue infections in hospitalized patients (SSTI, objective D), urinary tract infections in hospitalized patients (UTI, objective E), gastroenteritis (objective G), β-haemolytic streptococci from community-acquired infections (objective H), and assessment of pathogens and resistance patterns among infected patients in the intensive care unit (ICU, objective I). Objectives G, H and I were introduced to the Program in 2001.

b. Includes isolates from all objectives, including objectives G and H, which were not analyzed separately.

c. CoNS: coagulase-negative staphylococci.

d. The majority of β-haemolytic streptococci (198 isolates) were recovered from objective H in 2001

e. The majority of *Shigella* spp. (200 isolates) and a large number of *Salmonella* spp. (116 isolates) were collected from objective G (gastroenteritis) in 2001.

Table 2. Antimicrobial activity and spectrum of drugs tested against the most prevalent Gram-negative pathogens isolated in the year 2001 througout Latin America and in Brazil alone

Pathogen (nº total/Brazil)/ Antimicrobial agent	Latin America		Brazil	
	MIC_{50}	MIC_{90}	% Susceptible[a]	% Susceptible[a]
***Acinetobacter* spp. (166/90)**				
Cephalosporins				
Ceftazidime	>16	>16	30.1	28.9
Cefepime	>16	>16	34.3	36.7
Other β-lactams				
Aztreonam	>16	>16	7.2	5.6
Ticarcillin/clavulanate	128	>128	39.8	30
Piperacillin/tazobactam	>64	>64	27.7	31.1
Imipenem	1	>8	83.7	97.8
Meropenem	2	>8	81.9	96.7
Aminoglycosides				
Amikacin	>32	>32	38	35.6
Gentamicin	>8	>/8	30.7	38.9
Tobramycin	16	>16	45.8	50
Fluoroquinolones				
Ciprofloxacin	>2	>2	28.3	33.3
Levofloxacin	>4	>4	28.9	33.3
Gatifloxacin	>4	>4	30.1	34.4
Garenoxacin	>4	>4	29.5	34.4
Others				
Tetracycline	8	>8	33.7	36.7
Trimethoprim/ sulfamethoxazole	>2	>2	31.3	36.7
Polymyxin B	≤1	2	98.2	—
***Enterobacter* spp. (186/94)**				
Cephalosporins				
Cefazolin	>16	>16	4.3	4.3
Cefuroxime	>16	>16	38.7	48.9
Cefoxitin	>32	>32	2.2	2.1
Ceftriaxone	1	>32	61.3	73.4
Ceftazidime	≤2	>16	61.8	73.4
Cefepime	≤0.12	>16	84.9	95.7
Other β-lactams				
Ampicillin	>16	>16	2.7	3.2
Aztreonam	0.5	>16	60.2	72.3
Ticarcillin/clavulanate	16	>128	51.1	64.9
Piperacillin/tazobactam	4	>64	65.6	76.6

Imipenem	0.5	1	99.5	98.9
Meropenem	≤0.06	0.25	98.9	97.9
Aminoglycosides				
Amikacin	2	>32	84.9	91.5
Gentamicin	≤1	>8	67.7	81.9
Tobramycin	0.5	>16	62.4	78.7
Fluoroquinolones				
Ciprofloxacin	0.03	>2	78	89.4
Levofloxacin	0.03	>4	78.5	91.5
Gatifloxacin	0.03	>4	79.6	92.6
Garenoxacin	0.12	>4	76.9	90.4
Others				
Tetracycline	≤4	>8	71.5	81.9
Trimethoprim/ sulfamethoxazole	≤0.5	>2	68.8	77.7
Polymyxin B	≤1	>8	79.9	—
***E. coli* (457/158)**				
Cephalosporins				
Cefazolin	≤2	16	85.6	89.2
Cefuroxime	4	8	90.6	93
Cefoxitin	4	8	92.8	93.7
Ceftriaxone	≤0.25	0.25	95.6 (5.5)[b]	98.1 (3.2)[b]
Ceftazidime	≤2	≤2	96.1 (6.6)[b]	96.8 (3.8)[b]
Cefepime	≤0.12	0.25	97.2	98.1
Other β-lactams				
Ampicillin	>16	>16	40.9	41.1
Aztreonam	0.12	0.25	95.6 (5.5)[b]	97.5 (2.5)[b]
Ticarcillin/clavulanate	8	64	70.5	80.4
Piperacillin/tazobactam	1	4	95	96.8
Imipenem	0.12	0.12	99.8	100
Meropenem	≤0.06	≤0.06	100	100
Aminoglycosides				
Amikacin	2	4	97.2	100
Gentamicin	≤1	8	89.3	95.6
Tobramycin	1	8	89.7	95.6
Fluoroquinolones				
Ciprofloxacin	0.01	>2	85.8	91.1
Levofloxacin	0.03	4	87.1	93
Gatifloxacin	0.03	4	87.1	92.4
Garenoxacin	0.03	>4	85.8	91.1
Others				
Tetracycline	≤4	8	58.4	58.2
Trimethoprim/				

sulfamethoxazole	≤0.5	>2	52.3	44.3
Polymyxin B	≤1	≤1	99.4	—
***Haemophilus influenzae* (319/129)**				
Cephalosporins				
Cefazolin	8	16	NA	NA
Cefuroxime	1	2	96.9	96.1
Cefoxitin	2		NA	NA
Ceftriaxone	0.01	0.5	100	100
Ceftazidime	≤2	≤2	100	100
Cefepime	0.06	0.12	100	100
Other β-lactams				
Ampicillin	≤0.5	>4	81.5[c]	82.2[c]
Aztreonam	0.12	0.12	100	100
Piperacillin/tazobactam	≤0.5	≤0.5	100	100
Imipenem	0.25	0.5	100	100
Meropenem	0.06	0.06	100	100
Macrolides				
Azithromycin	1	2	99.6	99.2
Clarithromycin	8	8	93.4	91.4
Aminoglycosides				
Amikacin	4	8	NA	NA
Gentamicin	2	2	NA	NA
Tobramycin	2	4	NA	NA
Fluoroquinolones				
Ciprofloxacin	0.03	0.03	100	100
Levofloxacin	0.03	0.03	100	100
Gatifloxacin	0.03	0.03	100	100
Garenoxacin	0.03	0.03	100	100
Others				
Tetracycline	≤4	≤4	80.3	93.8
Choranphenicol	≤2	≤2	95.6	96.1
Trimethoprim/ sulfamethoxazole	≤0.5	>2	54.9	48.1
***K. pneumoniae* (292/143)**				
Cephalosporins				
Cefazolin	4	>16	54.1	46.3
Cefuroxime	4	>16	56.5	54.5
Cefoxitin	4	16	83.6	83.9
Ceftriaxone	0.25	>32	65.4 (39.7)[b]	59.4 (43.4)[b]
Ceftazidime	≤2	>16	70.9 (37)[b]	65.7(42)[b]
Cefepime	0.12	>16	77.1	70.6
Other β-lactams				

Ampicillin	>16	>16	3.8	2.8
Aztreonam	0.12	>16	64.7 (38)[b]	57.3 (43.4)[b]
Ticarcillin/clavulanate	16	>128	54.1	51.7
Piperacillin/tazobactam	2	>64	76	72.7
Imipenem	0.12	0.25	100	100
Meropenem	≤0.06	0.12	99	98.6
Aminoglycosides				
Amikacin	2	32	83.6	86.7
Gentamicin	≤1	>8	63.7	62.9
Tobramycin	0.5	>16	58.6	55.9
Fluoroquinolones				
Ciprofloxacin	0.03	>2	84.2	82.5
Levofloxacin	0.06	>4	86	82.5
Gatifloxacin	0.06	>4	86	82.5
Garenoxacin	0.12	>4	83.9	83.2
Others				
Tetracycline	≤4	>8	66.8	64.3
Trimethoprim/ sulfamethoxazole	≤0.5	>2	67.1	60.1
Polymyxin B	≤1	≤1	97.8	
***Moraxella catarrhalis*[d] (63/16)**				
β-lactams				
Ampicillin	≤2	4	0[c]	0[c]
Cefuroxime	1	2	100	100
Ceftriaxone	0.25	0.5	100	100
Cefepime	0.5	2	100	100
Macrolides				
Azithromycin	≤0.12	≤0.12	100	100
Clarithromycin	≤0.25	≤0.25	100	100
Fluoroquinolones				
Ciprofloxacin	0.03	0.03	100	100
Levofloxacin	0.03	0.03	100	100
Gatifloxacin	0.03	0.03	100	100
Garenoxacin	0.03	0.03	100	100
Others				
Tetracycline	≤2	≤2	95.2	100
Chloramphenicol	≤2	≤2	100	100
Trimethoprim/ sulfamethoxazole	≤0.5	≤0.5	90.5	81.3
***Proteus* spp. (32/-[e])**				
Cephalosporins				
Cefazolin	4	>16	62.5	[d]

Cefuroxime	2	>16	100	[d]
Cefoxitin	4	4	100	[d]
Ceftriaxone	0.25	32	78.1	[d]
Ceftazidime	≤2	≤2	100	[d]
Cefepime	0.12	>16	81.3	[d]
Other β-lactams				
Ampicillin	≤2	>16	62.5	[d]
Aztreonam	0.12	1	96.9	[d]
Ticarcillin/clavulanate	≤1	8	100	[d]
Piperacillin/tazobactam	≤0.5	1	100	[d]
Imipenem	1	1	100	[d]
Meropenem	0.06	0.12	100	[d]
Aminoglycosides				
Amikacin	2	8	96.9	[d]
Gentamicin	<1	>8	75	[d]
Tobramycin	1	8	81.3	[d]
Fluoroquinolones				
Ciprofloxacin	0.03	>2	78.1	[d]
Levofloxacin	0.06	>4	78.1	[d]
Gatifloxacin	0.12	>4	78.1	[d]
Garenoxacin	0.25	>4	68.8	[d]
Others				
Tetracycline	>8	>8	3.1	[d]
Trimethoprim/ sulfamethoxazole	≤0.5	>2	59.4	[d]
Polymyxin B	>8	>8	0	
***P. aeruginosa* (407/247)**				
Cephalosporins				
Ceftazidime	8	>16	56.3	50.2
Cefepime	16	>16	54.8	46.6
Other β-lactams				
Aztreonam	16	>16	41.3	36
Ticarcillin/clavulanate	64	>128	49.1	43.3
Piperacillin/tazobactam	32	>64	64.9	56.3
Imipenem	2	>8	62.2	51
Meropenem	2	>8	64.4	52.6
Aminoglycosides				
Amikacin	8	>32	65.4	54.7
Gentamicin	8	>8	49.6	42.5
Tobramycin	1	>16	54.5	45.7
Fluoroquinolones				
Ciprofloxacin	1	>2	49.9	46.2
Levofloxacin	4	>4	49.6	46.6

Gatifloxacin	4	>4	46.4	43.3
Garenoxacin	>4	>4	42.8	40.9
Others				
Tetracycline	>8	>8	1	0.4
Trimethoprim/ sulfamethoxazole	>2	>2	5.4	5.3
Polymyxin B	2	2	97	
***Salmonella* spp. (151/57)**				
Cephalosporins				
Cefazolin	≤2	4	96.7	100
Cefuroxime	4	8	96.7	94.7
Cefoxitin	2	4	97.4	98.2
Ceftriaxone	0.25	0.25	100	100
Ceftazidime	≤2	≤2	100	100
Cefepime	≤0.12	0.12	100	100
Other β-lactams				
Ampicillin	≤2	>16	86.1	96.5
Aztreonam	≤0.12	0.12	100	100
Ticarcillin/clavulanate	2	16	90.7	100
Piperacillin/tazobactam	2	4	99.3	100
Imipenem	0.25	0.25	100	100
Meropenem	≤0.06	0.06	100	100
Aminoglycosides				
Amikacin	1	2	100	100
Gentamicin	≤1	≤2	96.7	94.6
Tobramycin	0.5	1	96.7	94.7
Fluoroquinolones				
Ciprofloxacin	0.01	0.12	100	100
Levofloxacin	0.03	0.25	100	100
Gatifloxacin	0.03	0.12	100	100
Garenoxacin	0.06	0.25	100	100
Others				
Tetracycline	≤4	>8	84.1	91.2
Trimethoprim/ sulfamethoxazole	≤0.5	≤0.5	96	96.5
***Serratia* spp. (66/39)**				
Cephalosporins				
Cefazolin	>16	>16	1.5	0
Cefuroxime	>16	>16	1.5	0
Cefoxitin	32	>32	3	2.6
Ceftriaxone	0.5	>32	69.7	69.2
Ceftazidime	≤2	>16	83.3	76.9

Cefepime	0.25	>16	77.3	79.5
Other β-lactams				
Ampicillin	>16	>16	1.5	0
Aztreonam	0.5	>16	74.2	74.4
Ticarcillin/clavulanate	16	>128	50	43.6
Piperacillin/tazobactam	4	64	71.2	61.5
Imipenem	1	2	98.5	100
Meropenem	0.06	0.25	100	100
Aminoglycosides				
Amikacin	4	>32	68.2	64.1
Gentamicin	≤1	>8	59.1	53.8
Tobramycin	4	>16	51.5	43.6
Fluoroquinolones				
Ciprofloxacin	0.12	>2	72.7	59
Levofloxacin	0.25	>4	77.3	64.1
Gatifloxacin	0.25	>4	77.3	64.1
Garenoxacin	2	>4	60.6	53.8
Others				
Tetracycline	>8	>8	0	0
Trimethoprim/ sulfamethoxazole	≤0.5	>2	66.7	64.1
Polymyxin B	>8	>8	0	
***Shigella* spp. (202/84)**				
Cephalosporins				
Cefazolin	≤2	4	99	98.8
Cefuroxime	2	4	99.5	98.8
Cefoxitin	2	4	99.5	98.8
Ceftriaxone	≤0.25	0.25	100	100
Ceftazidime	≤2	2	100	100
Cefepime	0.12	0.25	100	100
Other β-lactams				
Ampicillin	>16	>16	30.2	28.6
Aztreonam	≤0.12	0.12	99.5	98.8
Ticarcillin/clavulanate	32	32	83.7	86.9
Piperacillin/tazobactam	2	2	100	100
Imipenem	0.12	0.25	100	100
Meropenem	0.06	0.06	100	100
Aminoglycosides				
Amikacin	4	8	100	100
Gentamicin	≤1	2	100	100
Tobramycin	1	2	100	100
Fluoroquinolones				
Ciprofloxacin	≤0.01	≤0.01	100	100

