Seasonal Trends in Hospitalized Patients with Pneumonia

by Anne Mahoney, BA, and Ronald E. Polk, PharmD

According to data from the National Center for Health Statistics from the year 2000, pneumonia and influenza combined represented the sixth leading cause of death in the U.S. It has been estimated that more than 1.3 million patients were discharged from the hospital after having pneumonia. MediMedia’s Hospital Diagnosis and Therapy Audit (HDTA), reporting similar numbers, also showed that the highest number of pneumonia patients treated each season consistently peaked during the first quarter of the year, followed by the fourth, second, and third quarters, respectively (Figure 1).

Because the development of pneumonia often follows ordinary respiratory infections and influenza, these findings support those from the National Immunization Program of the Centers for Disease Control and Prevention (CDC), which state that the flu season in the U.S. can range from November through March and even past March in some years.

Community-acquired pneumonia (CAP) develops outside the hospital setting; nosocomial or hospital-acquired pneumonia (HAP) develops 72 hours or more after hospital admission. The data in this article represent patients with a combination of both CAP and HAP. International Classification of Disease (ICD-9) pneumonia codes 481 to 486 were used to select the patients. These codes define bacterial pneumonia and exclude diagnoses of viral pneumonia.

Only the sickest patients are admitted for CAP on the basis of age and comorbidities. These patients are usually treated for pneumonia with a combination of ceftriaxone sodium (Rocephin®, Roche) and a macrolide, such as azithromycin (Zithromax®, Pfizer) or erythromycin, or with a fluoroquinolone. These drugs cover the most common bacteria, including Streptococcus pneumoniae. Intravenous azithromycin is usually given in combination with ceftriaxone (46% vs. 41% alone). Ceftriaxone is the most widely used cephalosporin, and its popularity has been rising steadily since 1999. It is given alone 64% of the time. Levofoxacin (Levaquin™, Ortho-McNeil), the top quinolone, is administered alone more than 80% of the time. These agents were selected because they are effective against most of the bacteria that cause CAP. The top three agents in each of these classes also have once-a-day dosing, which might be another factor in their favorable status on hospital formularies.

In contrast, HAP is usually treated with more aggressive therapies directed toward gram-negative infections, such as Pseudomonas aeruginosa and some gram-positive pathogens, such as methicillin-resistant Staphylococcus aureus (MRSA). These treatments vary according to the specific organism identified within the institution. Patients with gram-negative infections generally need broad-spectrum drugs such as piperacillin/tazobactam (Zosyn®, Lederle), imipenem/cilastatin sodium (Primaxin®, Merck), and aminoglycosides. Patients with gram-positive organisms are often treated with vancomycin HCl (e.g., Vancocin® HCl, Eli Lilly).

Cephalosporins have been the most frequently prescribed class of antimicrobials for treating hospitalized patients with pneumonia.

Ms. Mahoney is a Senior Data Analyst for the Hospital Diagnosis and Therapy Audit at MediMedia USA, Inc., in Yardley, Pennsylvania. Dr. Polk is Professor of Pharmacy and Medicine and Vice Chair for Research and Graduate Studies at the Virginia Commonwealth University’s School of Pharmacy in Richmond, Virginia.
pneumonia since 1995; however, their usage peaked at 80% in 1997 and decreased to 59% in 2002 (Figure 2).

The use of cephalosporins for pneumonia patients has been eroded dramatically by the quinolone class, which includes levofloxacin, gatifloxacin (Tequin®, Bristol-Myers Squibb), ciprofloxacin HCl (Cipro®, Bayer), and moxifloxacin (Avelox®, Bayer). Among patients with a diagnosis of pneumonia, fluoroquinolone usage grew from 16% in 1995 to 54% in 2002. The newer macrolide antibiotics, such as azithromycin and clarithromycin, have more than doubled their presence in this market since their inception in the early 1990s.

