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Racial and Ethnic Disparities in Pneumonia Treatment and Mortality

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Abstract

Background: The extent to which racial/ethnic disparities in pneumonia care occur within or between hospitals is unclear.

Objective: Examine within and between-hospital racial/ethnic disparities in quality indicators and mortality for patients hospitalized for pneumonia.

Research Design: Retrospective cohort study.

Subjects: 1,183,753 non-Hispanic white, African American and Hispanic adults hospitalized for pneumonia between January 2005 and June 2006.

Measures: 8 pneumonia care quality indicators and in-hospital mortality.

Results: Performance rates for the 8 quality indicators ranged from 99.4% (oxygenation assessment within 24 hours) to 60.2% (influenza vaccination). Overall hospital mortality was 4.1%. African American and Hispanic patients were less likely to receive pneumococcal and influenza vaccinations, smoking cessation counseling, and first dose of antibiotic within 4 hours than white patients at the same hospital (ORs=.65-.95). Patients at hospitals with the racial composition of those attended by average African Americans and Hispanics were less likely to receive all indicators except blood culture within 24 hours than patients at hospitals with the racial composition of those attended by average whites. Hospital mortality was higher for African

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Americans (OR=1.05, 95% CI=1.02,1.09) and lower for Hispanics (OR=.85, 95% CI=.81,.89) than for whites within the same hospital. Mortality for patients at hospitals with the racial composition of those attended by average African Americans (OR=1.21, 95% CI=1.18,1.25) or Hispanics (OR=1.18, 95% CI=1.14,1.23) was higher than for patients at hospitals with the racial composition of those attended by average whites.

Conclusions: Racial/ethnic disparities in pneumonia treatment and mortality are larger and more consistent between hospitals than within hospitals.

Keywords

Health disparities; pneumonia; quality of care

Pneumonia leads to 1.2 million hospital admissions annually in the United States at a cost exceeding $8 billion, and, combined with influenza, represents the 8th leading cause of death in the country.[1–3] Although certain processes of care recommended for patients who develop pneumonia are cost-effective prevention strategies (e.g., pneumococcal and influenza vaccination),[4–9] and others have been associated with reduced mortality for patients hospitalized for pneumonia (e.g., appropriate and timely initial antibiotic therapy),[10–14] there is wide variation across hospitals in the performance of many of the quality measures recommended for patients with pneumonia.[15] Moreover, there has been concern that these quality measures are not performed uniformly across patients from all racial and ethnic groups. Given that pneumonia accounts for over 5% of the overall difference in potential life-years lost to death between African Americans and Non-Hispanic whites,[16] it is important to understand whether systematic racial and ethnic differences exist in the management of pneumonia.

The current study investigates whether there are racial and ethnic disparities in quality of care and outcomes for patients hospitalized for pneumonia. Previous studies have found that racial/ethnic minorities are less likely than whites to receive some, but not all, recommended processes of care for pneumonia.[17–23] For example, minorities hospitalized for pneumonia are less likely than whites to receive antibiotics within 8 hours of presentation or smoking cessation counseling.[20–22] In contrast, minorities and whites are equally likely to have blood cultures conducted prior to receiving antibiotics and to receive appropriate antibiotics.[21, 22] Whether there are racial disparities in pneumonia-related mortality is unclear, as documented mortality rates for African Americans hospitalized for pneumonia have been similar[19, 24, 25] or lower[21, 26, 27] than for patients of other races.

Prior investigations of disparities in pneumonia care have been limited in that they examined relatively few quality indicators, included data from a small number of hospitals, or combined all minority patients into a single category or compared just one minority group (e.g., African Americans) with whites.[20–23] Prior work has also provided little information about whether disparities in pneumonia care occur because racial/ethnic minorities receive lower quality of care than whites within the same hospital (i.e., within-hospital disparities) and/or because minorities are more likely than whites to receive care in hospitals that deliver poorer quality of care overall (i.e., between-hospital disparities). Two studies have documented that hospitals serving higher concentrations of African American and Hispanic

patients have lower performance on pneumonia quality indicators,[17, 18] while a third found that differences between minority and white patients in pneumonia quality indicators were attenuated after controlling for site of care.[20] These studies indicate that disparities in pneumonia care are due, at least in part, to differences in where minority and white patients receive care. However, these studies offer no information on the relative magnitude of within- and between-hospital disparities.

The objectives of the current study were to examine racial/ethnic disparities in pneumonia care and in-hospital mortality for African American, Hispanic, and non-Hispanic white adults hospitalized for pneumonia, and to examine the extent to which such disparities occur within and between hospitals. By examining 8 process quality indicators and mortality in a sample of patients from over 95% of acute-care hospitals in the United States, our goal was to provide a comprehensive account of racial/ethnic variation in the management of pneumonia.