Levofloxacin	≤0.03	0.03	100	100
Gatifloxacin	≤0.03	0.03	100	100
Garenoxacin	≤0.03	0.03	100	100
Others				
Tetracycline	≤4	>8	53.5	71.4
Trimethoprim/ sulfamethoxazole	>2	>2	26.7	15.5
***Stenotrophomonas maltophilia* (70/27)**				
Cephalosporins				
Ceftazidime	8	>16	54.3	74.1
Cefepime	16	>16	30	44.4
Other β-lactams				
Aztreonam	>16	>16	2.9	0
Ticarcillin/clavulanate	32	128	45.7	63
Piperacillin/tazobactam	64	>64	21.7	29.6
Imipenem	>8	>8	0	0
Meropenem	>8	>8	2.9	7.4
Aminoglycosides				
Amikacin	>32	>32	10	11.1
Gentamicin	>8	>8	5.7	11.1
Tobramycin	>16	>16	7.1	11.1
Fluoroquinolones				
Ciprofloxacin	1	>2	55.7	48.1
Levofloxacin	0.5	1	98.6	100
Gatifloxacin	0.5	1	98.6	100
Garenoxacin	1	4	88.6	81.5
Others				
Tetracycline	>8	>8	11.4	11.1
Trimethoprim/ sulfamethoxazole	≤0.5	≤0.5	98.6	100
Polymyxin B	2	8	59.2	—

a. Interpreted by NCCLS 2003 criteria, when available [6] except for polymyxin B (≤ 2 for susceptible and ≥ 4 for resistant);
b. Percentage of strain with MIC ≥ 2 µg/mL, indicating possible ESBL production;
c. Percentage of non-β-lactamase producing strains. This value also represents the susceptibility rate to amoxicillin.
d. Breakpoints for *Haemophilus influenzae* were used;
e. The results were not analyzed because the number of isolates was low (<10).
NA - Not applicable because there was no breakpoint established by the NCCLS [6].

Table 3. Antimicrobial activity and spectrum of drugs tested against the most prevalent Gram-positive cocci isolated from hospitalized patients in 2001

Pathogen (nº total/Brazil)/ Antimicrobial agent	America		Brazil	
	MIC_{50}	MIC_{90}	% Susceptible[a]	% Susceptible[a]
***S. aureus* (669/329)**				
Cephalosporins				
Ceftriaxone	4	>32	56.2 [b]	56.8[b]
Cefepime	4	>16	56.2 [b]	56.8[b]
Other β-lactams				
Oxacillin	0.5	>8	56.2	56.8
Penicillin	16	>32	7.5	8.8
Amoxicillin/clavulanate	≤2	>16	56.2 [b]	56.8[b]
Piperacillin/tazobactam	2	>64	56.2 [b]	56.8[b]
Imipenem	0.06	>8	56.2 [b]	56.8[b]
MLS				
Clindamycin	0.12	>8	60.5	59.9
Erythromycin	0.5	>8	50.7	48.9
Fluoroquinolones				
Ciprofloxacin	0.5	>2	58.4	59.9
Levofloxacin	0.25	4	62.9	65
Gatifloxacin	0.12	4	89.7	86.9
Garenoxacin	0.03	1	97.8	97.9
Others				
Gentamicin	≤2	>8	55.3	56.2
Rifampin	≤0.25	2	75.7	63.8
Chloramphenicol	8	>16	72.2	67.8
Tetracycline	≤4	>8	74.1	59.6
Doxycycline	≤0.5	>4	82.4	70.8
Trimethoprim/sulfamethoxale	≤0.5	>2	73.4	56.2
Vancomycin	1	1	100	100
Teicoplanin	1	2	99.9	99.7
Quinupristin/dalfopristin	0.25	0.5	100	100
Linezolid	2	2	100	100
CoNS (246/147)				
Cephalosporins				
Ceftriaxone	16	>32	20.7[b]	17.7[b]
Cefepime	4	>16	20.7[b]	17.7[b]
Other β-lactams				
Oxacillin	>8	>8	20.7	17.7
Penicillin	8	>32	11	10.2
Amoxicillin/clavulanate	≤2	>16	20.7[b]	17.7[b]
Piperacillin/tazobactam	4	>64	20.7[b]	17.7[b]
Imipenem	0.5	>8	20.7[b]	17.7[b]
MLS				

Clindamycin	0.12	>8	53.7	46.9
Erythromycin	>8	>8	28.5	27.9
Fluoroquinolones				
Ciprofloxacin	0.5	>2	52.4	44.9
Levofloxacin	0.5	>4	63	57.1
Gatifloxacin	0.25	2	93.1	92.5
Garenoxacin	0.06	2	95.1	94.6
Others				
Gentamicin	8	>8	44.9	39.7
Rifampin	0.25	>2	74.8	70.7
Chloramphenicol	8	>16	68.3	59.2
Tetracycline	≤4	>8	77.6	74.1
Doxycycline	≤0.5	>4	88.6	87.8
Trimethoprim/sulfamethoxale	2	>2	48.8	35.4
Vancomycin	2	2	100	100
Teicoplanin	2	8	92.3	91.2
Quinupristin/dalfopristin	0.25	0.5	99.2	100
Linezolid	1	2	100	100
***Enterococcus* spp. (102 / 52)**				
β-lactams				
Ampicillin	≤2	8	90.2	96.2
Penicillin	4	16	70.6	61.5
Amoxicillin/Clavulanate	≤2	4	90.2[c]	96.2[c]
Piperacillin/Tazobactam	4	>64	90.2[c]	96.2[c]
MLS				
Erythromycin	>8	>8	6.9	9.6
Fluoroquinolones				
Ciprofloxacin	2	>2	46.1	38.5
Levofloxacin	2	>4	54.9	46.2
Gatifloxacin	1	>4	54.9	46.2
Garenoxacin	1	4	92.2	59.6
Others				
Gentamicin (HL)	≤500	>1,000	55.9	42.3
Streptomycin (HL)	≤1,000	>2,000	62.7	82.7
Rifampin	>2	>2	22.5	15.4
Chloramphenicol	8	>16	57.8	42.3
Tetracycline	>8	>8	29.4	30.8
Doxycycline	>4	>4	37.3	36.5
Trimethoprim/sulfamethoxale	≤0.5	>2	73.5	61.5
Vancomycin	1	2	93.1	92.3
Teicoplanin	0.12	0.5	94.1	92.3
Quinupristin/dalfopristin	8	>8	6.9	3.8
Linezolid	2	2	100	100

a. Interpreted by NCCLS 2003 criteria, when available [6]; b. Susceptibility is predicted by the oxacillin result [6]; c. Susceptibility is predicted by the ampicillin result [6]; CoNS: coagulase-negative staphylococci; HL: High level aminoglycoside resistance screen.

Table 4. Antimicrobial activity and spectrum of drugs tested against the most prevalent Gram-negative pathogens isolated in the year 2001 throughout Latin America and in Brazil alone, from patients with bacteremia and pneumonia.

Pathogen/ Antimicrobial agents	**% Susceptible strains (number of isolates tested)**			
	Latin America		**Brazil**	
	Bacteremia (67)	**Pneumonia (60)**	**Bacteremia (40)**	**Pneumonia (29)**
***Acinetobacter* spp.**				
Cephalosporins				
Ceftazidime	44.8	21.7	47.5	13.8
Cefepime	49.3	23.3	55	17.2
Other β-lactams				
Aztreonam	11.9	6.7	10	3.4
Ticarcillin/clavulanate	38.8	11.7	47.5	10.3
Piperacillin/tazobactam	44.8	15	50	6.9
Imipenem	88.1	86.7	97.5	100
Meropenem	85.1	85	97.5	96.6
Aminoglycosides				
Amikacin	50.7	33.3	55	17.2
Gentamicin	46.3	21.7	57.5	24.1
Tobramycin	58.2	38.3	70	34.5
Fluoroquinolones				
Ciprofloxacin	44.8	18.3	52.5	13.8
Levofloxacin	46.3	18.3	52.5	13.8
Gatifloxacin	46.3	20	52.5	17.2
Garenoxacin	46.3	20	52.5	17.2
Others				
Tetracycline	47.8	21.7	52.5	17.2
Trimethoprim/ sulfamethoxazole	46.3	23.3	52.5	24.1
***Enterobacter* spp.**	**Bacteremia (117)**	**Pneumonia (31)**	**Bacteremia (59)**	**Pneumonia (14)**
Cephalosporins				
Cefazolin	3.4	6.5	3.4	7.1
Cefuroxime	37.6	41.9	50.8	42.9
Cefoxitin	0.9	6.5	0	7.1
Ceftriaxone	63.2	51.6	78	57.1
Ceftazidime	61.5	61.3	72.9	57.1
Cefepime	86.3	77.4	96.6	92.9
Other β-lactams				
Ampicillin	3.4	3.2	3.4	7.1
Aztreonam	62.4	51.6	72.9	57.1
Ticarcillin/clavulanate	51.3	51.6	67.8	57.1

Piperacillin/tazobactam	67.5	61.3	83.1	57.1
Imipenem	100	96.8	100	92.9
Meropenem	99.1	96.8	98.3	92.9
Aminoglycosides				
Amikacin	84.6	87.1	93.2	85.7
Gentamicin	69.2	67.7	83.1	85.7
Tobramycin	63.2	67.7	79.7	85.7
Fluoroquinolones				
Ciprofloxacin	76.9	71	86.4	92.9
Levofloxacin	78.6	71	89.8	92.9
Gatifloxacin	79.5	71	91.5	92.9
Garenoxacin	77.8	71	88.1	92.9
Others				
Tetracycline	67.5	83.9	79.7	85.7
Trimethoprim/ sulfamethoxazole	65	80.6	74.6	85.7

E. coli **(381)**	**Bacteremia (14)**	**Pneumonia (122)**	**Bacteremia ([a])**	**Pneumonia**
Cephalosporins				
Cefazolin	87.4	64.3	93.4	[a]
Cefuroxime	91.6	85.7	95.1	[a]
Cefoxitin	93.4	85.7	93.4	[a]
Ceftriaxone	96.3 (4.7)[b]	92.9 (7.1)[b]	98.4 (2.5)[b]	[a]
Ceftazidime	96.3 (5.8)[b]	100 (7.1)[b]	96.7 (3.3)[b]	[a]
Cefepime	97.6	100	98.4	[a]
Other β-lactams				
Ampicillin	41.7	28.6	45.1	[a]
Aztreonam	96.6 (4.7)[b]	92.3 (7.7)[b]	98.4 (1.6)[b]	[a]
Ticarcillin/clavulanate	71.4	64.3	82	[a]
Piperacillin/tazobactam	95.8	85.7	96.7	[a]
Imipenem	100	92.9	100	[a]
Meropenem	100	100	100	[a]
Aminoglycosides				
Amikacin	96.9	92.9	100	[a]
Gentamicin	90.3	85.7	95.9	[a]
Tobramycin	90.3	92.9	95.9	[a]
Fluoroquinolones				
Ciprofloxacin	85.8	85.7	91.8	[a]
Levofloxacin	87.4	85.7	94.3	[a]
Gatifloxacin	87.1	92.9	93.4	[a]
Garenoxacin	85.8	92.9	91.8	[a]
Others				
Tetracycline	58.8	42.9	61.5	[a]

Trimethoprim/ sulfamethoxazole	52.8	57.1	45.1	[a]
K. pneumoniae	**Bacteremia (176)**	**Pneumonia (73)**	**Bacteremia (90)**	**Pneumonia (28)**
Cephalosporins				
Cefazolin	56.3	57.5	56.7	53.6
Cefuroxime	58.5	58.9	60	53.6
Cefoxitin	84.7	84.9	86.7	82.1
Ceftriaxone	66.5 (37.5)[b]	69.9 (39.7)[b]	64.4 (37.8)[b]	57.1 (42.9)[b]
Ceftazidime	69.9 (36.4)[b]	82.2 (28.8)[b]	70 (37.8)[b]	67.9 (39.3)[b]
Cefepime	79	82.2	75.6	71.4
Other β-lactams				
Ampicillin	5.7	1.4	4.4	0
Aztreonam	64.8(36.9)[b]	74(32.9)[b]	62.2(35.6)[b]	57.1(42.9)[b]
Ticarcillin/clavulanate	56.3	57.5	55.6	50
Piperacillin/tazobactam	73.9	84.9	74.4	78.6
Imipenem	100	100	100	100
Meropenem	99.4	100	98.9	100
Aminoglycosides				
Amikacin	84.1	89	90	85.7
Gentamicin	63.6	71.2	65.6	67.9
Tobramycin	59.7	63	62.2	50
Fluoroquinolones				
Ciprofloxacin	84.7	90.4	86.7	85.7
Levofloxacin	86.9	91.8	86.7	85.7
Gatifloxacin	86.9	91.8	86.7	85.7
Garenoxacin	84.1	90.4	86.7	85.7
Others				
Tetracycline	64.2	78.1	62.2	67.9
Trimethoprim/ sulfamethoxazole	65.3	78.1	58.9	71.4
P. aeruginosa	**Bacteremia (119)**	**Pneumonia (203)**	**Bacteremia (58)**	**Pneumonia (142)**
Cephalosporins				
Ceftazidime	68.1	50.7	69	40.8
Cefepime	66.4	49.8	65.5	38.7
Other β-lactams				
Aztreonam	47.9	39.4	51.7	31
Ticarcillin/clavulanate	59.7	47.8	58.6	38.7
Piperacillin/tazobactam	79.8	56.2	75.9	46.5
Imipenem	79	53.7	75.9	41.5
Meropenem	80.7	57.3	77.6	45.1

