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Pneumonia in the Elderly Hospitalized in the VA Health Care System

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Abstract

Introduction—Pneumonia is a major cause of hospital admissions and death worldwide, and the Veterans Health Administration (VA) is the largest integrated healthcare organization in the United States. Our aim was to examine trends in admissions for pneumonia in the VA system and compare characteristics and outcomes.

Methods—Data was collected for fiscal years (FY) 2002 through 2007 on patients ≥ 65 years of age hospitalized with pneumonia in the VA health care system. We examined hospitalization rates, mortality, length of stay, intensive care unit admission, and mechanical ventilation.

Results—The case rate of hospital admissions for pneumonia increased slightly during the period of study. However, patients including those requiring management in the ICU, had decreased lengths of stay, as well as decreased 30- and 90-day mortality. The proportion of patients admitted to the ICU remained relatively constant, but fewer received mechanical ventilation with a substantial increase in non-invasive ventilation.

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Conclusion—Hospitalization rates for pneumonia in the VA have increased since 2002. Concomitantly, once admitted these patients have had substantially decreased length of stay and mortality. While ICU admissions have remained steady, there has been a dramatic shift in mechanical ventilation practice towards a non-invasive approach. In the VA pneumonia-related admissions are being managed more effectively even as they are increasing in prevalence.

Keywords

pneumonia; mortality; Department of Veterans Affairs; length of stay

Introduction

In the United States (US), pneumonia (along with influenza) is the eighth leading cause of death and the number one infectious cause of death [1]. In addition, pneumonia is the second leading cause of hospitalization (after child birth) in the United States with > 1.2 million hospitalizations in 2006 [2]. In the last two decades, patients aged 65-84 have had a 20% increase in the number of pneumonia-related hospitalizations[2]. Furthermore, the risk of death during a pneumonia-related hospitalization is significantly higher than many other major causes of hospitalization, as in 2005 it caused 4.6 deaths per 100 discharges versus heart disease (3.7) or all-cause mortality (4.2) [3]. Despite improvements in treatment and management, pneumonia-related mortality was still on the rise in 2005, causing over 63,000 deaths nationally, up 2.5% from the preceding year [1].

The Department of Veterans Affairs (VA) Veteran Health Administration is the largest integrated health care system in the US. Over 95% of the VA patient population is 65 years of age and 26% have at least one major comorbid condition such as respiratory disease, heart disease, or malignancy [4]. Many chronic diseases are found with much greater frequency in the VA, such as chronic obstructive pulmonary disease (COPD), which has a VA prevalence of 16% versus 5-10% in the general public [5]. In 1999, Roselle et al. examined pneumonia in the VA system and showed increasing rates of pneumonia-related hospitalizations but decreasing mortality (unknown follow-up period) from 22.5% in fiscal year (FY) 1991 to 18.1% in FY 1996 [6]. However, the VA system has since undergone considerable change (e.g., from an almost exclusively inpatient emphasis to a comprehensive health care system with both outpatient and inpatient services) and no one has examined the effect, if any, on VA pneumonia care. In addition, important factors such as length of stay, use of vasopressors, rates of mechanical ventilation and/or non-invasive ventilation, and 30- and 90-day mortality rates have not been characterized.

The purpose of this paper is to use the extensive VA administrative databases to examine outpatient-acquired pneumonia (e.g., community-acquired and health-care associated pneumonias) for those 65 years of age and requiring inpatient care in the VA health care system between FY 2002-2007.

Methods

We used data from the administrative databases of the Department of Veterans Affairs health care system to examine trends in pneumonia care and mortality. The VA databases

are the repositories of clinical data from the more than 150 VA hospitals and 850 VA clinics [7]. The Institutional Review Board of the University of Texas Health Science Center at San Antonio approved this study.

Inclusion and Exclusion Criteria

Subjects who were a) aged 65 and older on the date of admission, b) had at least one outpatient clinic visit during the year preceding the index admission, c) received at least one active and filled medication within 90-days of admission, d) were hospitalized during fiscal years 2002-2007, and e) had a previously validated discharge diagnosis of pneumonia/influenza (ICD-9 codes 480.0-483.99 or 485-487) [8] were included in this study. Failure to receive antimicrobial therapy within the first 48 hours after admission was grounds for exclusion.

