Cost of Treating Influenza in Emergency Department and Hospital Settings

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Abstract

Objectives: **To provide an estimate of the costs of treating influenza in emergency department and hospital settings.**

Study Design: **Retrospective, descriptive study using patient-level data from the Perspective™ Comparative Database.**

Patients and Methods: **We analyzed clinical and cost data obtained from 75 of the 169 hospitals in the database. These hospitals were located throughout the United States. Patients were included in the study if they visited the emergency department between January 1, 1997, and June 30, 1998, and had a primary diagnosis of influenza.**

Results: **A total of 1362 patients with influenza visited the emergency department during the study period. Of these, 333 (24.4%) required hospitalization. The mean cost of treatment for patients discharged directly from the emergency department was $141.89; the mean cost of treatment for hospitalized patients was $3251.04. The mean length of stay for hospitalized patients was 4.3 days. Compared with younger patients, elderly patients were more likely to be hospitalized and incur higher costs. Thirty-eight percent of hospitalized patients for whom drug data were available received either amantadine or rimantadine during their stay.**

Conclusions: **Few data are available documenting resource utilization and associated costs for patients with influenza treated in the emergency department or hospital. Our results represent a significant addition to the identification of the costs associated with the treatment of influenza. This suggests early intervention care aimed at minimizing the impact of influenza, especially in the elderly, could result in decreased hospitalizations and substantial cost savings to managed care.**

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Influenza viruses are highly contagious pathogens well known for their ability to cause sudden, pervasive infection in all age groups on a global scale.[1] Each year in the United States, there are approximately 17 to 50 million influenza illnesses, resulting in 4 to 24 million medical care visits, 314,000 hospitalizations, and 20,000 deaths.[2] Influenza is associated with increased morbidity and mortality in the elderly, with approximately 25% of influenza-related hospitalizations and 90% of influenza deaths occurring in patients older than age 65.[2] Even though many of the deaths attributed to influenza and pneumonia occur in the elderly, mortality resulting from influenza is reported across all age groups.[3]

Typical influenza illness is characterized by abrupt onset of fever, myalgia, sore throat, and nonproductive cough. Unlike other common respiratory tract illnesses, influenza can cause severe malaise lasting several days to several weeks. More severe illness can result if either primary influenza pneumonia or secondary bacterial pneumonia occurs. During

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influenza epidemics, high attack rates of acute illness result in both an increased number of visits to physicians' offices, walk-in clinics, and emergency departments (EDs) and increased hospitalizations for managing lower respiratory tract complications.[3]

Influenza treatment usually consists of symptomatic and supportive care, including bed rest, increased fluid intake, and medications such as aspirin or acetaminophen to relieve fever and discomfort.[4] Amantadine (Symmetrel®, Endo Pharmaceuticals, Inc., Chadds Ford, PA) and rimantadine (Flumadine®, Forest Pharmaceuticals, Inc., St. Louis, MO) are 2 antiviral agents approved for the prophylaxis and treatment of influenza infections.[5] Both drugs have been shown to decrease the duration of fever and symptoms when administered within 48 hours of the onset of illness.[5] However, these drugs are only effective against influenza type A, are associated with adverse effects and drug interactions, have variable efficacy in some populations (eg, the elderly), and have increasingly been susceptible to viral resistance.[6] To decrease the possibility of drug resistance, treatment with these agents should be discontinued after 3 to 5 days or within 24 to 48 hours after symptoms disappear.[5]

Influenza vaccination prevents illness in approximately 70% of healthy, nonelderly persons and in 50% to 60% of persons aged 65 or older.[5] The influenza vaccine should be considered for groups such as the elderly or persons with chronic cardiovascular, pulmonary, or metabolic disorders because these populations are at a greater risk for influenza-related hospitalization and mortality.[4]

An estimated $4.6 billion is spent each year in the United States on influenza-related medical costs.[6] Hospitalization is the greatest single element of medical costs, but little is known about the specific resources consumed and associated costs of an ED visit or hospital stay for influenza. Medical information on the type of patients seen in the ED and admitted to the hospital and their treatments can provide valuable insight into ways of decreasing resource costs.

The purpose of our study was to provide a more accurate estimate of the resources consumed and costs of treating influenza in the ED and hospital in the United States during 1997 and 1998.