Aminoglycosides				
Amikacin	73.9	61.1	70.7	51.4
Gentamicin	63	43.3	69	35.9
Tobramycin	67.2	50.7	69	41.5
Fluoroquinolones				
Ciprofloxacin	60.5	43.3	70	40.1
Levofloxacin	60.5	42.9	70.7	40.8
Gatifloxacin	56.3	39.9	5.2	38
Garenoxacin	51.3	37.4	62.1	35.9
Others				
Tetracycline	3.4	0	1.7	0
Trimethoprim/ sulfamethoxazole	2.5	3.9	3.4	7.7

***Salmonella* spp.**	**Bacteremia (35)**	**Pneumonia ([a])**	**Bacteremia ([a])**	**Pneumonia ([a])**
Cephalosporins				
Cefazolin	100	a	a	a
Cefuroxime	91.4	a	a	a
Cefoxitin	97.1	a	a	a
Ceftriaxone	100	a	a	a
Ceftazidime	100	a	a	a
Cefepime	100	a	a	a
Other β-lactams				
Ampicillin	91.4	a	a	a
Aztreonam	100	a	a	a
Ticarcillin/clavulanate	91.4	a	a	a
Piperacillin/tazobactam	97.1	a	a	a
Imipenem	100	a	a	a
Meropenem	100	a	a	a
Aminoglycosides				
Amikacin	100	a	a	a
Gentamicin	97.1	a	a	a
Tobramycin	97.1	a	a	a
Fluoroquinolones				
Ciprofloxacin	100	a	a	a
Levofloxacin	100	a	a	a
Gatifloxacin	100	a	a	a
Garenoxacin	100	a	a	a
Others				
Tetracycline	85.7	a	a	a
Trimethoprim/ sulfamethoxazole	100	a	a	a

***Serratia* spp.**	**Bacteremia (32)**	**Pneumonia (18)**	**Bacteremia (22)**	**Pneumonia ([a])**
Cephalosporins				
Cefazolin	0	5.6	0	[a]
Cefuroxime	0	0	0	[a]
Cefoxitin	0	5.6	0	[a]
Ceftriaxone	62.5	83.3	68.2	[a]
Ceftazidime	78.1	94.4	77.3	[a]
Cefepime	68.8	94.4	77.3	[a]
Other β-lactams				
Ampicillin	0	0	0	[a]
Aztreonam	68.8	88.9	77.3	[a]
Ticarcillin/clavulanate	34.4	72.2	31.8	[a]
Piperacillin/tazobactam	56.3	94.4	45.5	[a]
Imipenem	100	94.4	100	[a]
Meropenem	100	100	100	[a]
Aminoglycosides				
Amikacin	62.5	83.3	59.1	[a]
Gentamicin	43.8	88.9	40.9	[a]
Tobramycin	37.5	72.2	31.8	[a]
Fluoroquinolones				
Ciprofloxacin	56.3	100	45.5	[a]
Levofloxacin	62.5	100	50	[a]
Gatifloxacin	62.5	100	50	[a]
Garenoxacin	46.9	83.3	40.9	[a]
Others				
Tetracycline	0	0	0	[a]
Trimethoprim/ sulfamethoxazole	46.9	83.3	45.5	[a]
Stenotrophomonas maltophilia	**Bacteremia (38)**	**Pneumonia (19)**	**Bacteremia (16)**	**Pneumonia ([a])**
Cephalosporins				
Ceftazidime	65.8	52.6	93.8	[a]
Cefepime	39.5	26.3	62.5	[a]
Other β-lactams				
Aztreonam	5.3	0	0	[a]
Ticarcillin/clavulanate	52.6	47.4	81.3	[a]
Piperacillin/tazobactam	29.7	15.8	43.8	[a]
Imipenem	0	0	0	[a]
Meropenem	2.6	5.3	6.3	[a]
Aminoglycosides				
Amikacin	13.2	10.5	18.8	[a]
Gentamicin	10.5	0	18.8	[a]

Tobramycin	10.5	5.3	18.8	[a]
Fluoroquinolones				
Ciprofloxacin	68.4	42.1	62.5	[a]
Levofloxacin	100	100	100	[a]
Gatifloxacin	100	100	100	[a]
Garenoxacin	94.7	84.2	87.5	[a]
Others				
Tetracycline	15.8	5.3	18.8	[a]
Trimethoprim/ sulfamethoxazole	97.4	100	100	[a]

a. The results were not analyzed because the number of isolates was low (<10);
b. Percentage of strains with MIC ≥ 2 µg/mL, indicating possible ESBL production [6].

Table 5. Antimicrobial activity and spectrum of drugs tested against the most prevalent Gram-positive pathogens isolated in the year 2001 from patients with bacteremia and pneumonia

Pathogen/ Antimicrobial agents	**% Susceptible strains (number of isolates tested)**			
	Latin America		**Brazil**	
S. aureus	**Bacteremia (389**	**Pneumonia (178)**	**Bacteremia (182)**	**Pneumonia (105)**
Cephalosporins				
Cefazolin	65[b]	43.3[b]	64.8[b]	47.6[b]
Ceftriaxone	65[b]	43.3[b]	64.8[b]	47.6[b]
Cefepime	65[b]	43.3[b]	64.8[b]	47.6[b]
Other β-lactams				
Oxacillin	65	43.3	64.8	47.6
Penicillin	10	2.8	12.6	3.8
Amoxicillin/clavulanate	65[b]	43.3[b]	64.8[b]	47.6[b]
Piperacillin/tazobactam	65[b]	43.3[b]	64.8[b]	47.6[b]
Imipenem	65[b]	43.3[b]	64.8[b]	47.6[b]
MLS				
Clindamycin	69.9	46.1	68.7	47.6
Erythromycin	57.6	39.9	54.9	40
Fluoroquinolones				
Ciprofloxacin	66.6	47.2	68.1	49.5
Levofloxacin	71.2	51.1	73.1	54.3
Gatifloxacin	91.3	87.1	88.5	84.8
Garenoxacin	98.7	95.5	98.9	96.2
Others				
Gentamicin	63.2	44.9	63.7	47.6
Rifampin	81.7	64	72.5	51.4
Chloramphenicol	78.7	65.7	74.7	62.9

Tetracycline	81.2	62.9	67	51.4
Doxycycline	87.4	75.3	76.4	64.8
Trimethoprim/sulfamethoxale	79.7	64	62.1	52.4
Vancomycin	100	100	100	100
Teicoplanin	99.7	100	99.5	100
Quinupristin/dalfopristin	100	100	100	100
Linezolid	100	100	100	100
CoNS	**Bacteremia (219)**	**Pneumonia (11)**	**Bacteremia (123)**	**Pneumonia (11)**
Cephalosporins				
Cefazolin	19.6[b]	54.5[b]	15.4[b]	54.5[b]
Ceftriaxone	19.6[b]	54.5[b]	15.4[b]	54.5[b]
Cefepime	19.6[b]	54.5[b]	15.4[b]	54.5[b]
Other β-lactams				
Oxacillin	19.6	54.5	15.4	54.5
Penicillin	10.5	36.4	8.9	36.4
Amoxicillin/clavulanate	19.6[b]	54.5[b]	15.4[b]	54.5[b]
Piperacillin/tazobactam	19.6[b]	54.5[b]	15.4[b]	54.5[b]
Imipenem	19.6[b]	54.5[b]	15.4[b]	54.5[b]
MLS				
Clindamycin	55.7	63.6	49.6	63.6
Erythromycin	30.1	27.3	30.9	27.3
Fluoroquinolones				
Ciprofloxacin	54.3	54.5	47.2	54.5
Gatifloxacin	93.2	81.8	92.7	81.8
Levofloxacin	65.3	54.5	61	54.5
Garenoxacin	95.4	90.9	95.1	90.9
Others				
Gentamicin	45.9	54.5	40.2	54.5
Rifampin	77.2	72.7	74	72.7
Chloramphenicol	69.4	81.8	60.2	81.8
Tetracycline	78.1	63.6	74	63.6
Doxycycline	89	81.8	87.8	81.8
Trimethoprim/sulfamethoxale	51.1	27.3	39.8	27.3
Vancomycin	100	100	100	100
Teicoplanin	93.2	81.8	92.7	81.8
Quinupristin/dalfopristin	99.5	100	100	100
Linezolid	100	100	100	100
***Enterococcus* spp.**	**Bacteremia (64)**	**Pneumonia ([d])**	**Bacteremia (28)**	**Pneumonia ([d])**
β-lactams				
Ampicillin	90.6	[d]	96.4	[d]

Penicillin	76.6	[d]	64.3	[d]
Amoxicillin/Clavulanate	90.6[c]	[d]	96.4[c]	[d]
Piperacillin/Tazobactam	90.6[c]	[d]	96.4[c]	[d]
MLS				
Erythromycin	7.8	[d]	10.7	[d]
Fluoroquinolones				
Ciprofloxacin	50	[d]	39.3	[d]
Levofloxacin	62.5	[d]	53.6	[d]
Gatifloxacin	60.9	[d]	53.6	[d]
Garenoxacin	90.6	[d]	89.3	[d]
Others				
Gentamicin (HL)	60.9	[d]	46.4	[d]
Streptomycin (HL)	62.5	[d]	75	[d]
Rifampin	28.1	[d]	21.4	[d]
Chloramphenicol	62.5	[d]	46.4	[d]
Tetracycline	32.8	[d]	35.7	[d]
Doxycycline	42.2	[d]	39.3	[d]
Vancomycin	96.9	[d]	100	[d]
Teicoplanin	96.9	[d]	100	[d]
Quinupristin/dalfopristin	7.8	[d]	7.1	[d]
Linezolid	100	[d]	100	[d]

a. Interpreted by NCCLS 2003 criteria, when available [6]; b. Susceptibility is predicted by the oxacillin result [6]; c. Susceptibility is predicted by the ampicillin result [6]; d. The results were not analyzed because the number of isolates was low (<10). Abbreviations: CoNS - coagulase negative staphylococci; HL - High level aminoglycoside resistence screen; NA – Not applicable, there is no breakpoint established by the NCCLS [6].

Table 6. Antimicrobial activity and spectrum of drugs tested against the five most prevalent Gram-negative pathogens isolated from January 1997 to December 2001 throughout Latin America and in Brazil alone

Pathogen (nº total/Brazil)/ Antimicrobial agent	**Latin America**		**Brazil**	
	MIC_{50}	**MIC_{90}**	**% Susceptible**	**% Susceptible**
***Acinetobacter* spp. (826/ 400)**				
Cephalosporins				
Ceftazidime	>16	>16	28.6	27.3
Cefepime	16	>16	35.4	33.8
Other β-lactams				
Aztreonam	>16	>16	7.6	6.5
Ticarcillin/clavulanate	>128	>128	24.8	28.3
Piperacillin/tazobactam	>64	>64	26.8	28.8
Imipenem	1	>8	86.9	90.8
Meropenem	1	>8	86.8	90.8

Aminoglycosides				
Amikacin	>32	>32	34	32.3
Gentamicin	>8	>16	32.9	37.8
Tobramycin	16	>16	41.7	51.8
Fluoroquinolones				
Ciprofloxacin	>2	>2	30.5	35.3
Levofloxacin	>4	>4	32.3	36.3
Gatifloxacin	4	>4	34.4	38.5
Garenoxacin	>4	>4	34.9	35.8
Others				
Tetracycline	≤4	>8	51	56.1
Trimethoprim/ sulfamethoxazole	>1	>2	32.4	31
***Burkholderia cepacia* (68/ 34)**				
Cephalosporins				
Ceftazidime	4	16	82.4	85.3
Cefepime	8	>16	51.5	47.1
Other β-lactams				
Aztreonam	>16	>16	19.1	20.6
Ticarcillin/clavulanate	>128	>128	17.6	14.7
Piperacillin/tazobactam	8	64	67.6	64.7
Imipenem	4	>8	52.9	52.9
Meropenem	2	>8	76.5	85.3
Aminoglycosides				
Amikacin	>32	>32	17.6	8.8
Gentamicin	16	>16	13.2	8.8
Tobramycin	>16	>16	13.2	8.8
Fluoroquinolones				
Ciprofloxacin	1	>2	60.3	70.6
Levofloxacin	1	4	80.9	82.4
Gatifloxacin	1	>4	77.9	79.4
Garenoxacin	2	>4	66.7	76.9
Others				
Tetracycline	>8	>8	13.2	8.8
Trimethoprim/ sulfamethoxazole	≤ 0.5	>1	79.4	97.1
***Citrobacter* spp. (136/ 43)**				
Cephalosporins				
Cefazolin	>16	>16	19.1	18.6
Cefuroxime	8	>16	56.6	55.8
Cefoxitin	>32	>32	20.6	20.9
Ceftriaxone	0.25	>32	70.6	65.1

