Health Care-associated Pneumonia: An Evidence-based Review

Russell T. Attridge, PharmD, MSc,a b c Christopher R. Frei, PharmD, MScb c
Feik School of Pharmacy, University of the Incarnate Word, San Antonio, Tex; College of Pharmacy, The University of Texas at Austin; Pharmacotherapy Education and Research Center, School of Medicine, The University of Texas Health Science Center at San Antonio.

ABSTRACT

Health care-associated pneumonia is a relatively new classification of pneumonia that includes community-dwelling pneumonia patients having contact with the health care system. Current data indicate that health care-associated pneumonia patients present with more severe disease, are more likely to be infected with drug-resistant pathogens, and suffer increased mortality compared with community-acquired pneumonia patients. Guidelines recommend that these patients receive empiric antibiotics similar to those recommended for nosocomial pneumonia; however, it is not currently known if outcomes are improved when health care-associated pneumonia patients are treated with these therapies. In addition, the individual health care-associated pneumonia risk factors are based on limited data and are a poor predictor of patients likely to be infected with drug-resistant pathogens. Many questions remain on how to most appropriately care for this growing group of pneumonia patients. This review is an evidence-based discussion of current health care-associated pneumonia data, the individual health care-associated pneumonia risk factors, and limitations and additional considerations for the health care-associated pneumonia classification system.

© 2011 Elsevier Inc. All rights reserved.

KEYWORDS: Guideline-concordant antibiotic therapy; Multidrug-resistant; Pneumonia

Pneumonia is a major cause of morbidity and mortality worldwide. Data from the US Centers for Disease Control and Prevention (CDC) indicate that pneumonia is the leading cause of infectious disease-related death in the US and is responsible for more than 1.2 million of the 35 million annual US hospitalizations.1 2

As health care expands and technology advances, many traditional inpatient services can be provided in nonhospital settings. Long-term care facilities, skilled nursing facilities, outpatient hemodialysis centers, and home health care represent current modalities for nonhospital care, and their use likely will only expand as the US elderly population continues to increase at a disproportionate rate to the rest of the population.3 5

An emphasis on outpatient management leads to an increase in the number of community patients with recent and sometimes routine exposure to the health care system. In pneumonia, the term “health care-associated pneumonia” classifies these patients and includes those with recent hospitalization, residence in a nursing home or extended care facility, home infusion therapy, chronic dialysis, or home wound care.6 Because health care-associated pneumonia is a relatively new entity, there are little data from which to provide evidence-based recommendations, and many questions remain on how to properly care for these patients.

Search Strategy

A query of the US National Library of Medicine’s MEDLINE database was used to identify original research articles related to health care-associated pneumonia. The medical
subject heading (MeSH) term “pneumonia” was combined with a combination of key words (“healthcare-associated” or “health care associated” or “health-care-associated” or “health-care associated”) to return a listing of 99 MEDLINE-indexed articles. Forty-three articles were directly relevant to health care-associated pneumonia, and 12 of these were original research articles. A review of each publication’s bibliography was performed to identify further pertinent articles.

HEALTH CARE-ASSOCIATED PNEUMONIA

EPIDEMIOLOGY

In community-acquired pneumonia, the majority of studies have documented that Streptococcus pneumoniae is the most common pathogen, followed by atypical pathogens and Haemophilus influenzae. In hospital-acquired and ventilator-associated pneumonia, concerns swell for resistant pathogens, particularly methicillin-resistant Staphylococcus aureus (MRSA) and Pseudomonas aeruginosa. Recent studies suggest that health care-associated pneumonia etiology may be more similar to hospital-acquired and ventilator-associated pneumonia, and this is reflected by the inclusion of health care-associated pneumonia in the 2005 nosocomial pneumonia guidelines.

Generating an accurate estimate of the number of patients with health care-associated pneumonia is a difficult task. Pneumonia is not a reportable disease in the US, and variability in health care-associated pneumonia inclusion criteria makes for a heterogeneous population. Current data indicate that health care-associated pneumonia encompasses 17% to 67% of pneumonia patients admitted from the community, thereby replacing a substantial portion of the traditional community-acquired pneumonia population.