···METHODS ···

We retrospectively collected patient-level clinical and cost data from the Perspective™ Comparative Database, which is part of the Premier Decision Support Services database. The Perspective Comparative Database contains ED and inpatient hospital cost data and utilization information from 169 hospitals throughout the United States.

For this study, we analyzed data from 75 hospitals in the database; 65 sites had data available for 1997, 9 sites had data available for 1997 and 1998, and 1 site had data available for 1998 only. Data available from all hospitals were similar except for additional medication information (drug name, strength, units dispensed) for all hospitals with 1998 data and a small group of hospitals with 1997 data (10 hospitals).

The 75 hospitals included in this study represented a fairly broad spectrum of localities and bed sizes. Twenty-six hospitals were considered rural (33 to 392 beds), 20 hospitals were suburban (50 to 805 beds), and 29 were urban (55 to 1626 beds). Most of the hospitals (66%) were in the southeastern United States, although the mid-atlantic (11%), midwest (9%), northwest (8%), southwest (3%), and northeast (3%) were also represented. Of the 75 hospitals included in the study, 13 (17%) were teaching hospitals.

The Perspective Comparative Database is drawn from the largest cost-based, test-level comparative database in the country and provides severity-adjusted, detailed resource utilization data, along with patients' primary and secondary diagnoses codes and demographic information. Utilization information is categorized into departments, such as laboratory, surgery, and nursing care. For the small group of hospitals mentioned previously, detailed medication information (ie, drug name and strength, quantity dispensed, and unit cost) was available in addition to the utilization information.

Our study sample included all patients in the Perspective Comparative Database who were treated for influenza between January 1, 1997, and June 30, 1998. We identified occurrences of influenza using International Classification of Diseases, Ninth Revision-Clinical Modification (ICD-9 CM) codes. Specific codes used were 487, 487.1, and 487.8. An occurrence was defined as a visit to any ED or an inpatient admission with a primary diagnosis code of influenza. Diagnoses codes in the database were assigned at patient discharge; we assumed that the primary discharge diagnosis was the primary reason for the care the patient received. As part of an internal auditing system, patient diagnoses codes in the Perspective Comparative Database are compared to the procedures performed and medications dispensed to ensure that the correct diagnosis was assigned.

We collected patient demographic data, health-

care resource utilization information, and resource costs for each occurrence of influenza. Patient demographics included age (categorized as ≤ 18 years, 19-45 years, 46-65 years, and > 65 years), sex, race, and insurance status.

Costs reflected in the database are the costs to the ED and hospital for managing patients with influenza. These costs are the "true" costs of care to the hospital (ie, the acquisition costs for medications and supplies or physician or health professional fees for services); they do not include any overhead allocation or markup. To identify the costs of care to the payer(s), charges sent to the insurance provider(s) are reported.

After visiting the ED and being treated, a patient could either be released or admitted to the hospital. The costs and resource utilization associated with these 2 possibilities were collected. The costs and resource utilization included medications and procedures in the ED, length of stay, medications and procedures for a hospital visit, and costs associated with any resource utilization.

For hospitalized patients, a severity-of-illness level was assigned using the 3M™ All Patient Refined (APR-DRG) severity measurement system. The APR-DRG software is a patient classification system that uses hospital patient discharge data and computer-based logic to assign patients to severity-of-illness and risk-of-mortality classes; this allows an accurate comparison between patients in terms of length of stay, resource consumption, and outcomes.