Data

This study used demographic, utilization, and comorbid condition data from the National Patient Care Database, pharmacy data from the VA Decision Support System, and mortality data from the VA vital status file and inpatient portion of the National Patient Care Database. Encrypted patient identifiers were used to link the information from each database for each subject.

Demographic information (age, sex, race) was obtained from inpatient and outpatient data. Race categories included white, black, Hispanic, and other/unknown.

Comorbid conditions were obtained from inpatient and outpatient administrative data. Charlson's comorbidity score was used to assign a comorbidity score for preexisting comorbid conditions [9, 10]. Charlson's comorbidity score is based on 19 comorbid conditions each of which has an associated prognostic weight, which ranges from 1 to 6. Age was not included in the Charlson score.

Outcomes

Outcomes for this study included rates of pneumonia-related hospitalizations, 30- and 90-day mortality, length of hospital stay, the need for intensive care unit (ICU) care, and mechanical ventilation. We choose 30-day mortality as previous research has demonstrated that 30-day mortality is primarily due to the pneumonia and 90-day mortality is due to other co-existing co-morbid conditions [11]. Mortality was assessed through October 1, 2007 using the VA vital status file. Previous studies have demonstrated that this methodology has a sensitivity of ~98% for veterans' deaths [12].

Statistical Analyses

Bivariate statistics were used to test the association of sociodemographic and clinical characteristics with all-cause 30-day mortality. Categorical variables were analyzed using the chi-square test and continuous variables were analyzed using Student's t-test. All analyses were performed using STATA 9 (College Station, Texas).

Results

Over the 6-year period examined in our cohort, the total number of hospital admissions increased from 395,646 in 2002 to 435,052 in 2007. Over this same time period, all-cause admissions for those 65 years of age decreased by 12.8% from 164,225 to 157,405 while pneumonia-related admissions for the same age range increased by 11.2% from 9,939 in FY 2002 to 11,053 in FY 2007 (Table 1). Overall, the case rate of pneumonia increased by 1% over the 6-year period.

Of the patients with an inpatient stay between FY 2002-2007 (n = 2,492,122), 64,173 subjects (2.6%) met our inclusion criteria (Table 1). Table 2 shows the demographic and comorbid characteristics of the cohort. The mean age was 77.6 years with a standard deviation (SD) of 6.7, 98.2% were male and 53.2% were married. By race and ethnicity, there were 42,180 white patients (65.7%), 7,060 black (11.0%), 1,066 Hispanic (1.7%), 3,246 other (5.1%), and 10,621 (16.6%) patients did not report. Rates of comorbidity ranged from 0.1% of patients with HIV (but not AIDS) to 51.6% with chronic obstructive pulmonary disease.

Between FY 2002 and 2007, the mean patient age increased by 1.9% from 76.7 years (standard deviation [SD] 6.4) to 78.2 years (SD 7.1). The number of male patients was stable at 98.2% to 98.3% and the percentage of married patients decreased from 53.8% (n=5,3470) to 53.3% (n =5,890).

Table 3 shows the results for outcomes of interest over the study period. The mean length of stay decreased 18.7% from 10 days (SD 15.8) in 2002 to 8.2 days (SD 11.5) in 2007. For those who required ICU care, length of stay dropped by 18.8% during the study period from 20.8 days (SD 24.1) to 16.9 days (SD 20.1). For those who did not require ICU admission it changed from 7.4 days (SD 11.4) to 6.1 days (SD 6.8). Regarding mortality, the overall rate of 30-day of mortality for patients decreased 12% from 19.5% in 2002 to 17.12% in 2007, a decrease of 1.7% in ICU patients from 39.5% to 38.8% and 17.5% in non-ICU patients from 14.5% to 11.9%. The overall 90-day mortality decreased 9.9% from 29.4% to 26.5%, a decrease of 5.0% in ICU patients from 55.6% to 52.8% and 11.7% in non-ICU patients from 23.0% to 20.3%.

