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Antimicrobial Susceptibility and Epidemiology of a Worldwide Collection of *Chryseobacterium* spp.: Report from the SENTRY Antimicrobial Surveillance Program (1997–2001)

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Limited data are available on *Chryseobacterium* spp. leading to an evaluation of the patient demographics and susceptibility patterns for *Chryseobacterium* spp. collected in the first 5 years of the SENTRY Antimicrobial Surveillance Program (1997 to 2001). Fifty isolates (24 *Chryseobacterium meningosepticum*, 20 *Chryseobacterium indologenes*, two *Chryseobacterium gleum*, and 4 *Chryseobacterium* spp. isolates) were collected. The highest *Chryseobacterium* prevalence was detected among the elderly. The most active antimicrobials were the newer quinolones (garenoxacin, gatifloxacin, and levofloxacin, each with a MIC at which 90 percent of the isolates are inhibited [MIC_{90}] of 1 μg/ml and 98.0% susceptibility) followed by rifampin (MIC_{90}, 2 μg/ml and 85.7% susceptibility). Trimethoprim-sulfamethoxazole, ciprofloxacin, and piperacillin-tazobactam also showed reasonable activity; vancomycin showed poor potency.

Ubiquitous in nature, *Chryseobacterium* species are found primarily in soil and water. Environmental studies have revealed that these organisms can survive in chlorine-treated municipal water supplies, often colonizing sink basins and taps and creating potential reservoirs for infections inside hospital environments. Colonization of patients via contaminated medical devices involving fluids (respirators, intubation tubes, mist tents, humidifiers, incubators for newborns, ice chests, syringes, etc.) has been documented (8, 12). Contaminated surgically implanted devices such as intravascular catheters and prosthetic valves have also been reported (18). In other clinical settings, chryseobacteria have been described as etiological agents of meningitis, bacteremia, pneumonia, endocarditis, infections of skin and soft tissue, ocular infections, and other infections (6). Primarily opportunistic pathogens, they infect mainly newborns and immunocompromised hosts from all age groups.

Chryseobacterium meningosepticum is the most pathogenic member of the genus. As an agent of neonatal meningitis, it reportedly demonstrates mortality rates of up to 57% and produces severe postinfection sequelae including hydrocephalus, deafness, and developmental delay. *C. meningosepticum* is involved to a lesser extent in cases of pneumonia and bacterial sepsis in neonates and adults (6, 23).

Antimicrobial susceptibility data on *Chryseobacterium* spp. remain very limited, since this pathogen has been rarely isolated from clinical specimens. In addition, results of susceptibility testing vary when different methods are used. Results from disk diffusion methods may not be reliable, so broth reference quality microdilution tests should be performed when possible (1, 9).

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Increasing concerns over the possibility of disseminating plasmid-mediated carbapenem-hydrolyzing enzymes has led researchers to characterize the natural reservoir of chromosomally linked metallo-β-lactamases (MβLs) found in *Chryseobacterium* strains (3, 5). Multiple heterogeneous carbapenem-hydrolyzing enzymes have been reported in a single strain of *C. meningosepticum*. Investigations have also detected synergistic effects between cephalosporins and clavulanic acid, adding Ambler class A extended-spectrum β-lactamases to the growing list of resistance mechanisms found in chryseobacteria (4, 21).

Chryseobacterium spp. are known to exhibit resistance to aminoglycosides, tetracyclines, chloramphenicol, erythromycin, clindamycin, and teicoplanin (1, 6, 14). However, some fluoroquinolones have shown favorable results (9, 25). Minocycline has also shown good in vitro activity, while susceptibility to doxycycline and trimethoprim-sulfamethoxazole appears variable. Rifampin is usually active in vitro and has been used as part of a combination therapy to clear persistent infection (11). Vancomycin alone or in combination with other agents, including rifampin, has in the past been successful in the treatment of meningitis in infants (20). However, the usefulness of vancomycin against *Chryseobacterium* spp. infections has more recently been questioned (6, 9). Thus, there is no optimal regimen for the treatment of *Chryseobacterium* spp. infections and antimicrobial therapy should be based on MIC from properly performed susceptibility tests.

