

# Direct Medical Costs and Utilization of Health Care Services to Treat Pneumonia in the United States: An Analysis of the 2007–2011 Medical Expenditure Panel Survey

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## ABSTRACT

**Purpose:** This study aimed to assess how pneumonia incidence, health care resource utilization, costs, and hospital length of stay differ by age category in the United States.

**Methods:** A retrospective cross-sectional analysis of the Medical Expenditure Panel Survey database was conducted from 2007 to 2011 for patients with pneumonia. Study outcomes were pneumonia incidence, annual health care utilization, and expenditures across 5 age groups. Early trends of outcomes in the period after introduction of the 13-valent pneumococcal conjugate vaccine (PCV13) (2011) were compared with the pre-PCV13 period (2007–2009).

**Findings:** Pneumonia incidence rates for the 1790 patients ranged from 9.2 to 33.0 per 1000 patients. Patients <5 years old had the highest incidence rate at 33.0 per 1000 patients, followed by patients ≥65 years old (27.2 per 1000 patients) and patients ≥45 to <65 years old (14.4 per 1000 patients). The percentages of patients with pneumonia-related hospitalization were 26%, 7%, 15%, 24%, and 46%, respectively ( $P < 0.0001$ ). Mean (SD) days in hospital stay were 1.73 (0.08), 0.31 (0.50), 0.58 (0.10), 1.86 (0.29), and 3.05 (0.33), respectively ( $P < 0.05$ ), for patients <5, ≥5 to <18, ≥18 to <45, ≥45 to <65, and ≥65 years old. Mean total pneumonia-related medical costs in patients aged <5 years (\$3376;  $P = 0.009$ ), ≥45 to ≤65 years (\$4726;  $P < 0.0001$ ), and >65 years (\$7206;  $P < 0.0001$ ) were significantly higher compared with patients ≥5 to <18 years old (\$1175) after controlling for covariates. Compared with the pre-PCV13 period (2007–2009;  $n = 1075$ ), a 16% decrease in incidence, a 27% decrease length of stay in hospital, and a 22% decrease in medical costs were observed in the post-PCV13 period (2011;  $n = 382$ ), although these differences were not statistically significant ( $P > 0.05$ ).

**Implications:** Pneumonia remains a disease with significant burden in the United States, and clinical and economic outcomes varied widely by age. Hospitalization for pneumonia has a considerable effect on economic burden, particularly for the very young (<5 years old), middle-aged (≥45 to <65 years old), and elderly (≥65 years old) populations. A trend toward reductions in pneumonia incidence and associated medical costs was observed after the PCV13 was introduced, although these findings were not statistically significant. (*Clin Ther.* 2015;37:1466–1476) © 2015 Elsevier HS Journals, Inc. All rights reserved.

**Key words:** health care costs, health care utilization, incidence, pneumonia, vaccine.

## INTRODUCTION

Pneumonia causes substantial morbidity, mortality, and economic burden worldwide. In the United States, pneumonia occurs in 30 to 45 of every 1000 children <5 years of age.<sup>1</sup> In individuals ≥65 years old, approximately 1 million cases of community-acquired pneumonia have been reported to occur annually, with 40% resulting in hospital admission.<sup>2</sup> In 2011, pneumonia and influenza combined were the eighth leading cause of deaths across all age groups.<sup>3</sup>

In February 2010, the 13-valent pneumococcal conjugate vaccine (PCV13) was approved by the Food and Drug Administration (FDA) to replace the 7-valent pneumococcal conjugate vaccine (PCV7), which had been used since 2000. PCV13 is recommended for children <5 years old, in adults who are ≥65

