Computed Tomography Scan Use Variation: Patient, Hospital, and Geographic Factors

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Objectives: To examine patient, hospital, and geographic characteristics influencing variation in computed tomography (CT) scan use in inpatients in New York State.

Study Design: Retrospective cohort study.

Methods: We used the 2007 Healthcare Cost and Utilization Project's State Inpatient Database from the Agency for Healthcare Research and Quality and applied descriptive univariate statistics and logistic regression models to quantify the influence of each factor on CT scan use.

Results: The primary contributors to variation in CT scan use were the inpatients' diagnosis, age, and hospital county, whereas inpatients' sex and method of payment and hospitals' teaching status and size had very little effect. Inpatients diagnosed with trauma had the highest CT scan use; CT scan use increased with age for inpatients over 30 years; and CT scan use varied widely between counties.

Conclusions: After controlling for patient and hospital characteristics, significant geographic variation remained at the level of the county, which indicates that additional research investigating the use of CT scans is necessary to understand the reasons behind small-area variation. Understanding the distribution and practice patterns of specific physician specialties may be helpful in curtailing underuse and overuse.

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For author information and disclosures, see end of text.

Since computed tomography (CT) was first introduced in the 1970s, its use has grown to an estimated 72 million CT scans performed annually in the United States.[1] Computed tomography scans are currently a fundamental diagnostic tool in the evaluation of a multitude of conditions, including malignancies, cardiovascular disease, and infectious diseases, among others. The largest increase in CT scan use in recent years has been for procedures such as virtual colonoscopy, cardiac screening, and whole-body CT scans for asymptomatic patients as well as smokers and children.[2] With the increased use of CT scans in low-risk populations, some have begun to question the public health implications of unnecessary radiation exposure of patients.[3-5]

The ubiquity of CT scanners provides access to accurate data to diagnose complex medical problems. However, the availability of CT scanners may have created a supply-induced demand, which may contribute to the variability in practice and CT scan use.[6,7] Computed tomography scans improve diagnostic accuracy for certain conditions. However, in some instances, such as appendicitis, the benefit to patients' health may not be justified.[8,9]

Almost 40 years ago, Wennberg and Gittelsohn[10] observed that more care is not always better care. Numerous publications after this study observed variations in medical usage patterns (eg, a study on small-area variation in New York State for cesarean section[11]). Understanding small-area variation in CT scan use can help identify underuse and overuse, both of which may be costly and negatively affect healthcare quality.[4,12] We investigated how patient, hospital, and geographic characteristics influence CT scan use for inpatients with the goal that our research will lead to more effective CT scan use, lower costs, and higher quality.

METHODS

Data Set

This research used the 2007 edition of the New York State Inpatient Database (SID) from the Healthcare Cost and Utilization Project. This data set resulted from a federal-state-industry partnership sponsored by the Agency for Healthcare Research and Quality. We analyzed 2,485,498 inpatients from 221 hospitals in 56 counties in New State. In our analysis, we expunged fewer than 5% of the inpatient records in the SID because of missing values. No

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An inpatient's diagnosis and age were the strongest predictors of the likelihood of receiving a computed tomography (CT) scan. The third strongest predictor among 8 patient, hospital, and geographic characteristics was the county in which the scan was administered.

- Counties in New York State deviated between −11% and +9.4% from the state's average CT scan rate.
- Hospital teaching status and patient method of payment (insurance) played only a minor role in explaining variation in CT scan use.
- Additional research on county factors (eg, economic status, technology density, practice habits) is necessary to explain the observed small-area variation.

obvious patterns were evident in these expunged records compared with those that had complete data. As the data were de-identified, no institutional review board approval was requested or required.

Procedure Identification

The Agency for Healthcare Research and Quality created a utilization flag to indicate inpatient CT scan use based on *International Statistical Classification of Diseases, Ninth Revision, Clinical Modification* (*ICD-9-CM*) codes, revenue codes, or both.[13] In our study, an inpatient was considered to have received a CT scan if the inpatient had at least 1 report based on the utilization flag. We found that *ICD-9-CM* codes identified only 23.2% of inpatients receiving a CT scan, whereas revenue codes identified 98.8% of them.

Study Variables

We determined the association of CT scan use with the following categories of independent variables: (1) patient characteristics, (2) hospital characteristics, and (3) geographic characteristics. Patient demographics (including sex, race, and age), Major Diagnostic Category (MDC), payment method, and CT scan use were drawn directly from variables available in SID. For the age variable, we used small age group intervals to describe variation in CT scan use across age ranges. We followed conventional pediatric age groupings for ages <18 years (birth to 1 year, 1-4 years, 5-12 years, and 13-17 years). The age groupings for adult inpatients were 18 to 29 years, 30 to 39 years, 40 to 64 years, 65 to 84 years, and ≥85 years. The MDCs divided patients into 25 mutually exclusive diagnostic areas based on the principal diagnosis from the *ICD-9-CM* codes.[14]

Hospital characteristics including hospital teaching status, location (urban or rural), and bed size were obtained from the New York State Department of Health.[15] We used the Health Cost and Utilization Project's classification to categorize hospitals as small, medium, or large based on their number of beds, location, and teaching status.[16] The hospital's county was the geographic characteristic we considered for this study.

