ORIGINAL RESEARCH

The Incidence Rate and Economic Burden of Community-Acquired Pneumonia in a Working-Age Population

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Background: Community-acquired pneumonia (CAP) is frequently associated with the very young and the elderly but is a largely underrecognized burden among working-age adults. Although the burden of CAP among the elderly has been established, there are limited data on the economic burden of CAP in the employed population.

Objective: To assess the economic impact of CAP in US working-age adults from an employer perspective by estimating the incidence rate and costs of healthcare, sick time, and short-term disability for this patient population.

Methods: This retrospective cohort study is based on data from 2 Truven Health Analytics databases. The study population consisted of commercially insured active employees aged 18 to 64 years, early retirees aged <65 years, and adult dependents of both cohorts. CAP was identified using medical claims with pneumonia diagnosis codes during the 2009 calendar year. Incidence rate, episode level, and annual costs were stratified by age and by risk based on the presence of comorbidities. Descriptive statistics were used to compare healthcare (ie, medical and pharmacy) costs, sick time, and short-term disability costs between the cohorts with and without CAP. Linear regression was used to estimate the average annual incremental healthcare cost in employed patients with inpatient or outpatient CAP versus individuals without CAP.

Results: Study eligibility was met by 12,502,017 employed individuals, including 123,920 with CAP and 12,378,097 without CAP; the overall incidence rate of CAP was 10.6 per 1000 person-years. Among individuals with and without CAP, the costs of healthcare, sick time, and short-term disability increased with advancing age and with higher risk status. The mean annual healthcare costs were $20,961 for patients with CAP and $3783 for individuals without CAP. Overall, the mean costs of sick time and short-term disability were $1129 and $1016, respectively, in active employees with CAP, and $853 and $322, respectively, in their counterparts without CAP. Compared with individuals without CAP, the average annual incremental healthcare cost ranged from $39,889 to $113,837 for inpatient management of patients with CAP and from $4170 to $31,524 for outpatient management of patients with CAP, depending on the risk level.

Conclusions: CAP is a common and costly infection among working-age individuals, especially in patients with comorbidities. Prevention strategies, such as influenza and pneumococcal vaccination, that target working-age adults with underlying medical conditions may be the most valuable in reducing the morbidity and costs associated with CAP.

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Community-acquired pneumonia (CAP) is most often defined as a lower respiratory tract infection characterized by cough, fever, chills, fatigue, dyspnea, rigors, and pleuritic chest pain—with or without new infiltrate on chest radiography—acquired outside of a hospital or long-term care setting.[1,2] Despite progress in the prevention and diagnosis of CAP, the development and use of antibiotic therapies, and in intensive care

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management, CAP remains a leading cause of morbidity, mortality, and economic burden worldwide.[2-8] In the United States, CAP affects approximately 5.6 million patients annually, and is the sixth leading cause of death in people aged ≥65 years.[3,9] Notably, in 2011, influenza and pneumonia were the eighth leading cause of US deaths across all age-groups.[10]

Pneumonia, which is widely recognized as a disease of the elderly (age ≥65 years) and the very young (age <5 years), is also common in nonelderly adults.[5] According to data from the 2010 National Hospital Discharge Survey, 257,000 adults aged 45 to 64 years and 621,000 adults aged ≥65 years had pneumonia as their primary diagnosis at hospital discharge.[11] Although the number of pneumonia hospitalizations was more than twice greater in elderly adults than in nonelderly adults, the mean lengths of hospital stay—5.6 and 5.5 days, respectively—were remarkably similar.[11] Unlike in elderly adults, however, the presence of pneumonia in younger individuals (ages 18-64 years) who are still actively employed has an impact on employers—most notably, lost productivity costs associated with workplace sick time and short-term disability.[12-16]

Several studies have evaluated the economic burden of CAP on elderly populations,[17-19] but data are scarce on the working-age population.[12,13] Three studies conducted in the late 1990s examined the direct and indirect costs of pneumonia from an employer perspective; however, the findings had several limitations, including the use of a single large national employer.[13-15] Two recent studies complement the findings of our study and are of particular interest.[12,16] Both studies show that CAP is a common and costly infection in the working-age population, especially in adults with comorbidities, with estimated national direct and indirect costs of $8.5 billion and $2.1 billion, respectively.[12,16] Despite the data, CAP remains an underrecognized burden among employers, payers, healthcare providers, and the nonelderly adult population.

The purpose of the current study was to assess the direct and indirect economic impacts of CAP in working-age adults by estimating the incidence rates and the associated healthcare, sick time, and short-term disability costs in the United States from an employer perspective of active employees aged 18 to 64 years, early retirees aged <65 years, and adult dependents in both cohorts.