Community-Acquired Pneumonia versus Health Care-Associated Pneumonia

In 2005, Kollef et al published the first study to delineate and analyze a cohort of culture-positive health care-associated pneumonia patients. The most common pathogens in all pneumonia cohorts (community-acquired, health care-associated, hospital-acquired, and ventilator-associated pneumonia) were S. aureus and P. aeruginosa. Mortality among health care-associated pneumonia patients was significantly greater than community-acquired pneumonia patients (19.8% vs 10.0%; P < .0001), and health care-associated pneumonia etiology more closely resembled hospital-acquired and ventilator-associated pneumonia than community-acquired pneumonia. The authors concluded that health care-associated pneumonia should be a separate category of pneumonia and that its microbial etiology necessitates empiric coverage for resistant organisms. A major limitation of this study is the high incidence of resistant organisms among community-acquired pneumonia patients (17.1% Pseudomonas, 8.9% MRSA). This challenges current beliefs regarding community-acquired pneumonia etiology and would effectively make current community-acquired pneumonia treatment recommendations irrelevant if it were widely true.

A 2007 prospective observational analysis of community-acquired and health care-associated pneumonia in Spain provides a different perspective. Pneumonia etiology was similar for the 2 cohorts, with S. pneumoniae the leading pathogen in both groups. Inappropriate antimicrobial therapy and 30-day mortality were more common in the health care-associated pneumonia group (5.6% vs 2% [P = .03]; 10.3% vs 4.3% [P = .007]); however, these results do not reflect the increased prevalence of resistant pathogens like some US health care-associated pneumonia research. Inappropriate antimicrobial therapy is defined, here and after, as an antimicrobial regimen without in vitro susceptibility toward isolated pathogens. Notably, this is the first health care-associated pneumonia cohort that included both culture-positive and culture-negative pneumonia patients.

Also in 2007, a US study published data comparing culture-positive community-acquired and health care-associated pneumonia patients. The leading pathogens in health care-associated pneumonia were S. aureus and Pseudomonas, while S. pneumoniae, Haemophilus species, and methicillin-sensitive S. aureus (MSSA) were most common in community-acquired pneumonia. Overall hospital mortality and inappropriate initial antimicrobial therapy were significantly higher in the health care-associated pneumonia population, and initial inappropriate antibiotic therapy was independently associated with hospital mortality (adjusted odds ratio [aOR], 2.19; 95% confidence interval [CI], 1.27 to 3.78). In 2008, a further analysis of this same health care-associated pneumonia cohort revealed that initial inappropriate antibiotic therapy remained an independent predictor of hospital mortality exclusively among health care-associated pneumonia patients (OR, 2.88; 95% CI, 1.46 to
Escalation of antibiotic therapy after 48 hours did not improve mortality in patients with initial inappropriate therapy.

In 2009, a multicenter, prospective observational study in Italy determined that health care-associated pneumonia patients presented with more severe disease, experienced higher mortality rates, and had longer hospital lengths of stay than community-acquired pneumonia patients (Figure 2). Later that year, a single-center retrospective observational study of culture-positive and culture-negative community-acquired and health care-associated pneumonia patients in Japan found *S. pneumoniae* to be the most common pathogen in both groups; however, health care-associated pneumonia patients had an increased incidence of pneumonia secondary to *Pseudomonas* and MRSA. Compared to community-acquired pneumonia, mortality was again higher in health care-associated pneumonia.

Most recently, Rello et al retrospectively analyzed community-acquired and health care-associated pneumonia patients with pneumococcal bacteremic pneumonia. Only one patient in each cohort received inappropriate antibiotic therapy; however, 30-day mortality rates remained significantly higher in health care-associated pneumonia patients (29.5% vs 7.6%; *P < .001*). These authors concluded that increased mortality in health care-associated pneumonia was independent of bacterial susceptibility and may be more attributable to age, comorbid conditions, and limitations on aggressive intervention.