Analytic Methods

To investigate the association of the independent variables with CT scan use, we calculated univariate statistics and reported mean values with their odds ratios (ORs) and confidence intervals (CIs). We used a logistic regression model to predict the odds of an inpatient receiving a CT scan based on the independent variables discussed above. The urban or rural location of an inpatient's hospital was not included in the logistic regression model because this variable was too highly collinear with the other variables in the model. We calculated the Schwarz criterion to determine the relative influence of each independent variable on explaining variation in CT scan use. The Schwarz criterion was calculated for the full model and separate submodels to evaluate the influence of each independent variable. For each submodel, we eliminated 1 independent variable and determined the difference in Schwarz criterion values between this submodel and the full model. The greater the difference between the Schwarz criterion values, the greater was the explanatory power of the independent variable.

RESULTS

CT Scan Use by Inpatients

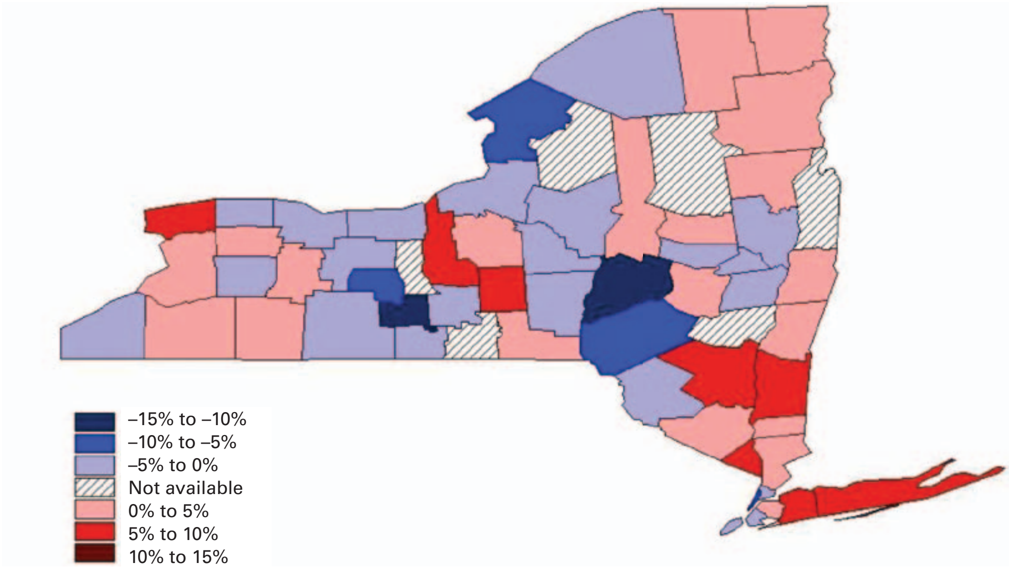
Figure 1 shows how the percentage of inpatients who received at least 1 CT scan deviated from the state average for each county. Across the state, 28.0% of inpatients received at least 1 CT scan. Cortland County had the highest rate with 37.4%, closely followed by Rockland County with 37.2%. As shown in Figure 1, these 2 counties had CT scan use of +9.4% and +9.2% over the state average, respectively. In contrast, Otsego County and Schuyler County had the lowest rates of CT scan use and the largest deviation magnitude. Their rates were 17.0% and 17.3%, respectively, which translates into deviations from the state average of −11.0% and −10.7%.

Overall, we found considerable geographic variation. The median absolute deviation from the state average was 3.6%. No correlation existed between these CT scan use percentages and county population, even when adjusted for numbers of inpatients (r = −0.01, n =56 counties, 95% CI, −0.27 to 0.26). Also, no correlation existed between CT scan use percentages and number of hospitals per county (r = −0.008, 95% CI, −0.27 to 0.26).

Patient Characteristics Associated With Inpatient CT Scan Use

Patient Demographics and CT Scan Use. Appendix A shows inpatient CT scan use according to various patient

■ **Figure 1.** Geographic Variation of CT Scan Use for Inpatients: Deviation From State Average in Percentage Points (Observed Percentage Minus Average Percentage)



CT indicates computed tomography.

characteristics. In this univariate analysis, there was statistically significant variation in inpatient CT scan based on sex, race, payer, age, and diagnosis. Males were more likely to have CT scans performed than females, with an OR of 1.172 (95% CI, 1.165-1.178). White inpatients were more likely to have CT scans than other racial groups. The ORs for racial groups compared with whites ranged from 0.687 (95% CI, 0.675-0.697) for Asians to 0.881 (95% CI, 0.875-0.888) for blacks. Medicare beneficiaries had the highest likelihood of receiving a CT scan, with an OR of 2.237 (95% CI, 2.222-2.252) compared with inpatients with private insurance.