KEY POINTS

- Community-acquired pneumonia (CAP) is traditionally considered a disease of the elderly and is underrecognized among working-age adults.
- CAP remains a leading cause of morbidity and mortality, with a substantial economic burden.
- Using a large database, this new study shows that in 2009, the overall incidence of CAP in active employees was 10.6 per 1000 person-years and 6-fold greater in high-risk patients than in low-risk patients.
- Lost productivity costs associated with sick time and short-term disability of employees with CAP have a significant impact on US employers.
- During a 12-months period, the mean sick time cost was $1129 for an employee with CAP compared with $853 for an employee without CAP.
- Similarly, the mean short-term disability cost was $1016 for an employee with CAP compared with $322 for an employee without CAP.
- Implementing effective preventive services for working-age adults with underlying medical conditions may reduce morbidity and the associated costs.

Methods

This retrospective cohort study is based on data from the Truven Health Analytics MarketScan Commercial Claims and Encounters Database (hereafter, "MarketScan database") and the Truven Health Analytics Health and Productivity Management (HPM) database between January 1, 2008, and March 31, 2010. The MarketScan database captures healthcare administrative claims data (ie, medical and pharmacy) from employer-sponsored private health insurance plans for several million individuals annually, encompassing employees, early retirees, and the dependents of both cohorts. The claims data were derived from approximately 100 different insurance companies representing more than 30 million lives who were covered under a variety of health plans during the study period. The HPM database contains employee-level workplace information collected by employers, including employment status, sick leave and short-term disability benefit eligibility, reported sick leave time, and short-term disability and workers' compensation paid by employers. The HPM database is a subset of approximately 1.4 million individuals in the MarketScan database.

The study population was derived from the MarketScan database. The population consisted of active employees or early retirees aged 18 to 64 years and their adult dependents who were actively enrolled in employer health plans (with medical and pharmacy benefits) on January 1, 2009, and continued with the plans until the loss of health coverage as a result of death or a change of employment. Active employees and adult dependents aged ≥65 years or adults who were eligible for Medicare were excluded from the study. Eligible individuals also had to have continuous medical and pharmacy coverage between January 1, 2008, and December 31, 2008. The

incidence of CAP, all-cause costs associated with CAP episodes, and overall healthcare costs (medical and pharmacy) were estimated in 2009 using the same data source. To assess the sick time and short-term disability costs associated with CAP, eligible active employees from the MarketScan database were merged with employees in the HPM database. Eligible active employees who were not in both databases were dropped from the sick time and/or the short-term disability cost analyses.

Identification of the Cohorts with and without CAP

The presence of CAP was identified by pneumonia claims between January 1, 2009, and December 31, 2009. Patients who were hospitalized in a skilled nursing facility or other institutional facility within 2 weeks before a pneumonia diagnosis were excluded. Inpatient CAP diagnosis was identified by (1) a primary inpatient diagnosis for pneumonia (*International Classification of Diseases Clinical Modification, Ninth Edition*, [*ICD-9-CM*] 480.xx or 487.0); or (2) a secondary inpatient diagnosis for pneumonia but with a primary inpatient diagnosis for sepsis (*ICD-9-CM* 515.8), respiratory failure (*ICD-9-CM* 038.x), bacteremia (*ICD-9-CM* 790.7), or empyema (*ICD-9-CM* 510, 510.0, or 510.9); or (3) a secondary inpatient diagnosis for pneumonia with an outpatient or emergency department diagnosis for pneumonia or a chest x-ray claim (*Current Procedural Terminology* code between 71010 and 71035) less than 90 days before hospitalization.

Outpatient CAP was defined as a primary or a secondary diagnosis of pneumonia in the outpatient or emergency department setting, with a chest x-ray claim within 14 days of the first pneumonia diagnosis and no inpatient pneumonia claim.

An episode of CAP was defined as the period between the date of the first and last pneumonia claims or the last date of an antibiotic medication, based on prescription fill data. A 90-day period free of pneumonia claims was applied to distinguish one episode of CAP from another. Using these criteria, an individual could have ≥1 episodes of CAP during 2009. Eligible patients with any episodes of CAP were designated as part of the cohort with CAP. Individuals with no pneumonia claims between January 1, 2009, and December 31, 2009 were designated as part of the cohort without CAP. For the cost analysis of the CAP episode level, follow-up until March 2010 was allowed to capture all resource use for episodes of CAP that started late in 2009.

Stratification by Risk Level

Because the risk of developing pneumonia, healthcare resource use, and costs differ by the presence of underlying comorbidities,[20,21] each individual was assigned to a risk category (high, moderate, or low) based on claims data from January 1, 2008, through December 31, 2009. The risk category assignment was based on the presence of immunocompromising and/or chronic conditions on either 1 inpatient claim, 1 emergency department claim, or 2 outpatient claims on different dates, or 2 pharmacy claims for the same immunocompromising or chronic conditions.

