Bacteremia in a Long-Term-Care Facility: A Five-Year Prospective Study of 163 Consecutive Episodes

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The clinical features, microbiological characteristics, and outcomes of 163 episodes of bacteremia occurring at a long-term-care facility were evaluated. The rate of nosocomial bacteremia increased from 0.20 to 0.36 cases/1,000 patient-days from 1985 to 1989; there was a parallel increase in the rate of all nosocomial infections combined. Bacteremia was documented in 6.5% of all hospital-acquired infections. The majority of isolates were gram-negative, and *Providencia stuartii* was the most common gram-negative species. *Staphylococcus aureus* was the most frequent isolate; one-third of *S. aureus* strains were resistant to methicillin. Bacteremia was polymicrobial in 36 episodes (22%), 14 of which involved an enterococcal species. Portals of entry included the urinary tract (55%), the respiratory tract (11%), and soft tissue (9%). Overall mortality was 21.5%. Death was significantly associated with residence on the intermediate-care unit, the presence of a respiratory infection, a change in mental status, and relatively recent admission. Optimal management of bacterial infection in a long-term-care setting requires the availability of blood culture results. Initial decisions about antibiotic therapy should be made in light of the likelihood of infection with multiresistant organisms and of polymicrobial infection.

A number of surveys have documented that infection is a major cause of morbidity among patients residing in long-term-care facilities [1–4]. Considerable evidence suggests that the number and seriousness of infections among such patients are likely to increase. The demand for long-term care is increasing along with the mean age of the population of the United States [5]. Moreover, changes in Medicare and Medicaid reimbursement have led to earlier discharge of patients from hospitals [6]; as a result, many nursing homes are admitting patients who require a higher level of skilled care than was the case in the early 1980s [7]. Such patients have higher rates of infection than do other patients in this setting [4, 8]. Unfortunately, many long-term-care facilities lack the level of support in infection control and microbiological evaluation found in acute-care hospitals [9–11]. Thus the recognition, treatment, and control of infection may be suboptimal.

In a 5-year prospective study of infections occurring at a long-term-care Veterans Affairs hospital, we followed the overall infection rate over time and compared it with patterns of admission and mortality. In addition, we conducted a detailed study of 163 cases of bacteremia in our population of patients. To our knowledge, these cases constitute the largest series of bacteremia cases in long-term-care patients reported to date.

Received 15 April 1991; revised 4 September 1991.

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Clinical Infectious Diseases 1992;14:647–54

Methods

Setting. The Aspinwall division of the Pittsburgh Department of Veterans Affairs Medical Center is a 432-bed facility with 204 intermediate-care and 228 nursing-home-care beds. There is a full-time medical staff with 24-hour on-site physician coverage. The facility has a full-time nurse epidemiologist. Microbiological and other laboratory support is provided by the acute-care division, which is located ~8 miles away. Equipment for portable radiographic studies and a limited number of laboratory studies, such as arterial blood gases, is available on site.

Patients assigned to intermediate-care units have active medical problems that require a high level of skilled nursing care and visits by physicians several times weekly. Patients assigned to nursing-home-care units require nursing care but less extensive medical care.

Microbiological methods. From 1985 through 1987, isolates were recovered with the Bactec 460 automated blood culture system (Johnston Laboratories, Towson, MD). A 5- to 10-mL volume of blood was drawn by the medical staff and transferred to a yellow-stoppered Vacutainer tube (Becton, Dickinson Vacutainer Systems, Rutherford, NJ) for transport to the laboratory. Equal portions of the blood sample were inoculated into a 7C anaerobic bottle and a 6B aerobic bottle. Aerobic bottles were incubated at 35°C on a reciprocal shaker for the first 48 hours, and their contents were tested in the Bactec 460 system three times on day 1, three times on day 2, and once daily on days 3–7. Anaerobic bottles were incubated at 35°C without agitation, and their contents were tested once daily for 7 days.