Ceftazidime	1	>16	67.6	62.8
Cefepime	0.12	4	93.4	95.3
Other β-lactams				
Ampicillin	>16	>16	12.5	11.6
Aztreonam	0.25	>16	66.2	60.5
Ticarcillin/clavulanate	4	>128	59.6	55.8
Piperacillin/tazobactam	4	>64	68.4	67.4
Imipenem	0.5	1	100	100
Meropenem	0.06	0.12	100	100
Aminoglycosides				
Amikacin	2	32	81.6	74.4
Gentamicin	≤1	16	79.4	74.4
Tobramycin	1	>16	73.5	71.8
Fluoroquinolones				
Ciprofloxacin	0.25	>2	81.6	76.7
Levofloxacin	≤0.5	4	84.6	81.4
Gatifloxacin	0.12	4	83.1	76.7
Garenoxacin	0.12	>4	85.3	81
Others				
Tetracycline	≤4	>8	67.6	67.4
Trimethoprim/ sulfamethoxazole	≤0.5	>2	68.4	62.8
***Enterobacter* spp. (897/ 441)**				
Cephalosporins				
Cefazolin	>16	>16	5.1	3.9
Cefuroxime	>16	>16	35.9	40.4
Cefoxitin	>32	>32	2.2	5.9
Ceftriaxone	0.5	>32	64.2	69.4
Ceftazidime	≤1	>16	64	69.2
Cefepime	≤0.12	8	90.5	92.3
Other β-lactams				
Ampicillin	>16	>16	5.6	5.2
Aztreonam	0.25	>16	63.4	69.4
Ticarcillin/clavulanate	16	>128	52.1	55.8
Piperacillin/tazobactam	4	>64	64.9	68.3
Imipenem	0.5	1	99.8	99.5
Meropenem	≤0.06	0.25	99.7	99.5
Aminoglycosides				
Amikacin	2	>32	83.4	82.3
Gentamicin	≤1	>8	74.1	74.6
Tobramycin	1	>16	63	66.8
Fluoroquinolones				
Ciprofloxacin	0.25	>2	80.2	82.8

Levofloxacin	≤0.5	>4	81.7	84.8
Gatifloxacin	0.06	>4	82.5	86.4
Garenoxacin	0.12	>4	75	85.6
Others				
Tetracycline	≤4	>8	66.6	67.8
Trimethoprim/ sulfamethoxazole	≤0.5	>2	70.9	71.4
***E. coli* (3164/ 835)**				
Cephalosporins				
Cefazolin	≤2	>16	81.8	86
Cefuroxime	4	16	88	89.1
Cefoxitin	4	8	92.8	93.8
Ceftriaxone	≤0.25	≤0.25	94.6 (6.1)[b]	94.3 (6.7)[b]
Ceftazidime	0.25	≤2	95.8 (6.5)[b]	95.3 (7.4)[b]
Cefepime	≤0.12	0.25	96.9	96.9
Other β-lactams				
Ampicillin	>16	>16	39.7	42.9
Aztreonam	≤0.12	0.25	94.7 (6.6)[b]	94.4 (7)[b]
Ticarcillin/clavulanate	8	128	65.2	72.7
Piperacillin/tazobactam	2	16	91.3	94.3
Imipenem	0.12	0.25	99.9	100
Meropenem	≤0.06	≤0.06	99.9	100
Aminoglycosides				
Amikacin	2	8	97.3	97.6
Gentamicin	≤1	8	89	92.5
Tobramycin	1	8	87	89.7
Fluoroquinolones				
Ciprofloxacin	0.25	>2	82.9	89.7
Levofloxacin	≤0.5	>4	82.9	90.3
Gatifloxacin	≤0.03	>4	83.5	90.5
Garenoxacin	0.03	>4	84.4	91.2
Others				
Tetracycline	≤4	>8	51.4	58.7
Trimethoprim/ sulfamethoxazole	≤0.5	>2	52.5	52.3
***Haemophilus influenzae* (1176/ 406)**				
Cephalosporins				
Cefuroxime	1	2	98.6	97.8
Ceftriaxone	0.01	0.25	99.8	100
Ceftazidime	0.25	0.25	99.8	100
Cefepime	0.06	0.12	99.8	100
Other β-lactams				

Ampicillin	≤ 0.5	>4	86.4[c]	87.4[c]
Aztreonam	0.12	0.12	100	100
Piperacillin/tazobactam	≤ 0.5	≤ 0.5	99.3	100
Imipenem	0.25	0.5	100	100
Meropenem	0.06	0.06	100	100
Macrolides				
Azithromycin	1	2	99.7	99.5
Clarithromycin	8	8	91.1	90.8
Fluoroquinolones				
Ciprofloxacin	0.01	0.03	100	100
Gatifloxacin	0.03	0.03	100	100
Levofloxacin	0.03	≤ 0.5	100	100
Garenoxacin	0.03	0.03	100	100
Others				
Tetracycline	≤2	≤2	96.9	92.4
Choranphenicol	≤2	≤2	97.5	96.4
Trimethoprim/ sulfamethoxazole	≤ 0.5	>4	61	51.9
***K. pneumoniae* (1517/ 575)**				
Cephalosporins				
Cefazolin	16	>16	49.6	46.3
Cefuroxime	8	>16	54	51.3
Cefoxitin	4	16	83.6	84.5
Ceftriaxone	≤0.25	>32	61.8 (42.5)[b]	57.9 (47.8)[b]
Ceftazidime	≤2	>16	66.8 (42.7)[b]	67.5 (48)[b]
Cefepime	≤0.12	>16	76.3	67.1
Other β-lactams				
Ampicillin	>16	>16	0	0
Aztreonam	0.25	>16	62.2 (41.7)[b]	57.7 (46.3)[b]
Ticarcillin/clavulanate	16	>128	50.4	49
Piperacillin/tazobactam	4	>64	66.8	68.5
Imipenem	0.25	0.5	99.8	100
Meropenem	≤0.06	0.12	99.4	99.5
Aminoglycosides				
Amikacin	2	32	80.7	81.6
Gentamicin	≤1	>16	65.1	63.1
Tobramycin	1	>16	53.9	51.3
Fluoroquinolones				
Ciprofloxacin	0.25	>2	86.5	88.9
Levofloxacin	≤0.5	4	88.7	89.6

Gatifloxacin	0.06	2	89.8	90.3
Garenoxacin	0.12	>4	87.1	85.6
Others				
Tetracycline	≤4	>8	65.6	69.7
Choranphenicol	≤2	≤2	99.7	99.3
Trimethoprim/ sulfamethoxazole	≤0.5	2	68.2	62.1
***Moraxella catarrhalis* (379/141)**				
Beta-lactams				
Ampicillin	≤ 2	4	4.5[c]	5[c]
Cefuroxime	1	2	99.5	100
Ceftriaxone	0.25	0.5	100	100
Ceftazidime	0.25	0.25	99.6	100
Cefepime	0.5	2	98.2	97.2
Macrolides				
Azithromycin	≤0.12	≤0.12	100	100
Clarithromycin	≤0.25	≤0.25	100	100
Fluoroquinolones				
Ciprofloxacin	0.03	0.06	100	100
Levofloxacin	0.03	≤ 0.5	100	100
Gatifloxacin	0.03	0.06	100	100
Garenoxacin	0.03	0.03	100	100
Others				
Tetracycline	≤ 2	≤ 2	92.9	100
Trimethoprim/ sulfamethoxazole	≤ 0.5	1	89.1	86.5
***Morganella morgannii* (80/ 29)**				
Cephalosporins				
Cefazolin	>16	>16	3.8	6.9
Cefuroxime	>16	>16	10	10.3
Cefoxitin	16	>32	43.8	37.9
Ceftriaxone	0.25	4	92.5	82.8
Ceftazidime	0.25	8	90	93.1
Cefepime	0.12	2	95	89.7
Other β-lactams				
Ampicillin	>16	>16	0	0
Aztreonam	0.12	16	87.5	82.8
Ticarcillin/clavulanate	4	64	82.5	86.2
Piperacillin/tazobactam	≤0.5	8	92.5	96.6
Imipenem	2	4	97.5	93.1
Meropenem	0.06	0.25	100	100
Aminoglycosides				

Fluoroquinolones				
Ciprofloxacin	0.25	>2	76.3	69
Levofloxacin	≤0.5	>4	76.3	72.4
Gatifloxacin	0.12	>4	76.3	69
Garenoxacin	0.5	>4	71.1	40
Others				
Tetracycline	≤4	>8	51.3	37.9
Trimethoprim/ sulfamethoxazole	≤0.5	>2	67.5	58.6
***P. aeruginosa* (1984/ 913)**				
Cephalosporins				
Ceftazidime	4	>16	62.4	56
Cefepime	8	>16	62.7	53.9
Other β-lactams				
Aztreonam	16	>16	44.5	38.2
Ticarcillin/clavulanate	64	>128	55.6	47.8
Piperacillin/tazobactam	16	>64	72.1	64.6
Imipenem	2	>8	71.9	62.5
Meropenem	1	>8	74.8	65.8
Aminoglycosides				
Amikacin	4	>32	70	58.4
Gentamicin	4	>16	58.2	49.7
Tobramycin	1	>16	58.2	47.9
Fluoroquinolones				
Ciprofloxacin	0.5	>2	58.1	52.8
Levofloxacin	1	>4	56.8	52.4
Gatifloxacin	2	>4	54.4	50.2
Garenoxacin	4	>4	46.3	42
Others				
Tetracycline	>8	>8	1.5	0.9
Trimethoprim/ sulfamethoxazole	>2	>2	3.4	3.8
***Proteus* spp (328/ 66)**				
Cephalosporins				
Cefazolin	4	>16	62.2	74.2
Cefuroxime	2	>16	69.8	78.8
Cefoxitin	4	8	93.9	95.5
Ceftriaxone	0.25	>32	81.4	92.4
Ceftazidime	0.12	2	96.3	98.5
Cefepime	0.12	>16	83.2	92.4
Other β-lactams				
Ampicillin	4	>16	52.4	56.1

Aztreonam	0.12	4	93.6	95.5
Ticarcillin/clavulanate	≤1	16	94.5	97
Piperacillin/tazobactam	≤0.5	2	94.2	98.5
Imipenem	1	4	98.8	98.5
Meropenem	0.06	0.25	100	100
Aminoglycosides				
Amikacin	4	16	93.6	97
Gentamicin	1	>16	74.4	87.9
Tobramycin	2	16	75.6	87.7
Fluoroquinolones				
Ciprofloxacin	0.25	>2	76.2	92.4
Levofloxacin	≤0.5	>4	79.6	95.5
Gatifloxacin	0.12	>4	76.8	93.9
Garenoxacin	0.5	>4	75.1	87.8
Others				
Tetracycline	>8	>8	5.5	9.1
Trimethoprim/ sulfamethoxazole	≤0.5	>2	61.6	71.2
***Salmonella* spp (308/ 97)**				
Cephalosporins				
Cefazolin	≤2	4	96.8	99
Cefuroxime	4	8	96.8	96.9
Cefoxitin	2	4	97.7	97.9
Ceftriaxone	0.25	0.25	100	100
Ceftazidime	≤1	≤2	100	100
Cefepime	0.12	0.12	100	100
Other β-lactams				
Ampicillin	≤2	16	89.3	96.9
Aztreonam	0.12	0.12	99	100
Ticarcillin/clavulanate	2	8	92.5	100
Piperacillin/tazobactam	2	4	99.4	100
Imipenem	0.25	0.25	100	100
Meropenem	0.06	0.06	100	100
Aminoglycosides				
Amikacin	1	4	99.7	100
Gentamicin	≤1	1	96.4	95.8
Tobramycin	1	2	95.7	94.3
Fluoroquinolones				
Ciprofloxacin	0.01	0.25	100	100
Levofloxacin	0.06	≤0.5	100	100
Gatifloxacin	0.03	0.12	100	100
Garenoxacin	0.06	0.12	100	100
Others				

Tetracycline	≤4	8	86.4	94.8
Trimethoprim/ sulfamethoxazole	≤0.5	≤0.5	93.8	97.9
***Serratia* spp. (320/ 169)**				
Cephalosporins				
Cefazolin	>16	>16	1.6	1.2
Cefuroxime	>16	>16	2.2	0.6
Cefoxitin	32	>32	8.1	6.5
Ceftriaxone	0.5	>32	76.3	71.6
Ceftazidime	0.5	>16	86.3	81.1
Cefepime	0.25	16	89.4	93.5
Other β-lactams				
Ampicillin	>16	>16	4.1	3
Aztreonam	0.25	>16	82.8	84
Ticarcillin/clavulanate	16	>128	57.8	47.9
Piperacillin/tazobactam	2	>64	73.1	64.5
Imipenem	1	2	99.7	100
Meropenem	0.06	0.25	100	100
Aminoglycosides				
Amikacin	4	>32	73.4	66.9
Gentamicin	1	>16	66.6	56.2
Tobramycin	4	>16	54.4	45
Fluoroquinolones				
Ciprofloxacin	0.25	>2	74.1	59.8
Levofloxacin	≤0.5	4	82.2	69.8
Gatifloxacin	0.25	>4	80	67.5
Garenoxacin	2	>4	62.5	51.7
Others				
Tetracycline	>8	>8	7.5	4.7
Trimethoprim/ sulfamethoxazole	≤0.5	>2	66.9	58.6
***Shigella* spp (209/ 87)**				
Cephalosporins				
Cefazolin	≤2	4	98.6	98.9
Cefuroxime	2	4	99	98.9
Cefoxitin	2	4	99	98.9
Ceftriaxone	0.25	0.25	99.5	100
Ceftazidime	≤ 2	≤ 2	100	100
Cefepime	0.12	0.25	100	100
Other β-lactams				
Ampicillin	>16	>16	30.1	31
Aztreonam	0.12	0.12	99	98.9

Ticarcillin/clavulanate	16	32	82.8	86.2
Piperacillin/tazobactam	2	2	99	100
Imipenem	0.12	0.25	100	100
Meropenem	0.06	0.06	100	100
Aminoglycosides				
Amikacin	8	8	100	100
Gentamicin	≤1	2	100	100
Tobramycin	1	2	100	100
Fluoroquinolones				
Ciprofloxacin	0.01	0.01	100	100
Levofloxacin	0.03	0.03	100	100
Gatifloxacin	0.03	0.03	100	100
Garenoxacin	0.03	0.03	100	100
Others				
Tetracycline	≤4	> 8	53.1	71.3
Trimethoprim/ sulfamethoxazole	>2	> 2	25.8	14.9
***Stenotrophomonas maltophilia* (166/ 62)**				
Cephalosporins				
Ceftazidime	8	>16	57.8	66.1
Cefepime	16	>16	31.3	35.5
Other β-lactams				
Aztreonam	>16	>16	5.4	4.8
Ticarcillin/clavulanate	16	128	56	69.4
Piperacillin/tazobactam	64	>64	33.3	40.3
Imipenem	>8	>8	1.2	0
Meropenem	>8	>8	4.8	6.5
Aminoglycosides				
Amikacin	>32	>32	16.3	12.9
Gentamicin	>8	>16	15.1	11.3
Tobramycin	>16	>16	13.1	8.1
Fluoroquinolones				
Ciprofloxacin	2	>2	43.4	33.9
Levofloxacin	0.5	4	88	90.3
Gatifloxacin	0.5	2	91	93.5
Garenoxacin	1	4	82.4	78.4
Others				
Tetracycline	>8	>8	14.5	12.9
Trimethoprim/ sulfamethoxazole	≤0.5	≤0.5	97.1	100

a. The results were not analyzed because the number of isolates was low (<10); b. Percentage of strains with MIC ≥ 2 µg/mL, indicating possible ESBL production [6]; c. Percentage of non-beta-lactamase producing strains. This value also represents the susceptbility rate to amoxicillin [6].