Patients were considered to be high risk if they had an immunocompromising condition (eg, HIV, neoplasm, nephritic syndrome, chronic renal failure, organ transplant). Moderate risk was assigned to patients who had no indication of an immunocompromising condition but had ≥1 chronic conditions (eg, congestive heart failure [CHF], cardiomyopathy, diabetes, chronic obstructive pulmonary disease [COPD], liver disease, asplenia, sickle-cell disease, alcoholism, asthma, or coronary artery disease [CAD]). Patients who did not belong to either the high- or moderate-risk categories were assigned to the low-risk category.

Statistical Analysis

Demographic characteristics, including 5 common comorbidities of interest—diabetes, CHF, CAD, COPD, and asthma—were described in the cohorts with and without CAP. The incidence rate of CAP was analyzed as the number of episodes per 1000 person-years in 2009.

All-cause healthcare (ie, medical and pharmacy) costs were compiled for inpatient and outpatient episodes of CAP. The annual all-cause healthcare costs, sick leave, and short-term disability costs were descriptively compared between the cohorts with and without CAP during 2009. Amounts paid by the health plan and the individual were used to estimate the costs for all services that were rendered.

Monetized values of sick leave were derived by multiplying recorded sick days by the national average wage according to age and sex. The costs of short-term disability were estimated based on actual amounts paid to the employee for the incident.

To further assess the impact of CAP, multivariate linear regression was used to estimate the incremental overall healthcare costs between patients with inpatient or outpatient CAP and individuals without CAP during 2009. Factors adjusted in the models included age, sex, and risk category. Based on published literature, as well as on our current study, age and underlying medical conditions are major risk factors for developing pneumonia and are determinants of cost to treat pneumonia.[1,16,22] Therefore, these variables were included in the regression analysis. Employment is not a main factor for the development of pneumonia or for the associated high cost of the disease.

Table 1 Demographic Characteristics by Members with and without CAP: 2009 MarketScan Data

Characteristics	All members, N (%)[a]	Members with CAP, N (%)[a]	Members without CAP, N (%)[a]
	12,502,017	123,920	12,378,097
Age, yrs			
18-29	2,279,922 (18.2)	13,055 (10.5)	2,266,867 (18.3)
30-39	2,498,276 (20.0)	20,436 (16.5)	2,477,840 (20.0)
40-49	3,178,212 (25.4)	30,894 (24.9)	3,147,318 (25.4)
50-64	4,545,607 (36.4)	59, 535 (48.0)	4,486,072 (36.2)
Sex			
Female	6,534,732 (52.3)	67,412 (54.4)	6,467,320 (52.2)
Male	5,967,285 (47.7)	56,508 (45.6)	5,910,777 (47.8)
Geographic distribution			
Northeast	1,143,089 (9.1)	10,667 (8.6)	1,132,422 (9.1)
North central	3,420,281 (27.4)	34,238 (27.6)	3,386,043 (27.4)
South	5,703,475 (45.6)	58,393 (47.1)	5,645,082 (45.6)
West	2,235,172 (17.9)	20,622 (16.6)	2,214,550 (17.9)
CAP risk level			
Low	11,201,501 (89.6)	83,107 (67.1)	11,118,394 (89.8)
Moderate	1,053,299 (8.4)	30,122 (24.3)	1,023,177 (8.3)
High	247,217 (2.0)	10,691 (8.6)	236,526 (1.9)
Chronic medical conditions[b]			
Diabetes	709,694 (5.7)	16,330 (13.2)	693,364 (5.6)
Congestive heart failure	44,893 (0.4)	4765 (3.8)	40,128 (0.3)
Coronary artery disease	205,852 (1.6)	7546 (6.1)	198,306 (1.6)
Chronic obstructive pulmonary disease	78,174 (0.6)	9584 (7.7)	68,590 (0.6)
Asthma	183,145 (1.5)	10,302 (8.3)	172,843 (1.4)
Employment category			
Active employees	7,363,171 (58.9)	71,737 (57.9)	7,291,434 (58.9)
Adult dependents of active employees	4,187,260 (33.5)	39,265 (31.7)	4,147,995 (33.5)
Early retirees and their adult dependents	951,586 (7.6)	12,918 (10.4)	938,668 (7.6)

[a]Percentages are rounded.
[b]Comorbidities were not mutually exclusive.
CAP indicates community-acquired pneumonia.