The SENTRY Antimicrobial Surveillance Program is a world-wide study monitoring the susceptibility and resistance patterns of bacterial and fungal pathogens. This investigation was conducted by using results from over 119 sentinel hospitals and laboratories in North America, Latin America, Europe, and the Asia-Pacific region from the initial 5 years of the program (1997 to 2001). During this time period, over 155,811 clinical isolates were collected from several sites of infections, including bloodstream, the lower respiratory tract, skin and

soft tissue, and the urinary tract. All *Chryseobacterium* spp. isolates collected during this period were evaluated. Fifty isolates unique to a given patient were identified and selected for detailed characterization and additional antimicrobial susceptibility testing.

Individual strains came from hospitalized patients in the Asia-Pacific region (16 strains from 7 centers), Europe (5 strains from 5 centers), Latin America (14 strains from 6 centers), and North America (15 strains from 15 centers). Each strain was tested against 47 antimicrobials, of which only selected agents were used for comparison of activity. Manufacturers for each agent supplied standard compounds that were placed in dry-form, validated microdilution panels (Trek Diagnostic Systems Inc., Cleveland, Ohio). All organisms were tested by broth microdilution methodology as specified by the NCCLS (16). Interpretation of quantitative MIC results was in accordance with NCCLS (16, 17) criteria. Selected gram-positive-active drugs were tested against *Chryseobacterium* spp. isolates, and the results were interpreted according to breakpoints approved for *Staphylococcus* or *Enterococcus* species by the NCCLS (17).

Multiple isolates of the same species isolated by the same medical center were selected for molecular typing. These isolates were characterized by macrorestriction analysis of chromosomal DNA by using pulsed-field gel electrophoresis (PFGE) as previously described (19, 24). Meropenem hydrolysis was evaluated for 21 randomly selected strains (11 *C. indologenes* and 10 *C. meningosepticum* isolates) by UV spectrophotometric assays (Pharmacia LKB Ultrospec II) in 1-cm light path cuvettes with readings recorded at 2-s intervals for 2 min at a wavelength of optimal absorbance (loss of substrate at 298 nm). The ability to induce MβLs was assessed by challenging mid-log growth cells with cefoxitin at 0.25 μg/ml for 2 h (26). The cells were harvested by centrifugation (12,000 × *g*), washed in the aforementioned buffer, and ribolysed. The ribolysed cells were centrifuged at 12,000 × *g* to remove cellular debris. The activities of the enzymes were converted to a specific activity (micromolar substrate hydrolyzed/minute/milligram of protein) using −2,500 as the extinction coefficient for meropenem as previously described (2).

The 50 isolates were collected from 33 medical centers in 16 countries. Only three medical centers sent multiple isolates of the same species. *Chryseobacterium* spp. represented only 0.27% (50 of 18,569) of the processed nonfermentative gram-negative bacilli and 0.03% (50 of 155,811) of all bacterial isolates collected by the SENTRY Program during the 5-year period evaluated (1997 to 2001). In addition, *Chryseobacterium* spp. represented only 0.10% of respiratory tract isolates and 0.03% of bloodstream infection isolates. The low frequency of this pathogen as a cause of infection is probably related to its reduced degree of pathogenicity. Some studies have shown that *Chryseobacterium* can be rapidly cleared by the immune system when introduced into the bloodstream or respiratory tract of a healthy animal or human host (6, 8, 22).

The most frequently isolated species was *C. meningosepticum* (24 isolates [48.0%]), followed by *C. indologenes* (20 isolates [40%]) and *C. gleum* (2 isolates [4.0%]). Four isolates (8.0%) could not be identified to the species level. All isolates were from hospitalized patients, and the vast majority was recovered from either lower respiratory tract (26 isolates [52.0%]) or blood cultures (23 isolates [46.0%]). The frequency of *Chryseobacterium* among respiratory tract specimens (0.10%; 26 of 25,657 specimens evaluated) was threefold higher than among positive blood cultures (0.03%; 23 of 74,236). Among isolates from bloodstream infections, 52.2% were *C. meningosepticum* and 30.4% were *C. indologenes*. Conversely, one-half of the isolates from the respiratory tract were *C. indologenes* and 42.3% were *C. meningosepticum*. One isolate (*C. meningosepticum*) was recovered from skin and/or soft tissue infection. The highest frequency of *Chryseobacterium* spp. infection occurred among the elderly (≥65 years old; 0.045%) and the lowest frequency occurred among children ≤5 years of age (0.016%).