In 1988 and 1989, the laboratory used the Bactec 730

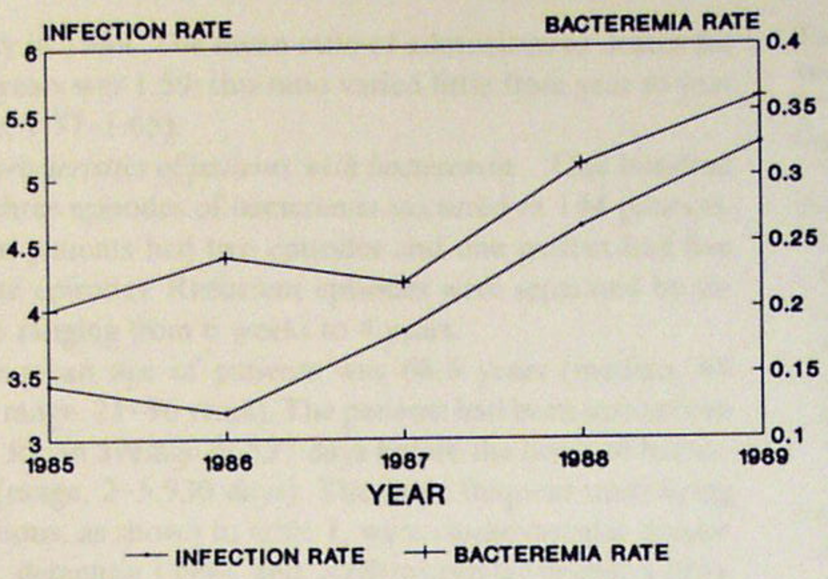

Figure 1. Annual rates of all types of nosocomial infection and of nosocomial bacteremia, expressed as events per 1,000 patient-days, 1985–1989.

nonradiometric system (Johnston Laboratories). Each sample was submitted for blood culture in two yellow-stoppered Vacutainer tubes, and a maximum of 10 mL was inoculated into each of two Bactec bottles: one Plus 26 bottle and one Plus 27 bottle. The incubation and testing schedule remained the same as in previous years.

Isolates were identified according to standard microbiological techniques. The resistance of *Staphylococcus aureus* to methicillin was defined as growth on Mueller-Hinton agar supplemented with 4% NaCl and 6 μg of oxacillin/mL after incubation at 35°C for 24 hours.

Infection surveillance. Whole-house surveillance for infection was conducted by a single trained nurse epidemiologist. Surveillance was based on regular review of microbiology data, radiology reports, and autopsy results. In addition, twice-weekly visits were made to each nursing unit for chart review and case discussion with nursing and medical staff. Surveillance was carried out year-round during 1985–1988 and for the first three quarters of 1989. Nosocomial infection was defined according to standardized criteria [12]. Infection rates were expressed as events per 1,000 patient-days.

The decision to culture the blood of an individual patient was made by the patient's physician, who performed the venipuncture. All positive blood cultures were reported by the laboratory to the physician and the nurse epidemiologist.

Definitions. Bacteremia was defined as a positive blood culture in the presence of signs and symptoms compatible with systemic infection. The diagnosis of bacteremia due to coagulase-negative staphylococci required a minimum of two positive cultures of blood drawn from different sites or a single positive blood culture plus isolation of the organism from a normally sterile site of clinical infection. Two episodes of candidemia were included in the analysis.

The primary site of infection was delineated according to the criteria for nosocomial infection published by the Centers for Disease Control [12]. Fever was defined as a body temperature of ≥100°F. Prior antibiotic therapy was defined as the receipt of a systemic antimicrobial agent for at least 48 hours within the preceding 4 weeks. Because of the difficulty involved in identifying the cause of death in a septic, debilitated patient with multiple underlying illnesses, we defined death due to infection as that occurring within 2 weeks of the onset of bacteremia.

Data analysis. On identification of a positive blood culture, one of the investigators abstracted clinical data from the patient's medical record onto a computer-ready data collection form. Clinical and microbiological data were entered into a computer data base (Prophet Systems, National Institutes of Health, Bethesda, MD) for statistical analysis.