Inpatient Age and CT Use Rate. We found significant variation in CT scan use for different ages. We calculated the percentage of inpatients of a given age who received a CT scan (Figure 2). Inpatients aged 88 years had the highest rate of CT scan use, at 47.2% of 20,783 inpatients aged 88 years. Only 1.7% of inpatients younger than 1 year received a CT scan (n = 260,503). Use of CT scans increased by age from birth to 8 years (23.3%, n = 4082), stayed relatively flat until age 15 years (23.7%, n = 8077), decreased until age 30 years (14.7%, n = 27,604), and then steadily increased until age 88 years. The percentages of CT scan use for the oldest inpatients in the data set were slightly lower than the percentage for the peak age of 88.

Inpatient Medical Condition and CT Use Rate. Appendix B shows the association of MDCs with CT scan use. As expected, there was considerable variability in CT scan use across diagnostic categories. Trauma was the diagnostic category with the highest CT scan use (89.8%, n = 3377), while Newborn and Other Neonates (Perinatal Period) was the diagnostic category with the lowest use (1.0%, n = 234,290).

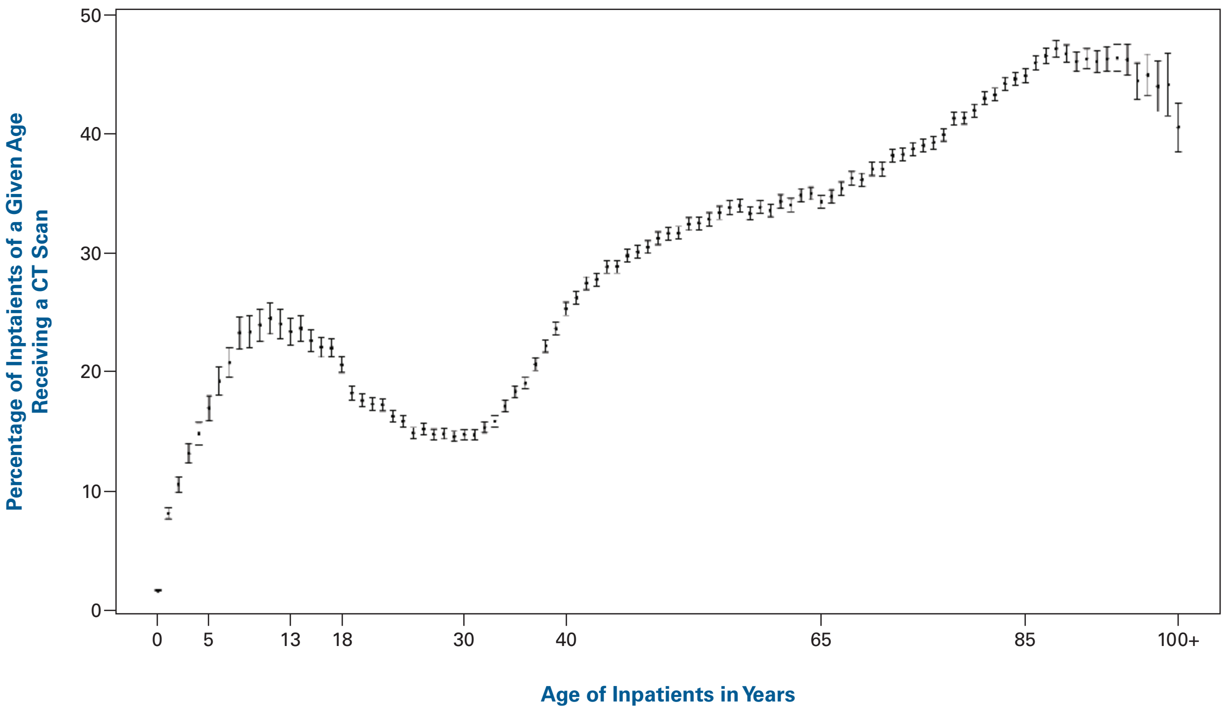
Hospital Characteristics Associated With Inpatient CT Scan Use

Appendix C lists the CT scan use rates for differences in hospitals' teaching status, location, and bed size. The inpatient CT scan use was 30.7% for nonteaching and 27.1% for teaching hospitals. The inpatient CT scan use was 28.1% for urban and 26.3% for rural hospitals. Only a weak positive correlation could be observed between CT scan use and hospital bed size ($r = 0.15$, n = 221 hospitals, 95% CI, 0.02-0.27).