The quinolones showed the highest potency and spectrum of activity against the overall collection of *Chryseobacterium* spp. Garenoxacin was the most active quinolone (MIC_{50}, 0.12 μg/ml; MIC_{90}, 1 μg/ml), and this new desfluoro compound inhibited 98.0% of isolates at the proposed susceptible breakpoint for other nonfermentative gram-negative bacilli (≤2 μg/ml) (13). Gatifloxacin (MIC_{50}, 0.25 μg/ml) and levofloxacin (MIC_{50}, 0.5 μg/ml) also inhibited 98.0% of the isolates at susceptible breakpoints (17), and the rate of susceptibility to ciprofloxacin (MIC_{50}, 0.5 μg/ml) was significantly lower (80.0% overall). Trimethoprim-sulfamethoxazole showed reasonable activity (87.8% susceptibility overall). Among the β-lactams, the most active agents overall were piperacillin-tazobactam (MIC_{50}, 4 μg/ml; 80.0% susceptibility), piperacillin (MIC_{50}, 8 μg/ml; 74.0% susceptibility), and cefepime (MIC_{50}, 8 μg/ml; 62.0% susceptibility). The carbapenems (6 to 12% susceptible) and the aminoglycosides (8 to 14% susceptible) exhibited poor activity against these pathogens. MβL activity was demonstrated for all isolates evaluated. Activity ranged from 381 to 788 (average 529) μmol/min/mg of protein.

Many studies have shown that vancomycin has marginal in vitro activity against *Chryseobacterium* spp. isolates. In addition, some reports have documented the successful use of vancomycin to treat *C. meningosepticum* infections, and this antimicrobial agent has been recommended as a therapeutic choice (7, 8, 10). We tested vancomycin and several other antimicrobial agents used to treat gram-positive infections, and all of these compounds showed poor activity against the contemporary *Chryseobacterium* spp. isolates tested. For the vast majority of strains (87.8%) the vancomycin MIC was intermediate (8 to 16 μg/ml). Rifampin was active against the majority of strains (85.7% susceptibility overall) and can be used in combination to treat severe invasive infections (10, 11).

C. meningosepticum showed slightly lower susceptibility rates to the β-lactams (71.0% susceptibility to piperacillin-tazobactam) and to trimethoprim-sulfamethoxazole (79.2%) when compared to *C. indologenes* (90.0 and 95.0% susceptibility to piperacillin-tazobactam and trimethoprim-sulfamethoxazole, respectively). On the other hand, these two species had similar rates of susceptibility to fluoroquinolones and other antimicrobial agents (Table 1).

Interestingly, isolates from the Asia-Pacific region showed higher rates of resistance to the β-lactams (Table 2). The rate of susceptibility to piperacillin-tazobactam was only 50.0% in the Asia-Pacific region (16 isolates) compared to 100% in North America (15 isolates) and Europe (5 isolates) and 85.7% in Latin America (14 isolates). This higher rate of resistance

TABLE 1. Spectrum of selected antimicrobial agents against the most frequently isolated species

Antimicrobial agent[a]	*C. meningosepticum* (*n* = 24)				*C. indologenes* (*n* = 20)			
	MIC_{50}	MIC_{90}	% Susceptible	% Resistant	MIC_{50}	MIC_{90}	% Susceptible	% Resistant
Gatifloxacin	0.5	2	100.0	0.0	0.25	1	95.0	0.0
Garenoxacin[b]	0.12	1	100.0	0.0	0.12	2	95.0	0.0
Levofloxacin	0.5	2	95.8	4.2	≤0.5	1	100.0	0.0
Ciprofloxacin	1	>2	70.9	16.7	0.5	2	85.0	10.0
Trimethoprim-sulfamethoxazole	2	>2	79.2	20.8	≤0.5	2	95.0	5.0
Piperacillin-tazobactam	8	64	71.0	4.2	4	32	90.0	5.0
Piperacillin	8	128	62.4	29.2	4	32	85.0	10.0
Ticarcillin-clavulanate	128	>128	0.0	58.3	>128	>128	5.0	90.0
Cefepime	16	>16	37.6	33.0	0.5	>16	85.0	15.0
Ceftazidime	>16	>16	4.2	91.7	4	>16	85.0	15.0
Ceftriaxone	32	>32	4.2	37.5	16	>32	35.0	15.0
Imipenem	>8	>8	0.0	95.8	>8	>8	15.0	85.0
Meropenem	>8	>8	0.0	91.7	>8	>8	10.0	90.0
Amikacin	>32	>32	4.2	62.5	>8	>8	15.0	20.0
Gentamicin	>8	>8	8.3	91.7	>8	>8	5.0	95.0
Tobramycin	>16	>16	0.0	100.0	>16	>16	0.0	100.0
Chloramphenicol	>16	>16	4.2	79.2	>16	>16	5.0	85.0
Linezolid[c]	8	>8	8.3	91.7	>8	>8	5.0	95.0
Teicoplanin[c]	16	>16	20.9	33.3	>16	>16	5.0	60.0
Vancomycin[c]	16	16	4.2	4.2	16	>16	0.0	20.0
Rifampin[c]	0.5	2	87.5	0.0	0.5	2	85.0	0.0