Results

Rate of infection. Figure 1 shows the overall nosocomial infection rate and the nosocomial bacteremia rate per 1,000 patient-days. From 1985 to 1989, the infection rate rose from 3.42/1,000 patient-days to 5.25/1,000 patient-days. There were no clear-cut trends for the rates of infection at individual sites.

The rate of bacteremia increased from 0.20/1,000 patient-days to 0.36/1,000 patient-days during this period, paralleling the increase in the overall infection rate. The correlation between the rate of infection and the rate of bacteremia was statistically significant ($r = .92$, $P = .025$). The rate of bacteremia increased on both the nursing-home-care and the intermediate-care units; the rate on the intermediate-care unit consistently exceeded that on the nursing-home-care unit by 0.10/1,000 patient-days.

The rates of hospital admission and of death during the period studied are shown in figure 2. Both admissions and deaths per 1,000 patient-days increased over time, peaking at 3.39 and 2.05, respectively, in 1988 and then declining

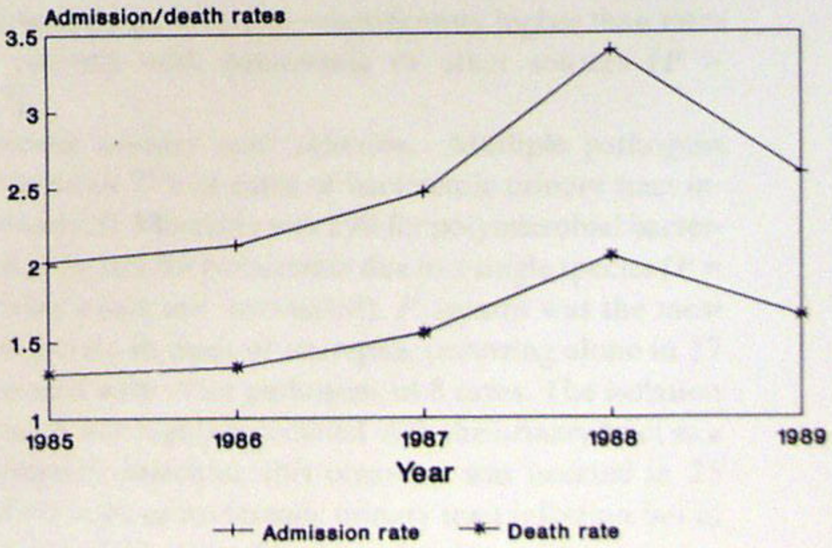

Figure 2. Annual rates of admission to the hospital and death, expressed as events per 1,000 patient-days, 1985–1989.

slightly in 1989. The mean ratio of admissions to deaths for the 5 years was 1.59; this ratio varied little from year to year (range, 1.57–1.65).

Characteristics of patients with bacteremia. One hundred sixty-three episodes of bacteremia occurred in 144 patients. Fifteen patients had two episodes and one patient had five discrete episodes. Recurrent episodes were separated by intervals ranging from 6 weeks to 4 years.

The mean age of patients was 68.6 years (median, 69 years; range, 21–96 years). The patients had been institutionalized for an average of 537 days before the onset of bacteremia (range, 2–5,930 days). The most frequent underlying conditions, as shown in table 1, were cardiovascular disease (46%), dementia (39%), and cerebrovascular disease (38%). Twelve patients were undergoing either hemodialysis or peritoneal dialysis; only 10% were immunosuppressed, as defined by the presence of hematologic or lymphatic malignancy or the receipt of corticosteroids or other immunosuppressive agents. Fever was present in 138 (97%) of the 142 episodes in which body temperature was documented. Two patients were hypothermic (<96°F). In 54 episodes (33%), the patient had received prior antibiotic therapy.

Infecting organisms. Two hundred seven isolates were obtained from the blood during the 163 episodes (table 2). Thirty-six (22%) of the episodes of bacteremia were polymicrobial. Of the gram-positive bacteria, *S. aureus* was by far the most frequently isolated (30 cases); 10 *S. aureus* isolates (33%) were resistant to methicillin. *Enterococcus* species were isolated in a total of 16 episodes and concomitantly with other organisms in 14 episodes.