The number of patients with pneumonia-related hospitalizations requiring treatment in the ICU was essentially stable at 19.9% in 2002 to 19.2% in 2007 (Table 3). Of those patients requiring ICU admission, the number requiring mechanical ventilation decreased from 52.4% (n=1,035) in 2002 to 45.7% (n=973) in 2007 with the use of non-invasive ventilation increasing by 78%.

Conclusion

Pneumonia continues to be one of the most common causes of hospitalization in the VA health care system. While the number of all-cause hospital admissions in the VA has increased nearly 10% in the last five years due in part to the expanding population of veterans created by Operation Iraqi Freedom and Operation Enduring Freedom, there have been decreasing admissions for patients over 65 years of age. Unfortunately, among this

elderly group of patients, the incidence of pneumonia-related admissions has been on the rise.

The increasing incidence of pneumonia-related admissions in the face of waning all-cause admissions for patients over 65 years of age forms a prominent finding from our cohort. This may represent a shift in disease management with a lower clinical threshold for admitting patients whom previously may have received therapy exclusively in an outpatient setting. The concomitant markedly decreased length-of-stay and mortality for non-ICU patients in the face of an increasing admission rate may illustrate the significant strides in the treatment of these patients e.g., JCAHO performance measures [13], increased use of guideline-concordant antibiotics [14,15], and sepsis bundles for ICU patients [16].

The decreasing rate of ICU admissions lends support to the idea that admitting patients earlier in their course of pneumonia prevents its progression to a state requiring intensive care. There may be a similar pattern of early-course admissions to the ICU as these patients have had decreased lengths-of-stay, decreased mortality, albeit not as marked as for the non-ICU patients, and needed less mechanical ventilation. Among those receiving ventilation, a strong shift in favor of non-invasive modalities has appeared and seemingly overtaken the invasive route as the preferred and/or recommended first-line option.

For those patients in our cohort, the average age increased between FY 2002 and FY 2007, which could indicate a combination of better outpatient management of these patients or more effective treatment leading to an increased lifespan and a larger pool of elderly veterans. This was despite the substantial amount of comorbid conditions present in this cohort, including instances of pulmonary disease, diabetes, and malignancy over twice that of a comparable Medicare population [17]. The significant decreases in the average length of stay may be due to attention paid to pneumonia admissions, e.g., JCAHO performance measures, and/or improved use of severity of illness measures [18, 19] for the admission decision. Considering the increased risk of nosocomial infection with prolonged hospitalization, these decreasing lengths of stay will likely decrease the associated morbidity and mortality. This is demonstrated by the decrease in both the 30- and 90-day mortality rates over the time period studied.

The limitations of this study included that we looked exclusively at patients older than 65 years of age and almost all of the male sex, both being established risk factors for hospitalization with pneumonia [20]. Most of our cohort had risk factors for pneumonia and chronic underlying diseases, thus these results may not be applicable to the general, non-VA, population. In addition, variables to calculate severity of illness adjustment such as the pneumonia severity index (PSI) [18] or CURB-65 [19] scores were not available and thus it was not possible to determine if patients were inappropriately admitted or admitted to the inappropriate level of care. Furthermore, we were unable to obtain microbiological culture results and could not analyze any etiologic trends, which would be beneficial to help assess the efficacy of current antibiotic regimens.

Over the last six years, pneumonia has continued to be a significant source of hospital admissions in VA facilities. While the length of stay and mortality rates have been

decreasing for this condition, the successful treatment of pneumonia demands continued vigilance and attention to delivering the best possible care to these patients.