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years old, and those >6 years with certain medical conditions.<sup>4,5</sup> PCV13 was later approved in 2011 by the FDA for use among adults aged  $\geq 50$  years. Although the use of PCV7 has been associated with a significant decrease in pneumonia-related health care use and expenditure in children <5 years old,<sup>6,7</sup> an estimated 4 million cases of pneumonia are still reported yearly, resulting in significant health care resource spending and lost productivity.<sup>8</sup> More than 10 million physician visits, 600,000 hospitalizations, and 64 million days of restricted activity have been attributed to community-acquired pneumonia.<sup>9</sup> In addition, it has been reported that approximately \$10 billion is spent yearly on the treatment of patients with community-acquired pneumonia, with 92% of this costs due to hospitalizations.<sup>10</sup> Moreover, the Centers for Disease Control and Prevention reported that there were 1.1 million pneumonia-related hospital discharges in 2010, with a mean of 5.2 days spent in the hospital, and the pneumonia-related mortality rate was 16.8 per 100,000 people.<sup>11</sup>

Several studies have assessed the burden of pneumonia in the United States, but these studies have included only hospitalized patients,<sup>7,12</sup> very young children,<sup>13,14</sup> and/or seniors in particular before PCV13 was introduced in 2010.<sup>2</sup> An up-to-date and comprehensive picture of the clinical and economic burden of pneumonia in the United States is yet to be provided. To better assess the current burden of pneumonia (incidence, direct medical costs, and health care utilization) in the general US population by age groups and to identify risk factors for this disease, we conducted a retrospective cross-sectional analysis using a nationally representative data during a 5-year period.

The objectives of the present study were (1) to assess incidence, health care utilization, and costs of the treatment of pneumonia by age groups in the United States from 2007 to 2011, (2) to determine what factors are related to pneumonia-related direct medical health care costs and length of stay (LOS) in the hospital, and (3) to examine whether incidence, LOS, and health care costs changed between the period before and after the PCV13 was introduced in February 2010.

## PATIENTS AND METHODS

### Data Source and Study Population

A retrospective cross-sectional analysis of the Medical Expenditure Panel Survey (MEPS) database was

conducted between 2007 and 2011. The MEPS database is a nationally representative survey of the non-institutionalized civilian US population. Administered by the Agency for Healthcare Research and Quality, the survey collects comprehensive data on health care service utilization by respondents. For this analysis, we used the Household Component file of the MEPS data from panels 11 to 16 (most recent data available at the time of the study). This is the core component of the survey that collects data on demographic characteristics, health expenditures, medical conditions, health status, utilization of medical services, access to care, health insurance coverage, and income for each respondent. We included patients who had at least 1 diagnosis for pneumonia using a Clinical Classification Code (CCC) of 122 and at least 1 event associated with pneumonia between 2007 and 2011. An event associated with pneumonia refers to ambulatory care visit (outpatient and office-based visits), inpatient hospitalization, home health visit, emergency department (ED) visit, and/or prescribed medicines associated with pneumonia, such as antibiotics, glucocorticoids, and bronchodilators.

### Study Outcomes

The outcomes in this study include pneumonia incidence and pneumonia-related health care utilization and expenditures. Study outcomes were assessed across 5 age groups: (1) <5 years, (2)  $\leq 5$  to <18 years, (3)  $\geq 18$  to <45 years, (4)  $\geq 45$  to <65 years, and (5)  $\geq 65$  years. Incidence was defined as the number of patients diagnosed as having pneumonia who had at least one pneumonia-related event divided by the number of the entire MEPS population within the study period (2007–2011). Health care utilization was measured as the percentage of patients who used any medical service and the mean numbers of visits made within a year in the study period. Medical services consisted of ambulatory care, ED, home health care visits, inpatient hospitalizations, and prescribed medicines. Costs measurement focused on annual direct expenditures for pneumonia from all payer groups. Health care costs per person per year (PPPY) were pooled across 5 years (2007–2011), and all costs were adjusted for inflation to 2011 US dollars. To examine changes in incidence, LOS, and health care costs after the introduction of PCV13 in 2010, we compared outcomes between 2007 to 2009 and 2011. The year of PCV13 introduction (2010)

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