

# County-Level Population Economic Status and Medicare Imaging Resource Consumption

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## Abstract

**Purpose:** The aim of this study was to assess relationships between county-level variation in Medicare beneficiary imaging resource consumption and measures of population economic status.

**Methods:** The 2013 CMS Geographic Variation Public Use File was used to identify county-level per capita Medicare fee-for-service imaging utilization and nationally standardized costs to the Medicare program. The County Health Rankings public data set was used to identify county-level measures of population economic status. Regional variation was assessed, and multivariate regressions were performed.

**Results:** Imaging events per 1,000 Medicare beneficiaries varied 1.8-fold (range, 2,723-4,843) at the state level and 5.3-fold (range, 1,228-6,455) at the county level. Per capita nationally standardized imaging costs to Medicare varied 4.2-fold (range, \$84-\$353) at the state level and 14.1-fold (range, \$33-\$471) at the county level. Within individual states, county-level utilization varied on average 2.0-fold (range, 1.1- to 3.1-fold), and costs varied 2.8-fold (range, 1.1- to 6.4-fold). For both large urban populations and small rural states, Medicare imaging resource consumption was heterogeneously variable at the county level. Adjusting for county-level gender, ethnicity, rural status, and population density, countywide unemployment rates showed strong independent positive associations with Medicare imaging events ( $\beta = 26.96$ ) and costs ( $\beta = 4.37$ ), whereas uninsured rates showed strong independent positive associations with Medicare imaging costs ( $\beta = 2.68$ ).

**Conclusions:** Medicare imaging utilization and costs both vary far more at the county than at the state level. Unfavorable measures of county-level population economic status in the non-Medicare population are independently associated with greater Medicare imaging resource consumption. Future efforts to optimize Medicare imaging use should consider the influence of local indigenous socioeconomic factors outside the scope of traditional beneficiary-focused policy initiatives.

**Key Words:** Socioeconomics, imaging utilization, Medicare, geographic variation, public health

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## INTRODUCTION

Marked geographic variation in health care utilization is well established [1,2]. Such variation has important implications for the US health care system, leading to a potentially substantial amount of unnecessary resource utilization and spending without a corresponding improvement in outcomes [3]. Great variation has been demonstrated for medical imaging, with past studies exploring the variation in imaging utilization and spending at the state or other large regional levels. For example, one such study observed more than a fivefold statewide variation in Medicare spending on imaging [4]. However, studies of other categories of health care

services suggest that analysis of variation at the smaller county (rather than state) level may be of particular value for explaining overall utilization and guiding policy decisions [5-10]. For example, studies have supported the role of county-level analyses for developing interventions to improve preventive measures for chronic diseases [5] and rates of colonoscopy [8]. Nonetheless, little is known about variation in medical imaging in smaller markets, such as at the county level. Such insights may aid in crafting policy directed toward more efficiently deploying imaging resources and ensuring appropriate patient access.

Various reasons for variation in medical imaging have been hypothesized. Siström et al [11] showed that a small percentage of the variation in ordering of low-utility examinations is attributable to physician ordering behavior. On the other hand, some studies suggest that patient economic disparities affect imaging utilization in very specific clinical contexts. For example, Gornick et al [12] previously demonstrated reduced utilization of mammography among low-income Medicare beneficiaries. And Brinjikji et al [13] observed lower utilization of several modalities for imaging acute stroke among uninsured, Medicaid, and Medicare patients in comparison with patients with private insurance. Nonetheless, the impact of economic disparities on imaging intensity has not been assessed more broadly. Medicare's tracking of national state- and county-level utilization and spending metrics for numerous categories of health care services provides an opportunity to perform such an assessment. Moreover, relatively uniform coverage policies within the Medicare population nationwide may facilitate investigation of associations between variation in imaging and indigenous factors such as wealth that are less confounded by the marked variation in coverage and deductibles encountered in a more general private- and mixed-payer population. Thus, the aims of this study were (1) to assess national variation in medical imaging utilization and payer costs at the state and county levels in the Medicare fee-for-service population and (2) to assess associations with measures of local population economic status.

## METHODS

This retrospective study using administrative data sets did not constitute human subjects research and did not require institutional review board oversight. The most recent data sets available at the time of the initial analysis were used.

The CMS Geographic Variation Public Use File (PUF) provides measures of utilization and costs aggregated at various geographic (state, hospital referral region, and county) units [14]. The data are obtained primarily from CMS's Chronic Conditions Data Warehouse [15], which contains 100% of claims for beneficiaries enrolled in the fee-for-service program. The Geographic Variation PUF stratifies all Part A and Part B claims for physician services using the Berenson-Eggers Type of Service classification scheme into six major categories [16] that specifically include imaging. The file includes utilization (defined as the number of unique paid imaging events per 1,000 beneficiaries) and cost metrics. Within the PUF, state- and county-level imaging-related measures of imaging costs (defined as per capita spending by Medicare on both Part A and Part B claims) are nationally standardized to remove geographic differences in payment rates for services as a potential confounder of geographic variation study [17].

The County Health Rankings & Roadmaps database [18], maintained by the Robert Wood Johnson Foundation and the University of Wisconsin Population Health Institute, provides a wide range of county-level data relating to counties' physical environment, social and economic factors, clinical care, and health behaviors. The data set is compiled from a variety of national data sources [18]. Data from 2016 were obtained for the following three measures of the level of wealth of a county's population: the percentage unemployed (defined as the percentage of the population aged  $\geq 16$  years who are unemployed and actively seeking work), the percentage uninsured (defined as the percentage of people aged  $< 65$  years without insurance), and the 80th-percentile income (defined as the 80th percentile of median household income in that county).

Two additional measures were recorded as possible confounders of an association between income and county-level imaging resource consumption. First, counties' percentage rural populations were obtained from the County Health Rankings file. Also, counties' population densities were obtained from 2011 US Census Bureau data [19].

The states and counties with the highest and lowest values for both imaging resource consumption metrics were identified. The degree of variation for each measure at both the state and county levels was computed as the ratio between high and low values. The degree of variation within individual states was computed, similarly defined as the ratio between the highest and lowest values for counties within a given state. The states with the

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