Disparities in Emergency Department Visits Among Collocated Racial/Ethnic Medicare Enrollees

Amresh D. Hanchate, PhD*; K. Sophia Dyer, MD; Michael K. Paasche-Orlow, MD, MPH; Souvik Banerjee, PhD; William E. Baker, MD; Mengyun Lin, MPH, PhD; Wen Dao Xue, MA; James Feldman, MD, MPH

*Corresponding Author. E-mail: hanchate@bu.edu, Twitter: @AmreshHanchate.

Study objective: We estimate emergency department (ED) use differences across Medicare enrollees of different race/ethnicity who are residing in the same zip codes.

Methods: In this retrospective cohort study, we stratified all Medicare fee-for-service beneficiaries aged 66 years and older (2006 to 2012) by residence zip code and identified zip codes with racial/ethnic diversity, defined as containing at least 1 enrollee from each of 3 racial/ethnic groups: Hispanics, (non-Hispanic) blacks, and (non-Hispanic) whites. Our primary study population consisted of a stratified random sample of approximately equal number of each racial/ethnic group from each zip code with racial/ethnic diversity (N=1,563,631). We identified ED visits, comorbidities, primary-care-treatable status, and patient disposition. We characterized socioeconomic status by zip code poverty rate. The main outcome measure was the ratio of ED visit rate (number of visits/100 person-years) between each minority group and whites.

Results: Of 38,423 zip codes nationally, 41% met the racial/ethnic diversity criterion; these zip codes contained 85% of the Medicare fee-for-service beneficiaries. Among enrollees from zip codes with racial/ethnic diversity, the ED visit rate among whites was 45.4 (95% confidence interval 45.1 to 45.6), and the ED visit rate ratio was 1.34 (95% confidence interval 1.33 to 1.36) among blacks and 1.23 (95% confidence interval 1.22 to 1.24) among Hispanics. ED visit rate ratios for both minority groups were greater than 1.00 among all subgroups by age, comorbidity, zip code poverty rate, urban/rural area, and primary-care-treatable and disposition status.

Conclusion: Among Medicare enrollees, blacks and Hispanics had higher ED use rates than whites overall and among subgroups by demographics and socioeconomic status. [Ann Emerg Med. 2019;73:225-235.]

Please see page 226 for the Editor's Capsule Summary of this article.

Readers: click on the link to go directly to a survey in which you can provide **feedback** to *Annals* on this particular article.

INTRODUCTION

Background and Importance

Although use of many preventive and elective health care services is lower among racial/ethnic minorities, use of emergency department (ED) services has been shown to be consistently higher among racial/ethnic minorities than among non-Hispanic whites.[1-8] However, examination of ED use differences is complicated by long-standing racial/ethnic differences in health insurance coverage because persons with no insurance or insurance with limited acceptance (eg, Medicaid) are likely to turn to the ED for addressing a wider range of health care needs.[3,4,6,9,10] The extent to which ED use differs by race/ethnicity in a population with stable and widely accepted coverage is not known. We examined ED use among 3 groups—Hispanics, (non-Hispanic) blacks, and (non-Hispanic) whites—in a nationally representative population of Medicare enrollees aged 66 years and older.

Goals of This Investigation

Geographic location is an important determinant of health care provider availability. This effect is an important consideration for ED use because of urgency for medical attention and because there are fewer EDs relative to the number of outpatient care providers.[4,11-14] For instance, with greater than 40,000 zip codes and 4,600 EDs nationwide, differences in zip code location may lead to significant differences in proximity to the nearest ED[15] and in ED use.[16,17] A fair comparison of ED use across subpopulations should take into account differences in residential location, particularly in areas with substantial residential segregation of racial/ethnic minorities.[18] We

Editor's Capsule Summary

What is already known on this topic

There is variation in emergency department (ED) utilization in different patient populations.

What question this study addressed

This study examined differences in ED utilization according to race/ethnicity in a national Medicare population.

What this study adds to our knowledge

Within zip codes with racial and ethnic diversity, blacks and Hispanics with Medicare had more ED visits per person than whites with Medicare.

How this is relevant to clinical practice

Minority Medicare patient populations are more likely to utilize ED resources, potentially demonstrating their decreased access to continuing care and adequate disease management.

therefore examined ED use across Medicare enrollees of different race/ethnicity who were residing in the same zip code location. We identified zip codes with and without racial/ethnic diversity of Medicare enrollees and estimated relative ED use separately in each subpopulation. We also measured the extent to which racial/ethnic differences in ED use arise because of geographic variation in ED use. Also, we examined whether differences by race/ethnicity are larger in zip codes with higher poverty rates and for health problems treatable in the primary care setting.