Table 7. Antimicrobial activity and spectrum of drugs tested against the most prevalent Gram-positive cocci isolated from January 1997 to December 2001 throughout Latin America and in Brazil alone

Pathogen (nº total/Brazil)/ Antimicrobial agent	Latin America		Brazil	
	MIC_{50}	MIC_{90}	% Susceptible	% Susceptible
***S. aureus* (3396/ 1516)**				
Cephalosporins				
Cefazolin	≤2	>16	63.2[b]	62.7[b]
Ceftriaxone	4	>32	63.2[b]	62.7[b]
Cefepime	8	>16	63.2[b]	62.7[b]
Other β-lactams				
Oxacillin	0.5	>8	63.2	62.7
Penicillin	16	>32	7.2	9
Amoxicillin/clavulanate	2	>16	63.2 [b]	62.7[b]
Piperacillin/tazobactam	2	>64	63.2 [b]	62.7[b]
Imipenem	≤0.06	>8	63.2[b]	62.7[b]
MLS				
Clindamycin	0.25	>8	66	64.1
Erythromycin	0.5	>8	50.5	47.9
Fluoroquinolones				
Ciprofloxacin	0.5	>2	64.5	63.4
Levofloxacin	0.25	4	66.3	64.8
Gatifloxacin	0.12	4	89.6	87.8
Garenoxacin	0.03	2	97.6	96.9
Others				
Gentamicin	≤1	>16	62.7	61.9
Rifampin	≤0.25	2	76.6	67.8
Chloramphenicol	8	>16	64.4	63.2
Tetracycline	≤4	>8	71.1	60.9
Doxycycline	≤0.5	>4	83.7	75.2
Trimethoprim/sulfamethoxale	≤0.5	>1	75.8	63.5
Vancomycin	1	1	100	100
Teicoplanin	1	2	99.6	99.6
Quinupristin/dalfopristin	0.25	0.5	99.7	99.9
Linezolid	2	4	100	100
CoNS (1397/ 514)				
Cephalosporins				
Cefazolin	≤2	>16	22.8[b]	19.5[b]
Ceftriaxone	16	>32	22.8[b]	19.5[b]
Cefepime	16	>16	22.8[b]	19.5[b]
Other β-lactams				
Oxacillin	8	>8	22.8	19.5

Penicillin	8	>32	9.3	8.2
Amoxicillin/clavulanate	≤2	>16	22.8[b]	19.5[b]
Piperacillin/tazobactam	2	>64	22.8[b]	19.5[b]
Imipenem	0.5	>8	22.8[b]	19.5[b]
MLS				
Clindamycin	0.25	>8	55.3	46.3
Erythromycin	>8	>8	35.3	34.6
Fluoroquinolones				
Ciprofloxacin	0.5	>2	56.9	47.9
Levofloxacin	0.25	>4	65.7	58.1
Gatifloxacin	0.12	2	93.8	92.8
Garenoxacin	0.03	2	91.5	92.4
Others				
Gentamicin	8	>16	45.1	40.5
Rifampin	0.25	>2	72	68.1
Chloramphenicol	8	>16	62.7	55.6
Tetracycline	≤4	>8	76.5	74.9
Doxycycline	1	>4	87.1	85.8
Trimetoprim/sulfametoxale	1	>2	50.6	38.4
Vancomycin	2	2	100	100
Teicoplanin	2	8	90.3	90.3
Quinupristin/dalfopristin	0.25	0.5	98.7	98.2
Linezolid	1	2	100	100
***Enterococcus* spp. (583/ 243)**				
β-lactams				
Ampicillin	1	4	94.7	97.5
Penicillin	2	16	90.2	81.5
Amoxicillin/Clavulanate	≤2	4	94.7[c]	97.5[c]
Piperacillin/Tazobactam	4	>64	94.7[c]	97.5[c]
MLS				
Erythromycin	>8	>8	9.4	9.1
Fluoroquinolones				
Ciprofloxacin	1	>2	52.7	46.9
Levofloxacin	1	>4	65.7	56.3
Gatifloxacin	0.5	>4	73.9	66.7
Garenoxacin	0.25	4	93.6	94.9
Others				
Gentamicin (HL)	≤500	>1,000	76.2	65
Streptomycin (HL)	≤1,000	≤1,000	90.1	94.7
Rifampin	>2	>2	23.3	18.1
Chloramphenicol	8	>16	67.2	55.6
Tetracycline	>8	>8	33.4	32.1
Doxycycline	>4	>4	44.4	49.4

Vancomycin	1	2	97.5	97.5
Teicoplanin	0.25	0.5	98.1	97.5
Linezolid	2	2	96.4	97

a. Interpreted by NCCLS 2003 criteria, when available [6]; b. Susceptibility is predicted by the oxacillin result [6]; c. Susceptibility is predicted by the ampicillin result [6]; Abbreviations: HL - High level aminoglycoside resistance screen.

Table 8. Antimicrobial activity and spectrum of drugs tested against the most prevalent Gram-negative pathogens isolated from January 1997 to December 2001 throughout Latin America and in Brazil alone, from patients with bacteremia and pneumonia

Pathogen/ Antimicrobial agent	**% Susceptible strains[a] (number of isolates tested)**			
	Latin America		**Brazil**	
Acinetobacter *spp.*	**Bacteremia (380)**	**Pneumonia (299)**	**Bacteremia (212)**	**Pneumonia (139)**
Cephalosporins				
Ceftazidime	40	17.7	40.6	12.2
Cefepime	46.1	25.8	45.8	19.4
Other β-lactams				
Aztreonam	11.8	4.3	10.8	2.2
Ticarcillin/clavulanate	35.8	13.4	40.1	12.9
Piperacillin/tazobactam	37.6	16.4	39.6	15.1
Imipenem	88.9	85.3	91.5	89.2
Meropenem	89.5	84.3	92.5	88.5
Aminoglycosides				
Amikacin	43.2	23.1	43.9	17.3
Gentamicin	44.2	23.4	49.5	23.7
Tobramycin	52.4	32.7	64.7	36.2
Fluoroquinolones				
Ciprofloxacin	42.9	18.7	46.7	20.1
Levofloxacin	45	21.1	48.6	20.1
Gatifloxacin	45.5	24.1	48.6	25.2
Garenoxacin	48.9	24.5	48.7	19.7
Others				
Tetracycline	59.9	46.2	65.9	46
Trimethoprim/ sulfamethoxazole	42.4	23.4	40.6	19.4
Burkholderia cepacia	**Bacteremia (43)**	**Pneumonia (19)**	**Bacteremia (21)**	**Pneumonia ([b])**
Cephalosporins				
Ceftazidime	79.1	84.2	85.7	[b]
Cefepime	48.8	57.9	33.3	[b]

Other β-lactams				
Aztreonam	16.3	15.8	19	[b]
Ticarcillin/clavulanate	14	26.3	9.5	[b]
Piperacillin/tazobactam	62.8	84.2	52.4	[b]
Imipenem	48.8	57.9	38.1	[b]
Meropenem	79.1	68.4	85.7	[b]
Aminoglycosides				
Amikacin	16.3	21.1	4.8	[b]
Gentamicin	7	26.3	4.8	[b]
Tobramycin	9.3	21.1	4.8	[b]
Fluoroquinolones				
Ciprofloxacin	65.1	47.4	71.4	[b]
Gatifloxacin	76.7	78.9	76.2	[b]
Levofloxacin	81.4	84.2	81	[b]
Garenoxacin	62.5	75	66.7	[b]
Others				
Tetracycline	9.3	26.3	4.8	[b]
Trimethoprim/ sulfamethoxazole	74.4	89.5	95.2	[b]
***Citrobacter* spp.**	**Bacteremia (51)**	**Pneumonia (24)**	**Bacteremia (16)**	**Pneumonia ([b])**
Cephalosporins				
Cefazolin	15.7	33.3	12.5	[b]
Cefuroxime	51	54.2	50	[b]
Cefoxitin	15.7	33.3	12.5	[b]
Ceftriaxone	62.7	66.7	56.3	[b]
Ceftazidime	60.8	66.7	56.3	[b]
Cefepime	92.2	91.7	87.5	[b]
Other β-lactams				
Ampicillin	17.6	12.5	12.5	[b]
Aztreonam	56.9	66.7	50	[b]
Ticarcillin/clavulanate	52.9	62.5	37.5	[b]
Piperacillin/tazobactam	66.7	75	62.5	[b]
Imipenem	100	100	100	[b]
Meropenem	100	100	100	[b]
Aminoglycosides				
Amikacin	84.3	79.2	75	[b]
Gentamicin	78.4	83.3	62.5	[b]
Tobramycin	72.3	73.7	62.5	[b]
Fluoroquinolones				
Ciprofloxacin	82.4	83.3	75	[b]
Levofloxacin	82.4	95.8	75	[b]
Gatifloxacin	80.4	95.8	75	[b]

Garenoxacin	83.3	100	87.5	[b]
Others				
Tetracycline	74.5	70.8	75	[b]
Trimethoprim/ sulfamethoxazole	64.7	70.8	56.3	[b]
***Enterobacter* spp.**	**Bacteremia (517)**	**Pneumonia (165)**	**Bacteremia (266)**	**Pneumonia (76)**
Cephalosporins				
Cefazolin	5.2	6.1	4.1	6.6
Cefuroxime	37.7	40.6	44.7	43.4
Cefoxitin	5.2	5.5	6	9.2
Ceftriaxone	67.1	61.2	74.4	61.8
Ceftazidime	66.9	63	73.3	63.2
Cefepime	90.3	90.3	92.1	90.8
Other β-lactams				
Ampicillin	5.4	6.7	5.3	7.9
Aztreonam	67.1	62.4	74.8	64.5
Ticarcillin/clavulanate	55.3	52.7	61.7	51.3
Piperacillin/tazobactam	67.9	64.8	72.9	65.8
Imipenem	99.8	99.4	99.6	98.7
Meropenem	99.8	98.8	99.6	98.7
Aminoglycosides				
Amikacin	82.6	86.7	83.1	86.8
Gentamicin	74.5	79.4	76.7	78.9
Tobramycin	63.8	68.3	69.6	69
Fluoroquinolones				
Ciprofloxacin	83.2	81.2	85.7	86.8
Levofloxacin	84.5	83	87.6	89.5
Gatifloxacin	85.3	83.6	89.5	89.5
Garenoxacin	77.8	78.5	84.4	93.8
Others				
Tetracycline	68.3	73.3	71.1	71.1
Trimethoprim/ sulfamethoxazole	70.7	77.9	72.5	76
E. coli	**Bacteremia (1620)**	**Pneumonia (128)**	**Bacteremia (419)**	**Pneumonia (46)**
Cephalosporins				
Cefazolin	83.8	56.3	86.4	63
Cefuroxime	88.5	68	89.5	69.6
Cefoxitin	92.4	84.4	93.8	95.7
Ceftriaxone	94.7 (6.1)[a]	78.9 (21.1)[a]	94.5(6)[a]	76.1 (19.6)[a]
Ceftazidime	95.7 (6.4)[a]	89.1 (21.9)[a]	95 (6.4)[a]	89.1 (19.6)[a]