Methods

Patient Sample

Patient-level data from the Quality Improvement Organization Clinical Data Warehouse, an electronic data repository created by the Centers for Medicare & Medicaid (CMS), were analyzed. Greater than 95% of acute care hospitals paid under the CMS Inpatient Prospective Payment System (therefore excluding military or Veterans Affairs hospitals) submit all-payer data (including Medicare and non-Medicare) to this repository on over one million pneumonia cases per year.[28] All elements in the database were abstracted from medical records by chart reviews conducted by hospital personnel using uniform instructions. All abstracted medical record data were subject to randomly selected and independently performed validation audits conducted by a CMS contractor on a quarterly basis. Specification manuals containing the complete guidelines for data abstraction are available online.[29]

We selected pneumonia cases that occurred between January 2005 and June 2006. The initial sample included all patients aged 18 years or older with a principal diagnosis of pneumonia at the time of discharge, as identified by the *International Classification of Disease 9th Revision – Clinical Modification* (ICD−9−CM) codes 481–483.8, 485, 486, or 487.0. The sample also included patients with a principal diagnosis of septicemia (ICD-9-CM 038.0–038.9) or respiratory failure (ICD-9-CM 518.81 or 518.84) and a secondary diagnosis of pneumonia. Although these codes do not guarantee a diagnosis of community-acquired pneumonia, patients with hospital acquired pneumonia were largely excluded by selecting patients based on their principal diagnosis and using a medical review to confirm a working diagnosis of pneumonia at the time of admission. Patients were further defined as at risk for healthcare associated pneumonia if they stayed in a hospital, nursing home, or extended care facility within the last 90 days, or if they received dialysis, wound care, tracheostomy care, or ventilator care within the last 30 days. Twenty-nine percent of patients in the sample met these criteria.

As in previous studies examining pneumonia care, we excluded patients who did not have pneumonia as a working diagnosis at admission (physician documentation of the diagnosis of pneumonia written before or at admission), died on the day of admission, received comfort measures only (documentation of palliative care), left the hospital against medical advice, were transferred from or discharged to another acute care hospital, or received no antibiotic therapy during their hospital stay.[13, 21, 30] These characteristics were existing elements in the database. We also excluded patients who were from U.S. territories; had AIDS or HIV; had missing race/ethnicity or gender; had a race/ethnicity other than non-Hispanic white, African American, or Hispanic; remained hospitalized longer than 90 days; or had missing data on all study outcomes.

Measures

Patient characteristics.—Patient age, sex, race/ethnicity, insurance status, and presence of comorbid conditions were included in the analyses. Hospitals reported patient race as white, Black or African American, American Indian or Alaska Native, Asian, Native Hawaiian or Pacific Islander, and other; Hispanic or Latino ethnicity was reported as a separate variable. We created 4 mutually exclusive racial/ethnic categories: non-Hispanic whites, non-Hispanic African Americans, Hispanics (of all races), and other race/ethnicity. The other race/ethnicity group was excluded from analyses due to the relatively small proportion of patients in this group (3%) and the difficulty of drawing conclusions about them due to their heterogeneous nature (23% were American Indian or Alaska Native, 50% were Asian, 6% were Native Hawaiian or Pacific Islanders, and 21% were other). Hospitals reported all sources of payment as Medicare, Medicaid, and/or other, or indicated no insurance/not documented/unable to determine. We created an insurance variable with 3 mutually exclusive categories: Medicaid with or without other insurance, other insurance, and no insurance/unable to determine. The following comorbid conditions were identified using ICD-9-CM codes specified by Romano and colleagues[31]: cancer, liver disease, myocardial infarction, heart failure, chronic pulmonary disease, cerebrovascular disease (including hemiplegia or paraplegia), renal disease, peripheral vascular disease, dementia, rheumatologic disease, peptic ulcer disease, and diabetes.

Hospital characteristics.—Hospital characteristics were obtained from the 2005 CMS Inpatient Prospective Payment System Impact File and a CMS database maintained via the Online Survey Certification and Reporting System.[32] Hospital characteristics included rural or urban location, bed size, teaching status, and geographic location (4 U.S. census regions). Number of beds and teaching status were highly correlated and were therefore combined into a single categorical variable: large/teaching, large/non-teaching, small-medium/teaching, and small-medium/non-teaching. “Large” hospitals were those with >268 beds (75^{th} percentile).