MATERIALS AND METHODS

Study Design

Using the universe of Medicare beneficiaries in each year from 2006 to 2012, we identified those aged 66 years and older. We sampled enrollees from each year with continuous fee-for-service coverage for a maximum of 3 years (or until date of death) because claims data are not available for those enrolled in managed care plans. The number of eligible enrollees each year ranged from 20.0 to 24.6 million between 2006 and 2012.

Because residential location is a key determinant of the availability of health care providers and health care services used, our approach was to compare ED use by race/ethnicity, adjusting for collocation. Because of the presence of areas with few racial/ethnic minorities, such adjustment required identifying areas with residents of all racial/ethnic groups. From the population of eligible Medicare enrollees,

we obtained random samples of collocated enrollees by stratifying overall enrollee population by zip code because this is the smallest unit of area reported in Medicare data. Of 38,423 zip codes identified, 15,595 zip codes (40.6%) included at least 1 enrollee of each of the 3 racial/ethnic groups (henceforth referred to as zip codes with racial/ethnic diversity). These zip codes contained 85% of the eligible Medicare population. From each zip code, we randomly sampled an equal number of enrollees of each racial/ethnic group; in the majority of zip codes with a larger number of whites, sampling rate (ie, proportion of group sampled) was higher for blacks and Hispanics. The proportion sampled in each zip code also varied, depending on the eligible population size of each racial/ethnic group. We oversampled Massachusetts residents because these data are part of a larger study focused on obtaining racial/ethnic estimates for the state residents; however, use of appropriate sampling weights enables us to obtain population-representative national estimates. Those not belonging to the 3 racial/ethnic groups were categorized as one group ("other") and a random sample of enrollees was obtained from each zip code. The remaining 22,828 zip codes without racial/ethnic diversity were grouped at a larger area level, the Dartmouth hospital referral region, into 306 regions, and an equal number of enrollees of each racial/ethnic group were randomly sampled from each region (excluding enrollees from diverse zip codes).[19] Additional details of the sampling approach are provided in Appendix E1, available online at http://www.annemergmed.com. Our primary sample consisted of 1,563,631 enrollees from the zip codes with racial/ethnic diversity; combined with a sample of 117,823 enrollees from zip codes without racial/ethnic diversity, the total sample from all zip codes consisted of 1,681,454 enrollees.

For the study sample, health care utilization claims data were obtained for 1 to 3 years (or until the date of death). ED utilization was examined for each calendar year per enrollee. We also obtained zip code–level data on socioeconomic status from the United States Census Bureau.[20]

Outcome Measures

We measured the rate of ED use as the number of ED visits per 100 person-years. Our main outcome was the rate of ED use among blacks and Hispanics relative to that among whites, measured as the ratio of the ED use rate in each minority group to that among whites.

In identifying the covariates associated with ED use, we applied previous work that characterizes differences in ED use within an adapted Andersen behavior model of health care utilization, including predisposing factors (age, sex,

and race/ethnicity), indicators of need (health status, primary care treatability of ED visit, and hospitalization from the ED), and enabling factors (socioeconomic status and zip code).[21] Two race/ethnicity fields are identified in the Medicare beneficiary data. Previous studies have reported that the sensitivity of the original race field was high in identifying blacks and whites (>97%) but low in identifying Hispanics (33%).[22] We therefore used the revised race/ethnicity field, enhanced with surname-based imputation, because this approach has been validated and offers higher sensitivity in identifying Hispanics (77%).[23-25] We characterized individual baseline health status according to indicators (0/1) of baseline prevalence of the 23 conditions according to the Centers for Medicare & Medicaid Services' Chronic Condition Data Warehouse classification.[26-28] As an individual indicator of socioeconomic status, we used Medicare beneficiary data and defined eligibility for dual Medicaid coverage or benefits as a dichotomous indicator (0/1).[29]

To describe ED visit rate ratios across subgroups, we stratified ED visits by demographic, socioeconomic status, and visit characteristics. To stratify the study sample by socioeconomic status, we used zip code–level poverty rate from the United States Census Bureau,[20] and grouped the sample by poverty rate quintile. As a measure of patient illness severity, we used claims data on patient disposition and grouped all ED visits into those resulting in patient hospitalization and all others ("treat and release"). We also identified primary care treatability status aimed at identifying the type of services provided during the ED visit, using an algorithm based on Medicare claims data.[30] This algorithm identifies an ED visit as primary care treatable if 3 criteria are met: the patient is not hospitalized, the evaluation and management codes indicate mild or moderate illness severity, and services provided during the visit did not include "procedures frequently performed in the ED but not frequently performed in primary care visits."