[a] NCCLS MIC breakpoints for non-*Enterobacteriaceae* were categorically applied to *Chryseobacterium* spp.
[b] A susceptibility breakpoint of ≤2 μg/ml was applied (13).
[c] The NCCLS MIC breakpoint for *Staphylococcus* spp. was applied (17).

may be related to the higher proportion of *C. meningosepticum* isolated in this region, since this species has shown higher rates of resistance than *C. indologenes*, especially for β-lactams and trimethoprim-sulfamethoxazole (Table 1). Susceptibility rates did not vary greatly among regions for other classes of antimicrobial agents (Table 2).

Thirteen strains (five *C. indologenes* and eight *C. meningosepticum* isolates) from three medical centers (Brazil, China, and Hong Kong) were characterized by PFGE. Among *C. indologenes*, three isolates from a Brazilian center had identical PFGE patterns. Two *C. meningosepticum* isolates from the same Brazilian medical center also shared a unique PFGE pattern. These isolates were collected from elderly patients (ages 66 to 90 years) with nosocomial pneumonia hospitalized in intensive care units (ICU). All other tested isolates had distinct chromosomal DNA profiles. The finding of two small epidemic clusters involving elderly patients hospitalized in the ICU with lower respiratory tract infections raises concern for the possible occurrence of outbreaks in this patient population. *Chryseobacterium* spp. colonization in patients admitted to a respiratory-surgical ICU was reported more than two decades ago, and it was linked to the municipal water supply (8). In addition, its unusual resistance to antimicrobial agents directed to gram-negative bacteria allows for favorable environmental competition and subsequent colonization. Once patients become colonized, organisms can be transmitted to noncolonized patients primarily by hand carriage (8, 15).

In summary, the results of the evaluation of a world-wide

TABLE 2. In vitro activities of selected antimicrobials against *Chryseobacterium* spp. according to SENTRY region

Antimicrobial agent[a]	Asia-West Pacific (*n* = 16)		Europe (*n* = 5)		Latin America (*n* = 14)		North America (*n* = 15)	
	% Susceptible	% Resistant	% Susceptible	% Resistant	% Susceptible	% Resistant	% Susceptible	% Resistant
Gatifloxacin	100.0	0.0	100.0	0.0	92.9	0.0	100.0	0.0
Garenoxacin[b]	100.0	0.0	100.0	0.0	92.9	0.0	100.0	0.0
Levofloxacin	100.0	0.0	100.0	0.0	100.0	0.0	93.3	6.7
Ciprofloxacin	68.8	12.5	100.0	0.0	85.7	7.1	80.0	20.0
Trimethoprim-sulfamethoxazole	81.3	18.7	80.0	20.0[d]	85.7	14.3	93.3	6.7
Piperacillin-tazobactam	50.0	6.3	100.0	0.0	85.7	7.1	100.0	0.0
Piperacillin	37.5	50.1	100.0	0.0	85.7	14.3	93.3	0.0
Cefepime	18.8	62.5	100.0	0.0	64.3	14.3	93.3	0.0
Ceftazidime	12.5	87.5	100.0	0.0	57.1	42.9	53.3	40.0
Imipenem	0.0	100.0	20.0	80.0	14.3	85.7	20.0	73.3
Amikacin	6.3	81.2	20.0	0.0	14.3	28.6	20.0	26.7
Rifampin[c]	93.8	0.0	75.0	0.0	85.7	0.0	80.0	0.0