Table 1. Patient Demographic Characteristics

	Emergency Department Only (N = 1029)	Emergency Department & Hospitalization (N = 333)	Total (N = 1362)
	N (%)	N (%)	N (%)
Primary diagnosis			
Influenza w/other respiratory manifestations	941 (91.4)	163 (48.9)	1104 (81.1)
Influenza w/pneumonia	68 (6.6)	129 (38.7)	197 (14.5)
Influenza w/other manifestations	20 (1.9)	41 (12.3)	61 (4.5)
Sex			
Female	577 (56.1)	198 (59.5)	775 (56.9)
Male	452 (43.9)	135 (40.5)	587 (43.1)
Age (y)			
≤ 18	182 (17.7)	80 (24.0)	262 (19.2)
19 - 45	590 (57.3)	50 (15.0)	640 (47.0)
46 - 65	155 (15.1)	67 (20.1)	222 (17.8)
> 65	102 (9.9)	136 (40.8)	238 (17.5)
Race			
White	552 (53.6)	250 (75.1)	802 (58.9)
Black	186 (18.1)	31 (9.3)	217 (15.9)
Hispanic	19 (1.8)	10 (3.0)	29 (2.2)
Native American	0	2 (0.6)	2 (0.1)
Other/unknown	272 (26.4)	40 (12.0)	312 (22.9)
Admit type			
Elective	161 (15.6)	24 (7.2)	185 (13.6)
Emergency	292 (28.4)	115 (34.5)	407 (29.9)
Urgent	129 (12.5)	147 (44.1)	276 (20.3)
Other	88 (8.6)	17 (5.1)	105 (7.7)
Information not available	359 (34.9)	30 (9.0)	389 (28.6)
Insurance status			
Indemnity plan	245 (23.8)	88 (26.4)	333 (24.4)
Managed care	174 (16.9)	26 (7.8)	200 (14.7)
Medicaid	154 (15.0)	39 (11.7)	193 (14.2)
Medicare	126 (12.2)	140 (42.0)	266 (19.5)
Other	19 (1.8)	6 (1.8)	17 (1.2)
Preferred provider organization	25 (2.4)	10 (3.0)	35 (2.6)
Self-pay	286 (27.8)	24 (7.2)	310 (22.8)

The APR-DRG, an enhancement of the basic diagnosis-related group structure, includes 4 severity-of-illness and risk-of-mortality subclasses within each diagnosis-related group. The 4 subclasses indicate minor, moderate, major, or extreme severity of illness or risk of mortality. Patients within each of the 4 clinically meaningful severity-of-illness and risk-of-mortality subclasses have similar resource utilization and outcomes.[7]

Statistical Analysis

Our data are summarized using frequencies (%). Cost and utilization data are presented as means (± standard error). We performed multivariate analysis of variance to determine if observed differences in mean costs across demographic variables were statistically significant; all tests were performed at a significance level of $\alpha = .05$. When more than 2 levels of a variable were present, we performed comparison of means using Scheffé test for differences among means, with a family-wise error rate of 0.05. All analyses were performed using SAS software, version 6.12.[8]

···RESULTS ···

We identified 828 patients who met the inclusion criteria in 1997. A further 534 patients were identified during the first 6 months of 1998, giving a total of 1362 patients who met the inclusion criteria during the study period. There were no significant differences in hospitalization rates or cost data; therefore, all analyses are presented for the entire group. Patient demographic characteristics are summarized in Table 1. Of the 1362 patients included in this study, 333 (24.4%) required an inpatient hospital stay for influenza.

Compared with patients requiring an ED visit only, hospitalized patients were significantly more likely to have been diagnosed with influenza plus pneumonia or influenza plus other (nonrespiratory) manifestations ($P < .0001$). Ninety-one percent of the ED-only group had a primary diagnosis of influenza with other respiratory manifestations. In comparison, 49% of the hospitalized group had a primary diagnosis of influenza with other respiratory manifestations, 39% had influenza with pneumonia, and 12% had influenza with other (nonrespiratory) manifestations.

No differences were observed in hospitalization rates between males and females; approximately 60% of patients in both the ED-only and hospitalized groups were female. The elderly were more likely to be hospitalized than were other age groups, with approximately 10% of the ED-only group but 41% of the hospitalized group older than age 65.

The rate of hospitalization varied across payer types; 12% of the ED-only group and 42% of the hos-

Table 2. Most Common Secondary Diagnoses

Secondary Diagnosis	Emergency Department Only (N = 1029)	Emergency Department & Hospitalization (N = 333)	Total (N = 1362)
	N (%)	N (%)	
Cardiac conditions			
Hypertension	3 (0.3)	17 (5.1)	20
Congestive heart failure	1 (0.1)	14 (4.2)	15
Atrial fibrillation	2 (0.2)	8 (2.4)	10
Coronary angioplasty	0 (0)	4 (1.2)	4
Respiratory conditions			
Respiratory collapse	1 (0.1)	6 (1.8)	7
Bronchitis	2 (0.2)	4 (1.2)	6
Asthma	0(0)	5 (1.5)	5
Other			
Volume depletion	3 (0.3)	19 (5.7)	22
Diabetes	4 (0.4)	14 (4.2)	18
Electrolyte disorders	3 (0.3)	7 (2.1)	10

pitalized group were Medicare recipients. More patients in the ED-only group (28%) were classified as self-pay than were patients in the hospitalized group (7%).