Primary Data Analysis

We estimated ED visit rates and rate ratios with regression models, with the number of ED visits per person-year as the dependent variable and race/ethnicity, age (categorized as aged 66 to 74 years, 75 to 84 years, and 85 years and older), sex, comorbidity burden (using 0/1 indicators of 23 individual chronic conditions), and year as the independent covariates. To adjust for collocation, we included zip code fixed effects to use only ED use variation across individuals within the same zip code to obtain estimates.[31] Because this inclusion leads to a regression model specification with a distinct dummy variable indicator (0/1) for each zip code, including all 15,595 zip codes with racial/ethnic diversity, the scope of such models

renders Poisson or other count regression models computationally infeasible. We therefore estimated linear regression models (treating the dependent variable as a continuous measure) with zip code fixed effects; additional details in regard to considerations in model estimation are presented in Appendix E1, available online at http://www.annemergmed.com. In addition, to confirm that our choice of linear regression models with zip code fixed effects was reasonable we conducted sensitivity analyses of the differences in ED visit rate and rate ratio estimates from linear, Poisson, and negative binomial regression models for (random) subsamples of the study data from 1,000 and 2,000 zip codes.

For each linear model estimated, we obtained the predicted ED visit rate and ED visit rate ratios; for comparability by race/ethnicity, we evaluated the predicted ED visit rates at the overall study population mean of all independent covariates.[32]

To examine differences in the frequency of ED visits by race/ethnicity, we defined dichotomous indicators by number of ED visits (1, 2 to 3, and more than 3) and estimated linear (probability) models, with and without adjustment for collocation, and obtained frequency of the dichotomous indicators and the relative rates by race/ethnicity.

We also estimated similar linear regression models but without collocation adjustment by excluding zip code fixed effects (ie, no dummy variables). Here, comparisons of ED use by race/ethnicity were made regardless of where the enrollees resided.

We applied the fixed-effects linear regression approach to obtain ED visit rate and rate ratios for a variety of subgroups, including subgroups by patient age, health status, ED visit characteristics, and (zip code) poverty status. We also estimated these rates for the subsample from zip codes without racial/ethnic diversity, after replacing hospital referral region for zip code as the unit of geography (and fixed effects) in the regression model. We estimated ED visit rate ratios for subgroups of zip codes with racial/ethnic diversity categorized by the number of enrollees of all 3 racial/ethnic groups.

Because our data cover multiple years (2006 to 2012), we estimated ED visit rate ratios by year and tested for a linear trend over time. We also performed a trend test in ED visit rate ratio by poverty quintile by combining data from all zip codes with racial/ethnic diversity and using a linear model including an interaction of poverty quintile (continuous) and race/ethnicity indicator.

All regression models were estimated to take into account the stratified sampling design and the sampling weights, and produced heteroskedasticity-consistent robust standard error estimates.[33] Statistical significance was assessed at $P<.05$. All estimation was performed with Stata (version 14.1; StataCorp, College Station, TX).[34] The

institutional review board of Boston University School of Medicine approved this study.

RESULTS

Our study data consist of 4,710,572 person-year observations from a stratified random sample of 1,681,454 Medicare enrollees aged 66 years and older during 2006 to 2012 (Table 1). The share of blacks in the diverse and nondiverse zip codes was 7.5% and 4.9%, respectively, and of Hispanics was 4.9% and 2.3%, respectively; this reflects the shares in the eligible Medicare enrollee population (Appendix E1, Table 2, available online at http://www.annemergmed.com). Although both minority groups were younger, a larger proportion of blacks (22.5%) and Hispanics (23%) had 6 or more chronic conditions at baseline compared with whites (18.8%). Individual condition prevalence varied by race/ethnicity, with higher prevalence of diabetes, hypertension, and chronic kidney disease among blacks; osteoporosis and depression among Hispanics; and atrial fibrillation, breast cancer, and chronic obstructive pulmonary disease among whites (Appendix E1, Table 6, available online at http://www.annemergmed.com).