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References

1. Kung, HC., et al. Deaths: Final data for 2005. National Center for Health Statistics; Hyattsville, MD: 2008.
2. AHRQ News and Numbers. Agency for Healthcare Research and Quality; Rockville, MD: 2008. Pneumonia Most Common Reason for Hospitalization.
3. DeFrances CJ, Hall MJ. National Hospital Discharge Survey. Adv Data. 2005; 2007; (385):1–19.
4. Miller DR, et al. Patients' self-report of diseases in the Medicare Health Outcomes Survey based on comparisons with linked survey and medical data from the Veterans Health Administration. J Ambul Care Manage. 2008; 31(2):161–77. [PubMed: 18360178]
5. Spotswood, S. COPD Overshadows Asthma in Veterans. U.S. Medicine. 2006.
6. Roselle GA, et al. 1999; 164(4):293–7.
7. Brown SH, et al. VistA--U.S. Department of Veterans Affairs national-scale HIS. Int J Med Inform. 2003; 69(2-3):135–56. [PubMed: 12810119]
8. Meehan TP, et al. Quality of care, process, and outcomes in elderly patients with pneumonia. JAMA. 1997; 278(23):2080–4. [PubMed: 9403422]
9. Charlson ME, et al. A new method of classifying prognostic comorbidity in longitudinal studies: Development and validation. J Chron Dis. 1987; 40(5):373–383. [PubMed: 3558716]
10. Charlson M, et al. Validation of a combined comorbidity index. J Clin Epidemiol. 1994; 47(11): 1245–1251. [PubMed: 7722560]
11. Mortensen EM, et al. Causes of death for patients with community-acquired pneumonia: results from the Pneumonia Patient Outcomes Research Team cohort study. Arch Intern Med. 2002; 162(9):1059–64. [PubMed: 11996618]
12. Sohn MW, et al. Accuracy and completeness of mortality data in the Department of Veterans Affairs. Popul Health Metr. 2006; 4:2. [PubMed: 16606453]
13. Metersky ML, Galusha DH, Meehan TP. Improving the care of patients with community-acquired pneumonia: a multihospital collaborative QI project. Connecticut Medicine. 1999; 63(7):425–31. [PubMed: 10461412]
14. Mortensen EM, et al. Effects of guideline-concordant antimicrobial therapy on mortality among patients with community-acquired pneumonia. Am J Med. 2004; 117(10):726–31. [PubMed: 15541321]
15. Frei CR, et al. Impact of guideline-concordant empiric antibiotic therapy in community-acquired pneumonia. Am J Med. 2006; 119(10):865–71. [PubMed: 17000218]
16. Gao F, et al. The impact of compliance with 6-hour and 24-hour sepsis bundles on hospital mortality in patients with severe sepsis: a prospective observational study. Crit Care. 2005; 9(6):R764–70. [PubMed: 16356225]
17. Kaplan V, et al. Hospitalized community-acquired pneumonia in the elderly: age- and sex-related patterns of care and outcome in the United States. Am J Respir Crit Care Med. 2002; 165(6):766–72. [PubMed: 11897642]
18. Fine MJ, et al. A prediction rule to identify low-risk patients with community-acquired pneumonia. N Engl J Med. 1997; 336(4):243–50. [PubMed: 8995086]

19. Mandell LA, et al. Infectious diseases society of america/american thoracic society consensus guidelines on the management of community-acquired pneumonia in adults. Clin Infect Dis. 2007; 44(Suppl 2):S27–72. [PubMed: 17278083]
20. Loeb M, et al. Risk factors for pneumonia and other lower respiratory tract infections in elderly residents of long-term care facilities. Arch Intern Med. 1999; 159(17):2058–64. [PubMed: 10510992]

Figure 1.
ICU admissions and use of invasive and non-invasive ventilation incidence per fiscal year

Figure 2.
Percentage change length-of-stay and 30- and 90-day mortality for fiscal years 2002-2007.