[a] NCCLS MIC breakpoints for non-*Enterobacteriaceae* were categorically applied to *Chryseobacterium* spp. (17).
[b] A susceptibility breakpoint of ≤2 μg/ml was applied (13).
[c] NCCLS MIC breakpoints for *Staphylococcus* spp. were applied (17).
[d] A *C. gleum* isolate had an MIC >1/19 μg/ml and was not available for retesting.

collection of unique *Chryseobacterium* strains indicate that (i) the newer quinolones (garenoxacin, gatifloxacin, and levofloxacin) may represent the most appropriate antimicrobial agents to treat infections caused by this pathogen, (ii) vancomycin and other anti-gram-positive antimicrobial agents may not represent satisfactory therapeutic options for *Chryseobacterium* infections, (iii) the production of metallo-β-lactamase seems to be constitutive among *Chryseobacterium* spp., and (iv) epidemic clusters may occur among elderly patients hospitalized in ICUs. Extensive world-wide surveillance programs, such as the SENTRY Program, are extremely important to guide empirical antimicrobial therapy and clinical context of rarely isolated pathogens.

REFERENCES

1. **Aber, R. C., C. Wennersten, and R. C. Moellering, Jr.** 1978. Antimicrobial susceptibility of *Flavobacteria*. Antimicrob. Agents Chemother. **14:**483–487.
2. **Avison, M. B., C. S. Higgins, C. J. von Heidreich, P. M. Bennett, and T. R. Walsh.** 2001. Plasmid location and molecular heterogeneity of the L1 and L2 β-lactamase genes of *Stenotrophomonas maltophilia.* Antimicrob. Agents Chemother. **45:**413–419.
3. **Bellais, S., D. Aubert, T. Naas, and P. Nordmann.** 2000. Molecular and biochemical heterogeneity of class B carbapenem-hydrolyzing beta-lactamases in *Chryseobacterium meningosepticum.* Antimicrob. Agents Chemother. **44:**1878–1886.
4. **Bellais, S., T. Naas, and P. Nordmann.** 2002. Molecular and biochemical characterization of Ambler class A extended-spectrum beta-lactamase CGA-1 from *Chryseobacterium gleum.* Antimicrob. Agents Chemother. **46:** 966–970.
5. **Bellais, S., L. Poirel, S. Leotard, and P. Nordmann.** 2000. Genetic diversity of carbapenem-hydrolyzing metallo-beta-lactamases from *Chryseobacterium* (*Flavobacterium*) *indologenes.* Antimicrob. Agents Chemother. **44:**3028–3034.
6. **Bloch, K. C., R. Nadarajah, and R. Jacobs.** 1997. *Chryseobacterium meningosepticum*: an emerging pathogen among immunocompromised adults. Report of 6 cases and literature review. Medicine (Baltimore) **76:**30–41.
7. **Di Pentima, M. C., E. O. Mason, and S. L. Kaplan.** 1998. In vitro antibiotic synergy against *Flavobacterium meningosepticum*: implications for therapeutic options. Clin. Infect. Dis. **26:**1169–1176.
8. **Du Moulin, G. C.** 1979. Airway colonization by *Flavobacterium* in an intensive care unit. J. Clin. Microbiol. **10:**155–160.
9. **Fraser, S. L., and J. H. Jorgensen.** 1997. Reappraisal of the antimicrobial susceptibilities of *Chryseobacterium* and *Flavobacterium* species and methods for reliable susceptibility testing. Antimicrob. Agents Chemother. **41:**2738–2741.
10. **Gilbert, D. N., R. C. Moellering, and M. A. Sande.** 2003. The Sanford guide to antimicrobial therapy, 3rd ed., p. 48. Antimicrobial Therapy, Inc., Hyde Park, Vt.
11. **Hirsh, B. E., B. Wong, T. E. Kiehn, T. Gee, and D. Armstrong.** 1986. *Flavobacterium meningosepticum* bacteremia in an adult with acute leukemia. Use of rifampin to clear persistent infection. Diagn. Microbiol. Infect. Dis. **4:**65–69.