Quality indicators.—We assessed 8 processes of care designated by CMS and the Joint Commission as quality indicators for the treatment of pneumonia: 1) oxygenation assessment within 24 hours of admission, 2) administration of pneumococcal vaccination, 3) blood culture within 24 hours of admission, 4) blood culture before first dose of antibiotic, 5) smoking cessation counseling, 6) first antibiotic dose administered within 4 hours of

presentation, 7) appropriate antibiotic selection within 24 hours of admission, and 8) administration of influenza vaccination.[33] According to CMS and Joint Commission specifications, oxygenation assessment and appropriate antibiotic selection were indicated for all patients. Blood culture within 24 hours was restricted to patients who were transferred or admitted to the intensive care unit within 24 hours of hospital arrival. Blood culture before antibiotic was restricted to patients who received a blood culture in the emergency department. Smoking cessation counseling was applicable to patients who had documentation in their medical record of having smoked cigarettes anytime during the previous year. Appropriate antibiotic selection was applicable to immunocompetent patients with community-acquired pneumonia. Excluded from this measure were immunocompromised patients (i.e, those with AIDS, cystic fibrosis, prior hospitalization within 14 days, or chemotherapy, systemic immunosuppressive therapy, leukemia, lymphoma, or radiation therapy within the past 3 months) and those at-risk for healthcare associated pneumonia, as defined previously. Pneumococcal vaccination was applicable to those 65 or older and influenza vaccination was applicable to those 50 or older who were discharged between October and February. Patients were counted as achieving the pneumococcal and influenza vaccination measures if they received them during their hospital stay, or if they were not vaccinated due to documented contraindications, documented vaccination prior to admission, or refusal of the vaccination.

Completion rates of each quality indicator were calculated by dividing the number of patients who had an indicator completed by the number of patients who were eligible for it. We also calculated a composite measure to assess the extent to which patients received all quality indicators for which they were eligible. We utilized an “observed-minus-expected” (O-E) composite measure to take into account that overall performance was higher on some indicators than on others (e.g. overall performance was 99.4% for oxygenation assessment and 60.2% for influenza vaccination).[34] Observed scores were the number of indicators each patient had completed divided by the number for which they were eligible (possible range of 0 – 100%). Expected scores were the average population performance rate for the indicators that were applicable to each patient. The composite consisted of the observed scores minus the expected scores. For example, a patient who was eligible for 6 indicators and had 3 completed would have an observed score of 50%. If the average population performance rate across the 6 measures for which the patient was eligible was 80% (i.e., the expected score), the patient’s O-E composite would be −30%. This would indicate that 30% fewer quality indicators were completed for that patient than would be expected given the population completion rates for the relevant indicators.

In-hospital mortality.—We also examined in-hospital mortality, which was defined as deaths that occurred within 30 days of admission while the patient was in the hospital. Vital status after discharge was not available to ascertain overall 30-day mortality.

Statistical Analyses

We examined unadjusted differences in completion rates for each quality indicator, the O-E composite, and hospital mortality across the 3 racial/ethnic groups using chi-square tests for categorical outcomes and analysis of variance for continuous outcomes. We used

generalized linear mixed model regression to examine the effects of patient race/ethnicity on these measures, adjusting for patient (i.e., age, sex, insurance status, and comorbid conditions) and hospital (i.e., rural versus urban, bed size/teaching status, and geographic region) characteristics. Linear models were used for the O-E composite measure and logistic models for the other measures. Random intercepts were used for each hospital.

We partitioned the effect of patient race/ethnicity into within-hospital and between-hospital components. Within-hospital effects were estimated by including 2 patient-level terms, one for African Americans and one for Hispanics. These terms were computed as a standard dummy variable for each minority group (1 = patient belongs to the minority group, 0 = patient does not belong to that group) minus the proportion of patients in our analytic sample who were treated for pneumonia at the hospital and who belong to that minority group. The within-hospital effects provide an estimate of the difference in outcome for a patient of a given race/ethnicity compared to an otherwise identical white patient at the same hospital. The between-hospital effects were estimated by including 2 hospital-level variables indicating the proportion of African American and Hispanic pneumonia patients in our analytic sample at the hospital where the patient was treated. The between-hospital effects estimate the effect of a hospital's proportion of African American or Hispanic pneumonia patients on the study outcomes. Use of this approach allows for direct estimation of the within-hospital and between-hospital effects of race/ethnicity without making assumptions about the association of within-hospital and between-hospital effects, as do methods that estimate these effects individually.[35, 36]