Table 1

Admissions to VA Facilities during Fiscal Years 2002 to 2007

	2002	2003	2004	2005	2006	2007	2002- 2007	Change during FY 2002- 2007
All-cause hospital admissions	395,646	397,000	408,409	432,095	423,920	435,052	2,492,122	+10%
Total admissions > 65 years- of-age (%)	164,225 (41.5)	160,833 (40.5)	161,917 (39.7)	161,445 (37.4)	156,583 (36.9)	157,405 (36.2)	962,408 (38.6)	-12.8%
Pneumonia admissions > 65 years (%)	9939 (6.1)	10,407 (6.5)	10,821 (6.7)	11,385 (7.1)	10,568 (6.8)	11,053 (7.0)	64,173	+11.2%

Table 2

Demographic and Comorbid Conditions of Patients with Pneumonia (N=64,173)

Characteristic	N (%)*
Age	77.6 ± 6.7
Men	63,043 (98)
Married	34,140 (53)
Race	
White	42,180 (66)
Black	7060 (11)
Hispanic	1066 (2)
Other/Unknown	13,867 (21)
Charlson Comorbid Conditions	
Myocardial infarction	4723 (7)
Congestive heart failure	16,979 (27)
Peripheral vascular disease	10,240 (16)
Stroke	11,810 (18)
Dementia	3,286 (5)
Chronic lung disease	32,887 (51)
Rheumatologic disease	1832 (3)
Peptic ulcer	2178 (3)
Mild liver disease	675 (1)
Liver failure	312 (0.5)
Diabetes	21,567 (34)
Diabetes with complications	6780 (11)
Hemiplegia or paraplegia	1136 (2)
Renal disease	9302 (14)
Cancer	15,404 (24)
Metastatic cancer	2512 (4)
HIV only	53 (0.1)
AIDS	154 (0.2)

Table 3

Outcomes for Patients during Fiscal Years 2002 to 2007

Outcomes	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	FY 2002-2007	Change during FY 2002-2007
Length of stay								
length of stay mean (SD)	10.0 (15.8)	9.8 (16.5)	9.6 (16.3)	9.2 (16.6)	9.1 (16.1)	8.2 (11.5)	9.3 (15.5)	-18.7%
Not requiring ICU admission mean (SD)	7.4 (11.4)	7.2 (10.5)	6.9 (9.6)	6.5 (8.6)	6.4 (7.6)	6.1 (6.8)	6.7 (9.0)	-17.4%
Requiring ICU admission mean (SD)	20.8 (24.1)	20.4 (27.9)	20.5 (28.5)	20.3 (30.8)	20.2 (30.3)	16.9 (20.1)	19.8 (27.0)	-18.8%
ICU admission/Mechanical Ventilation								
ICU admission, N (%)	1975 (19.9)	2078 (20.0)	2159 (20.0)	2243 (19.7)	2096 (19.8)	2127 (19.2)	12678 (19.8)	-3.5%
Requiring mechanical ventilation, N (%)	1035 (52.4)	1064 (51.2)	1115 (51.6)	1146 (51.1)	1005 (47.9)	973 (45.7)	6338 (50)	-6.0%
Invasive, N (%)	750 (72.5)	691 (64.9)	704 (63.1)	686 (59.9)	480 (47.8)	466 (47.9)	3777 (59.6)	-37.9%
Non-Invasive, N (%)	285 (27.5)	373 (35.1)	411 (36.9)	460 (40.1)	525 (52.2)	507 (52.1)	2561 (40.4)	+77.9%
Mortality								
Mortality at 30-days, N (%)	1933 (19.5)	1989 (19.1)	1993 (18.4)	1981 (17.4)	1882 (17.8)	1892 (17.1)	11670 (18.2)	-12%
ICU	780 (39.5)	818 (39.4)	814 (37.7)	881 (39.3)	856 (40.8)	826 (38.8)	4975 (39.2)	-1.7 %
Non-ICU	1153 (14.5)	1171 (14.1)	1179 (13.6)	1100 (12)	1026 (12.1)	1066 (11.9)	6695 (13)	-17.5 %
Mortality at 90-days, N (%)	2926 (29.4)	3035 (29.2)	3028 (28)	2977 (26.2)	2864 (27.1)	2931 (26.5)	17761 (27.7)	-9.9%
ICU	1098 (55.6)	1122 (54)	1142 (52.9)	1187 (52.9)	1139 (54.3)	1123 (52.8)	6811 (53.7)	-5.0 %
Non-ICU	1828 (23)	1913 (23)	1886 (21.8)	1790 (19.6)	1725 (20.4)	1808 (20.3)	10950 (21.3)	-11.7 %