Cefepime	97.2	85.9	97.1	87
Other β-lactams				
Ampicillin	39.8	28.9	42.2	26.1
Aztreonam	94.9 (6.2)[a]	78.7 (21.3)[a]	94.7 (5.7)[a]	80 (20)[a]
Ticarcillin/clavulanate	66.7	48.4	72.8	58.7
Piperacillin/tazobactam	92.5	77.3	93.6	82.6
Imipenem	100	99.2	100	100
Meropenem	100	100	100	100
Aminoglycosides				
Amikacin	97	92.2	97.6	97.8
Gentamicin	90.4	77.3	93.3	82.6
Tobramycin	88.7	72	91.5	73.3
Fluoroquinolones				
Ciprofloxacin	85.5	78.1	92.4	91.3
Gatifloxacin	86.2	78.9	93.3	91.3
Levofloxacin	86.1	78.1	93.3	91.3
Garenoxacin	85.9	73.2	92.4	89.3
Others				
Tetracycline	53.7	54.7	60.9	65.2
Trimethoprim/ sulfamethoxazole	50.9	58.3	47.5	63
K. pneumoniae	**Bacteremia (840)**	**Pneumonia (328)**	**Bacteremia (328)**	**Pneumonia (124)**
Cephalosporins				
Cefazolin	47.5		54.6	47.3 45.2
Cefuroxime	52.7	55.2	53.7	46
Cefoxitin	84.6	82	86.6	83.9
Ceftriaxone	60.7 (45)[b]	63.1 (41.2)[b]	59.8 (45.4)[b]	50.8 (51.6)[a]
Ceftazidime	65.2 (45)[b]	67.4 (39.3)[b]	70.1 (43.9)[b]	57.3 (60)[b]
Cefepime	75.7	77.4	73.8	72.6
Other β-lactams				
Ampicillin	0	0	0	0
Aztreonam	60.2 (44)[b]	63.4 (40.2)[b]	60.4 (43.6)[b]	51.6 (60)[b]
Ticarcillin/clavulanate	48.9	56.7	50.9	46.8
Piperacillin/tazobactam	65.4	72.3	69.8	66.9
Imipenem	99.9	99.7	100	100
Meropenem	99.8	99.4	99.7	99.2
Aminoglycosides				
Amikacin	78.6	85.7	80.8	85.5
Gentamicin	62.5	71.6	63.1	66.9
Tobramycin	50.6	60.6	52.3	52.7
Fluoroquinolones				
Ciprofloxacin	88.1	87.5	91.8	88.7

Levofloxacin	90.1	88.4	91.8	88.7
Gatifloxacin	91.2	89.9	93	88.7
Garenoxacin	89.1	88.5	89.6	86.7
Others				
Tetracycline	65.3	71.6	72.9	66.1
Trimethoprim/ sulfamethoxazole	66.1	76.1	59.3	66.1
Morganella morgannii	**Bacteremia (32)**	**Pneumonia ([b])**	**Bacteremia (12)**	**Pneumonia ([b])**
Cephalosporins				
Cefazolin	0	[b]	0	[b]
Cefuroxime	6.3	[b]	8.3	[b]
Cefoxitin	31.3	[b]	33.3	[b]
Ceftriaxone	87.5	[b]	75	[b]
Ceftazidime	84.4	[b]	91.7	[b]
Cefepime	90.6	[b]	83.3	[b]
Other β-lactams				
Ampicillin	0	[b]	0	[b]
Aztreonam	84.4	[b]	83.3	[b]
Ticarcillin/clavulanate	71.9	[b]	83.3	[b]
Piperacillin/tazobactam	90.6	[b]	100	[b]
Imipenem	100	[b]	100	[b]
Meropenem	100	[b]	100	[b]
Aminoglycosides				
Amikacin	96.9	[b]	91.7	[b]
Gentamicin	81.3	[b]	91.7	[b]
Tobramycin	85.7	[b]	81.8	[b]
Fluoroquinolones				
Ciprofloxacin	68.8	[b]	66.7	[b]
Levofloxacin	68.8	[b]	66.7	[b]
Gatifloxacin	68.8	[b]	66.7	[b]
Garenoxacin	66.7	[b]	[b]	[b]
Others				
Tetracycline	40.6	[b]	25	[b]
Trimethoprim/ sulfamethoxazole	56.3	[b]	50	[b]
P. aeruginosa	**Bacteremia (589)**	**Pneumonia (862)**	**Bacteremia (247)**	**Pneumonia (473)**
Cephalosporins				
Ceftazidime	69.1	58.7	66.8	51.8
Cefepime	71	58.5	65.2	51.2
Other β-lactams				

Aztreonam	51.3	42.1	49.8	35.1
Ticarcillin/clavulanate	62.8	52.8	18.2	13.1
Piperacillin/tazobactam	78.9	67.1	59.1	44
Imipenem	83.4	65.5	79.8	56.4
Meropenem	84.6	68.3	80.6	59.6
Aminoglycosides				
Amikacin	75.4	68.7	69.2	57.3
Gentamicin	65.5	56.3	63.2	47.8
Tobramycin	64.8	57.7	59	47.9
Fluoroquinolones				
Ciprofloxacin	66.2	55.7	66.4	50.7
Levofloxacin	65.7	54.4	66.8	50.5
Gatifloxacin	63.7	50.9	64.8	47.4
Garenoxacin	57.7	40.7	58.9	39
Others				
Tetracycline	1.5	1.5	1.6	0.8
Trimethoprim/ sulfamethoxazole	2.2	5.2	3.6	5.1
***Proteus* spp.**	**Bacteremia (92)**	**Pneumonia (42)**	**Bacteremia (15)**	**Pneumonia ([b])**
Cephalosporins				
Cefazolin	54.3	54.8	80	[b]
Cefuroxime	65.2	59.5	86.7	[b]
Cefoxitin	95.7	90.5	100	[b]
Ceftriaxone	72.8	66.7	100	[b]
Ceftazidime	93.5	97.6	100	[b]
Cefepime	75	66.7	100	[b]
Other β-lactams				
Ampicillin	43.5	57.1	60	[b]
Aztreonam	92.4	83.3	100	[b]
Ticarcillin/clavulanate	90.2	97.6	100	[b]
Piperacillin/tazobactam	91.3	92.9	100	[b]
Imipenem	97.8	100	93.3	[b]
Meropenem	100	100	100	[b]
Aminoglycosides				
Amikacin	91.3	88.1	100	[b]
Gentamicin	63	69	100	[b]
Tobramycin	65.4	69.4	100	[b]
Fluoroquinolones				
Ciprofloxacin	68.5	71.4	100	[b]
Levofloxacin	70.7	76.2	100	[b]
Gatifloxacin	67.4	71.4	100	[b]
Garenoxacin	70.2	72	[b]	[b]

Others				
Tetracycline	4.3	7.1	13.3	[b]
Trimethoprim/ sulfamethoxazole	53.3	64.3	86.7	[b]
***Salmonella* spp.**	**Bacteremia (179)**	**Pneumonia ([b])**	**Bacteremia (44)**	**Pneumonia ([b])**
Cephalosporins				
Cefazolin	97.8	[b]	100	[b]
Cefuroxime	95.5	[b]	95.5	[b]
Cefoxitin	98.3	[b]	97.7	[b]
Ceftriaxone	98.9	[b]	100	[b]
Ceftazidime	98.9	[b]	100	[b]
Cefepime	98.9	[b]	100	[b]
Other β-lactams				
Ampicillin	92.2	[b]	100	[b]
Aztreonam	98.3	[b]	100	[b]
Ticarcillin/clavulanate	93.3	[b]	100	[b]
Piperacillin/tazobactam	98.9	[b]	100	[b]
Imipenem	100	[b]	100	[b]
Meropenem	100	[b]	100	[b]
Aminoglycosides				
Amikacin	99.4	[b]	100	[b]
Gentamicin	96.1	[b]	95.5	[b]
Tobramycin	94.7	[b]	91.7	[b]
Fluoroquinolones				
Ciprofloxacin	100	[b]	100	[b]
Levofloxacin	100	[b]	100	[b]
Gatifloxacin	100	[b]	100	[b]
Garenoxacin	100	[b]	100	[b]
Others				
Tetracycline	87.2	[b]	97.7	[b]
Trimethoprim/ sulfamethoxazole	93.3	[b]	100	[b]
***Serratia* spp.**	**Bacteremia (157)**	**Pneumonia (89)**	**Bacteremia (86)**	**Pneumonia (40)**
Cephalosporins				
Cefazolin	0	2.2	0	0
Cefuroxime	1.3	3.4	0	0
Cefoxitin	8.3	3.4	5.8	2.5
Ceftriaxone	72.6	80.9	69.8	72.5
Ceftazidime	85.4	85.4	81.4	77.5
Cefepime	86	93.3	90.7	97.5
Other β-lactams				

Ampicillin	4.5	1.1	2.3	0
Aztreonam	79.6	88.8	82.6	87.5
Ticarcillin/clavulanate	57.3	60.7	48.8	45
Piperacillin/tazobactam	72	77.5	62.8	70
Imipenem	100	98.9	100	100
Meropenem	100	100	100	100
Aminoglycosides				
Amikacin	70.7	80.9	64	75
Gentamicin	63.7	75.3	53.5	62.5
Tobramycin	51.8	57.9	42.9	45.9
Fluoroquinolones				
Ciprofloxacin	75.2	78.7	60.5	67.5
Levofloxacin	82.2	87.6	69.8	77.5
Gatifloxacin	79.6	84.3	65.1	75
Garenoxacin	59.2	75	46.5	63.2
Others				
Tetracycline	9.6	7.9	4.7	5
Trimethoprim/ sulfamethoxazole	63.1	70.8	54.7	60
Stenotrophomonas maltophilia	**Bacteremia (86)**	**Pneumonia (60)**	**Bacteremia (35)**	**Pneumonia (23)**
Cephalosporins				
Ceftazidime	73.3	46.7	85.7	47.8
Cefepime	40.7	23.3	42.9	30.4
Other β-lactams				
Aztreonam	8.1	1.7	8.6	0
Ticarcillin/clavulanate	64	51.7	77.1	69.6
Piperacillin/tazobactam	43.5	26.7	51.4	30.4
Imipenem	2.3	0	0	0
Meropenem	7	3.3	5.7	8.7
Aminoglycosides				
Amikacin	20.9	15	17.1	8.7
Gentamicin	20.9	11.7	14.3	8.7
Tobramycin	19	8.9	8.6	8.7
Fluoroquinolones				
Ciprofloxacin	50	38.3	45.7	17.4
Levofloxacin	88.4	90	94.3	87
Gatifloxacin	88.4	96.7	94.3	95.7
Garenoxacin	83.3	81.8	79.2	80
Others				
Tetracycline	17.4	13.3	17.1	8.7
Trimethoprim/ sulfamethoxazole	95.3	100	100	100

a. Percentage of strains with MIC ≥ 2 µg/mL, indicating possible ESBL production [6]; b. The results were not analyzed because the number of isolates was low (<10).

Table 9. Antimicrobial activity and spectrum of drugs tested against the most prevalent Gram-positive pathogens isolated from January 1997 to December 2001 throughout Latin America and in Brazil alone, from patients with bacteremia and pneumonia

Pathogen/ Antimicrobial agent	% Susceptible strains (number of isolates tested)			
	Latin America		Brazil	
S. aureus	**Bacteremia (1,921)**	**Pneumonia (760)**	**Bacteremia (840)**	**Pneumonia (346)**
Cephalosporins				
Cefazolin	68.5[a]	45.4[a]	68.2[a]	48.8[a]
Ceftriaxone	68.5[a]	45.4[a]	68.2[a]	48.8[a]
Cefepime	68.5[a]	45.4[a]	68.2[a]	48.8[a]
Other β-lactams				
Oxacillin	68.5	45.4	68.2	48.8
Penicillin	8.5	5.7	11.2	6.4
Amoxicillin/clavulanate	68.5[a]	45.4[a]	68.2[a]	48.8[a]
Piperacillin/tazobactam	68.5[a]	45.4[a]	68.2[a]	48.8[a]
Imipenem	68.5[a]	45.4[a]	68.2[a]	48.8[a]
MLS				
Clindamycin	72	46.3	69.9	48.6
Erythromycin	54.6	37.4	52.5	38.4
Fluoroquinolones				
Ciprofloxacin	70.3	45.9	69.5	48
Levofloxacin	72.9	48.4	72.2	50.3
Gatifloxacin	90.7	85.7	88.3	85.3
Garenoxacin	97.9	95.4	97.1	95.1
Others				
Gentamicin	67.4	45.8	66.8	49.1
Rifampin	80.4	66.3	74.8	53.8
Chloramphenicol	68	54.5	68.6	54.3
Tetracycline	75	61.6	66.3	48.6
Doxycycline	87	75.7	80.1	64.7
Trimetoprim/sulfametoxale	79.4	64.8	87	74.8
Vancomycin	100	100	100	100
Teicoplanin	99.5	99.9	99.3	100
Quinupristin/dalfopristin	99.6	100	99.8	100
Linezolid	100	100	100	100
CoNS	**Bacteremia (1,221)**	**Pneumonia (41)**	**Bacteremia (458)**	**Pneumonia (19)**
Cephalosporins				
Cefazolin	23.8[a]	24.4[a]	19.2[a]	36.8[a]
Ceftriaxone	23.8[a]	24.4[a]	19.2[a]	36.8[a]