### HEALTH CARE-ASSOCIATED PNEUMONIA

**EMPIRIC ANTIBIOTIC RECOMMENDATIONS**

If empiric antibiotic treatment is based on expected pathogens, the health care-associated pneumonia evidence leads to conflicting recommendations on optimal treatment. Current guidelines suggest that health care-associated pneumonia patients are at risk for resistant pathogens and should receive empiric therapy with 2 antipseudomonal agents and one MRSA-active agent (Table 2). This approach is necessary for some patients, but significant heterogeneity among health care-associated pneumonia patients makes a blanket approach to treatment problematic.

### Risk Factors for Multidrug Resistant Pathogens

Health care-associated pneumonia was created to delineate a group of patients more likely to be infected with resistant pathogens; however, criteria are overly broad. The diversity with which today’s community-dwelling pneumonia patients present necessitates that clinicians consider each patients’ individual risk factors. As defined in studies, health care-associated pneumonia commonly includes patients

<table>
<thead>
<tr>
<th>Health Care-Associated Pneumonia Risk Factor</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospital admission in past 30 days</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hospital admission in past 90 days</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hospital admission or pneumonia treatment in 90 days</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hospital admission/surgery in past 180 days</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hospital admission in past 12 months</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Admission from nursing home/extended care facility</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Transfer from other health facility</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Home infusion/intravenous therapy</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chronic dialysis</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Home wound care</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Family member with MDR pathogen</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Attended hospital or HD clinic past 30 days</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regular clinic visits (HD, PD, and infusions)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intravenous chemotherapy in past 30 days</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Immunocompromised state</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>


HD = hemodialysis; IV = intravenous; MDR = multidrug resistant; PD = peritoneal dialysis.

*Defined as daily administration of corticosteroids (at least 5 mg per day of prednisone or an equivalent drug), seropositivity for HIV, having received either a solid organ transplant or bone marrow transplant, treated with radiation therapy or chemotherapy for an underlying malignancy during the 6 months before hospital admission, and having an underlying acquired immune deficiency disorder (hypogammaglobulinemia, combined variable immunodeficiency).*

†Defined as an HIV/AIDS, cancer with chemotherapy, or the use of immunosuppressive drugs.

‡Defined as presence of neutropenia, concurrent use of an oral corticosteroid or other immunosuppressive agent (eg, cyclosporine), active chemotherapy for malignancy, or infection with HIV.

§Defined as HIV infection, neutropenia in the past 2 weeks, use of ≥20 mg of prednisone per day, or the use of other immunosuppressant drugs.
with recent hospitalization, admission from a nursing home, chronic hemodialysis, home healthcare, and immunosuppression. Each will be discussed in turn.

**Recent Hospitalization.** Recent hospitalization is the most common reason for classification as health care-associated pneumonia (Table 3). The definition of recent hospitalization varies by investigator but is most commonly defined as a hospital admission in the previous 90 days. Few studies are available to indicate that recent hospitalization is a risk factor for *Pseudomonas* and MRSA pneumonia among community-dwelling pneumonia patients; however, the large proportion of recently hospitalized patients in health care-associated pneumonia studies implies the importance of this risk factor. Specific knowledge of previous admissions including reason for admission, duration of hospitalization, and antibiotic exposure also should be used to assist in clinical decisions.

**Admission from a Nursing Home.** Patients admitted from nursing homes with pneumonia, termed nursing home-acquired pneumonia, have been heavily studied and may constitute up to 61% of health care-associated pneumonia patients. All studies of health care-associated pneumonia patients have included patients admitted from nursing homes and/or long-term care facilities; however, variations in level of care provided by individual facilities may result in fundamentally different patient populations.

In the outpatient setting, nursing home-acquired pneumonia is often treated at the nursing home with traditional community-acquired pneumonia therapy. Among hospitalized, non-intensive care nursing home-acquired pneumonia patients, pathogen distributions are similar to expected community-acquired pneumonia distributions.