The majority of isolates were gram-negative. Of these, *Providencia stuartii*, *Escherichia coli*, and *Proteus* species were the most common, together accounting for 65% of aerobic gram-negative isolates.

Antibiotic susceptibilities of the most frequent gram-negative isolates are given in table 3. Resistance to ampicillin, piperacillin, cephalothin, trimethoprim-sulfamethoxazole, and gentamicin was common. Most strains of Enterobacteriaceae were susceptible to cefotetan and amikacin.

Table 1. Underlying conditions of bacteremic patients at a long-term-care facility.

Condition	Percentage of patients
Cardiovascular disease	46.0
Dementia	38.6
Cerebrovascular disease	38.0
Diabetes mellitus	18.4
Chronic obstructive pulmonary disease	18.4
Malignancy	15.9
Paraplegia	15.3
Immunosuppression*	10.4
Renal failure (dialysis)	7.4

* Due to hematologic malignancy and/or to treatment with corticosteroids and/or cytotoxic drugs.

Table 2. Organisms isolated from the blood in 163 cases of bacteremia at a long-term-care facility.

Organism	No. of isolates
Gram-positive	
Staphylococcus aureus	30*
Enterococcus species	16
Coagulase-negative *Staphylococcus*	8
Streptococcus agalactiae	9
Streptococcus pneumoniae	7
Streptococcus pyogenes, group A	1
Streptococcus species	1
Total	72
Gram-negative	
Providencia stuartii	27
Escherichia coli	26
Proteus species	26
Klebsiella pneumoniae	18
Pseudomonas aeruginosa	11
Morganella morganii	6
Serratia marcescens	2
Enterobacter species	2
Citrobacter species	1
Haemophilus influenzae	1
Xanthomonas maltophilia	1
Providencia rettgeri	1
Total	122
Other	
Anaerobes	9
Candida species	2
Miscellaneous	2
Total	13
Total, all blood isolates	207

* Ten isolates were resistant to methicillin.

Portal of entry. Table 4 shows the sites of primary infection in cases of bacteremia and the mortality associated with bacteremia due to infection originating at each site. The overall mortality from all sites was 21.5%. The majority of infections (55%) originated from the urinary tract, with a mortality of 15.5%. Mortality was 50% among the 18 patients with bacteremic pneumonia—significantly higher than rates among patients with bacteremia of other sources ($P = .024$, χ^2).

Bacteremic urinary tract infection. Multiple pathogens were isolated in 27% of cases of bacteremic urinary tract infection (table 5). Mortality was 29% for polymicrobial bacteremia but only 10% for bacteremia due to a single species ($P = .047$, Fisher exact test, two-tailed). *P. stuartii* was the most common isolate in cases of urosepsis, occurring alone in 17 instances and with other pathogens in 8 cases. The isolation of *P. stuartii* was highly associated with the urinary tract as a site of primary infection: this organism was isolated in 25 (28%) of 90 cases of bacteremic urinary tract infection but in just 1 (1.4%) of 72 cases of bacteremia with another primary source ($P < .001$, χ^2).

Enterococci were the most frequently isolated gram-posi-

Table 3. Antimicrobial susceptibility data for gram-negative isolates from cases of bacteremia at a long-term-care facility.

	Percentage of isolates susceptible (total no. of isolates tested)*						
Organism	Amp	Pip	Cthn	Cfot	TMP-SMZ	Gm	Amik
Providencia stuartii	33 (24)	71 (24)	12 (24)	100 (15)	21 (24)	79 (24)	100 (14)
Escherichia coli	61 (23)	65 (23)	61 (23)	100 (13)	57 (23)	91 (23)	100 (14)
Proteus species	61 (23)	79 (24)	79 (24)	100 (15)	54 (24)	92 (24)	100 (15)
Klebsiella pneumoniae	6 (18)	39 (18)	61 (18)	100 (11)	56 (18)	67 (18)	93 (15)
Morganella morganii	14 (7)	71 (7)	14 (7)	75 (4)	86 (7)	37 (7)	100 (6)
Pseudomonas aeruginosa	...	88 (8)	...	...	...	78 (9)	71 (7)

* Amp = ampicillin; Pip = piperacillin; Cthn = cephalothin; Cfot = cefotetan; TMP-SMZ = trimethoprim-sulfamethoxazole; Gm = gentamicin; and Amik = amikacin.

tive organisms in bacteremia of urinary origin, occurring in 12 (13%) of 90 cases. In 10 cases enterococci were isolated in association with another organism. Enterococcal infections were associated with indwelling and external catheters in eight and three cases, respectively.