Logistic Regression Results

To control for patient and hospital characteristics and determine residual geographic variation in CT scan use at the county level, we used a logistic regression model. Figure 3 shows how the percentage of inpatients who received at least 1 CT scan deviated from the model's prediction for each county. Based on its patient and hospital characteristics, Schoharie County had the highest predicted CT scan use, 39.7%. Its actual use was 30.1%, showing a deviation of –9.6%. Jefferson County had the lowest predicted CT scan use, 21.5%. Its actual use was 20.7%, showing a deviation of –0.8%. Delaware County had the largest magnitude deviation. The model predicted that 33.9% of its inpatients would receive at least 1 CT scan, but only 20.7% of its inpatients did, for a deviation of –13.2%. Rockland County had the largest positive devia-

■ **Figure 2.** Relationship Between Age of Inpatients and the Percentage Receiving CT Scans (Point Estimates and 95% Confidence Intervals)



CT indicates computed tomography.

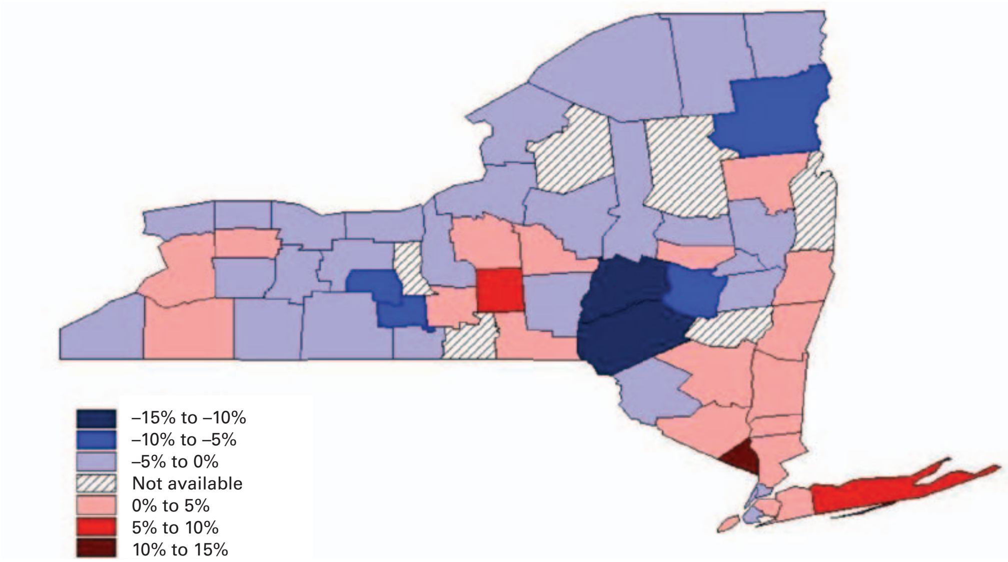
tion, +10.1%, from its model prediction. Its prediction was 27.2%, but 37.2% of its inpatients received at least 1 CT scan. Appendix D lists for each county the observed percentage of inpatients receiving a CT scan, the expected percentage, the deviation, and the standardized ratio of observed percentage to expected percentage.

After controlling for patient and hospital characteristics, we still found considerable variation between counties. The median absolute deviation from the state average was 3.1%. Before using the logistic regression model (see Figure 1), the median absolute deviation was 3.6%.

The results of a logistic regression analysis that included county as an independent variable, along with the patient and hospital characteristics, can be found in Appendix E. After controlling for the other factors, the results show that males, whites, and Medicare beneficiaries were not more likely to receive a CT scan, contrary to the results of the univariate analysis above. The OR for males compared with females was 0.977 (95% CI, 0.970-0.983). Compared with whites, the OR for Asians was 1.145 (95% CI, 1.123-1.168) and the OR for blacks was 1.128 (95% CI, 1.118-1.139). Medicare beneficiaries had an OR of 1.052 (95% CI, 1.041-1.068) compared with inpatients paying with private insurance. Inpatients who self-paid (OR = 1.228; 95% CI, 1.209-1.248) or were not charged (OR= 1.619; 95% CI, 1.505-1.743) were the most likely to have received a CT scan. An inpatient's odds of receiving a CT scan generally increased with age. Compared with the reference group of 30- to 39-year-olds, the youngest inpatients (birth to 1 year) had the lowest odds of receiving a CT scan (OR = 0.109; 95% CI, 0.104-0.115), and the oldest patients (85 years and older) had the highest odds (OR = 1.604; 95% CI, 1.576-1.633). Trauma was the diagnostic category most likely to result in a CT scan (OR compared with the reference category of Endocrine, Nutritional and Metabolic System was 24.531; 95% CI, 21.888-27.493), while Pregnancy, Childbirth and Puerperium was the least likely category (OR = 0.049; 95% CI, 0.047-0.051). Inpatients at nonteaching hospitals were slightly less likely to receive a CT scan than those at teaching hospitals (OR = 0.971; 95% CI, 0.962-0.981). Inpatients at large hospitals (OR = 0.975; 95% CI, 0.967-0.984) or small hospitals (OR = 0.842; 95% CI, 0.832-0.852) were less likely to receive a CT scan than those at medium-sized hospitals.