Rescaling of between-hospital effects.—The between-hospital effects estimate the differences in outcomes for patients at a hospital where 100% of patients belong to a given racial/ethnic group compared to a hospital where 0% of patients belong to that group. Given that few hospitals have predominantly-minority patient populations, we rescaled the between-hospital effects to reflect the racial composition of hospitals attended by typical patients of each racial/ethnic group in our sample. For example, for African Americans we identified the median African American concentration such that half of the African Americans in the sample attended hospitals with that concentration or more of African Americans and half attended hospitals with fewer African Americans. Similarly, we identified the median concentration of African Americans at hospitals attended by whites. We scaled the between hospital effects by multiplying the between-hospital parameter estimates by the difference in these two values. For dichotomous outcomes, scaled odds ratios were computed in the standard way: by exponentiating the scaled parameter estimates. The scaled between hospital effects indicate the effect of hospital racial/ethnic concentration for the typical patient from each racial/ethnic group compared to the typical white patient. All analyses were conducted using SAS Version 9.1 (SAS Institute Inc, Cary, NC).

Human Subjects Review

The use of the data and analytic plan for the current study were approved by the Institutional Review Board at the Veterans Affairs Pittsburgh Healthcare System.

Results

Our sample was drawn from 4,527 hospitals, of which 54.3% were urban and 68.1% were small-to-medium/non-teaching (Table 1). Of the 1,761,953 patients hospitalized for pneumonia at these hospitals, 1,183,753 (67.2%) met all eligibility criteria (Figure 1). The final study population was 82.5% non-Hispanic white, 11.4% African American, and 6.1% Hispanic. Overall, 53.7% of all patients were women, 82.3% had insurance other than Medicaid, and their mean age was 70 years (Table 2). There was significant variation in demographic characteristics across racial/ethnic subgroups (Table 2).

Patients were most often hospitalized in urban areas (75.0%) and were most often treated at small-to-medium, non-teaching (43.0%) or large, teaching hospitals (31.8%). African American and Hispanic patients were treated at urban and large/teaching hospitals significantly more often than white patients (Table 2). African American and Hispanic patients were also more likely than whites to be admitted to hospitals with diverse patient populations. For whites, the median concentration of African American pneumonia patients admitted to the same hospital was 4%; in contrast, the median concentration of African American patients at hospitals attended by African Americans was 27%. The median concentrations of Hispanic pneumonia patients at hospitals attended by whites and Hispanics were 1% and 29%, respectively. The differences of these values (27%−4%=23% and 29% −1%−28%, respectively) were used to scale the between-hospital effects.

Quality Indicators

Overall performance rates on quality indicators ranged from 99.4% for oxygenation assessment within 24 hours to 60.2% for influenza vaccination (Table 3). Although there were statistically significant ($p<.001$) differences across racial/ethnic groups for all 8 indicators, only 4 of the indicators displayed clinically meaningful differences (Table 3). Specifically, pneumococcal vaccination was completed for 67.7% of whites, compared to 53.8% for African Americans and 52.9% for Hispanics, with a similar pattern observed for influenza vaccination. First antibiotic dose within 4 hours was also achieved more frequently for whites (77.9%) than for African Americans (70.0%) or Hispanics (70.7%). Finally, smoking cessation counseling was completed for more whites (81.6%) than for Hispanics (76.1%).

Unadjusted performance on the O-E composite was significantly lower ($p<.001$) for African Americans and Hispanics than for whites (Table 3). Whites, on average, received 0.4% more quality indicators than would be expected given population performance rates. In contrast, African Americans and Hispanics received 3.5% and 4.0% fewer quality indicators, respectively, than expected.

In adjusted models, the within-hospital effects of patient race/ethnicity indicated that the odds of receiving a pneumococcal vaccination was significantly lower for African Americans (OR=.65) and Hispanics (OR=.73) compared to whites treated in the same hospital (Table 4). This was also the case for smoking cessation counseling (OR=.87 and .85 for African Americans and Hispanics, respectively), first antibiotic dose within 4 hours (OR=.89 and .95), and influenza vaccinations (OR=.70 and .78). Within-hospital effects for

the remaining measures were less consistent, with performance being roughly equivalent or better for at least one minority subgroup compared to whites. According to the O-E composite, African Americans and Hispanics each had significantly (p<.001) fewer quality indicators completed than expected, compared to whites at the same hospital (−1.6% and −0.9%, respectively).

There were consistent between-hospital effects of racial/ethnic patient concentration on the quality indicators. Patients who received care at hospitals that served higher concentrations of African American or Hispanic patients had significantly lower odds of receiving 7 of the 8 quality indicators, with the exception of blood culture within 24 hours (Table 4). These effects were substantial, even after rescaling them to reflect the racial composition of hospitals observed in our sample: scaled ORs ranged from .66 to .90 for African American patient concentration and from .61 to .90 for Hispanic patient concentration (Table 4). Performance on the O-E composite was also significantly lower (p<.001) for patients who attended hospitals with higher concentrations of African American or Hispanic patients (scaled estimates = −2.7% and −2.4%, respectively).