The patient's status with regard to urinary catheterization at onset of bacteremia was recorded in 162 episodes; 16% of patients had no catheter, 46% had an indwelling (Foley) catheter, 5% had a suprapubic catheter, and 33% had an external catheter (table 6). Bacteremia in patients with indwelling catheters, suprapubic catheters, and external catheters was more likely to have a urinary source than that in patients with no catheter. There were no significant associations between underlying illness and catheterization status. However, functional status was significantly different among the groups: 55% of patients with indwelling catheters, 42% of those with external catheters, and 16% of those with no catheter were completely bedridden ($P = .002$, χ^2).

Bacteremic pneumonia. *Streptococcus pneumoniae* and *S. aureus* were the two most common isolates from cases of bacteremic pneumonia and were associated with mortality figures of 43% and 67%, respectively (table 7). The annual rate of pneumococcal bacteremia for the period studied was 4 cases/1,000 total population. None of the patients with pneumococcal sepsis had received pneumococcal polysaccharide vaccine.

Skin and soft tissue infections. *S. aureus* and anaerobes were the predominant pathogens in bacteremia originating in infections of the skin and soft tissue (table 8). Thirty-six percent of these cases were due to infected decubiti. Mortality was 14% overall.

Other sites. Fifteen cases of bacteremia were from other sources. Nine (with three deaths) were from intraabdominal foci, and four (with one death) were secondary to infected intravenous catheters.

Source unknown. In 26 cases no source of the bacteremia was clinically apparent. A wide variety of organisms was isolated, with *S. aureus* found most frequently (in seven cases, including two of polymicrobial bacteremia). Overall mortality was 23%—a rate similar to that for the group of patients as a whole.

Outcome. Twenty-one percent of patients died within 2 weeks of the documentation of bacteremia. Forty-one percent of these deaths occurred within 24 hours after collection of the blood sample that ultimately proved culture-positive. The median interval to death from blood culture was 2 days, and the mean interval was 3.7 days. Mortality was not corre-

Table 4. Mortality from nursing home–acquired bacteremia, by site of primary infection.

Site	No. of deaths/no. of patients (% dying)
Urinary tract	14/90 (16)
Respiratory tract	9/18 (50)*
Skin/soft tissue	2/14 (14)
Other	4/15 (27)
Unknown	6/26 (23)
Total	35/163 (21.5)

* $P = .024$ (χ^2) vs. mortality from bacteremia of other sources.

Table 5. Microbial etiology of bacteremia originating in infections of the urinary tract.

Etiology	No. of cases (% of total)	No. of deaths (% of cases)
Polymicrobial*	24 (27)	7 (29)
Providencia stuartii	17 (19)	1 (6)
Escherichia coli	16 (18)	1 (6)
Proteus species	15 (17)	3 (20)
Klebsiella pneumoniae	7 (8)	1 (14)
Pseudomonas aeruginosa	4 (6)	0 (. . .)
Staphylococcus aureus	4 (4)	0 (. . .)
Enterococcus species	2 (2)	1 (50)
Xanthomonas maltophilia	1 (1)	0 (. . .)
Total	90 (100)	14 (15.6)

* Organisms included *P. stuartii* (8), *Enterococcus* species (10), *P. aeruginosa* (4), *S. aureus* (5), *Streptococcus agalactiae* (4), and *Morganella morganii* (4). Organisms isolated in fewer than four polymicrobial cases included *K. pneumonia*, *Proteus mirabilis*, coagulase-negative staphylococci, *E. coli*, *Serratia marcescens*, and *Providencia rettgeri*.