However, in severe nursing home-acquired pneumonia, resistant pathogens emerge. A 2001 study of nursing home-acquired pneumonia patients admitted to the intensive care unit and mechanically-ventilated had higher rates of *S. aureus* than their community-acquired pneumonia counterparts (29.8% vs 7.0%). A subsequent 2004 study of long-term care patients with severe nursing home-acquired pneumonia found *S. pneumoniae* to be the most frequent pathogen (25.3%); however, MRSA (20.2%), *Pseudomonas* (9.1%), and other Gram-negative enteric bacteria were common.

Nursing home-acquired pneumonia patients also are the only health care-associated pneumonia subgroup where functional status has been consistently evaluated. Poor functional status has been linked to an increased risk of infection with a drug-resistant pathogen and increased mortality among nursing home-acquired pneumonia patients.

By itself, residence in a nursing home does not necessitate health care-associated pneumonia therapy. Based on the evidence, nursing home-acquired pneumonia patients with severe disease (admitted to an intensive care unit) and/or poor functional status are at the highest risk of resistant pathogens and poor outcomes and are the subset of nursing home-acquired pneumonia patients that may benefit the most from health care-associated pneumonia therapy.
Chronic Hemodialysis. In health care-associated pneumonia cohorts, dialysis patients comprised up to one-third of patients. Two large retrospective studies of Medicare data provide the limited evidence available for pneumonia etiology in these patients. In 2006, data from the US Renal Data System revealed that *S. pneumoniae* and *P. aeruginosa* were the most common pneumonia pathogens isolated in a cohort of more than 10,000 hospitalized dialysis patients. Less than 1% of infections were caused by *S. aureus*. In 2008, a subsequent analysis determined that the most common pathogens were, in descending order, *S. aureus*, *S. pneumoniae*, and *P. aeruginosa*. Results are conflicting, and neither of these studies was able to provide data on methicillin-resistance. *S. aureus*, including MRSA, is a major pathogen of concern in dialysis-associated infections overall; however, this has not been clearly established for pneumonia in dialysis patients. Dialysis seems to be included as a health care-associated pneumonia risk factor more by convention than evidence.

Home Health Care. Patients using home health care are the smallest cohort of health care-associated pneumonia patients. Most health care-associated pneumonia studies have not included these patients; however, of those that have, home health care patients comprised 2% to 14% of the health care-associated pneumonia population. There are...
no epidemiologic data specifically on pneumonia risk factors, pathogens, or outcomes in home health care patients alone. In 2006, a case control study comparing MSSA and MRSA infections isolated within the first 48 hours of hospital admission (27.3% respiratory infections) determined home nursing care to be an independent risk factor for isolation of MRSA.19 Because of its limited evidence, it does not seem appropriate to classify home health care as a health care-associated pneumonia risk factor at this time.

Immunosuppression. Immunosuppression is not listed in guidelines as a health care-associated pneumonia risk factor; however, multiple studies have included immunosuppression as health care-associated pneumonia criteria.10,12,14 Within these studies, immunosuppression referred to a diverse group of patients including, but not limited to, patients with bone marrow or solid organ transplants, those found to be infected with HIV, patients recently receiving treatment for malignancy, and the use of certain immunosuppressive medications.

The two largest groups under this category, cancer patients and HIV-positive patients, both have pneumonia recommendations from specialty-specific guidelines.29,30 There are no data regarding either non-neutropenic cancer patients or those receiving chemotherapy with pneumonia; however, when a patient presents with suspected pneumonia and febrile neutropenia, Pseudomonas coverage is indicated.29 In HIV-infected patients, the most common pathogens are S. pneumoniae and H. influenzae, but Pseudomonas and S. aureus may be prominent in patients with advanced disease.30 Current HIV guidelines are similar to current community-acquired pneumonia guidelines and do not recommend treatment for resistant organisms without specific risk factors.7,30 As defined in health care-associated pneumonia studies, immunosuppression encompasses a wide range of patients with varying risk at different stages of disease processes. These populations should not be included as health care-associated pneumonia patients, but disease-specific characteristics (febrile neutropenia in cancer, CD4 count in HIV) should be considered when making treatment decisions.