Hospital Mortality

Unadjusted hospital mortality was significantly higher (*p*<.001) for African Americans (4.5%) and Hispanics (4.6%) compared to whites (4.1%). In adjusted models, within-hospital effects indicated that African Americans had significantly higher odds of mortality compared to whites treated at the same hospital (OR=1.05, 95% CI=1.02–1.09), while Hispanics had significantly lower odds of mortality (OR=0.85, 95% CI=.81-.89). Between-hospital effects indicated that patients at hospitals with 100% African American patients and 100% Hispanic patients were 2.31 (95% CI=2.05–2.61) and 1.83 (95% CI=1.60–2.09) times more likely to experience hospital death, compared to patients at hospitals with 0% of each minority subgroup (scaled OR [95% CI]=1.21 [1.18,1.25] and 1.18 [1.14,1.23], respectively).

Discussion

This study provides evidence of within-hospital and between-hospital racial/ethnic disparities in processes of care and hospital mortality for patients hospitalized for pneumonia. Compared to white patients at the same hospital, African Americans and Hispanics had lower odds of receiving pneumococcal vaccination, smoking cessation counseling, first antibiotic dose within 4 hours, and influenza vaccination. Moreover, patients at hospitals serving higher concentrations of African American and Hispanic patients had lower odds of receiving 7 of 8 recommended quality indicators. Mortality was higher for African Americans than for whites within the same hospital, as well as for patients treated at hospitals with higher concentrations of African Americans or Hispanics. Hispanics had lower mortality than whites within the same hospital. Although this might seem surprising, it is consistent with the “Hispanic paradox”, which refers to the fact that Hispanics often have better health outcomes than the general population even though one would expect poorer health outcomes given their relative socio-economic position.[37, 38]

Our focus on whether disparities occur within and/or between hospitals is relevant to on-going efforts to understand the source of racial/ethnic disparities so that appropriate steps can be taken to address them.[39] Although we found evidence of within-hospital and between-hospital disparities, the between-hospital disparities were more striking. Not only were between-hospital disparities observed for more processes of care (7 vs. 4), they tended to be of greater magnitude. For instance, the within-hospital disparity on blood culture before antibiotic for African American patients (OR=.97) was almost 10% smaller than the corresponding between-hospital disparity (scaled OR=.89). Similar differences in magnitude existed for first antibiotic dose administered within 4 hours (within-hospital and scaled between-hospital OR: .89 and .82 for African American race; .95 and .86 for Hispanic ethnicity).

The consistent and large between-hospital disparities observed in the current study support the argument that racial/ethnic disparities exist because minority patients are concentrated in lower-performing medical facilities.[17–20, 40, 41] There are several reasons why facilities with high concentrations of minority patients may provide lower-quality care, such as being larger, having lower nurse-staffing levels, and obtaining more revenue from Medicaid.[17, 18] It is also possible that patients at such hospitals have poorer health overall, which could contribute to poorer outcomes (e.g., mortality). We attempted to account for some of these factors by controlling for hospital size, location, and teaching status, source of payment at the patient level, and comorbid illnesses. Nevertheless, we still observed considerable between-hospital disparities on the majority of outcomes.

Our results suggest that efforts to reduce racial/ethnic disparities in pneumonia care should focus on improving performance at hospitals with large minority patient populations. Existing quality-improvement programs typically encompass all hospitals, regardless of performance, and tend to utilize financial incentive programs that reward top performing hospitals and penalize low performing hospitals. Financial incentives based on relative performance across institutions, however, may inadvertently increase disparities between institutions.[42] Incentive programs aimed at improving low-performing hospitals may therefore need to be designed to reward absolute improvements rather than relative performance.

This study had several limitations. Although we were able to control for patients' age, sex, insurance status, and comorbid conditions, we were unable to adjust for severity of the pneumonia.[43] Given that the database contained limited patient demographic information, we were also unable to control for potential confounders such as patient socio-economic status. The observed racial and ethnic differences may therefore have been driven by differences in economic resources. The lack of extensive patient background information is one downside to using a national database of almost all pneumonia cases versus collecting in-depth data on a smaller sample.