Table 6. Relation of catheterization status to source of bacteremia.

Status*	No. of cases	No. (%) of cases with urinary source	Relative risk (95% confidence interval)
Indwelling	75	54 (72)	3.1 (1.5, 6.4)
External	53	24 (45)	2.0 (0.9, 4.2)
Suprapubic	8	6 (75)	3.2 (1.4, 7.3)
None	26	6 (23)	. . .

* Catheterization status was not recorded in one episode of bacteremia.

Table 8. Microbial etiology of bacteremia originating in infections of the skin and soft tissue.

Etiology	No. of cases (% of total)	No. of deaths (% of cases)
Anaerobic bacteria	5 (36)	0 (. . .)
Staphylocccus aureus	4 (29)	1 (25)
Mixed aerobes/anaerobes	3 (21)	1 (33)
Group A *Streptococcus*	1 (7)	0 (. . .)
Coagulase-negataive *Staphylococcus*	1 (7)	0 (. . .)
Total	14 (100)	2 (14)

lated with underlying medical diagnoses but was higher among patients with several markers for increased severity of illness than among those without such markers. In addition to the previously noted association with pneumonia as the source of bacteremia, mortality was significantly associated with acute change in mental status: 13 (36%) of 36 of patients with changes in mentation vs. only 15 (13%) of 118 without such changes died ($P = .001$). Mortality was higher among residents of intermediate-care units (28 of 97, or 29%) than among residents of nursing-home-care units (7 of 66, or 11%; $P = .005$). The mean age of patients who died, 70.9 years, was similar to that of patients who survived, 68 years ($P = .146$). The median duration of institutionalization prior to the onset of bacteremia was significantly shorter for patients who died (117 days) than for those who survived (269.5 days; $P = .008$). Mortality was identical among patients with and without prior antibiotic treatment. Thirty-six percent of patients required transfer to an acute-care unit; such transfer did not correlate with mortality.

Discussion

Comparison with prior reports. Two previous analyses of bacteremia in long-term-care facilities have been published [13, 14]. Setia et al. [13] reported a retrospective analysis of 100 episodes of bacteremia in a private facility with a predominantly female population. Although the distribution of sources of primary infection was similar to that in our study, the majority of cases of bacteremia with a urinary source occurred in noncatheterized patients. Rudman and coworkers [14] reported a retrospective analysis of 42 episodes of bacteremia in a long-term Veterans Administration facility with a population of patients similar to that which we evaluated. Unlike Setia and colleagues, Rudman's group found that 40% of cases of gram-negative bacteremia were associated with urinary catheterization. Despite the differences between the populations studied by these two groups of investigators, the reported rates of bacteremia were identical—0.3 episodes/1,000 patient-days—as was the proportion of episodes with the urinary tract as the portal of entry—56%. Mortality was 35% in Setia's series and 21% in Rudman's series.

Table 7. Microbial etiology of bacteremic pneumonia.

Etiology	No. of cases (% of total)	No. of deaths (% of cases)
Streptococcus pneumoniae	7 (39)	3 (43)
Staphylococcus aureus	6 (33)	4 (67)
Gram-negative and mixed*	4 (22)	2 (50)
Haemophilus influenzae	1 (6)	0 (. . .)
Total	18 (100)	9 (50)

* *Pseudomonas aeruginosa, Proteus mirabilis, P. aeruginosa* plus *S. aureus*, and *Providencia stuartii* plus *P. mirabilis*.

Increase in the rate of bacteremia over time. Both the overall rate of infection and the rate of bacteremia increased over the course of our study. These increases were accompanied by increases in the rate of new admissions and in the rate of death in the population, with a relatively constant relation between admissions and deaths over time. Thus rates of patient turnover rose concomitantly with rates of infection. A possible explanation is that the severity of underlying illness of patients admitted to the facility increased over time, with a corresponding increase in the risk of infection. The observation that more recent admission was a significant risk factor for death from bacteremia indirectly supports this theory.