Cefepime	23.8[a]	24.4[a]	19.2[a]	36.8[a]
Other β-lactams				
Oxacillin	23.8	24.4	19.2	36.8
Penicillin	9.3	12.2	7.9	21.1
Amoxicillin/clavulanate	23.8[a]	24.4[a]	19.2[a]	36.8[a]
Piperacillin/tazobactam	23.8[a]	24.4[a]	19.2[a]	36.8[a]
Imipenem	23.8[a]	24.4[a]	19.2[a]	36.8[a]
MLS				
Clindamycin	55.8	36.6	46.3	47.4
Erythromycin	36	17.1	35.4	26.3
Fluoroquinolones				
Ciprofloxacin	58	31.7	48.5	42.1
Levofloxacin	66.2	57.9	59.9	53.3
Gatifloxacin	94.6	80.5	93	84.2
Garenoxacin	97.9	67.9	92.6	87.5
Others				
Gentamicin	44.8	36.6	40	42.1
Rifampin	72.5	68.3	69	63.2
Chloramphenicol	62.2	63.4	55.2	68.4
Tetracycline	77.1	75.6	75.8	57.9
Doxycycline	87.7	82.9	86.7	68.4
Trimethoprim/sulfamethoxale	51.1	70.7	69.8	68.4
Vancomycin	100	100	100	100
Teicoplanin	90.6	85.4	90.4	89.5
Quinupristin/dalfopristin	98.6	100	98	100
Linezolid	100	100	100	100
***Enterococcus* spp.**	**Bacteremia (280)**	**Pneumonia (58)**	**Bacteremia (101)**	**Pneumonia (44)**
β-lactams				
Ampicillin	91.8	100	95	100
Penicillin	84.6	81	78.2	75
Amoxicillin/Clavulanate	91.8[b]	100[b]	95[b]	100[b]
Piperacillin/Tazobactam	91.8[b]	100[b]	95[b]	100[b]
MLS				
Erythromycin	9.3	13.8	5	15.9
Fluoroquinolones				
Ciprofloxacin	48.2	48.3	40.6	43.2
Levofloxacin	67.2	41.2	57.4	36.4
Gatifloxacin	72.1	63.8	62.4	63.6
Garenoxacin	90	91.2	90.6	91.3
Others				
Gentamicin (HL)	73.9	65.5	57.4	65.9
Streptomycin (HL)	88.2	91.4	92.1	95.5

Rifampin	25.4	20.7	19.8	11.4
Chloramphenicol	66.4	55.2	50.5	54.5
Tetracycline	36.1	37.9	35.6	36.4
Doxycycline	47.5	48.3	53.5	50
Vancomycin	97.4	100	98	100
Teicoplanin	97.5	100	98	100
Quinupristin/dalfopristin	12.1	3.4	7.9	4.5
Linezolid	96.1	97.9	97.5	97.1

a. Interpreted by NCCLS 2003 criteria, when available [6]; b. Susceptibility is predicted by the oxacillin result [6]; c. Susceptibility is predicted by the ampicillin result [6]. Abbreviation: HL - High level aminoglycoside resistance screen.

Table 10. Antimicrobial activity and spectrum of drugs tested against the most prevalent streptococci isolated from January 1997 to December 2001 throughout Latin America and in Brazil alone

Pathogen (nº total/Brazil)/ Antimicrobial Agent	**Latin America[a]**		**Brazil[a]**	
	MIC_{50}	**MIC_{90}**	**% susceptible**	**% susceptible**
β-haemolytic streptococci (443/178)				
Amoxicillin	0.06	0.12	100[d]	100[d]
Penicillin	0.03	0.06	100	100
Cefuroxime[b]	0.06	0.12	100[d]	100[d]
Cefprozil	≤0.12	0.5	100[d]	100[d]
Cefpodoxime	0.06	0.12	100[d]	100[d]
Cefotaxime[c]	0.06	0.12	100	100
Cefepime	0.12	0.12	100	100
Erythromycin	0.06	0.25	92.8	96.6
Azithromycin	0.06	0.12	92.2	95
Clarithromycin	0.25	0.25	96.1	94.1
Clindamycin	0.06	0.12	97.7	99.4
Levofloxacin	0.5	1	100	100
Gatifloxacin	0.25	0.5	100	100
Garenoxacin	0.06	0.12	—-	—-
Chloramphenicol	≤2	4	98.4	100
Tetracycline[e]	4	>8	49.9	38.8
Trimethoprim/sulfamethoxale	≤0.5	≤0.5	NA	NA
Linezolid	1	1	100	100
Quinupristin/ dalfopristin	0.25	0.5	100	100
Vancomycin	0.5	0.5	100	100
***S. bovis* (29/18)**				
Amoxicillin	0.06	0.12	100[d]	94.4[d]

Penicillin	0.06	0.12	100	94.4
Cefuroxime[b]	0.12	0.25	100[d]	94.4[d]
Cefprozil	0.5	1	100[d]	94.4[d]
Cefpodoxime	0.25	0.5	100[d]	94.4[d]
Cefotaxime[c]	0.12	0.25	100	100
Cefepime	0.12	0.25	96.6	94.4
Erythromycin	0.25	>8	62.1	61.1
Azithromycin	0.12	>16	66.7	60
Clarithromycin	0.25	>32	75	62.5
Clindamycin	0.12	>8	72.4	72.2
Levofloxacin	1	>2	100	100
Gatifloxacin	0.5	0.5	100	100
Garenoxacin	0.06	0.12	—	—
Chloramphenicol	4	4	100	100
Tetracycline[e]	>8	>8	48.3	33.3
Trimethoprim/sulfamethoxale	≤0.5	>1	NA	NA
Linezolid	1	2	100	100
Quinupristin/ dalfopristin	1	4	86.2	83.3
Vancomycin	0.5	0.5	100	100
***S. pneumoniae* (1561/497)**				
Amoxicillin	0.06	1	98.2	98.8
Penicillin	0.03	2	69.3 (11.9)[f]	78.5 (4.6)[f]
Cefuroxime[b]	0.06	4	84.5	93.5
Cefprozil	0.25	8	84.1	93.1
Cefpodoxime	≤0.03	2	84.4	93.8
Cefotaxime[c]	0.03	0.5	98.3	98.6
Cefepime	0.06	1	97.5	99.2
Erythromycin	0.25	2	87.1	88.5
Azithromycin	0.12	2	88.5	91.4
Clarithromycin	0.25	1	87.5	89.2
Clindamycin	0.06	0.25	94.2	94.6
Levofloxacin	1	1	99.8	100
Gatifloxacin	0.25	0.5	99.7	100
Garenoxacin	0.06	0.06	—	—
Chloramphenicol	≤2	4	95.6	98.2
Tetracycline[e]	≤2	>16	79.5	80.5
Trimethoprim/sulfamethoxale	≤0.5	4	60.5	49.7
Linezolid	1	1	100	100
Quinupristin/ dalfopristin	0.5	0.5	100	100
Vancomycin	0.25	0.5	100	100
Viridans group (124/36)				
Amoxicillin	0.12	4	66.1	80.6

Penicillin	0.06	2	66.1	80.6
Cefuroxime	0.25	8	66.1[d]	80.6
Cefprozil	1	8	66.1	80.6
Cefpodoxime	0.12	>4	66.1[d]	80.6
Cefotaxime[c]	0.12	2	85.7	100
Cefepime	0.25	2	89.5	94.4
Erythromycin	0.25	2	65.3	72.2
Azithromycin	0.12	1	84.7	78.9
Clarithromycin	0.25	0.25	92.9	100
Clindamycin	0.06	0.12	91.9	97.2
Levofloxacin	1	2	100	100
Gatifloxacin	0.25	0.5	100	100
Garenoxacin	0.06	0.12	—	—
Chloramphenicol	≤2	4	97.6	100
Tetracycline[e]	≤4	>16	69.4	72.2
Trimethoprim/sulfamethoxale	≤0.5	2	NA	NA
Linezolid	1	1	100	100
Quinupristin/ dalfopristin	0.5	1	96	97.2
Vancomycin	0.5	1	100	100

a. Interpreted by NCCLS criteria [6]; b. Percentage of susceptible strains defined by cefuroxime axetil (oral) [6]; c. Also indicates susceptibility spectrum of ceftriaxone [6]; d. Susceptibility is predicted by the penicillin result [6]; e. Includes susceptible and intermediate isolates [6]; f. Percentage of isolates showing high level resistance (MIC ≥2 μg/ml) [6].

Table 11a. Antimicrobial activity and spectrum of drugs tested against ESBL-producing *Escherichia coli* and *Klebsiella pneumoniae* in the year 2001 throughout Latin America and in Brazil alone

Pathogen (nº total/Brazil)/ Antimicrobial agent	**Latin America**	**Brazil**
	% Susceptible	**% Susceptible**
E. coli (35/[a])		
Cephalosporins		
Cefazolin	20	[a]
Cefuroxime	22.9	[a]
Cefoxitin	54.3	[a]
Ceftriaxone	42.9	[a]
Ceftazidime	48.6	[a]
Cefepime	62.9	[a]
Other β-lactams		[a]
Ampicillin	0	[a]
Aztreonam	42.9	[a]
Ticarcillin/clavulanate	22.9	[a]
Piperacillin/tazobactam	65.7	[a]

Imipenem	97.1	[a]
Meropenem	100	[a]
Aminoglycosides		[a]
Amikacin	82.9	[a]
Gentamicin	54.3	[a]
Tobramycin	45.7	[a]
Fluoroquinolones		[a]
Ciprofloxacin	42.9	[a]
Levofloxacin	48.6	[a]
Gatifloxacin	48.6	[a]
Garenoxacin	40	[a]
Others		[a]
Tetracycline	34.3	[a]
Trimethoprim/ sulfamethoxazole	17.1	[a]
***Klebsiella pneumoniae* (122/63)**		
Cephalosporins		
Cefazolin	0.8	0
Cefuroxime	2.5	1.6
Cefoxitin	71.3	71.4
Ceftriaxone	17.2	7.9
Ceftazidime	30.3	22.2
Cefepime	45.1	33.3
Other β-lactams		
Ampicillin	0	0
Aztreonam	15.6	3.2
Ticarcillin/clavulanate	4.9	3.2
Piperacillin/tazobactam	46.7	39.7
Imipenem	100	100
Meropenem	97.5	96.8
Aminoglycosides		
Amikacin	63.9	74.6
Gentamicin	24.6	27
Tobramycin	13.1	12.7
Fluoroquinolones		
Ciprofloxacin	67.2	65.1
Levofloxacin	70.5	65.1
Gatifloxacin	70.5	65.1
Garenoxacin	66.4	66.7
Others		
Tetracycline	53.3	55.6
Trimethoprim/ sulfamethoxazole	41	34.9

Table 11b. Antimicrobial activity and spectrum of drugs tested against ESBL-producing *E. coli* and *K. pneumoniae* in the year 2001 throughout Latin America from patients with bloodstream infections and lower respiratory tract infections.

Pathogen/ Antimicrobial agent	**% Susceptible strains (number of isolates tested)**			
	Latin America		**Brazil**	
E. coli	**Bacteremia (27)**	**Pneumonia ([a])**	**Bacteremia ([a])**	**Pneumonia ([a])**
Cephalosporins				
Cefazolin	22.2	[a]	[a]	[a]
Cefuroxime	25.9	[a]	[a]	[a]
Cefoxitin	59.3	[a]	[a]	[a]
Ceftriaxone	48.1	[a]	[a]	[a]
Ceftazidime	48.1	[a]	[a]	[a]
Cefepime	66.7	[a]	[a]	[a]
Other β-lactams		[a]	[a]	[a]
Ampicillin	0	[a]	[a]	[a]
Aztreonam	51.9	[a]	[a]	[a]
Ticarcillin/clavulanate	22.2	[a]	[a]	[a]
Piperacillin/tazobactam	66.7	[a]	[a]	[a]
Imipenem	100	[a]	[a]	[a]
Meropenem	100	[a]	[a]	[a]
Aminoglycosides		[a]	[a]	[a]
Amikacin	81.5	[a]	[a]	[a]
Gentamicin	59.3	[a]	[a]	[a]
Tobramycin	44.4	[a]	[a]	[a]
Fluoroquinolones		[a]	[a]	[a]
Ciprofloxacin	40.7	[a]	[a]	[a]
Levofloxacin	48.1	[a]	[a]	[a]
Gatifloxacin	44.4	[a]	[a]	[a]
Garenoxacin	37	[a]	[a]	[a]
Others		[a]	[a]	[a]
Tetracycline	33.3	[a]	[a]	[a]
Trimethoprim/ sulfamethoxazole	18.5	[a]	[a]	[a]
Klebsiella pneumoniae	**Bacteremia (69)**	**Pneumonia (30)**	**Bacteremia (35)**	**Pneumonia (13)**
Cephalosporins				
Cefazolin	0	3.3	0	0
Cefuroxime	2.9	3.3	2.9	0
Cefoxitin	71	76.7	74.3	69.2
Ceftriaxone	14.5	26.7	8.6	7.7

Ceftazidime	23.2	56.7	22.9	30.8
Cefepime	46.4	56.7	37.1	38.5
Other β-lactams				
Ampicillin	0	0	0	0
Aztreonam	10.1	36.7	2.9	7.7
Ticarcillin/clavulanate	2.9	10	2.9	0
Piperacillin/tazobactam	37.7	66.7	37.1	53.8
Imipenem	100	100	100	100
Meropenem	98.6	100	97.1	100
Aminoglycosides				
Amikacin	62.3	76.7	77.1	76.9
Gentamicin	23.2	36.7	28.6	30.8
Tobramycin	11.6	20	17.1	0
Fluoroquinolones				
Ciprofloxacin	66.7	80	71.4	69.2
Levofloxacin	71	83.3	71.4	69.2
Gatifloxacin	71	83.3	71.4	69.2
Garenoxacin	65.2	80	71.4	69.2
Others				
Tetracycline	49.3	73.3	51.4	69.2
Trimethoprim/ sulfamethoxazole	37.7	60	31.4	53.8

Table 11c. Antimicrobial activity and spectrum of drugs tested against ESBL-producing *E. coli* and *K. pneumoniae* collected throughout Latin America and in Brazil alone, from January 1997 to December 2001

Pathogen (no. total/Brazil)/ Antimicrobial agent	**Latin America**	**Brazil**
	% Susceptible	**% Susceptible**
***E. coli* (250/64)**		
Cephalosporins		
Cefazolin	7.2	10.9
Cefuroxime	10	7.8
Cefoxitin	56.4	73.4
Ceftriaxone	31.2	25
Ceftazidime	47.2	39.1
Cefepime	61.6	59.4
Other β-lactams		
Ampicillin	0	0
Aztreonam	32.4	26.6
Ticarcillin/clavulanate	13.2	15.6
Piperacillin/tazobactam	55.6	57.8