Secondary diagnoses were uncommon in the ED-only group; only 4% of patients discharged from the ED had one or more recorded secondary diagnoses. In comparison, 24% of the hospitalized group had recorded secondary diagnoses. Within the hospitalized group, the most common secondary diagnoses were volume depletion (5.7%), hypertension (5.1%), diabetes (4.2%), and congestive heart failure (4.2%) (Table 2).

Patients Discharged After Emergency Department Visit

The mean total cost per patient for an ED visit (not leading to hospi-

Table 3. Influenza-Related Emergency Department Resources Consumed and Associated Costs for Patients Discharged Directly From Emergency Department (N =1029)

Resource	Average Cost ($) (SE)*	Average Charge ($) (SE)*
Emergency department supplies	82.52 (2.08)	99.97 (2.80)
Laboratory	14.97 (1.13)	40.44 (2.92)
Radiology	13.84 (1.08)	27.75 (2.28)
General medicine	13.60 (1.26)	13.44 (1.39)
Medications	9.82 (2.86)	25.00 (5.02)
Nursing care	2.15 (1.07)	1.83 (0.90)
Physical therapy	0.03 (0.03)	0.11 (0.11)
Respiratory therapy	1.71 (0.33)	2.72 (0.42)
Central/material services	1.62 (0.22)	3.17 (0.44)
Other miscellaneous procedures	1.60 (0.73)	1.88 (0.69)
Surgery	0.51 (0.11)	0.95 (0.24)
Physical therapy	0.03 (0.03)	(0.11 (0.11)
Total	**141.89 (4.26)**	**218.25 (8.53)**

*Costs and charges are averaged across entire sample.

Table 4. Influenza-Related Medications Used and Associated Costs for Emergency-Department Only Patients (N = 570)*

Medications	No. of Patients† (% of Sample)	Total No. of Units Used	Average Unit/Visit (SE)	Average Cost/Unit ($) (SE)	Average Cost/Visit‡ ($) (SE)	Average Charge/Visit‡ ($) (SE)
Symptomatic medications	72 (12.6)					
NSAIDs	47	78	1.66 (0.15)	3.58 (0.59)	4.73 (0.85)	20.88 (3.77)
Hydrocodone/acetaminophen	14	25	1.79 (0.21)	2.14 (0.21)	3.43 (0.29)	16.71 (1.45)
Vitamin supplements	6	7	1.19 (0.19)	0.83 (0.34)	1.04 (0.54)	7.75 (3.56)
Antitussives	5	6	1.20 (0.20)	2.37 (0.52)	2.58 (0.52)	5.02 (1.85)
Antibiotics	21 (3.7)					
Ceftriaxone	6	9	1.50 (0.50)	28.28 (3.50)	38.14 (8.70)	143.32 (31.88)
Azithromycin	5	8	1.60 (0.24)	4.50 (0)	7.20 (1.10)	22.00 (3.37)
Erythromycin	4	5	1.25 (0.25)	1.05 (0.11)	1.36 (0.38)	5.19 (0.95)
Clarithromycin	3	6	2.00 (1.00)	3.21 (0.64)	7.26 (4.49)	15.67 (4.84)
SMZ/TMP	2	2	1.00 (0)	1.23 (0)	1.23 (0)	3.75 (0)
Asthma medications	8 (1.4)					
Albuterol	7	8	1.14 (0.14)	4.10 (0.79)	4.30 (0.69)	21.23 (4.80)
Prednisone	1	3	3.00 (—)	0.33 (—)	0.99 (—)	6.00 (—)
Antivirals	4 (0.7)					
Amantadine	4	7	1.75 (0.75)	1.10 (0.25)	2.25 (1.31)	3.62 (1.55)

NSAIDs = nonsteroidal anti-inflammatory drugs; SMZ/TMP = sulfamethoxazole/trimethoprim.
*Detailed drug information was not available for 459 emergency-department only patients.
†Because patients may have received more than one medication, the number of patients column does not sum to 570.
‡Average cost (charge) per visit is the average across only those patients receiving the drug.

talization) was $141.89, with a mean total charge of $218.25 (Table 3). Emergency department resources accounted for 58.2% of the total cost, laboratory accounted for 10.6%, radiology 9.8%, general medicine 9.6%, and medications 6.9%. The mean total cost increased with age; patients older than age 18 had a mean ED cost of $135.23 (SE 8.96), but those older than age 65 had a mean ED cost of $190.25 (SE 23.66). The difference in mean costs for these age groups was significant at a family-wise error rate of 0.05 ($P < .008$).