We determined how efficient and effective each variable was in explaining CT scan use rates by using the Schwarz criterion. The Table presents Schwarz criterion values for the

■ **Figure 3.** Deviation of CT Scan Use for Inpatients After Controlling for Patient and Hospital Characteristics (Observed Percentage Minus Predicted Percentage)



CT indicates computed tomography.

full model and the submodels. The greater the difference in Schwarz criterion values (Δ Schwarz criterion) between the full model and the submodel, the greater the efficiency and effectiveness of the corresponding categorical factor of the submodel in describing CT scan use rates. Results indicate that MDC was the variable associated with the greatest variation in CT scan use, followed by age group and county. Race, hospital bed size, and method of payment had little explanatory value, and sex and hospital teaching status played virtually no role in predicting CT scan use.

DISCUSSION

Geographic analysis can be a helpful tool for understanding care patterns, technology use, and small-area variations in healthcare. Several broad-based studies have demonstrated differences in health outcomes on a geographic level.[10,11,17-20] However, the use of geographic analysis to determine the variability in radiology testing, specifically the use of CT scans, has not been performed. Therefore, we conducted a geographic analysis of CT scan use and examined how patient, hospital, and geographic factors affect the use of this technology for inpatients in New York State. We found significant variations due to patient characteristics (age, race, insurance status, sex, MDC). In addition, we found that hospital characteristics (bed size, hospital teaching status) had a weak influence on CT scan use. Finally, after controlling for patient and hospital factors, unexplained variability remained at the level of the county. Identifying additional factors that may explain the residual variability is important for developing interventions and managing care to ensure the appropriate use of this important technology.

Since Wennberg and Gittelsohn[10] first developed their conceptual approach to understanding the effect of geographic variation on the use of medical services for surgical procedures, others have advanced their work both in content and methodology for a broad range of procedures and populations.[10,11,17-20] One of the major findings of these studies was that procedural variation is greatly influenced by patient and hospital factors. Without controlling for these factors, a geographic analysis on medical procedures could be biased. Our study also found several important patient and population level characteristics—including age, insurance status, and diagnosis—that influenced the geographic variation of CT scans. Although certain characteristics such as age or diagnosis cannot be modified, interventions informed by evidence-based guidelines or protocols can help to enforce appropriate CT scan use and can ultimately reduce variation and improve healthcare value.

Teaching hospitals perform important societal functions including the provision of direct care for patients and the education of the next generation of healthcare professionals. Surprisingly, we found little difference in CT scan use rates between teaching and nonteaching hospitals. This finding

Table. Schwarz Criterion and Change in Schwarz Criterion Values

Categorical Factor Excluded From Submodel	Schwarz Criterion	Δ Schwarz Criterion
MDC	2,676,067	349,933
Age	2,364,532	38,398
County	2,342,153	16,019
Race	2,327,119	985
Hospital bed size	2,326,900	766
Method of payment	2,326,875	741
Sex	2,326,170	36
Hospital teaching status	2,326,153	19
Full model	2,326,134	—

MDC indicates Major Diagnostic Category.

was interesting given that teaching hospitals have medical trainees who are less experienced in identifying the appropriate indications for ordering these diagnostic tests. In addition, teaching hospitals often serve a population who have worse access to healthcare, more comorbid conditions, and fewer resources to care for them. Hence, overuse of certain technologies and therapies was expected. Since teaching hospitals are involved in the education of medical trainees and evidence-based medicine principles have become foundational in this setting, we speculate that our observation is related to better adherence to protocols and guidelines for CT scan prescribing. If true, generalizing these findings outside of teaching institutions to a broad geographic catchment area may help to address the important issues of guideline adherence and reduce variability.

Finally, after controlling for patient and hospital characteristics, we found that geographic variation persisted at the level of the county. This remaining variation may be related to the number of CT scanners available for use,[21] the number of radiologists and other physicians in the region, differences in provider practice preferences,[22] or the economic status of a county. Regulatory mechanisms such as the Certificate of Need program are in place in New York State to assist with the appropriate allocation of expensive technologies. The major drivers of CT scan use are prescribing physicians. Hence, variability in the geographic distribution of physicians generally and in specific specialties like radiology may be as responsible for CT scan use patterns as the presence of CT scanners. Practice pattern differences can be ameliorated through continuing education and peer review programs. Unfortunately, the relationship between these factors and CT use cannot be understood by using the existing data elements in SID, but can certainly be investigated using other data sources and methods.