12. **Hoque, S. N., J. Graham, M. E. Kaufmann, and S. Tabaqchali.** 2001. *Chryseobacterium (Flavobacterium) meningosepticum* outbreak associated with colonization of water taps in a neonatal intensive care unit. J. Hosp. Infect. **47:**188–192.
13. **Howard, W., D. J. Biedenbach, and R. N. Jones.** 2002. Comparative antimicrobial spectrum and activity of the desfluoroquinolone BMS 284756 (T-3811) tested against non-fermentative Gram-negative bacilli. Clin. Microbiol. Infect. **8:**340–344.
14. **Hsueh, P. R., L. J. Teng, P. C. Yang, S. W. Ho, W. C. Hsieh, and K. T. Luh.** 1997. Increasing incidence of nosocomial *Chryseobacterium indologenes* infections in Taiwan. Eur. J. Clin. Microbiol. Infect. Dis. **16:**568–574.
15. **Kienzle, N., M. Muller, and S. Pegg.** 2001. *Chryseobacterium* in burn wounds. Burns **27:**179–182.
16. **National Committee for Clinical Laboratory Standards.** 2003. Methods for dilution antimicrobial susceptibility tests for bacteria that grow aerobically, 6th ed. Approved Document M7-A6. National Committee for Clinical Laboratory Standards, Wayne, Pa.
17. **National Committee for Clinical Laboratory Standards.** 2003. Performance standards for antimicrobial susceptibility testing. Thirteenth information supplement M100-S13. National Committee for Clinical Laboratory Standards, Wayne, Pa.
18. **Nulens, E., B. Bussels, A. Bols, B. Gordts, and H. W. Van Landuyt.** 2001. Recurrent bacteremia by *Chryseobacterium indologenes* in an oncology patient with a totally implanted intravenous device. Clin. Microbiol. Infect. **7:**391–393.
19. **Pfaller, M. A., R. J. Hollis, and H. S. Sader.** 1992. Molecular biology—PFGE analysis of chromosomal restriction fragments, p. 10.5.c.1–10.5.c.11. *In* H. D. Isenberg (ed.), Clinical microbiology procedures handbook. American Society for Microbiology, Washington, D.C.
20. **Ratner, H.** 1984. *Flavobacterium meningosepticum.* Infect. Control **5:**237–239.
21. **Rossolini, G. M., N. Franceschini, L. Lauretti, B. Caravelli, M. L. Riccio, M. Galleni, J.-M. Frere, and G. Amicosante.** 1999. Cloning of a *Chryseobacterium (Flavobacterium) meningosepticum* chromosomal gene ($blaA_{CME}$) encoding an extended-spectrum class A β-lactamase related to the *Bacteroides* cephalosporinases and the VEB-1 and PER β-lactamases. Antimicrob. Agents Chemother. **43:**2193–2199.
22. **Sader, H. S., R. N. Jones, and M. A. Pfaller.** 1995. Relapse of catheter-related *Flavobacterium meningosepticum* bacteremia demonstrated by DNA macrorestriction analysis. Clin. Infect. Dis. **21:**997–1000.
23. **Tekerekoglu, M. S., R. Durmaz, M. Ayan, Z. Cizmeci, and A. Akinci.** 2003. Analysis of an outbreak due to *Chryseobacterium meningosepticum* in a neonatal intensive care unit. New Microbiol. **26:**57–63.
24. **Tenover, F. C., R. D. Arbeit, R. V. Goering, P. A. Mickelsen, B. E. Murray, D. H. Persing, and B. Swaminathan.** 1995. Interpreting chromosomal DNA restriction patterns produced by pulsed-field gel electrophoresis: criteria for bacterial strain typing. J. Clin. Microbiol. **33:**2233–2239.
25. **Visalli, M. A., S. Bajaksouzian, M. R. Jacobs, and P. C. Appelbaum.** 1997. Comparative activity of trovafloxacin, alone and in combination with other agents, against gram-negative nonfermentative rods. Antimicrob. Agents Chemother. **41:**1475–1481.
26. **Walsh, T. R., A. P. MacGowan, and P. M. Bennett.** 1997. Sequence analysis and enzyme kinetics of the L2 serine β-lactamase from *Stenotrophomonas maltophilia.* Antimicrob. Agents Chemother. **41:**1460–1464.