Some interesting seasonal trends have emerged from analyses of the HDTA data by quarter. Even though the summer months (the third quarter) were associated with the smallest number of pneumonia patients, patients who were hospitalized in the summer had the longest length of stay of any quarter each year (at least 10 days) for the past eight years; patients treated in the busiest months (the first quarter) were able to experience a reduced length of stay by more than one day between 1995 and 2002 (Table 1).

The demographic profile of pneumonia patients hospitalized in the summer also differs from the profile of patients in the first quarter. There are considerably fewer hospitalized pediatric patients in the third quarter than in the first quarter, and more hospitalized patients are between ages 18 and 59.

More men than women acquire pneumonia in the summer, and the percentage of surgical patients is higher in the third quarter than in any other quarter. This is important to note because some of the risk factors for nosocomial pneumonia include:

- severe underlying conditions (including immunosuppression), which would cause a longer hospital stay.
- a higher incidence in males than in females.
- surgical procedures.

Patients who undergo surgery of the head, neck, thorax, or abdomen are at high risk for developing postoperative pulmonary complications, including pneumonia. In addition, the mortality rate for a diagnosis of pneumonia is higher in the summer (10.5%) than in the first quarter (9.4%) and patients are least likely to be discharged home (52.6% in the third quarter vs. 57.5% in the first quarter). All of these factors—mortality rate, length of stay, and discharge status—indicate that the severity of pneumonia is higher in the third quarter. The types of pneumonia infections treated bear this out.

The percentage of patients who have pseudomonal pneumonia is greater during the third quarter (4.3%) than at any other time of the year (3.2%). Pseudomonal infections are considered to be nosocomial; patients were hospitalized for other existing conditions and then became infected, which probably contributed to their longer hospital stays. Although the actual number of patients with these pseudomonal infections has remained relatively stable, it is the ratio of HAP patients to CAP patients that is driving up the length of stay and mortality rates.

Most cases of pneumonia (more than 80%) are assigned

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<th>3rd Quarter</th>
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an ICD-9 code of 486—Pneumonia, Organism Not Otherwise Specified. This code indicates either that the patient was treated empirically or that results were indeterminate if culture specimens were taken. Other commonly coded organisms causing pneumonia are *S. areus* and pneumococcus.

Drug analyses show that treatment patterns varied during the third quarter each year as well. The percentage of patients treated with cephalosporins and the newer macrolides has decreased from the first quarter to the third quarter almost every year, whereas the use of quinolones, broad-spectrum to medium-spectrum antibiotics, beta-lactamase inhibitors, and aminoglycosides has increased. This makes sense because many cephalosporins and macrolides do not have the spectrum needed to cover these specific organisms (Figure 3).

We had thought that there might be a correlation between patients’ source of admission (e.g., from the emergency department or a nursing home) and the type of pneumonia or their lengths of stay. Patients from nursing homes often present with aggressive strains of infections, but the HDTA data showed no association between admissions from other facilities and the presence of nosocomial infections.

**SUMMARY**

Data from MediMedia’s Hospital Diagnosis and Therapy Audit show definite seasonal trends in the incidence of pneumonia over the last eight years. The first and fourth quarters have been the more active months in terms of patient volume, and the third quarter has been associated with the more seriously ill patients.

The overall treatment patterns of prescribed antibiotics have also changed with the introduction of the fluoroquinolone class and the newer macrolide antibiotics, leading to the decreased use of cephalosporins to treat pneumonia. The move away from certain cephalosporins may be attributed to the ease of once-a-day dosing, which would help explain the increased popularity of ceftriaxone sodium; the move away from ciprofloxacin toward levofloxacin is probably the result of better activity for *S. pneumoniae*.

Patients who are hospitalized in the third quarter of the year for pneumonia experience a higher mortality rate, a lengthier hospital stay, and a greater variety of drugs used to combat the illness than do first-quarter patients because of the increased number of nosocomial infections. Although the percentage of nosocomial infections is higher during the summer months, the resulting mortality rates and increased lengths of stay have been largely a result of the ratio of HAP patients to CAP patients.

**REFERENCES**