Several limitations in our study must be considered. The SID includes only inpatient data and does not include CT scans performed on outpatients even if performed at the same hospital. This limitation does not affect the conclusions for inpatient CT scan use, but may influence conclusions at the population level. In addition, while we used literature-defined approaches for identifying the performance of CT scans during inpatient stays in the SID, misclassification biases associated with poor documentation may exist. We believe that we have overcome this limitation to the extent possible by using complementary approaches for acquiring CT scan use rates. Finally, we included all factors potentially affecting CT scan use that were available through the data set. However, we are humbled by the number of other potential explanatory variables that may be operational at the level of the county but that are not contained in the SID.

Despite these limitations, we believe that this study has significant strengths because it demonstrates that area variation exists for an expensive medical imaging technology like CT. In addition, the relationship between CT scan use and age is an important finding and can serve as guidance to alter physician practices, particularly for those patients who may be harmed by CT scan overuse like children and adolescents, in whom lifelong radiation dosage may adversely affect health.[3-5] Further, as acute care hospitals and physicians consider methods for integrating inpatient and outpatient care for the benefit of patient populations, analyses that incorporate geography are likely to provide practical insights that ensure the continuity of service while avoiding oversupply of an expensive resource. These results can help to inform Certificate of Need programs both inside and outside of New York State for regulating CT scan deployment. Finally, we believe our study provides guidance for future research investigating racial and ethnic disparities in the provision of healthcare services because it identifies other factors that may account for county-level geographic variation in CT scan use or the use of other technologies.

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Appendix A. Inpatient Demographics and CT Scan Use

Characteristics	CT Scan Use	Odds Ratio	95% Confidence Interval
Sex			
Female[a]	26.6%	1	
Male	29.8%	1.172	1.165-1.178
Race			
White[a]	29.8%	1	
Black	27.2%	0.881	0.875-0.888
Native American	24.5%	0.764	0.746-0.783
Asian	22.5%	0.687	0.675-0.697
Pacific Islander	27.0%	0.875	0.849-0.902
Other	24.0%	0.744	0.737-0.750
Missing	24.4%	0.763	0.750-0.776
Age, y			
Birth to <1	1.7%	0.079	0.077-0.082
1-4	10.8%	0.545	0.526-0.564
5-12	21.9%	1.261	1.227-1.296
13-17	22.7%	1.316	1.284-1.349
18-29	16.3%	0.872	0.86-0.885
30-39[a]	18.2%	1	…
40-64	31.7%	2.081	2.059-2.105
65-84	39.4%	2.92	2.888-2.953
≥85	46.1%	3.838	3.787-3.889
Method of payment			
Private insurance[a]	22.7%	1	…
Medicare	39.7%	2.237	2.222-2.252
Medicaid	18.9%	0.79	0.784-0.797
Self-pay	24.4%	1.096	1.082-1.111

No charge	33.2%	1.69	1.583-1.804
Other	26.4%	1.219	1.195-1.243

CT indicates computed tomography.

[a]Reference.

Appendix B. MDC and CT Scan Use

MDC No.	Description	CT Scan Use	Odds Ratio	95% Confidence Interval
0	Unknown category	10.1%	0.294	0.172-0.501
1	Nervous system	72.3%	6.807	6.68-6.937
2	Eye	55.4%	3.231	3.046-3.428
3	Ear, nose, mouth, and throat	43.5%	2.006	1.954-2.059
4	Respiratory system	37.8%	1.58	1.553-1.608
5	Circulatory system	26.4%	0.934	0.919-0.949
6	Digestive system	52.6%	2.889	2.84-2.939
7	Hepatobiliary system and pancreas	52.6%	2.89	2.828-2.953
8	Musculoskeletal system and connective tissue	25.0%	0.87	0.855-0.886
9	Skin, subcutaneous tissue, and breast	22.2%	0.742	0.724-0.759
10	Endocrine, nutritional, and metabolic system[a]	27.7%	1	…
11	Kidney and urinary tract	45.4%	2.171	2.129-2.213
12	Male reproductive system	13.4%	0.403	0.383-0.424
13	Female reproductive system	13.5%	0.406	0.394-0.418
14	Pregnancy, childbirth, and puerperium	1.9%	0.049	0.048-0.051
15	Newborn and other neonates (perinatal period)	1.0%	0.027	0.026-0.029
16	Blood and blood-forming organs and immunologic disorders	26.2%	0.923	0.897-0.95
17	Myeloproliferative DDs (poorly differentiated neoplasms)	30.6%	1.15	1.115-1.186
18	Infectious and parasitic DDs	48.7%	2.471	2.419-2.525
19	Mental DDs	11.9%	0.351	0.343-0.359
20	Alcohol/drug use or induced mental disorders	10.9%	0.319	0.311-0.328

21	Injuries, poison, and toxic effect of drugs	33.5%	1.315	1.28-1.351
22	Burns	9.2%	0.264	0.233-0.298
23	Factors influencing health status	22.8%	0.769	0.749-0.790
24	Multiple significant trauma	89.8%	22.97	20.53-25.71
25	Human immunodeficiency virus infection	51.4%	2.755	2.65-2.865

CT indicates computed tomography; DD, diseases and disorders; MDC, Major Diagnostic Categories. **[Au: verify definition of DD.]**

[a]Reference.