Of the 1029 ED-only patients, detailed drug information was available for 570 patients (55.3%). The most commonly prescribed drug classes for these patients were analgesics, antibiotics, asthma medications, antitussives, and antivirals (Table 4). The most commonly prescribed antibiotics were ceftriaxone, azithromycin, and erythromycin (Table 4). Four patients received amantadine, accounting for a total of 7 units, or 1.75 units per patient. The mean cost per unit was $1.10 and the mean cost per administration was $2.25. No patient in the ED-only group received rimantadine.

Patients Hospitalized After Emergency Department Visit

Patients admitted to the hospital after an ED visit for influenza stayed approximately 4.3 days. The mean total cost per hospitalized patient was $3251.04, with a mean total charge of $5937.79 (Table 5). Nursing care accounted for 46.4% of the total cost, medication accounted for 10.6%, laboratory 9.5%, and respiratory therapy 6.7%.

Older age was associated with increased total costs and length of stay. Hospitalized patients younger than age 18 had a mean total cost of $2284.33 (SE 232.83) and a mean length of stay of 2.9 days (SE 0.23). This increased to $3622.08 (SE 233.63) and 5.4 days (SE 0.29) for patients older than age 65. The differences between these 2 groups in mean cost ($P < .008$) and length of stay ($P < .008$) were both significant at a family-wise error rate of 0.05. Patients admitted from or discharged to a skilled nursing facility had a longer mean length of stay (12.8 days; SE 3.3) and total cost ($10,107.55; SE 4577.71) than did the overall group.

Table 5. Influenza-Related Hospital Resources Consumed and Associated Costs for Patients Admitted to the Hospital (N = 329)*

Resource	Average Cost ($) (SE)†	Average Charge ($) (SE)†
Nursing care	1508.95 (84.27)	1669.99 (112.21)
Medications	344.87 (26.44)	1217.51 (90.56)
Laboratory	307.90 (32.84)	949.83 (107.12)
Other miscellaneous procedures	262.82 (105.97)	251.33 (119.25)
Respiratory therapy	217.33 (24.42)	616.97 (77.04)
Central/material services	170.99 (40.94)	320.33 (42.08)
Radiology	148.28 (12.91)	346.53 (29.51)
Emergency department	122.02 (7.73)	173.83 (11.61)
General medicine	71.26 (8.40)	186.76 (23.45)
Physical therapy	28.03 (5.98)	48.13 (10.13)
Surgery	24.25 (6.55)	44.57 (12.73)
Occupational therapy	2.24 (1.45)	1.26 (0.70)
Total	**3251.04 (254.94)**	**5937.79 (495.71)**

*Of the 333 hospitalized patients, departmental cost data were not available for 4 patients. Mean total cost for all 333 patients was $3239.63 (252.08). Mean total charge for all 333 patients was $5955.69 (490.27).
†Costs and charges are averaged across entire sample.

The mean cost of nursing care for hospitalized patients was $1508.95 (Table 6). Routine nursing care (ie, nonspecialized or nonintensive care) was provided to 95.7% of hospitalized patients and represented 80.0% of the mean total cost. Other nursing care provided to a portion of the hospitalized group included care within the telemetry/step-down unit (7.9% of patients), intensive care unit (4.6%), and holding and observation (3.3%).

Approximately 37% of hospitalized patients had an APR-DRG severity level of 1 (minor), 45% had a severity level of 2 (moderate), 15% had a severity level of 3 (major), and 3% had a severity level of 4 (extreme). Patients older than age 65 were more likely than those in other age groups to be assigned a severity level of major or extreme; 25.7% of patients older than age 65 had an APR-DRG severity level of major, compared with 6.7% of patients aged 18 to 65. Fifty-six percent of

patients younger than age 65 but only 9.6% of elderly patients were assigned a severity level of minor.