Results

In total, 12,502,017 individuals in the MarketScan database met the study's eligibility criteria (**Table 1**). Of these, 58.9% (N = 7,363,171) were active employees, 33.5% (N = 4,187,260) were adult dependents of active employees, and 7.6% (N = 951,586) were early retirees and their adult dependents. The mean age of the active employees and their dependents was 41.9 years, and that of the early retirees and their dependents was 56.5 years.

In the database, the number of patients with CAP was 123,920 and the number of individuals without CAP was 12,378,097. In general, the CAP population was older and had higher risk levels for pneumonia and more comorbidities than the population without CAP. Approximately 39% of the CAP population had underlying comorbidities (ie, moderate- or high-risk combined) compared with only 10% of the population without CAP. The prevalence of each of the 5 selected comorbidities (ie, diabetes, CHF, CAD, COPD, asthma) was at least 2-fold higher in the population with CAP than in the population without CAP. Overall, there was no obvious difference in the geographic distribution between the populations with and without CAP.

Incidence Rates of CAP

During 2009, there were 114,063 episodes of CAP

Table 2 CAP Incidence Rates for Active Employees, Early Retirees, and their Dependents: 2009 MarketScan Data

Age and risk categories	All patients with CAP			Patients with CAP managed in the hospital		Patients with CAP in outpatient setting	
	Person-years, N	Episodes, N	Incidence per 1000 person-years	Episodes, N	Incidence per 1000 person-years	Episodes, N	Incidence per 1000 person-years
Active employees and their adult dependents							
Age, 18-49 yrs	7,267,964	65,045	8.9	8936	1.2	56,109	7.7
Low risk	6,847,855	51,503	7.5	3831	0.6	47,672	7.0
Moderate risk	348,130	10,530	30.2	3536	10.2	6994	20.1
High risk	71,978	3012	41.8	1569	21.8	1443	20.0
Age, 50-64 yrs	3,479,241	49,018	14.1	11,908	3.4	37,110	10.7
Low risk	2,865,264	26,871	9.4	2655	0.9	24,216	8.5
Moderate risk	492,878	15,981	32.4	5882	11.9	10,099	20.5
High risk	121,099	6166	50.9	3371	27.8	2795	23.1
Total: age, 18-64 yrs	10,747,205	114,063	10.6	20,844	1.9	93,219	8.7
Low risk	9,713,119	78,374	8.1	6486	0.7	71,888	7.4
Moderate risk	841,009	26,511	31.5	9418	11.2	17,093	20.3
High risk	193,077	9178	47.5	4940	25.6	4238	21.9
Early retirees and their adult dependents							
Total: age, 18-64 yrs	896,885	13,411	15.0	4067	4.5	9344	10.4
Low risk	703,402	6314	9.0	821	1.2	5493	7.8
Moderate risk	154,762	4967	32.1	2026	13.1	2941	19.0
High risk	38,721	2130	55.0	1220	31.5	910	23.5

CAP indicates community-acquired pneumonia.

among active employees and their adult dependents (inpatient, N = 20,844 [18.3%]; outpatient, N = 93,219 [81.7%]) and 13,411 CAP episodes among early retirees and their adult dependents (inpatient, N = 4067 [30.3%]; outpatient, N = 9344 [69.7%]; **Table 2**). Overall, approximately 19.5% of CAP episodes were inpatient.

The overall incidence rate of CAP in active employees and their adult dependents was 10.6 per 1000 person-years; the rate was almost 6 times greater in high-risk patients than in low-risk patients (47.5 vs 8.1 per 1000 person-years, respectively). The incidence rates of inpatient and outpatient CAP in this population were 1.9 and 8.7 per 1000 person-years, respectively. The overall incidence rate of CAP in early retirees and their adult dependents was somewhat higher, at 15.0 per 1000 person-years (ie, 4.5 and 10.4 per 1000 person-years for inpatient and outpatient CAP, respectively). There was a clear trend in both groups: the incidence of CAP was greater with increasing age and risk.

Costs for a CAP Episode

Overall, the mean cost for an inpatient CAP episode among active employees and their adult dependents was $36,139 compared with $1091 for an outpatient CAP episode (**Table 3**). The mean cost for an episode rose dramatically with increased risk for inpatient and outpatient episodes of CAP, with more than a doubling noted between low-risk and high-risk patients; in contrast, the increase in mean episode costs was more modest across age-groups. The overall mean episode costs for early retirees and their adult dependents (inpatient CAP, $32,133; outpatient CAP, $1462) were close to those of active employees, and a similar pattern of cost increase was observed across risk categories.

Total Healthcare Costs

The annual healthcare costs were higher with increasing age and increased risk in the 2 cohorts with and without CAP. Among active employees and their adult dependents, the mean annual healthcare costs were found to be more than 5 times higher in patients with CAP than in individuals without CAP ($20,961 vs $3783, respectively; **Table 4**). Such costs in patients with CAP versus those without CAP were consistently 3-fold higher across all risk strata. A similar pattern was observed among early retirees and their adult dependents.