Imipenem	99.2	100
Meropenem	99.6	100
Aminoglycosides		
Amikacin	72.8	71.4
Gentamicin	43.2	42.2
Tobramycin	30	20.6
Fluoroquinolones		
Ciprofloxacin	47.6	68.8
Levofloxacin	49.2	71.9
Gatifloxacin	50.4	73.4
Garenoxacin	53.2	69.7
Others		
Tetracycline	31.6	40.6
Trimethoprim/ sulfamethoxazole	27.3	26.6
***Klebsiella pneumoniae* (697/284)**		
Cephalosporins		
Cefazolin	1.6	1.4
Cefuroxime	7	6
Cefoxitin	72.7	77.1
Ceftriaxone	18.4	14.8
Ceftazidime	27.8	34.2
Cefepime	48.4	43.7
Other β-lactams		
Ampicillin	0	0
Aztreonam	17.6	14.4
Ticarcillin/clavulanate	6.3	6
Piperacillin/tazobactam	34.3	39.8
Imipenem	99.6	100
Meropenem	98.7	98.9
Aminoglycosides		
Amikacin	61.1	67.3
Gentamicin	30.7	32.4
Tobramycin	13.1	15.3
Fluoroquinolones		
Ciprofloxacin	75	80.3
Levofloxacin	79.5	81.3
Gatifloxacin	81.5	82.4
Garenoxacin	76.6	73.7
Others		
Tetracycline	49	59.2
Trimethoprim/ sulfamethoxazole	45.2	40.1

Table 11d. Antimicrobial spectrum of drugs tested against ESBL-producing *E. coli* and *K. pneumoniae* isolated from January 1997 to December 2001 from patients with bacteremia and pneumonia

Pathogen/ Antimicrobial agent	% Susceptible strains (number of isolates tested)			
	Latin America		Brazil	
E. coli	**Bacteremia (123)**	**Pneumonia (30)**	**Bacteremia (28)**	**Pneumonia (11)**
Cephalosporins				
Cefazolin	8.1	0	10.7	0
Cefuroxime	11.4	3.3	10.7	0
Cefoxitin	60.2	73.3	75	100
Ceftriaxone	30.1	10	17.9	0
Ceftazidime	43.9	53.3	25	54.5
Cefepime	63.4	43.3	57.1	45.5
Other β-lactams				
Ampicillin	0	0	0	0
Aztreonam	33.3	10	21.4	18.2
Ticarcillin/clavulanate	14.6	0	17.9	0
Piperacillin/tazobactam	54.5	43.3	50	45.5
Imipenem	100	96.7	100	100
Meropenem	100	100	100	100
Aminoglycosides				
Amikacin	69.9	70	71.4	90.9
Gentamicin	43.9	30	42.9	36.4
Tobramycin	27.7	11.5	22.2	0
Fluoroquinolones				
Ciprofloxacin	52.8	56.7	71.4	90.9
Levofloxacin	56.9	56.7	82.1	90.9
Gatifloxacin	57.7	60	82.1	90.9
Garenoxacin	60.3	47.1	73.3	[a]
Others				
Tetracycline	30.1	46.7	35.7	63.6
Trimethoprim/ sulfamethoxazole	25.2	37.9	21.4	45.5
Klebsiella pneumoniae	**Bacteremia (405)**	**Pneumonia (142)**	**Bacteremia (156)**	**Pneumonia (65)**
Cephalosporins				
Cefazolin	1	2.1	1.3	0
Cefuroxime	8.1	2.8	6.4	0
Cefoxitin	75.3	70.4	79.5	76.9
Ceftriaxone	18.5	14.8	15.4	6.2
Ceftazidime	27.9	24.6	37.2	18.5

Cefepime	49.6	47.9	44.9	47.7
Other β-lactams				
Ampicillin	0	0	0	0
Aztreonam	17.5	15.5	16.7	7.7
Ticarcillin/clavulanate	7.2	6.3	7.7	3.1
Piperacillin/tazobactam	34.6	37.3	41.7	38.5
Imipenem	99.8	99.3	100	100
Meropenem	99.5	98.6	99.4	98.5
Aminoglycosides				
Amikacin	59.3	67.6	64.1	73.8
Gentamicin	29.9	36.6	31.4	38.5
Tobramycin	12.2	14.8	15.6	12.1
Fluoroquinolones				
Ciprofloxacin	79.5	73.9	85.3	80
Levofloxacin	83.2	76.8	85.3	80
Gatifloxacin	84.9	76.1	87.2	80
Garenoxacin	80.8	77.3	78.8	78.7
Others				
Tetracycline	49.8	54.2	63.5	55.4
Trimethoprim/ sulfamethoxazole	44.6	52.5	34.6	50

a. The results were not analyzed because the number of isolates was low (<10).

resistance among pneumococci, are less frequently described in Latin America [1].

The main antimicrobial resistance problems the Latin American countries are presently facing are multidrug resistant (MDR) non-fermentative Gram-negative bacilli (*Acinetobacter* spp. and *P. aeruginosa*) and ESBL-prodcing *Enterobacteriaceae* [1,3,8,9,11-13]. *Pseudomonas aeruginosa* was the third and the fifth most frequently isolated pathogen in general and from blood stream infections, respectively. In addition, resistance rates were very high for all antimicrobial agents evaluated, except polymyxin B, which was evaluated since January 2001 only (Tables 2, 4, 6, and 8). The prevalence of isolates resistant to all antimicrobial agents except the polymyxins has been increasing continuously since the program started in 1997 [12]. Additionally, *P. aeruginosa* resistance rates were slightly higher among isolates collected in the Brazilian centers (Tables 2, 4, 6, and 8).

Acinetobacter spp. is much more prevalent and presented higher rates of antimicrobial resistance in Latin America, when compared to other regions evaluated by the SENTRY Program [1]. However, resistance rates to the carbapenems imipenem and meropenem were lower than those presented by *P. aeruginosa* (Tables 2, 4, 6, and 8). Besides these two carbapenems, other reasonable therapeutic options for empirical therapy of *Acinetobacter* spp. infections are the polymyxins and sulbactam. The SENTRY Program started evaluating these compounds in 2001 (polymyxin B) and 2002 (sulbactam), and the *in vitro* activity of these antimicrobial agents will be presented in future publications [14].

The rates of ESBL-producing *Enterobacteriaceae*, especially *K. pneumoniae* and *E. coli*, are among the highest in the world (Tables 2, 4, 6, 8, and 11)[1,3,8,9,11] In addition to resistance to cephalosporins, broad-spectrum penicillins and

monobactam, these isolates have also shown high rates of resistance to most antimicrobial agents, including aminoglycosides and fluoroquinolones. Although the fluoroquinolones remained active against some ESBL-producing *K. pneumoniae* (61.7% to 87.7% susceptible), the carbapenems meropenem and imipenem remained the most reliable options for empirical therapy of infections due to ESBL-producing strains in the region (Table 11).

Other important resistance problems among *Enterobacteriaceae* include fluoroquinolone resistance due to altered target among *E. coli* [15]; and stably derepressed (AmpC) β-lactamases mediated resistance among *Enterobacter cloacae*, *Citrobacter freundii*, and other clinically important species. Ciprofloxacin susceptibility rates were as low as 85.5% among *E. coli* isolated from blood stream infections and 78.1% among isolates from patients hospitalized with lower respiratory tract infections (Tables 4 and 8).

Chromosomaly-inducible β-lactamases (AmpC or Bush group I) are produced by most *Enterobacteriaceae* species; however, some species, including *E. cloacae*, *C. freundii*, *Serratia marcescens* and indol-positive Proteus ("SPICE" or "CESP" group), can produce large amounts of these enzymes and have become resistant to third-generation cephalosporins, broad-spectrum penicillins and monobactams. In our study, *E. cloacae* resistance to ceftazidime, which indicates the production of the AmpC β-lactamase, was as high as 42.9% (Table 4). Cefepime (84.9 – 96.6% susceptibility) and the carbapenems imipenem and meropenem (92.9 – 100% susceptibility) remained very active against *E. cloacae* and these other pathogens in the hospitals evaluated by the SENTRY program (Tables 2, 4, 6, and 8).

Among Gram-positive cocci, oxacillin resistance among staphylococci has remained an important problem in Latin America; however, rates varied significantly from hospital to hospital, even within a specific country. The vast majority of ORSA strains showed cross-resistance to most of the antimicrobial agents evaluated, except vancomycin, teicoplanin, quinupristin/dalfopristin and linezolid. Resistance to these agents was not detected among *S. aureus* isolates (only a small number of isolates had intermediate-resistance to teicoplain or quinupristin/dalfopristin); however, decreased susceptibility to teicoplanin was relatively common among CoNS (90.3% susceptibility; Table 9).

The prevalence of glycopeptide-resistant enterococci remained low in the Latin American hospitals evaluated by the SENTRY Program (97.5% susceptibility in general) and its occurrence is usually linked to clonal dissemination of unique strains [1,10,16].

The prevalence of penicillin-resistant pneumococci varied significantly among the Latin American countries evaluated, and it was especially low in Brazil (only 4.6% with high-level resistance; Table 10). Macrolide resistance rates were around 10% to 12%, with approximately half of the erythromycin resistant isolates showing cross-resistance to clindamycin (MLS_B phenotype). Tetracycline resistance rates were relatively elevated (around 20%), while resistance rates to trimethoprim/sulfamethoxazole were very high, especially in Brazil (49.7% susceptibility; Table 10).

Fluoroquinolone resistance was very rare among pneumococci (99.7% susceptibility to gatifloxacin) and it was not detected among other streptococci species (Table 10). β-hemolytic streptococci remained very susceptible to penicillin and all other β-lactams evaluated. However, macrolide resistance was detected among the isolates of this pathogen (erythromycin susceptibility of 92.8% and 96.6% throughout Latin America and in Brazil, respectively). As expected, viridans group streptococci showed the highest rates of resistance among streptococci, with only 66.1% of the Latin American isolates being considered susceptible to penicillin.

Among the active surveillance systems, the SENTRY Program has incorporated extensive molecular strain typing and resistance genotyping as a means of providing additional information that may be useful for understanding pathogenic microorganisms worldwide [1,17]. In any surveillance program the phenotypic characterization of microorganisms and identification of epidemic clusters of certain species and resistance phenotypes is the primary role of the microbiology

laboratory. In this way, the surveillance laboratory serves as an "early warning system", alerting the participating institutions of a potential problem with resistant organisms in a variety of patient populations [18].

The rapid emergence and dissemination of numerous drug resistances among bacteria has raised the necessity for controlling these pathogens in hospitals on a global scale; and the determination of clonality within a phenotypically identical resistant clusters will have a direct impact on the method of corrective intervention. On a broader scale, identification of resistant clones with extensive geographic range may provide insight into strain virulence and pathogenesis; and also may result in broader public health interventions, such as vaccination and antimicrobial restrictions aimed at limiting the spread of the pathogen and associated resistance problems [1].

Molecular methods may also be used to detect specific antimicrobial resistance genes (resistance genotyping) in a wide variety of organisms and when coupled with DNA fingerprinting have made substantial contributions to our understanding of the genetics of antimicrobial resistance and the spread of resistance determinants in the SENTRY Program medical centers [7,15,19].

The main purpose of this report was to present a comprehensive tabular analysis of the antimicrobial susceptibility data of bacteria collected in the Latin American medical centers participating in the SENTRY Program. Antimicrobial resistances may vary significantly among Latin American countries and SENTRY Program evaluates only a small number of medical centers. However, the main objective of this program was to detect the most important problems of public health concern within the region and to assist/guide regional intervention programs. The data presented here allow the identification of these principal resistance problems and the comparison of the *in vitro* activity and spectrum of a large number of antimicrobial agents not often tested in most hospitals. Lastly, we emphasize that empirical therapy should be guided by local susceptibility data when those are available, but in the absence of such information, surveillance data can help with therapeutic choices.

Acknowledgements

We express our appreciation to all medical technicians who have worked in SENTRY. The SENTRY Latin America Study Group in 1997-2001 includes: Helio S. Sader, Ana C. Gales (São Paulo, Brazil - Latin American Coordinator); Jorge Sampaio (Lâmina Laboratory, Rio de Janeiro, Brazil; Cássia Zoccoli (Santa Lúzia Laboratory, Florianopolis, Brazil); Afonso Barth (Hospital de Clinicas, Porto Alegre, Brazil); Julival Ribeiro (Hospital de Base, Brasília, Brazil); José M. Casellas (Centro de Estudios en Antimicrobianos, San Isidro, Argentina); Jorgelina Smayevsky (Microbiology Laboratory C.E.M.I.C., Buenos Aires, Argentina); Valeria Prado (Faculdad de Medicina de Chile, Santiago, Chile); Elizabeth Palavecino / Patricia Garcia (Universidad Catolica del Chile, Santiago, Chile); Homero Bagnulo (Hospital Maciel, Montivideo, Uruguay); Jaime A. Robledo (Corporation para Investigaciones Biologicas, Medellin, Colombia); Jose Sifuentes-Osornio (Instituto Nacional de la Nutricion, Ciudade del Mexico, Mexico); and Manuel Guzmán-Blanco (Hospital Vargas, Caracas, Venezuela). Soraya Andrade, Rodrigo E. Mendes and Suzane Silbert provided excellent technical support. The SENTRY Antimicrobial Surveillance Program has been sponsored by a research/educational grant from Bristol-Myers Squibb.

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