Appendix C. **Hospital Teaching Status, Location, Bed Size and CT Scan Use**

Variable	CT Scan Use	Odds Ratio	95% Confidence Interval
Status			
Teaching[a]	27.1%	1	…
Nonteaching	30.7%	1.189	1.182-1.197
Location			
Urban[a]	28.1%	1	…
Rural	26.3%	0.914	0.903-0.926
Bed size			
Large	28.0%	0.962	0.956-0.968
Medium[a]	28.7%	1	…
Small	26.6%	0.899	0.890-0.908

CT indicates computed tomography.

[a]Reference.

Appendix D. **Percentage of Inpatients Receiving CT Scans by County**

County	Observed, %	Expected, %	Deviation, %	Standardized Ratio (Observed/Expected)
Albany	26.5	28.4	−2.0	0.93
Allegany	29.1	29.5	−0.4	0.99
Bronx	26.9	28.1	−1.2	0.96
Broome	30.2	28.9	1.3	1.05
Cattaraugus	31.1	28.6	2.5	1.09
Cayuga	33.4	35.1	−1.6	0.95
Chautauqua	24.4	28.2	−3.8	0.86
Chemung[a]	27.8	29.0	−1.2	0.96
Chenango	27.2	29.8	−2.6	0.91
Clinton	28.7	28.9	−0.2	0.99
Columbia	32.8	31.2	1.6	1.05
Cortland	37.4	29.1	8.4	1.29
Delaware	20.7	33.9	−13.2	0.61
Dutchess	33.6	30.3	3.4	1.11
Erie	30.5	28.9	1.6	1.06
Essex	30.1	38.3	−8.3	0.78
Franklin	31.6	33.0	−1.4	0.96
Fulton	30.2	30.6	−0.4	0.99
Genesee	28.9	28.3	0.6	1.02
Herkimer	28.7	32.9	−4.2	0.87
Jefferson	20.7	21.5	−0.8	0.96
Kings	24.8	26.4	−1.6	0.94
Livingston	28.4	28.6	−0.2	0.99
Madison	25.7	25.1	0.5	1.02
Monroe	25.2	28.0	−2.8	0.90
Montgomery	27.3	27.2	0.1	1.00
Nassau	33.8	30.6	3.3	1.11
New York	22.9	26.1	−3.2	0.88

Niagara	33.1	34.7	−1.6	0.95
Oneida	26.7	29.8	−3.1	0.89
Onondaga	29.1	27.5	1.6	1.06
Ontario	26.0	28.3	−2.3	0.92
Orange	33.0	31.3	1.7	1.06
Orleans	26.9	28.2	−1.4	0.95
Oswego	23.9	28.6	−4.7	0.83
Otsego	17.0	29.3	−12.3	0.58
Putnam	32.2	31.5	0.6	1.02
Queens	29.2	27.3	2.0	1.07
Rensselaer	32.1	31.6	0.5	1.02
Richmond	26.6	26.1	0.5	1.02
Rockland	37.2	27.2	10.1	1.37
Saratoga	27.5	29.1	−1.6	0.94
Schenectady	26.3	30.5	−4.2	0.86
Schoharie	30.1	39.7	−9.6	0.76
Schuyler	17.3	27.0	−9.7	0.64
St. Lawrence	25.8	30.0	−4.2	0.86
Steuben	27.2	30.0	−2.8	0.91
Suffolk	34.6	28.7	5.9	1.20
Sullivan	27.2	28.0	−0.8	0.97
Tompkins	25.1	24.3	0.8	1.03
Ulster	33.6	30.4	3.2	1.11
Warren	31.6	30.1	1.6	1.05
Wayne	25.7	26.5	−0.9	0.97
Westchester	29.5	28.1	1.4	1.05
Wyoming	25.8	27.0	−1.2	0.96
Yates	22.6	31.1	−8.6	0.73

CT indicates computed tomography.

[a]Reference county.