As with the descriptive results, the adjusted annual incremental healthcare costs between patients with inpatient and outpatient CAP versus individuals without CAP were significantly higher and rose with increasing risk (all *P* values <.01). Compared with individuals without CAP, the average annual incremental healthcare cost ranged from $39,889 to $113,837 for inpatient CAP and from $4170 to $31,524 for outpatient CAP, depending on the patient's risk level (**Table 5**).

Sick Time and Short-Term Disability Costs

Of the 12,502,017 eligible members in the MarketScan database, 1,254,974 employees were successfully merged with the HPM database. In total, 315,499 employees were eligible for sick time benefits and 1,031,231 employees were eligible for short-term disability benefits.

The mean sick time costs were calculated for 2911 employees with CAP and 312,588 employees without CAP (**Table 6**). Among employees with and without CAP, the mean sick time costs were higher in older individuals and in patients in the moderate- and high-risk categories. Overall, the mean sick time cost was $1129 for an employee with CAP and $853 for an employee without CAP.

The mean recorded sick times for employees with and without CAP were 5.0 and 3.8 days, respectively (data not shown). In general, the number of days of sick time increased with age and with higher risk status in employees with and without CAP. Overall, 31.4% of employees with CAP versus 41.6% of employees without CAP had no sick time reported.

The mean short-term disability costs were calculated in 9118 employees with CAP and in 1,022,113 employees without CAP (Table 6). Overall, the mean short-term disability cost was $1016 for employees with CAP and $322 for their counterparts without CAP. The mean recorded short-term disability times for employees with and without CAP were 16.1 and 4.9 days, respectively. As with sick time, the number of days of short-term disability increased with age and with higher risk status in employees with and without CAP. Overall, 75% of employees with CAP versus 92.8% of those without CAP had no short-term disability to report.

Table 3 Mean Costs for an Episode of CAP for Active Employees, Early Retirees, and Their Dependents: 2009 MarketScan Data

	Inpatient CAP	Outpatient CAP
	Mean (SD), $	Mean (SD), $
Active employees and their adult dependents	N = 20,844	N = 93,219
Age, 18-49 yrs	32,844 (81,395)	894 (7890)
Low risk	24,293 (57,365)	714 (7586)
Moderate risk	27,994 (67,542)	1604 (8155)
High risk	64,650 (134,854)	3369 (13,710)
Age, 50-64 yrs	38,612 (82,437)	1391 (8097)
Low risk	30,311 (83,962)	792 (3812)
Moderate risk	31,393 (62,900)	1908 (9042)
High risk	57,745 (105,088)	4712 (20,838)
Total: age, 18-64 yrs	36,139 (82,039)	1091 (7977)
Low risk	26,757 (69,551)	740 (6562)
Moderate risk	30,117 (64,699)	1784 (8691)
High risk	59,938 (115,408)	4255 (18,727)
Early retirees and their adult dependents	N = 4067	N = 9344
Total: age, 18-64 yrs	32,133 (73,073)	1462 (8041)
Low risk	23,730 (52,276)	760 (2746)
Moderate risk	28,029 (59,548)	2090 (10,141)
High risk	44,602 (99,251)	3665 (16,650)

CAP indicates community-acquired pneumonia; SD, standard deviation.

Discussion

The current study estimated the incidence rate and the healthcare, sick time, and short-term disability costs of CAP from an employer perspective in active employees aged 18 to 64 years, in early retirees aged <65 years, and in the adult dependents of both cohorts. The results of our study confirm the results of previous studies: the direct and indirect costs of CAP are substantial in working-age adults. It is well established that older adults carry a disproportionately higher epidemiologic burden of CAP than their younger counterparts, with higher incidence, hospitalization, and mortality rates with advancing age.[18,19,22,23] Given the strong correlation between older age and the presence of CAP, it is perhaps not surprising that the bulk of epidemiologic data focuses on older adults, and that there is a widely acknowledged lack of contemporary data in the nonelderly adult population.[12,24] Nonetheless, some limited information is available on working-age adults in the United States, and it warrants mention here.