Patients assigned an APR-DRG severity level of minor had a mean length of stay of 2.89 days and mean total cost of $2022.79 (SE 154.17). Patients with moderate severity stayed an average of 4.4 days (SE 0.25) and had a mean total cost of $3066.99 (SE 181.25). Those with major severity had a mean length of stay of 6.0 days (SE 0.48) and a cost of $4201.86 (SE 421.57). For the 10 patients with extreme severity, the mean length of stay was 14.9 days (SE 4.62) and mean total cost was $16,556.48 (SE 6255.53). One patient in the extreme severity category was hospitalized for 53 days. When data from this patient were removed, the mean length of stay for the extreme group was 10.7 days (SE 2.07) and mean total cost $10,840.25 (SE 2840.85). The differences in mean total cost and length of stay between patients with minor severity and those with major or extreme severity were significant at a family-wise error rate of 0.05.

Of the 333 hospitalized patients, detailed drug information was available for 133 (39.9%) (Table 7). The most commonly prescribed classes of medications for these patients were antibiotics (82.0%), vitamin supplements (52.6%), asthma medications (49%), analgesics (25.6%), and antivirals (37.6%).

The most commonly prescribed antibiotics were ceftriaxone, erythromycin, and clarithromycin. Of the 109 hospitalized patients who received an antibiotic, only 15 (13.8%) had a secondary diagnosis of bacterial infection.

The most common antiviral prescribed for influenza was amantadine, with 36 hospitalized patients (27.1%) receiving this agent. The total number of units of amantadine used for patient management was 356, or 9.88 units per patient receiving the drug. The mean cost per unit was $1.30 and the mean cost per administration was $10.74. Fourteen patients received rimantadine, accounting for 77 units, or 5.5 units per patient. The mean unit cost was $1.78 and the mean cost per patient receiving the medication was $32.55. Amantadine and rimantadine were dispensed primarily to older patients and those with an APR-DRG severity of mild to major.

Three other medications were dispensed fairly frequently to the hospitalized patients—albuterol (23 patients; mean cost, $10.34), methylprednisolone (21 patients; mean cost, $37.12), and oral nonsteroidal anti-inflammatory drugs (38 patients; mean cost, $7.63).

Influenza-Related Mortality

Five patients died during their hospitalization for influenza. Of this group, 4 patients were older than age 65 and had an APR-DRG severity rating of 2 (moderate) to 4 (extreme). Two patients rated as extreme severity were treated with antiviral therapy (either amantadine or rimantadine).

Table 6. Influenza-Related Nursing Care Required and Associated Costs per Patient (N = 329)*

Type of Nursing Care	No. of Patients	Average No. of Days (SE)	Average Cost ($)(SE)†	Average Charge ($)(SE)†
Overall average	329	4.36 (0.23)	1508.95 (84.27)	1669.99 (112.21)
Routine nursing care	315	4.17 (0.19)	1261.80 (63.79)	1338.67 (61.91)
Telemetry/step-down	26	4.12 (0.84)	1474.39 (265.32)	2369.64 (574.42)
Miscellaneous nursing care	25	0	1110.33 (349.10)	756.98 (282.98)
Intensive care unit	15	2.47 (0.41)	1515.74 (418.32)	2042.69 (585.16)
Holding & observation	11	0.96 (0.18)	269.29 (86.05)	387.55 (106.29)
Cardiac care unit	2	5.00 (3.00)	4454.90 (3650.06)	7510.00 (5970.00)

*Of the 333 hospitalized patients, departmental cost data were not available for 4 patients.
†Costs and charges for nursing care are averaged across only those patients receiving that type of care.

···DISCUSSION ···

This study is the first to measure influenza-related costs for treatment within the ED or after admission to the hospital. For patients discharged directly from the ED, the mean cost of ED care for influenza was approximately $140, with the main contributors to the total cost of care being ED-related supplies and resources, laboratory tests, radiology, general medical care, and medications. Elderly patients tended to require more care than did those in other age groups; consequently, the mean cost of care for patients older than age 65 was significantly higher than that for patients aged 65 or younger.

Approximately 25% of the patients in this study required hospitalization after a visit to the ED for treatment of influenza. The hospitalization rate was higher among elderly patients and those diagnosed with influenza with pneumonia or influenza with nonrespiratory manifestations. The average length of stay for hospitalized patients was 4.3 days, at an average cost of $3251.04.

