Ambulatory Care–Sensitive Condition Hospitalizations Among Medicare Beneficiaries

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Introduction: This study examined the association between the distribution of primary care physicians and Medicare beneficiaries' ambulatory care sensitive condition hospitalizations using both statistical and spatial analyses.

Methods: Data from the 2014 County Health Rankings, 2013–2014 Area Resource File, and the 2014 Food Environment Atlas Data File were integrated to perform county-level ordinary least squares and geographically weighted regression. Analyses were conducted in late 2015.

Results: Primary care physician density was found to be negatively associated with Medicare beneficiaries' ambulatory care sensitive condition hospitalization rate in both ordinary least squares (β=−5.88, p=0.0037) and geographically weighted regression models (37.08% of all counties), with the latter model finding significant relationships in the South and Northeast.

Conclusions: Preventable hospitalizations are high in areas of the U.S. that have low primary care physician density and other healthcare resources, large non-white populations, high levels of area deprivation, and rural designations. Using geospatial techniques helped document areas of greatest concern for potential intervention. Future research needs to account for these regional differences and target surveillance accordingly.
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Introduction

Ambulatory care–sensitive conditions (ACSC) are a set of indicators to measure the access, availability, and effectiveness of primary care and offer a valuable perspective on system performance.[1–3] Many hospitalizations may be prevented by adequate, timely, and quality ambulatory care services, primary care, or early interventions.[4,5] The Agency for Healthcare Quality and Research developed the Prevention Quality Indicators, which are defined by the ICD-9-CM, to identify ACSC. Since 1993, IOM recommends using ACSC to monitor access of care.[3] Hospitalizations caused by ACSC are also known as preventable hospitalizations.

Previous studies have shown that the range for preventable hospitalizations rate varies by age, population, and geographic area from 10.7% to 29.1%.[2,6,7] Kozak et al.[3] analyzed the trend of preventable hospitalizations and found that from 1980 through 1998 the rate of preventable hospitalizations gradually increased from 99.2 to 133.8 per 10,000 people. Preventable hospitalizations also increase health expenditures. Kruzikas and colleagues[5] calculated that decreasing preventable hospitalization costs per admission by 5% would result in a cost savings of more than $1.3 billion. Preventable hospitalizations can also be impacted by health insurance coverage. For example, after Medicaid eligibility expanded in Oregon, Medicaid insured and uninsured patients experienced higher preventable hospitalizations whereas non–Medicaid insured patients' preventable hospitalization rates maintained a stable rate.[8]

The majority of the population aged 65 years and older in the U.S. are covered under Medicare. Medicare beneficiaries normally have better access to primary care

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and a regular source of care, and are more satisfied with their care than other populations.[9] However, previous studies found that people aged older than 65 years have a higher risk of preventable hospitalizations.[10,11]

Mobley et al.[12] aggregated Medicare utilization to the Primary Care Service Area level to examine the relationship between market-level supply and demand factors on market-level rates of ACSC admission among the elderly residing in the U.S. in the late 1990s. They found that older people living in poor/sprawling rural or suburban areas have a higher likelihood to be admitted for ACSC. They concluded that the existing supply of physicians is perhaps adequate, but their distribution across the landscape may not be optimal. Chang and colleagues[13] also applied Primary Care Service Areas to examine the association between the adult primary care physician (PCP) workforce and Medicare beneficiaries' health outcomes. They found that a higher density of PCP workforce was associated with lower mortality and ACSC hospitalization rates, and estimated that if all areas' PCPs or primary care full-time equivalents increased to the highest quintile, it might lead to 159,144 fewer deaths and 436,002 fewer ACSC hospitalizations, respectively.

The present study aims to model the distributions of both PCPs and Medicare beneficiaries' ACSC hospitalizations in U.S. counties, and to then examine the association between the distribution of PCPs and Medicare beneficiaries' ACSC hospitalizations, testing for locally varying relationships.

Methods

Data Sources

Data were obtained from the 2014 County Health Rankings (CHRs) files, and linked 2013–2014 Area Health Resource File (AHRF) and 2014 Food Environment Atlas Data File.[14–16] The CHRs are based on variables collected from multiple sources, including the National Center for Health Statistics, Behavioral Risk Factor Surveillance System, National Center for Chronic Disease Prevention and Health Promotion, Small Area Health Insurance Estimates, AHRF, Medicare/Dartmouth Institute, and several other data sources.[15] The county was the unit of analysis. There were 3,141 counties included in the 2014 CHRs. After merging with the 2013–2014 AHRF and the Food Environment Atlas Data File and excluding missing data in both outcome and independent variables, the final model included 2,001 counties.

Measures

Medicare beneficiaries' ACSC hospitalization rate was based on preventable hospital stays in 2011. It was calculated as the number of discharges for ACSC in a county divided by the number of Medicare beneficiaries in a county multiplied by 1,000 (i.e., Medicare beneficiaries' ACSC hospitalization rate per 1,000 Medicare beneficiaries). The outcome variable was obtained from the 2014 CHRs database, which originated from the 2012 Dartmouth Atlas.

The main independent variable of interest was PCP density. It was calculated by the number of PCPs in a county divided by the total population count, multiplied by 1,000. Secondary independent variables indicative of resource availability included non-physician primary care provider density (i.e., nurse practitioners, clinical nurse practitioners, and physician assistants); international medical graduate density; hospital bed to population ratio; long-term care facility to older population ratio; and home health agency to older population ratio. All health resources variables were extracted from the 2013–2014 AHRF.

Demographic characteristics of the population included percent non-white, female, age ≥65 years, and rural. Health status factors contained average health status (percent adults in fair/poor health); percent current smoking among adults; and percent excessive drinking among adults. Demographic and health status characteristics were obtained from the 2014 CHRs.

Socioeconomic characteristics included Ford and Dzealtowski's area deprivation index,[17] which was composed of eight indicators to represent area socioeconomic status (SES): percent unemployed adults, adults aged >25 years with less than a high school education, households under the federally designated poverty level, households with more than one person per room, female head of household with children, households with public assistance income, median household income, and households with no access to a vehicle. Only the percentage of households with no access to a vehicle was from the 2014 Food Environment Atlas Data File; others were from the 2013–2014 AHRF. All covariates were modeled continuously (Table 1).

Statistical Analysis

Descriptive data analyses were conducted for county-level demographic, socioeconomic, and health resources characteristics. Pearson correlations and bivariate associations were tested between all county-level covariates and the primary outcome, Medicare beneficiaries' ACSC hospitalization rate. Ordinary least squares (OLS) regression was used to investigate factors associated with the ACSC hospitalization rate, with the county as the unit of analysis. Three regression models were compared: Model 1, full model (including all variables); Model 2 using automated SAS model selection procedures (i.e., forward, backward, and stepwise selection procedures were tested; automated forward selection was ultimately chosen to represent Model 2); and Model 3 generated from a bivariate variable selection approach (applying simple linear regression for each variable with $p<0.10$). Analyses were performed using SAS, version 9.4, in late 2015. Statistical significance was determined for differences where two-sided $p<0.05$, and the global multicollinearity was assessed by examination of variance inflation factors. In the OLS model, no variable variance inflation factors exceeded 7.5,[18] so all variables were examined in the model selection process.

Spatial Analysis

The nearness of geographic units must be quantified when applying spatial analysis.[19] Global and local Moran's I (a local