Letters to the Editor

Prevalence of Ceftriaxone- and Ceftazidime-Resistant Gram-Negative Bacteria in Long-Term–Care Facilities

To the Editor:

Increasing use of third-generation cephalosporins has been associated with the emergence of resistance in gram-negative bacilli (GNB) in acute-care hospitals. Few studies have addressed this issue in long-term–care facilities (LTCFs). Studies of colonization or outbreaks of infection due to specific bacteria in single facilities have predominated.[1-6] We describe the prevalence of ceftriaxone resistance and ceftazidime resistance among clinical isolates of GNB obtained from three LTCFs from different geographic locations.

The LTCFs differed in size and services provided. The Ann Arbor Veterans Affairs (VA) LTCF is attached to a 150-bed acute-care medical center; its capacity ranged from 60 to 90 beds. Residents were admitted for comprehensive geriatric evaluation, rehabilitation, or long-term care. The mean length of stay was 3 months for the evaluation unit, 6 months for the rehabilitation unit, and 2 years for the long-term–care unit. The freestanding Pittsburgh VA LTCF contains 400 beds, of which 160 are intermediate-care and 240 are long-term–care beds. Data from long-term–care patients were included in this study; length of stay ranged from 6 to 24 months. The capacity of the freestanding Portland VA LTCF ranged from 70 to 109 beds during the study; it provides geriatric evaluation and management and rehabilitation. The length of stay ranged from 3 to 6 months.

Clinical isolate data from January 1995 to December 1997 from the three LTCFs were obtained retrospectively. If more than one isolate was obtained from the same anatomic site with the same susceptibility pattern in a given patient within 14 days, they were considered identical, and only the first was included in the analysis. At Ann Arbor and Pittsburgh, minimal inhibitory concentrations for ceftriaxone and ceftazidime were obtained for all isolates by microtiter plate methods, whereas at Portland all isolates were tested by disk diffusion, according to National Committee for Clinical Laboratory Standards recommendations. Because ceftriaxone generally lacks activity against *Pseudomonas aeruginosa*, results for this drug with *P aeruginosa* were excluded from analysis. Trends within and among the facilities were assessed by the chi-square test; $P<.05$ was considered significant.

The overall rate of resistance to third-generation cephalosporins was 4.5%; ceftriaxone resistance was 5%, and ceftazidime resistance was 4%. The overall prevalence of ceftriaxone resistance and ceftazidime resistance was much lower at Pittsburgh (1.5%), compared with Ann Arbor (9.4%) and Portland (7.6%; $P<.0001$). The most common sites of isolation of resistant GNB were urine (74%), wound (14%), and sputum (11%).

At Ann Arbor, 349 clinical GNB isolates were tested for antibiotic susceptibilities (Table). The predominant organisms isolated were *Proteus* species (94 isolates), *Escherichia coli* (69), and *P aeruginosa* (63). Of 286 nonpseudomonal isolates tested for susceptibility to ceftriaxone, 27 (9.4%) were resistant. *Acinetobacter* species (10/13) and *Enterobacter* species (9/18) were most commonly resistant. Of 349 isolates tested for susceptibility to ceftazidime, 33 (9.5%) were resistant. The organisms most commonly ceftazidime-resistant were *Enterobacter* species (11/18) and *Acinetobacter* species (8/13).

At Portland, 395 GNB were tested for antibiotic susceptibilities. Again, the predominant organisms isolated were *E coli* (88), *P aeruginosa* (84), *Proteus* species (75), and *Klebsiella pneumoniae* (61). Of 311 clinical isolates tested for ceftriaxone resistance, 26 (8.4%) were resistant. *Enterobacter* species (17/39) showed the greatest ceftriaxone resistance. Only 121 of 395 isolates were tested against ceftazidime, and resistance was noted in 7 (5.8%).

Susceptibility tests to third-generation cephalosporins were per-

TABLE
PREVALENCE OF RESISTANCE TO CEFTRIAXONE AND CEFTAZIDIME AT GEOGRAPHICALLY DISTINCT VETERANS AFFAIRS LONG-TERM–CARE FACILITIES

	Ann Arbor (Resistant/Total)		Portland (Resistant/Total)		Pittsburgh (Resistant/Total)	
Organism	**CTX**	**CAZ**	**CTX**	**CAZ**	**CTX**	**CAZ**
Acinetobacter species	10/13	8/13	1/2	0/1	1/29	1/29
Citrobacter species	3/27	4/27	0/18	0/1	1/8	0/8
Enterobacter species	1/3	3/3	4/18	1/3	3/18	5/18
Enterobacter cloacae	8/15	8/15	13/21	0/0	0/12	2/12
Escherichia coli	0/69	1/69	0/88	0/9	0/174	0/174
Klebsiella species	1/51	0/51	4/61	0/8	0/62	0/62
Morganella morganii	2/6	2/6	0/7	0/1	0/46	2/46
Proteus species	1/94	1/94	2/75	0/8	0/261	0/261
Pseudomonas aeruginosa	NA*	5/63	NA*	6/84	NA*	9/122
Providencia species	0/0	0/0	0/4	0/1	0/115	0/115
Serratia marcescens	1/8	1/8	0/14	0/5	0/29	0/29
Other	0	0	2/3	0	0	0
Total isolates	349	349	395	121	876	876
Isolates tested	286	349	311	121	754	876
Resistant, no. (%)	27 (9.4)	33 (9.5)	26 (8.4)	7 (5.8)	5 (0.7)	20 (2.3)

Abbreviations: CAZ, ceftazidime; CTX, ceftriaxone; NA, not applicable.
* CTX-resistant *Pseudomonas* was excluded from the analysis, as susceptibilities were not performed at all facilities for this organism.