Smith et al[9] reported that for respiratory conditions other than influenza, 20% of patients account for 80% of direct costs. Our findings support these data. In our study, hospitalized patients, who made up 24% of the sample, accounted for 88% of treatment costs. This finding suggests that a continuum of care aimed at avoiding hospitalization, especially

Table 7. Influenza-Related Medications Used and Associated Costs for Hospitalized Patients (N = 133)*

Medications	No. of Patients†	Total No. of Units Used	Average Units/Visit (SE)	Average Cost/Unit ($) (SE)	Average Cost/Visit‡ ($) (SE)	Average Charge/Visit‡($) (SE)
Symptomatic medications	118 (88.7%)					
Vitamins/minerals	70	645	9.21 (1.22)	2.04 (0.19)	15.96 (2.75)	39.12 (5.08)
NSAIDs	38	189	4.97 (0.67)	1.86 (0.33)	7.63 (1.90)	13.23 (4.52)
Antitussives	7	27	3.86 (1.22)	1.56 (0.30)	6.80 (3.82)	5.89 (1.73)
Hydrocodone/ Acetaminophen	3	29	9.67 (6.17)	1.81 (0.21)	14.92 (7.85)	25.86 (5.70)
Antibiotics	109 (82.0%)					
Ceftriaxone	59	215	3.64 (0.40)	29.00 (2.55)	104.07 (15.14)	343.86 (60.53)
Erythromycin	26	314	12.08 (1.63)	2.81 (0.56)	26.61 (3.81)	119.43 (17.48)
Clarithromycin	14	97	6.93 (1.42)	3.36 (0.75)	24.60 (6.22)	87.45 (25.06)
Ceftizoxime	13	97	7.46 (1.02)	5.38 (0.04)	40.08 (5.45)	158.49 (21.62)
Cefotaxime	11	112	10.18 (2.04)	13.46 (1.99)	137.50 (26.12)	498.14 (94.88)
Azithromycin	11	47	4.27 (0.69)	8.91 (3.13)	30.27 (9.89)	102.97 (26.81)
Cefuroxime	6	45	8.75 (2.10)	7.60 (1.41)	63.42 (21.66)	127.44 (24.96)
Cefazolin	5	55	11.00 (2.65)	4.46 (1.12)	52.35 (17.22)	202.50 (55.20)
SMZ/TMP	5	41	8.20 (1.98)	1.95 (0.92)	12.47 (4.12)	41.30 (10.87)
Asthma medications	65 (48.9%)					
Albuterol	23	80	3.48 (1.07)	7.75 (1.25)	10.34 (1.26)	19.43 (2.32)
Dexamethasone	10	96	9.60 (1.59)	1.12 (0.08)	10.15 (1.63)	50.22 (8.61)
Methylprednisolone	21	142	6.76 (1.59)	4.41 (0.76)	37.12 (14.72)	137.07 (62.12)
Prednisone	11	99	9.00 (2.66)	0.87 (0.17)	6.56 (1.39)	14.01 (2.66)
Antivirals	50 (37.6%)					
Amantadine	36	356	9.88 (2.16)	1.30 (0.10)	10.74 (2.37)	41.01 (12.52)
Rimantadine	14	77	5.50 (0.97)	1.78 (0.10)	10.01 (1.91)	32.55 (5.94)

NSAIDs = nonsteroidal anti-inflammatory drugs; SMZ/TMP = sulfamethoxazole/trimethoprim.
*Detailed drug information was not available for 200 hospitalized patients.
†Because patients may have received more than one medication, the number of patients column does not sum to 133.
‡Average cost (charge) per visit is the average across only those patients receiving the drug.

among high-risk patients such as the elderly, could potentially substantially decrease the costs associated with treating respiratory conditions.

For patients in this study, the rate of hospitalization and cost of treatment increased with age, with 40.8% of hospitalized patients older than age 65. This percentage is somewhat higher than that reported by Sullivan,[5] who estimated that the elderly account for 25% of all influenza-related hospitalizations.[2] Possible reasons for this difference include differences in disease severity or socioeconomic status. The hospitals included in our study were located throughout the United States, whereas the estimate provided by Sullivan[5] was based on hospitalization rates in Houston, Texas.

Murtaugh and Freiman[10] found that the mean length of stay for nursing home residents hospitalized for influenza or pneumonia was 10.8 days. In our study, the mean length of stay for the 14 patients admitted from or discharged to a skilled nursing facility was 13 days. For patients older than age 65 not discharged to or admitted from a nursing home, the mean length of stay was 5.4 days, still higher than that for the rest of the study population. These results suggest that prophylaxis and treatment of influenza in this population could be both clinically and financially beneficial.