Using MarketScan data from 2003 through 2007, Bonafede and colleagues reported an annual incidence rate of CAP of 4.89 cases per 1000 person-years in working-age adults aged 18 years to 64 years.[12] This incidence rate is much lower than that obtained in our study (ie, 10.6 cases per 1000 person-years), which used 2009 MarketScan data from a similar population. The higher rate observed in our study may be explained by population differences—most notably, an older study population and a greater proportion of adults with comorbidities in the current cohort with CAP. For exam-

Table 4 Mean Annual Healthcare Costs for Active Employees, Early Retirees, and Their Dependents: 2009 MarketScan Data

	Mean (SD), $		*P* value of *t*-test
	With CAP	Without CAP	
Active employees and their adult dependents	N = 111,002	N = 11,439,429	
Age, 18-49 yrs	15,012 (55,239)	2937 (12,185)	<.001
Low risk	7310 (27,194)	2332 (8674)	<.001
Moderate risk	26,648 (64,813)	8843 (21,025)	<.001
High risk	110,855 (171,476)	34,899 (69,589)	<.001
Age, 50-64 yrs	28,942 (73,034)	5598 (18,307)	<.001
Low risk	10,657 (38,074)	3493 (9510)	<.001
Moderate risk	31,364 (59,447)	10,657 (22,824)	<.001
High risk	105,179 (142,409)	36,007 (66,173)	<.001
Total: age, 18-64 yrs	20,961 (63,825)	3783 (14,468)	<.001
Low risk	8453 (31,378)	2668 (8940)	<.001
Moderate risk	29,491 (61,676)	9904 (22,113)	<.001
High risk	107,044 (152,586)	35,595 (67,466)	<.001
Early retirees and their adult dependents	N = 12,918	N = 938,668	
Total: age, 18-64 yrs	30,932 (67,794)	6038 (18,578)	<.001
Low risk	11,536 (30,919)	3647 (9855)	<.001
Moderate risk	31,232 (58,410)	10,631 (22,099)	<.001
High risk	89,173 (117,917)	32,653 (59,491)	<.001

CAP indicates community-acquired pneumonia; SD, standard deviation.

Table 5 Regression Analysis of the Annual Incremental Healthcare Costs for Inpatient and Outpatient CAP Management versus Members without CAP: 2009 MarketScan Data

CAP management setting	Risk	Annual incremental healthcare costs, $	*P* value
Inpatient management of patients with CAP vs members without CAP	High	113,837	<.001
	Moderate	45,315	<.001
	Low	39,889	<.001
Outpatient management of patients with CAP vs members without CAP	High	31,524	<.001
	Moderate	8780	<.001
	Low	4170	.003

CAP indicates community-acquired pneumonia.

ple, in our study, 13.2% and 7.7% of the cohort with CAP had diabetes and COPD, respectively, compared with 8.1% and 4.1%, respectively, in the study by Bonafede and colleagues.[12] In addition, unlike Bonafede and colleagues,[12] we did not specifically exclude healthcare-associated pneumonia (HCAP), because of the substantial overlap between individuals with CAP and HCAP, as is recognized in guidelines from the American Thoracic Society and the Infectious Diseases Society of America.[1,25] This disparity in the incidence of CAP between the 2 studies can perhaps also be explained by methodologic differences.

Several early studies using data from the late 1990s have examined the direct and indirect costs of CAP from an employer perspective; however, their findings were limited by the use of the same large employer in those studies, a lack of incremental cost burden of CAP, and the imputation of sick leave time and costs.[13-15]

In addition to investigating the incidence of CAP, Bonafede and colleagues also used MarketScan data (2003 through 2007) to assess the excess direct medical and productivity (short-term disability and absence) costs (in 2008 dollars) of CAP in US adults aged 18 to 64 years.[15] The authors, who used generalized linear models to compare the cohorts with and without CAP, reported crude annual incremental healthcare costs that were lower than those in our study ($11,443 vs $17,178, respectively), but indirect costs that were higher ($2391 vs $970, respectively).[12] A follow-on study examining the annual excess cost of CAP in patients with asthma, diabetes, COPD, and CHF reported mean healthcare costs of $10,158 to $31,593, which were similar to our findings.[16]

Further assessment of healthcare costs by risk and care setting showed that the burden of CAP is very high in certain risk groups, even in adults with CAP who are not hospitalized for the treatment of CAP. The annual incremental healthcare cost burden in working-age adults with an outpatient episode of CAP compared with adults without CAP was surprisingly high—$4170, $8780, and $31,524 in the low-, moderate-, and high-risk groups, respectively. Several reports cite hospitalization the key driver of the treatment costs of CAP, but the cost burden of outpatient CAP is rarely highlighted.[14,17,18]

Our results suggest that outpatient CAP should not be dismissed as being inconsequential. Approximately 80% of all episodes of CAP in our study were outpatient, and the annual incremental healthcare costs associated with outpatient CAP was at least several thousand dollars more than that of an adult without CAP. The notable increase in cost in the higher-risk groups, regardless of whether CAP is treated in the hospital or in an outpatient setting, also points to the significance of chronic comorbidities in determining costs. As one would expect, the annual cost per patient with CAP managed in the inpatient setting was much higher than the annual cost per patient with CAP managed in the outpatient setting.