### Drug-Resistant Pneumonia

Because of the limited evidence among individual health care-associated pneumonia risk factors, delineating independent risk factors for pathogens that require coverage beyond that recommended for community-acquired pneumonia may prove useful. In 2008, Shorr et al12 published a retrospective cohort study to determine risk factors predictive of pneumonia related to drug-resistant pathogens (defined as MRSA, extended-spectrum beta-lactamase [ESBL]-producing Klebsiella species, and other nonfermenting Gram-negative rods). In a combined cohort of community-acquired and health care-associated pneumonia patients, all health care-associated pneumonia risk factors

---

**Table 2** Empiric Inpatient Guideline-Concordant Antibiotic Recommendations for Community-Acquired Pneumonia and Health Care-associated Pneumonia

<table>
<thead>
<tr>
<th>Community-Acquired Pneumonia</th>
<th>Health Care-associated Pneumonia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-ICU</td>
<td>Non-ICU and ICU</td>
</tr>
<tr>
<td>β-lactam plus macrolide†</td>
<td>Antibacterial and β-lactam† plus</td>
</tr>
<tr>
<td>Respiratory fluoroquinolone</td>
<td>Vancomycin or linezolid</td>
</tr>
<tr>
<td>ICU</td>
<td>Antibacterial, β-lactam† plus</td>
</tr>
<tr>
<td>azithromycin or fluoroquinolone</td>
<td>Aminoglycoside plus</td>
</tr>
<tr>
<td></td>
<td>Vancomycin or linezolid</td>
</tr>
</tbody>
</table>

†Doxycycline may be substituted for macrolide.
†In penicillin allergic patients, aztreonam may be substituted for β-lactam.

---

**Table 3** Prevalence of Health Care-Associated Pneumonia Risk Factors Among Health Care-Associated Pneumonia Patients, By Publication

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Recent hospitalization, %</td>
<td>*</td>
<td>43.7</td>
<td>68.9</td>
<td>—</td>
<td>39.0</td>
<td>56.8</td>
<td>23.8</td>
</tr>
<tr>
<td>Within 90 days</td>
<td></td>
<td>43.7</td>
<td>68.9</td>
<td>—</td>
<td>39.0</td>
<td>56.8</td>
<td>23.8</td>
</tr>
<tr>
<td>Within 180 days</td>
<td></td>
<td>—</td>
<td>89.1</td>
<td>80.0</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Within 365 days</td>
<td></td>
<td>—</td>
<td>93.3</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Nursing home/LTCF, %</td>
<td>49.6</td>
<td>25.4</td>
<td>28.1</td>
<td>10.0</td>
<td>61.0</td>
<td>38.5</td>
<td>29.9</td>
</tr>
<tr>
<td>Chronic hemodialysis, %</td>
<td>*</td>
<td>31.7</td>
<td>10.0</td>
<td>3.3</td>
<td>7.1</td>
<td>2.3</td>
<td>4.9</td>
</tr>
<tr>
<td>Home health care/recent IV therapy, %</td>
<td>14.3</td>
<td>†</td>
<td>6.7</td>
<td>2.1</td>
<td>18.2</td>
<td>†</td>
<td>†</td>
</tr>
<tr>
<td>Immunosuppression, %</td>
<td>†</td>
<td>†</td>
<td>39.2</td>
<td>†</td>
<td>†</td>
<td>†</td>
<td>57.9</td>
</tr>
</tbody>
</table>

IV = intravenous; LTCF = long-term care facility.
*Data not provided in the study.
†Cohort not included in the study population.
were significantly more prevalent in the cohort with resistant infections; however, 51.4% of patients with infections caused by nonresistant pathogens (most commonly S. pneumoniae) had at least one health care-associated pneumonia risk factor. Previous hospitalization, residence in a nursing home, long-term hemodialysis, and intensive care unit admission were independently associated with resistant infections (ORs 4.21, 2.75, 2.11, and 1.62, respectively; all \( P < .05 \)). In 2009, Shindo et al\(^\text{17}\) determined that the use of broad-spectrum antibiotics in the past 90 days and tube feeding were independent risk factors for drug-resistant pathogens among health care-associated pneumonia patients (ORs 3.1 and 2.5, both \( P < .05 \)); however, use of any antibiotic, chronic lung disease, probable aspiration, poor functional status, and immunosuppression were not independent risk factors.\(^\text{17}\)