When interpreting the study findings, one should also keep in mind that cases of healthcare associated pneumonia were included in all analyses except those examining appropriate antibiotic selection, which is the only process of care that CMS and the Joint Commission have restricted to patients with community-acquired pneumonia. Furthermore, one should

consider that for quality indicators such as vaccinations, patients satisfied the measure if they received the vaccination prior to hospitalization, making it possible that some of the observed disparities are due to differences in outpatient care prior to hospitalization. Finally, with the data available to us we were only able to assess in-hospital rather than 30-day mortality. Although it would have been preferable to assess 30-day mortality, in-hospital mortality has been shown to be an acceptable substitute when 30-day mortality data are unavailable.[44]

This study also had several strengths. Most notable is that it utilized a large national database that included patient-level data on pneumonia hospitalizations from over 4,000 hospitals, making our findings highly generalizable. Additional strengths were that we examined disparities in 8 quality indicators and hospital mortality across the 3 largest racial/ethnic groups in the United States, thus providing a more comprehensive assessment of disparities in pneumonia care and outcomes than previous studies. We also partitioned the effects of patient race into within-hospital and between-hospital effects, which was not possible in prior studies that relied on hospital-level data.[17, 18]

Our findings indicate that racial/ethnic disparities in pneumonia care occur both within and between hospitals, but that between-hospital disparities are more consistent across measures and are often of greater magnitude. Our comprehensive study of pneumonia quality indicators in a large number of hospitals adds substantial support to the emerging consensus that racial/ethnic disparities are largely due to such patients being treated in low-performing hospitals. Targeted efforts to improve quality of care at hospitals serving large minority populations are likely to be the most effective way to reduce racial/ethnic disparities in pneumonia management.

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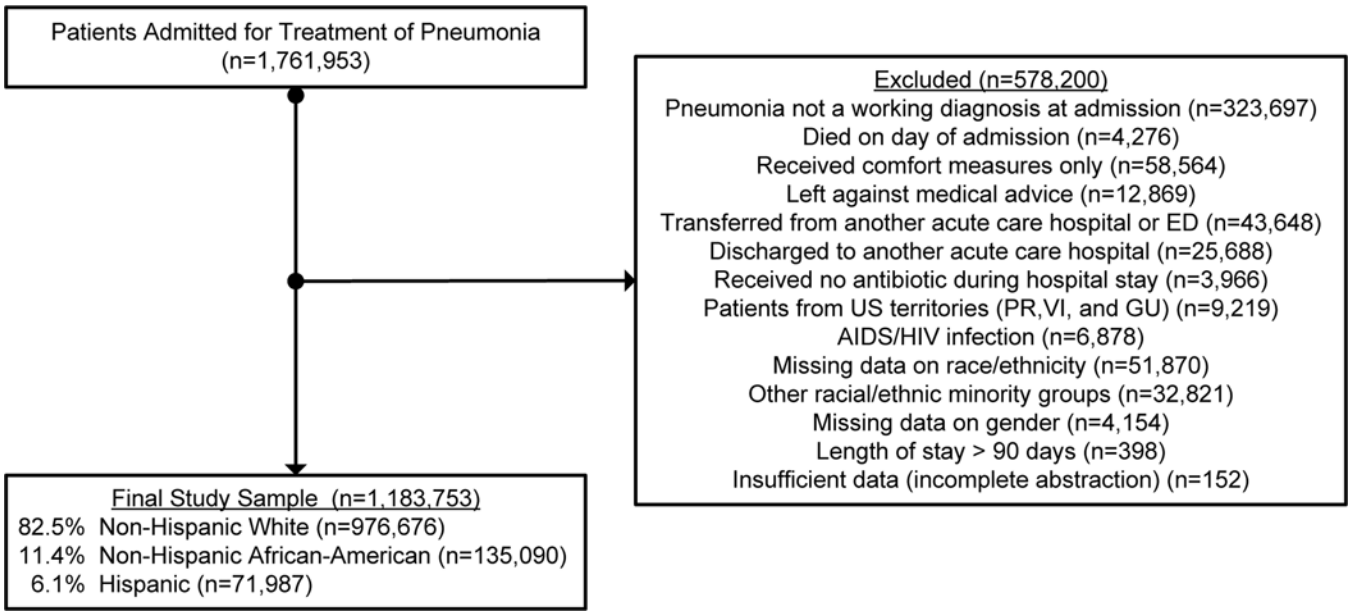

Figure 1:
Identification of the Study Sample

Table 1:

Hospital Characteristics

	Frequency (N = 4,527)	
Hospital Characteristics	**Number**	**Percent**
Urban	2,456	54.3
Bed Size/Teaching Status		
Large/Teaching	747	16.5
Large/Non-Teaching	393	8.7
Small-Medium/Teaching	303	6.7
Small-Medium/Non-Teaching	3,084	68.1
Geographic Region		
Northeast	622	13.7
Midwest	1,347	29.8
South	1,745	38.5
West	813	18.0