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formed on 876 GNB at Pittsburgh. *Proteus* species (261), *E coli* (174), *P aeruginosa* (122), and *Providencia* species (115) were most common. The prevalence of *Providencia* species was significantly higher at Pittsburgh (115 [13.1%] of 876 isolates) than at either Ann Arbor (0/349) or Portland (4/311; $P<.0001$). Of the 754 nonpseudomonal isolates tested, only 5 (0.7%) were ceftriaxone-resistant. Similarly, only 20 (2.3%) of 876 isolates were ceftazidime-resistant. *Enterobacter* species showed the most ceftazidime resistance (7/30 resistant). Ceftriaxone-resistant *Enterobacter* species were less prevalent at Pittsburgh than at Ann Arbor or Portland ($P<.005$).

The epidemiology of cephalosporin resistance in LTCF GNB has been assessed infrequently. Studies of gentamicin-resistant GNB isolates colonizing LTCF residents have been shown to have not only plasmids encoding for gentamicin resistance but also genes for the β-lactamase TEM-1, which hydrolyzes narrow-spectrum cephalosporins and cefoperazone.[1] Spread of GNB resistance to third-generation cephalosporins in hospitals has been associated with admission of LTCF residents colonized with strains of *E coli* or *K pneumoniae* containing plasmids encoding for SHV-7, conferring resistance to cefotaxime, ceftazidime, and aztreonam; TEM-10, conferring ceftazidime resistance, and TEM-26, conferring resistance to ceftazidime and piperacillin-tazobactam.[2,3] During one outbreak of infection, *K pneumoniae* and *E cloacae* containing plasmids encoding for YOU-1 and YOU-2 that confer ceftazidime resistance were detected among residents of a Massachusetts chronic-care facility.[4] Muder et al found resistance to multiple drugs, including ceftazidime, was common among clinical isolates, particularly *Pseudomonas* and *Providencia* species, and found evidence for clonal dissemination of *P aeruginosa*.[5]

In our study of clinical isolates, outbreaks had not occurred. *E coli*, *Proteus* species, *Providencia* species, and *P aeruginosa* were isolated most often, and ceftriaxone resistance and ceftazidime resistance were infrequent. The low prevalence of resistance to third-generation cephalosporins in these more common isolates is similar to that found in studies of GNB isolates from outpatients and community-dwelling older adults.[6] Most resistance to third-generation cephalosporins in our study was found in less commonly isolated bacteria. Although *Enterobacter* species accounted for only 6% of all clinical isolates, 33% and 38% were ceftriaxone-resistant and ceftazidime-resistant, respectively. The proportion of *Enterobacter* species resistant to third-generation cephalosporins exceeds that described in acute-care settings. Differences in third-generation cephalosporin use in referring hospitals and LTCFs or differences in patient populations might explain the differences noted in the rates of resistance among our three LTCFs.

Hospital-acquired multidrug-resistant GNB infections are thought to arise endogenously from a patient's own flora but can be acquired from the environment or a single nosocomial source. LTCF residents could become colonized with resistant GNB acquired in hospitals or in LTCFs and perhaps serve as a reservoir for reintroduction of the organism into acute-care facilities. The prevalence of resistant GNB and the mechanism of their spread need to be defined in LTCFs, so that appropriate infection control practices and antimicrobial-use policies can be developed.

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In Vitro Activity of a Nonmedicated Handwash Product, Chlorhexidine, and an Alcohol-Based Hand Disinfectant Against Multiply Resistant Gram-Positive Microorganisms

To the Editor:

Hands of healthcare workers are, without a doubt, the major source of transmission of nosocomial pathogens. Consequently, treatment of hands with appropriate disinfectants is the most important measure in breaking the chain of transmission, particularly in view of the increasing occurrence of multiply resistant microorganisms.

It still is unclear what kind of measure is the most effective. Whereas alcohol-based hand disinfectants are used predominantly in Europe, Anglo-American countries predominantly use antimicrobial scrubs containing 2% or 4% chlorhexidine or nonmedicated handwash products.

Recently, it was reported that chlorhexidine-containing formulations possess limited effectiveness against methicillin-resistant *Staphylococcus aureus* (MRSA) and vancomycin-resistant enterococci (VRE) compared to alcohol-based hand disinfectants.[1,2] Contrary to these results, other investigators demonstrated an adequate antimicrobial efficacy of chlorhexidine.[3] The contradictory results regarding the in vitro activity of chlorhexidine-containing scrubs might be explained by the difficulties in neutralizing chlorhexidine suffi-