When the presence of health care-associated pneumonia criteria are considered as a diagnostic test, the positive predictive value for resistant infections in the Shorr et al\(^\text{12}\) study was only 58.2%. Sensitivity, specificity, and negative predictive value were 86.9%, 48.6%, and 81.7%, respectively.\(^\text{12}\) A 2010 study by Schreiber et al\(^\text{31}\) encountered similar results, showing that health care-associated pneumonia as a tool for predicting resistant infections had a sensitivity and specificity of 78.3% and 56.2%, and positive and negative predictive values of 45.2% and 84.9%.\(^\text{31}\) These results emphasize the lackluster ability of health care-associated pneumonia criteria to predict patients who will have pneumonias caused by drug-resistant pathogens and indicate that a greater understanding of risk factors for specific pathogens may be more clinically relevant than the health care-associated pneumonia classification system.

Clinically, there is justified debate over the utility of the health care-associated pneumonia criteria. A survey of physicians responsible for choosing initial antibiotic therapy reports that 79% of participants agree with and practice according to published health care-associated pneumonia guidelines, yet guideline-concordant health care-associated pneumonia therapy was selected in only 9% of health care facilities, the evidence for each of the individual health care-associated pneumonia risk factors is incomplete and may factor into clinical decisions, because health care-associated pneumonia research has first, the presence of regional studies makes it difficult to extrapolate results, and the inclusion of only culture-positive patients in many studies may introduce a selection bias.\(^\text{38}\) Geographic variation in bacterial etiology and non-hospital care exists and may factor into clinical decisions, because health care-associated pneumonia research has been conducted throughout the world with inconsistent results.\(^\text{9,11,13,14,17}\) Most importantly, all studies show increased mortality among health care-associated pneumonia patients. However, there are limitations to current health care-associated pneumonia evidence.

**Summary of Health Care-associated Pneumonia**

Studies that have compared health care-associated to community-acquired pneumonia have consistently identified health care-associated pneumonia to include older patients with more severe disease and at an increased risk of pneumonia caused by drug-resistant pathogens.\(^\text{9,11,13,14,17}\) Most importantly, all studies show increased mortality among health care-associated pneumonia patients. However, there are limitations to current health care-associated pneumonia evidence.

First, evidence published since the guidelines reveals that health care-associated pneumonia criteria are a poor predictor of patients with drug-resistant pneumonia patients.\(^\text{12,31}\) Extraneous administration of broad spectrum an-
tibiotics leads to increased adverse events, increased costs, and increased bacterial resistance.

Finally, there are no definitive data to support that health care-associated pneumonia guideline-concordant antibiotic therapy will improve outcomes in health care-associated pneumonia patients over traditional community-acquired pneumonia guideline-concordant therapy.

CONCLUSION
This evidence-based review demonstrates the complexity of health care-associated pneumonia. Current evidence supporting the guidelines is strongest for nursing home patients with severe disease and/or poor functional status. Recent hospitalization also is an important risk factor, because this is the largest group of patients in the health care-associated pneumonia studies that show increased resistant pathogens and poor outcomes. For patients on chronic hemodialysis or receiving home health care, clinicians must use sound clinical judgment in determining initial antibiotic therapy. Evaluating additional factors, such as functional status and recent antibiotic exposure, also may be necessary. For all health care-associated pneumonia patients in an intensive care unit setting, initial broad-spectrum therapy seems indicated because of the increased risk of mortality and frailty among this group. Currently, health care-associated pneumonia recommendations are more of a concern in non-intensive care unit settings, where the risks of broad-spectrum therapy may outweigh benefits and contribute to increased lengths of stay and the risk of additional nosocomial infections.

ACKNOWLEDGMENT
We would like to thank Kyllie Ryan-Hummel for her assistance in editing the final draft of the manuscript.

References