In the current study, the proportion of episodes of CAP that resulted in hospitalization was high (19.5%), considering that patients who were hospitalized were of

Table 6 Mean Annual Sick Time and Short-Term Disability Costs for Active Employees: MarketScan and HPM Data in 2009

	Sick time cost, $					Short-term disability cost, $				
	With CAP (N = 2911)		Without CAP (N = 312,588)		With CAP vs without CAP	With CAP (N = 9118)		Without CAP (N = 1,022,113)		With CAP vs without CAP
	Mean (SD), $	No sick time, %	Mean (SD), $	No sick time, %	*P* value of *t*-test of means	Mean (SD), $	No short-term disability, %	Mean (SD), $	No short-term disability, %	*P* value of *t*-test of means
Age, 18-49 yrs	949 (1747)	35.0	762 (1313)	43.3	<.001	826 (3266)	78.2	288 (2020)	93.0	<.001
Low risk	888 (1605)	35.8	742 (1239)	43.7	<.001	689 (3033)	81.6	252 (1833)	93.6	<.001
Moderate risk	1172 (2209)	31.9	1034 (1902)	35.9	.185	1097 (3545)	63.2	692 (3121)	84.0	.001
High risk	1642 (2797)	26.5	1557 (3450)	34.8	.418	3136 (5847)	52.0	2150 (7019)	72.5	.010
Age, 50-64 yrs	1372 (2310)	27.1	1008 (1918)	38.7	<.001	1320 (4172)	70.2	396 (2617)	92.4	<.001
Low risk	1185 (1525)	27.2	927 (1672)	39.7	<.001	801 (2998)	79.3	279 (2114)	94.0	<.001
Moderate risk	1673 (3544)	25.6	1358 (2602)	33.2	.058	1767 (5135)	59.0	752 (3591)	86.1	<.001
High risk	1948 (2763)	29.8	1976 (3953)	32.2	.543	3464 (6417)	43.0	2,283 (6819)	72.6	<.001
Total: age, 18-64 yrs	1129 (2001)	31.4	853 (1553)	41.6	<.001	1016 (3644)	75.0	322 (2226)	92.8	<.001
Low risk	1002 (1583)	32.3	808 (1399)	42.3	<.001	725 (3027)	80.8	260 (1919)	93.7	<.001
Moderate risk	1441 (2990)	28.1	1208 (2299)	34.3	.038	1462 (4480)	60.7	726 (3397)	85.2	<.001
High risk	1811 (2697)	28.9	1789 (3701)	33.1	.459	3359 (6194)	46.2	2230 (6899)	72.6	<.001

CAP indicates community-acquired pneumonia; HPM, Health and Productivity Management; SD, standard deviation.

working age and that approximately 33% of them did not seem to have underlying comorbidities (ie, they were low risk). Coincidently, the proportion of hospitalized individuals was nearly identical to a nearly decade-old employer study that reported a 19.6% hospitalization rate.[13] This lack of change over time is noteworthy, given the trend in the past decade toward outpatient treatment and the establishment of society guidelines that serve to better identify patients with CAP who can be treated in an outpatient setting.[1]

The incremental indirect costs resulting from sick time and short-term disability in our study were approximately 33% to 50% that of previous reports using the same data source.[12,16] The magnitude of the difference was small in the context of overall costs, and could potentially be explained by methodologic differences. Previous studies have applied wage constants to employer-recorded sick days and to short-term disability days, whereas we used wage constants by age, sex, and short-term disability costs that were based on short-term disability payments made to the employee. As a result of the smaller indirect costs, the contribution of indirect cost within the total cost was only 5%, much lower than the 20% contribution that was previously reported by Bonafede and colleagues.[12]

Because our study relied on employer-recorded sick days, it is also possible that sick time tracking was incomplete, or that some workers took personal time off instead of reporting it as sick time. The latter scenario is likely, because almost 33% of employees with CAP who were eligible for sick time benefits did not have any sick days recorded during the 1 year period of this study.

Limitations

The limitations of a burden of disease study using administrative claims databases are well known; however,

we also acknowledge other limitations that are specific to our study. Although we applied *ICD-9* codes for pneumonia that were used in previous published studies, as well as additional criteria to identify adults with CAP, we might have misclassified some patients as having CAP when, in fact, they had another respiratory condition.

There is also the potential of misclassification of patients to certain risk strata, because we relied only on claims codes, despite applying the risk classification used in other similar studies.[18,26,27]

The area of greatest uncertainty, however, lies in estimating the indirect costs in this patient population. Specifically, we did not have wage information for the employees, nor could we explore the absence benefit structure to assess how it could potentially have impacted sick time leave and the recording of sick time. It is quite possible that the lack of such information might have led to an underestimation of indirect costs. In addition, reduced work performance during the pneumonia recovery period (after returning to work) was not considered. Furthermore, our results are largely descriptive, which may be viewed by some readers as limiting; yet, such descriptions may be very relevant to employers, who are more likely to compile crude cost values and differences than to calculate extensive multivariate-adjusted costs.