Appendix E. Logistic Regression Results Predicting Inpatient CT Scan Use

Variable	Odds Ratio	95% Wald Confidence Interval
Albany	0.861	0.825-0.899
Allegany	0.998	0.903-1.104
Bronx	0.888	0.854-0.924
Broome	1.103	1.05-1.157
Cattaraugus	1.143	1.072-1.219
Cayuga	1.032	0.956-1.113
Chautauqua	0.837	0.792-0.885
Chemung[a]	1	…
Chenango	0.948	0.846-1.061
Clinton	1.065	1.004-1.129
Columbia	1.178	1.098-1.264
Cortland	1.601	1.485-1.726
Delaware	0.54	0.469-0.622
Dutchess	1.319	1.261-1.38
Erie	1.123	1.079-1.17
Essex	0.766	0.645-0.909
Franklin	1.039	0.966-1.117
Fulton	1.1	1.01-1.198
Genesee	1.019	0.945-1.099
Herkimer	0.9	0.821-0.987
Jefferson	0.932	0.873-0.995
Kings	0.856	0.823-0.89
Livingston	1.128	1.03-1.237
Madison	1.072	0.994-1.156
Monroe	0.796	0.764-0.83
Montgomery	0.997	0.928-1.072
Nassau	1.197	1.151-1.245

New York	0.763	0.733-0.793
Niagara	1.03	0.975-1.087
Oneida	0.882	0.842-0.923
Onondaga	1.094	1.049-1.141
Ontario	0.915	0.864-0.969
Orange	1.216	1.16-1.275
Orleans	1.048	0.948-1.159
Oswego	0.831	0.776-0.889
Otsego	0.432	0.407-0.459
Putnam	1.159	1.087-1.236
Queens	1.098	1.054-1.143
Rensselaer	1.127	1.07-1.188
Richmond	1.012	0.969-1.057
Rockland	2.026	1.936-2.12
Saratoga	0.98	0.932-1.029
Schenectady	0.799	0.76-0.839
Schoharie	0.718	0.598-0.863
Schuyler	0.512	0.438-0.598
St. Lawrence	0.854	0.808-0.904
Steuben	0.935	0.878-0.997
Suffolk	1.448	1.391-1.506
Sullivan	1.013	0.939-1.093
Tompkins	1.094	1.02-1.174
Ulster	1.297	1.229-1.368
Warren	1.183	1.123-1.247
Wayne	1.071	0.974-1.178
Westchester	1.112	1.069-1.158
Wyoming	0.903	0.816-1
Yates	0.688	0.595-0.794
Female[a]	1	…
Male	0.977	0.97-0.983

White[a]	1	…
Black	1.128	1.118-1.139
Native American	1.033	1.004-1.062
Asian	1.145	1.123-1.168
Pacific Islander	1.264	1.217-1.313
Other	1.121	1.108-1.133
Missing	0.945	0.927-0.965
Birth to <1 y	0.109	0.104-0.115
1-4 y	0.163	0.157-0.169
5-12 y	0.41	0.398-0.422
13-17 y	0.698	0.678-0.718
18-29 y	1.041	1.024-1.059
30-39 y [a]	1	…
40-64 y	1.035	1.022-1.049
65-84 y	1.262	1.242-1.281
≥85 y	1.604	1.576-1.633
Private insurance[a]	1	…
Medicare	1.052	1.041-1.063
Medicaid	1.049	1.038-1.06
Self-pay	1.228	1.209-1.248
No charge	1.619	1.505-1.743
Other	0.981	0.959-1.003
MDC 0[b]	0.296	0.173-0.506
MDC 1	7.143	7.006-7.283
MDC 2	4.229	3.973-4.502
MDC 3	2.584	2.513-2.656
MDC 4	1.626	1.598-1.655
MDC 5	0.817	0.804-0.831
MDC 6	2.899	2.849-2.95
MDC 7	2.792	2.732-2.854
MDC 8	0.828	0.812-0.843

MDC 9	0.732	0.714-0.75
MDC 10[a]	1	…
MDC 11	2.019	1.98-2.06
MDC 12	0.401	0.381-0.422
MDC 13	0.401	0.389-0.414
MDC 14	0.049	0.047-0.051
MDC 15	0.257	0.241-0.274
MDC 16	0.928	0.902-0.956
MDC 17	1.224	1.186-1.263
MDC 18	2.366	2.314-2.419
MDC 19	0.363	0.355-0.372
MDC 20	0.32	0.312-0.329
MDC 21	1.357	1.321-1.395
MDC 22	0.378	0.333-0.429
MDC 23	0.696	0.677-0.715
MDC 24	24.531	21.888-27.493
MDC 25	2.919	2.806-3.038
Teaching[a]	1	…
Nonteaching	0.971	0.962-0.981
Large	0.975	0.967-0.984
Medium[a]	1	…
Small	0.842	0.832-0.852

CT indicates computed tomography; MDC, Major Diagnostic Category.

[a]Reference.

[b]See Appendix B for MDC description.