Table 2:

Baseline Characteristics of a National Sample of Adults Hospitalized for Pneumonia

Patient Characteristics	Total Sample (N=1,183,753)	Non-Hispanic White (n=976,676)	Non-Hispanic African American (n=135,090)	Hispanic (n=71,987)	*p value
Demographics					
Age, mean (SD)	70 (17)	71 (16)	61 (18)	66 (19)	<.0001
Women (%)	53.7	53.6	54.5	52.6	<.0001
Insurance status (%)					<.0001
Medicaid with or without other Insurance	13.9	11.1	25.8	29.1	<.0001
Other Insurance (Medicare or private)	82.3	85.9	66.5	63.0	<.0001
No insurance or unable to determine	3.8	3.0	7.6	7.9	<.0001
Comorbid Conditions (%)					
Chronic pulmonary disease	50.3	52.5	39.5	41.0	<.0001
Heart failure	26.8	27.4	24.1	23.4	<.0001
Diabetes	25.1	23.7	30.5	34.1	<.0001
Cancer	7.6	7.8	7.3	5.9	<.0001
Myocardial infarction	6.4	6.7	4.6	4.7	<.0001
Renal disease	4.9	4.5	7.3	6.0	<.0001
Cerebrovascular disease	4.9	4.8	6.0	5.1	<.0001
Peripheral vascular disease or hemiplegia or paraplegia	4.4	4.6	3.8	3.4	<.0001
Rheumatologic disease	3.2	3.2	3.3	3.0	<.0001
Dementia	1.6	1.6	1.5	1.4	<.0001
Peptic ulcer disease	1.1	1.1	1.1	1.2	0.11
Liver disease	1.0	0.9	0.9	2.2	<.0001
Types of Hospitals Attended					
Urban (%)	75.0	72.3	85.7	91.3	<.0001
Bed size/teaching status (%)					
Large/teaching	31.8	28.4	49.7	44.1	<.0001
Large/non-teaching	17.2	17.3	16.5	16.9	<.0001
Small-medium/teaching	8.0	8.1	7.9	7.1	<.0001
Small-medium/non-teaching	43.0	46.2	26.0	32.0	<.0001
Geographic region (%)					
Northeast	18.6	19.1	16.0	16.7	<.0001
Midwest	25.1	27.0	21.3	6.9	<.0001
South	41.5	39.5	55.0	42.7	<.0001
West	14.8	14.4	7.6	33.7	<.0001

* Comparisons across the three racial/ethnic groups were made using analysis of variance for age and chi-square tests for all other variables.

Table 3:

Unadjusted Performance on Quality Indicators by Race and Ethnicity

Quality Indicator	Total Sample (N=1,183,753)		Non-Hispanic White (n=976,676)		Non-Hispanic African American (n=135,090)		Hispanic (n=71,987)	
	n	(%)	n	(%)	n	(%)	N	(%)
Oxygenation assessment within 24 hours								
Eligible	1,183,577		976,542		135,063		71,972	
Completed	1,176,152	(99.4)	970,748	(99.4)	134,075	(99.3)	71,329	(99.1)
Pneumococcal vaccination								
Eligible	743,166		647,964		55,984		39,218	
Completed	489,540	(65.9)	438,702	(67.7)	30,102	(53.8)	20,736	(52.9)
Blood culture within 24 hours								
Eligible	403,876		331,600		49,085		23,191	
Completed	325,796	(80.7)	265,338	(80.0)	41,064	(83.7)	19,394	(83.6)
Blood culture before antibiotic								
Eligible	902,555		736,176		108,547		57,832	
Completed	769,485	(85.3)	631,240	(85.7)	90,032	(82.9)	48,213	(83.4)
Smoking cessation counseling								
Eligible	262,227		210,059		40,018		12,150	
Completed	212,866	(81.2)	171,391	(81.6)	32,228	(80.5)	9,247	(76.1)
First antibiotic dose within 4 hours								
Eligible	977,587		799,390		116,835		61,362	
Completed	748,147	(76.5)	622,940	(77.9)	81,834	(70.0)	43,373	(70.7)
Appropriate antibiotic selection								
Eligible	792,888		653,204		88,686		50,998	
Completed	647,109	(81.6)	533,943	(81.7)	71,972	(81.2)	41,194	(80.8)
Influenza vaccination								
Eligible	395,532		334,902		37,732		22,898	
Completed	238,044	(60.2)	208,699	(62.3)	18,196	(48.2)	11,149	(48.7)
Observed – Expected Composite								
Mean (Standard Deviation)	−0.3	(19.1)	0.4	(18.9)	−3.5	(19.5)	−4.0	(20.0)

Note: Overall tests for differences by race/ethnicity are significant for all measures. All pairwise comparisons between racial/ethnic minority groups and whites are significantly different at $p < .0001$.