Although influenza vaccines do not always prevent the elderly from becoming ill during an outbreak of pneumonia or influenza, vaccination can at least reduce symptom severity and possibly decrease the risk of hospitalization.[1,10] We do not know if any of the patients in our study received an influenza vaccination before being hospitalized; however, previous studies have found that high-risk groups, such as nursing home residents, often are not immunized.[11,12]

To our knowledge, our study is the first to report on antiviral drug use for influenza in a hospital setting. For the 133 hospitalized patients with detailed drug information, 27% received amantadine and 11% received rimantadine. Patients receiving these agents tended to have influenza of mild to moderate severity, although 22% of patients receiving amantadine were in the major or extreme severity groups. Patients older than age 65 accounted for most of the amantadine and rimantadine use, but not significantly more so than their underlying proportion in the hospitalized group.

Patients evaluated and treated for influenza in the ED were primarily diagnosed with influenza with concomitant respiratory manifestations. These patients tended to be younger and have fewer comorbidities. Surprisingly, a number of these patients received an antibiotic before discharge from the ED, and the antibiotics administered tended to be the newer, more expensive agents, such as azithromycin or ceftriaxone. The use of antibiotics in this context is not only unwarranted and ineffective but might also unnecessarily increase the risk of antibiotic resistance. Preventive measures, such as influenza vaccination or outpatient treatment with antivirals, might decrease the number of ED visits and subsequent antibiotic use.

Patients admitted to the hospital for influenza were more likely to be diagnosed with influenza with pneumonia or influenza with other nonrespiratory manifestations. These patients tended to be older and had more comorbidities than did the ED-only group. Drug therapy for this group included antibiotics, asthma medications, and, to a lesser extent, antivirals. The frequency of secondary diagnoses, such as volume depletion and electrolyte disorders, suggests that earlier treatment of these conditions, especially in the elderly, could decrease the need for inpatient care. Early management of underlying conditions associated with influenza and treatment with effective antivirals might also decrease the need for hospitalization in this group.

We acknowledge several limitations to our data analysis. We identified patients based on the presence of an ICD-9 code for influenza. It is possible that patients with influenza seen in an ED received a different primary diagnosis and therefore were not included in our study; the reverse situation could also be true, (ie, a patient without influenza incorrectly received an influenza diagnosis). However, diagnoses in the Perspective Comparative Database are put through an internal validation and editing system that assesses the "correctness" of a diagnosis based on resource utilization and procedure codes. If a diagnosis does not appear to match the treatment the patient received, that diagnosis is reassessed to determine if another diagnosis code is more appropriate. In this way, the risk of incorrect coding of diagnoses is minimized. Thus our estimates of influenza-related costs are conservative, because falsely excluding some patients with influenza is more likely than falsely including patients without influenza.

Another limitation of this study is the lack of knowledge of the underlying population. Because our study population consisted entirely of people who came to the ED for treatment of influenza, we cannot estimate the incidence of influenza cases in the general population. Furthermore, data on outpa-

tient influenza treatment or prophylaxis for the patients are lacking.

Descriptive studies do not lend themselves to causal inferences. This should be kept in mind when evaluating the results of our study. Although we found that certain patient groups had higher rates of hospitalization or treatment costs, we could not assess the intensity or appropriateness of care provided to these patients. Even though it was not possible to validate the diagnosis of influenza for each patient via chart review or subsequent laboratory tests, the resource utilization by patients in this study was similar to that observed in other studies of patients with influenza, and therefore we can assume that the costs presented here are representative of those for influenza care. An important next step is to better define the resources consumed (eg, types of medications used) and to determine the relationship between treatment choices and outcomes, so that optimal treatments can be identified.

To date, few data are available documenting resource utilization and associated costs for patients with influenza treated in the ED or hospital. Our study is the first to measure the true costs (ie, the cost to the hospital for providing treatment) of treating influenza in both these settings. Thus our findings represent a significant addition to the identification of the costs associated with the treatment of influenza, and suggests early intervention care aimed at minimizing the impact of influenza, especially in the elderly, could result in decreased hospitalizations and substantial cost savings to managed care.

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