Despite these limitations, our study draws from a diverse commercially insured working-age population with a variety of health and employer plans, which has enabled a realistic estimate of the burden of CAP from an employer perspective. Our stratification of results by age, risk group, and care setting further provides a transparent view of how costs differ among subgroups.

Conclusions

CAP is a common respiratory infection in the commercially insured working-age population and one that poses a substantial financial burden to employers. The current analysis documents higher annual direct costs for working-age adults with CAP than for their counterparts without CAP, regardless of age or risk group.

Given these findings, a call for renewed interest in the efforts to prevent CAP is clearly warranted. At present, society guidelines recommend annual influenza vaccination in all adults, pneumococcal vaccination in adults aged ≥65 years and in adults aged <65 years who have clinical risk factors (ie, underlying medical conditions), and smoking cessation.[1] Despite its recommendation, influenza vaccination rates in adults aged 18 years to 49 years and 50 years to 64 years were 28.6% and 42.7%, respectively, and even lower (20.1%) for working-age adults with indicated risk factors for pneumococcal vaccination.[28,29] The economic burden of CAP on employers and on health plans highlights the need to encourage and implement more effective preventive health services, including the prevention of CAP. The implementation of such preventive measures in working-age adults with comorbidities could be particularly meaningful, because such individuals face an increased risk of CAP and higher CAP-related costs, even if the treatment of CAP does not require hospitalization. Given the substantial medical, social, and economic ramifications of CAP for working-age adults and their employers, the following question is not unreasonable: should CAP be considered primarily a disease of the elderly or one with notable consequences that warrants attention in adults of all ages? ■

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STAKEHOLDER PERSPECTIVE

CAP Is a Burden for All Ages—Prevention Strategies Are Key

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PURCHASERS: As a respiratory disease that can lead to related chronic diseases, community-acquired pneumonia (CAP) has been typically seen as a health issue of retirees from the perspective of health benefits. The study by Broulette and colleagues in this issue of *American Health & Drug Benefits* aptly points out the common nature of CAP in a commercial health insurance population in the United States that can be treated and managed in the outpatient settings.

Not surprisingly, treatment costs in this study were higher in patients with CAP than in employees without CAP, yet the cost of CAP treatments can result in lower overall healthcare costs through more effective preventive services as part of an improved care strategy. For the past 2 years, the National Employer Initiative on Specialty Pharmacy showed that costs alone are not the only important factor for human resource decision makers. In fact, according to an online tool kit (available at www.specialtyrxtoolkit.com), the performances of the health plan and its vendors are of equal or greater importance to human resource decision makers: CAP is one example of a condition for which overall health plan performance rather than a silo cost management is needed. As the present study by Broulette and colleagues illustrates for purchasers of healthcare, occupational health, wellness programs, and traditional prevention strategies (eg, vaccinations) can contribute to reducing the economic risks and the health risks of working-age individuals that contribute to the overall savings or the enterprise savings.

PAYERS: Over the past several years, CAP has become a difficult condition to manage from a managed care standpoint. Drugs used for the treatment of CAP are beginning to get more attention and are growing slowly in number. Some newer drug entries to the market for the treatment of CAP are projected to become among the largest cost contributors, as a result of their expected increased use. For these reasons, medications for the treatment of patients with CAP have become a prominent concern for payers, including health insurance companies. Fortunately, much is known about CAP in the young and in the elderly populations that can allow more effective healthcare strategies to be implemented in the working-age population.

Drug manufacturers will likely hesitate to conduct comparative effectiveness trials for their products, because safety and efficacy have already been well documented. This means greater reliance on retrospective analyses or real-world evidence to determine if enough data are available to recommend the coverage of one therapy over another for first-line treatment of patients with CAP; however, prevention strategies can make a difference if health plan designs are more clearly communicated and executed.

PATIENTS: The past decade has led research and development efforts to give working-age patients with CAP some novel drug options for this life-altering condition that progresses if left untreated. This study demonstrates the value of preventive strategies toward minimizing the health risks and improving clinical and economic outcomes in the employed population in the United States.

Hospitalizations or expensive emergency department visits for CAP can be avoided. Nonetheless, differences between the medical and pharmacy benefits, and a lack of coverage clarity, may also create challenges for patients who are trying to understand the optimal prevention strategy or treatment coverage. However, healthcare reform coverage changes will provide first-dollar coverage for vaccinations, including for CAP prevention, if these are not already in place.