Although the decision to culture the blood was made by each individual physician, we believe that the increasing rate of bacteremia observed over the course of the study was not due merely to increases in the recognition of bacteremia and in the ordering of blood cultures in appropriate circumstances. The proportion of infections complicated by bacteremia (~6.5%) was relatively constant throughout the period studied, and the rates of bacteremia and of all infections rose in parallel. During this entire interval surveillance for infection was performed by the same nurse epidemiologist using the same methodology. The apparent rise in the overall infection rate is therefore likely to have been real, and it seems unlikely that the concomitant rise in the rate of bacteremia was spurious.

Infecting organisms. Overall, *S. aureus* was isolated more frequently from the blood than any other organism. *S. aureus* bacteremia was associated with primary infection at all major sites of such infection. One-third of the *S. aureus* isolates were resistant to methicillin. Recent reports have emphasized the importance of methicillin-resistant *S. aureus* as a pathogen in long-term-care facilities [15–18].

As a group, gram-negative bacilli were the most frequent isolates. We noted the predominance of *P. stuartii* among our blood culture isolates. Other researchers have reported an association between isolation of this organism from the urinary tract and chronic catheterization [19, 20]. During the period of the study, 195 urinary tract infections with *P. stuartii* were documented; the crude rate of *P. stuartii* bacteremia (12.5%) indicates the invasive potential of this organism. Infections with *P. stuartii* were distributed throughout the period studied, with no recognizable discrete outbreak.

Polymicrobial bacteremia was frequent, occurring in 22% of cases. The proportion of cases of bacteremia that are polymicrobial among patients on the medical services of acute-care hospitals ranges from 6% to 13% [21]. In the two prior reports from long-term-care facilities, the figures were 9% [13] and 15% [14], respectively. Two-thirds of the cases of polymicrobial bacteremia in our series originated in the urinary tract. Twenty-seven percent of cases of bacteremic urinary tract infection were polymicrobial; in contrast, previous studies have shown ≤5% of community-acquired cases of bacteremic urinary tract infection to be polymicrobial [22, 23]. Polymicrobial urosepsis is usually associated with catheterization, instrumentation, or significant anatomic abnormality of the urinary tract [21, 24]. The strong association between bacteremic urinary tract infection and the presence of an indwelling catheter in our patients was undoubtedly a major factor in the high incidence of polymicrobial bacteremia that we report. We also found enterococcal species in 39% of polymicrobial cases; frequent isolation of these species in conjunction with other organisms, particularly gram-negative rods and staphylococci, has been noted previously [21, 24].

The annual rate of bacteremic pneumococcal disease, 4 cases/1,000 population exceeds the overall rate of invasive pneumococcal disease among persons >60 years of age in the community [25, 26] by 20- to 25-fold. Receipt of pneumococcal polysaccharide vaccine was not documented for any patient with pneumococcal bacteremia.

Portal of entry. As in previous studies, we found the urinary tract to be the most frequent source of bacteremia. Moreover, the presence of an indwelling or suprapubic catheter was significantly associated with a urinary tract source. This observation supports the previous finding [14] that urinary catheterization was associated with a 39-fold increase in the incidence of bacteremia. The data do not permit us to postulate a direct cause-and-effect relation between urinary catheterization and bacteremia. We noted that cathet patients were significantly more likely to be totally b den than other patients. Rudman et al. [14] and Seti colleagues [13] reported nearly identical rates of bacte urinary tract infection; infected patients were predomin catheterized men in the former study and noncathete women in the latter. Thus the severity of underlying il may confound the relation between catheterization and teremia, since immobility is by itself a major risk facto nosocomial infection in long-term-care patients [1, 2].

Two gram-positive species, *S. pneumoniae* and *S. au* accounted for 72% of cases of pneumonia. It is not clear our findings are comparable to those of other studies of etiology of pneumonia in long-term-care facilities [27, 28 which *Klebsiella pneumoniae* and aspiration were the pred inant causes of pneumonia. These studies relied heavily sputum culture for etiologic diagnosis—a method consic ably less specific than blood culture. Confounding factors these investigations included an inability to obtain an ad quate sputum sample from the majority of patients w pneumonia and a high rate of prior antibiotic therapy. On t other hand, pneumococcal pneumonia is more likely to bacteremic at presentation than is pneumonia of other etiol gies [29]; thus the reliance on blood culture may have r sulted in underestimation of the overall contribution gram-negative rods and anaerobes to bacterial pneumonia i our population.