Table 4:

Adjusted within-hospital and between-hospital effects of race and ethnicity on quality indicators[†]

		Within-Hospital Effects[††]		Between-Hospital Effects[†††]		Scaled Between-Hospital Effects[††††]	
Measure	**Race/Ethnicity**	**OR**	**(95% CI)**	**OR**	**(95% CI)**	**Scaled OR**	**(95% CI)**
Oxygenation assessment	**African American**	**1.19**	**(1.10,1.30)**	**0.18**	**(0.13,0.26)**	**0.68**	**(0.62,0.73)**
within 24 hours	**Hispanic**	**1.01**	**(0.90,1.14)**	**0.17**	**(0.11,0.26)**	**0.61**	**(0.54,0.68)**
Pneumococcal	**African American**	**0.65**	**(0.64,0.67)**	**0.16**	**(0.12,0.20)**	**0.66**	**(0.62,0.69)**
Vaccination	**Hispanic**	**0.73**	**(0.71,0.76)**	**0.34**	**(0.26,0.45)**	**0.74**	**(0.69,0.80)**
Blood culture	**African American**	**1.04**	**(1.01,1.08)**	**1.06**	**(0.86,1.29)**	**1.01**	**(0.97,1.06)**
within 24 hours	**Hispanic**	**1.06**	**(1.01,1.11)**	**1.11**	**(0.88,1.39)**	**1.03**	**(0.97,1.10)**
Blood culture	**African American**	**0.97**	**(0.95,0.99)**	**0.61**	**(0.54,0.70)**	**0.89**	**(0.87,0.92)**
before antibiotic	**Hispanic**	**1.01**	**(0.98,1.04)**	**0.67**	**(0.59,0.78)**	**0.90**	**(0.86,0.93)**
Smoking	**African American**	**0.87**	**(0.83,0.90)**	**0.51**	**(0.39,0.68)**	**0.86**	**(0.80,0.92)**
cessation counseling	**Hispanic**	**0.85**	**(0.80,0.90)**	**0.55**	**(0.40,0.77)**	**0.85**	**(0.77,0.93)**
First antibiotic	**African American**	**0.89**	**(0.87,0.90)**	**0.43**	**(0.38,0.49)**	**0.82**	**(0.80,0.85)**
dose within 4 hours	**Hispanic**	**0.95**	**(0.93,0.97)**	**0.57**	**(0.50,0.65)**	**0.85**	**(0.82,0.89)**
Appropriate	**African American**	**1.04**	**(1.02,1.06)**	**0.63**	**(0.55,0.71)**	**0.90**	**(0.87,0.92)**
antibiotic selection	**Hispanic**	**1.10**	**(1.07,1.14)**	**0.61**	**(0.53,0.71)**	**0.87**	**(0.84,0.91)**
Influenza	**African American**	**0.70**	**(0.68,0.72)**	**0.19**	**(0.15,0.24)**	**0.69**	**(0.65,0.72)**
Vaccination	**Hispanic**	**0.78**	**(0.76,0.81)**	**0.39**	**(0.30,0.50)**	**0.77**	**(0.72,0.83)**
		Estimate	**(95% CI)**	**Estimate**	**(95% CI)**	**Scaled Estimate**	**(95% CI)**
O-E Composite	**African American**	**−1.6**	**(−1.77,−1.53)**	**−11.8**	**(−13.29,−10.23)**	**−2.7**	**(−3.06,−2.35)**
	Hispanic	**−0.9**	**(−1.07,−0.73)**	**−8.7**	**(−10.41,−6.94)**	**−2.4**	**(−2.91,−1.94)**

[†]Models adjusted for patient age, gender, insurance status, comorbidities, and hospital urban/rural status, size/teaching status, and U.S. region.

[††]Within-hospital ORs represent the odds of an outcome for patients of the given race/ethnic group compared to white patients within the same hospital.

[†††]Between-hospital ORs represent the odds of an outcome for patients treated at hospitals where 100% of pneumonia patients are of the given race/ethnic group compared to patients at hospitals where 0% of pneumonia patients or of that group.

[††††]Scaled between-hospital ORs are transformations of the original between-hospital ORs and are provided to aid interpretation of the effects with regard to the racial composition of hospitals observed in our sample. They represent the effect of hospital racial composition for the typical patient from each racial/ethnic group compared to the typical white patient (see Methods for full details).