Implications of our data for the care of patients acquirin infection in long-term-care facilities. Although the popula tion of patients at a Veterans Affairs facility may be quite different from that at many other public and private long-term-care facilities, our findings may offer some tentative guidelines for the management of infections in this setting. It is reasonable to suggest that blood cultures should be done routinely before the institution of therapy for most bacterial infections acquired in long-term-care facilities. Failure to consider the possibility of sepsis in this situation may lead to errors in the selection of antimicrobial therapy. For example, a number of oral anti-infective agents appropriate for the treatment of nonbacteremic infections of the urinary tract, the respiratory tract, or soft tissues do not reach blood levels adequate for the treatment of systemic infection.

Furthermore, 9%–22% of cases of bacteremia in this setting are polymicrobial. Polymicrobial urosepsis, which is relatively rare in community-acquired infection, is frequent among patients with an indwelling catheter or an anatomic abnormality. *Enterococcus* is a frequent isolate in this situation; quinolones, trimethoprim-sulfamethoxazole, and cephalosporins—widely used in therapy for urinary tract infection—are not optimal for the treatment of infections caused by this organism.

We have also noted that methicillin-resistant strains of *S.*

aureus frequently cause bacteremia. These organisms are resistant to all other β-lactam agents as well; in our facility resistance to gentamicin, trimethoprim-sulfamethoxazole, and the quinolones is widespread.

We currently recommend the combination of vancomycin and an agent with broad activity against gram-negative bacilli, such as an expanded-spectrum cephalosporin, for the initial treatment of suspected septicemia in residents of our long-term-care facility before identification of the etiologic agent(s). This regimen is active against *S. aureus*, enterococci, streptococci, and a variety of gram-negative organisms. The choice of an initial regimen in a given facility should be based on knowledge of the incidence of methicillin-resistant *S. aureus* as well as of the usual susceptibilities of the indigenous gram-negative organisms, since carriage of multiresistant gram-negative bacilli is frequent among long-term-care patients [30–32]. The initial regimen can be modified on the basis of the results of cultures and susceptibility tests.

Although pneumococcal bacteremia accounted for only a small proportion of cases, the rate among our population of patients exceeded that reported among the noninstitutionalized elderly by >20-fold. Immunization of residents of long-term-care facilities with pneumococcal polysaccharide vaccine clearly deserves high priority.

Implications for resource allocation in long-term-care facilities. Other long-term-care facilities, especially those providing a relatively high level of skilled nursing care, may be experiencing a similar increase in rates of bacteremia and overall infection over time. Few skilled-nursing facilities have the kind of support in infection control, epidemiology, infectious disease, and clinical microbiology needed to conduct an in-depth study of nosocomial infection over a prolonged period. As patients are discharged earlier from acute-care hospitals, they are being admitted to skilled-nursing facilities with more functional disability, more skilled-care requirements, and more serious levels of illness [7, 33]. It is reasonable to postulate that this population of patients is more susceptible to nosocomial infection. In support of this idea, Shaughnessy and Kramer [7] reported a doubling in the prevalence of urinary tract infection in nursing homes with a high case load of Medicare patients between 1982 and 1986. If our experience is being repeated elsewhere, affected long-term-care facilities will need to increase the resources allocated to diagnosis, treatment, and control of nosocomial infections. Examples of necessary measures might include increasing the personnel time allotted to infection control, obtaining the support of a hospital epidemiologist, improving the expertise of the medical staff in the diagnosis and treatment of infectious diseases, expanding available microbiology services, and providing for the timely administration of parenteral antibiotics on site.

Acknowledgments

The authors thank Drs. Victor L. Yu and Michael J. Fine for review of the manuscript and Shirley Brinker for assistance in its preparation.

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