Overall, the rate of ED visits among whites was 45.4 (95% confidence interval [CI] 45.1 to 45.6) (Table 2). With adjustment for collocation, the ratio of ED visit rate between blacks and whites was 1.34 (95% CI 1.33 to 1.36) and between Hispanics and whites was 1.23 (95% CI 1.22 to 1.24); ED visit rates are reported in Table 7*A* and full model estimates in Table 7*B* of Appendix E1, available online at http://www.annemergmed.com. These findings were similar in zip codes with and without diversity, indicating similarity in effect of collocation adjustment at zip code and hospital referral region levels. However, without any adjustment for collocation, the ratio of ED visit rates was significantly smaller for Hispanics and blacks; for Hispanics, in the overall sample, the ratio of ED visit rates was 1.08 (95% CI 1.06 to 1.11), and in the zip codes without diversity the corresponding ratio was 0.96 (95% CI 0.76 to 1.16). In sensitivity analysis limited to subsamples of zip codes, we found that the rate and rate ratio estimates were largely similar across different model specifications, including Poisson and negative binomial regression (Appendix E1, Table 8, available online at http://www.annemergmed.com).

Zip codes with racial/ethnic diversity were defined as those with at least 1 enrollee of each of the 3 racial/ethnic groups studied. We found that increasing this threshold to requiring larger number of enrollees of each group led to no sizable change in the estimated ED visit rate and rate ratios (Appendix E1, Table 9, available online at http://www.

annemergmed.com). Rate of ED visits increased over time (2006 to 2012), but ED visit rate ratios did not vary over time (Appendix E1, Table 10, available online at http://www.annemergmed.com).

Rate ratios by race/ethnicity differed by the frequency of ED visits (Table 3). After adjustment for collocation, 16.6% of whites experienced 1 ED visit; the corresponding rate ratios were 6% higher among blacks and Hispanics. But for the outcome of 2 to 3 ED visits (per person-year), the rate ratios were greater than 22% higher, and for more than 3 ED visits the rate ratios were greater than 47% higher.

ED visit rate increased with age, with a rate of 33.6 (95% CI 33.2 to 33.9) among whites aged 66 to 74 years and 71.4 (95% CI 70.7 to 72.1) among whites aged 85 years and older (Table 4). Relative to whites, among blacks and Hispanics in all age groups the ED visit rate was higher. Among blacks and Hispanics, the ED visit rate ratio was higher in the younger age group (blacks=1.44, 95% CI 1.41 to 1.46; and Hispanics=1.27, 95% CI 1.25 to 1.29) than for the oldest age group (blacks=1.21, 95% CI 1.18 to 1.23; and Hispanics=1.17, 95% CI 1.15 to 1.20). The ED visit rate was higher among women than among men; relative to that for whites, ED visit rates were higher among blacks and Hispanics and by similar magnitudes for both men and women. Higher disease burden was associated with greater ED use, ranging from 7.1 (95% CI 6.9 to 7.4) among whites with no comorbidities to 127.2 (95% CI 126.0 to 128.3) among whites with 6 or more chronic conditions. Compared with that for whites, ED visit rate was higher among blacks for all disease burden groups and among Hispanics for those with one or more chronic conditions. The ED visit rate was higher among blacks and Hispanics in each of the 6 most common chronic condition groups (Appendix E1, Table 11, available online at http://www.annemergmed.com).

ED visit rate ratios were higher for both blacks and Hispanics in all subgroups of zip codes by socioeconomic status and population density (metropolitan and rural areas) (Table 5). The ED visit rate among whites in the zip codes in the lowest and highest poverty quintiles were 44.3 (95% CI 43.7 to 44.9) and 46.3 (95% CI 45.7 to 46.9), respectively. ED visit rate ratios for both blacks and Hispanics were larger in higher poverty quintiles. Pooling data for all quintiles indicated an increasing trend in ED visit rate ratios across quintiles (blacks=0.65, 95% CI 0.25 to 1.05, *P*=.001; and Hispanics=0.85, 95% CI 0.49 to 1.21, *P*<.001).

Among whites, the rate of primary-care-treatable ED visits was 9.8 (95% CI 9.7 to 9.9) and composed 21.7% of all ED visits (Table 6). The ED visit rate ratio for primary-care-treatable visits was higher than that for visits that

Table 1. Summary characteristics of the study sample, 2006 to 2012.*

Characteristics	All%[†]	Whites, Non-Hispanic, %	Blacks, Non-Hispanic, %	Hispanics, %
Zip codes with racial/ethnic diversity				
No. of annual (person-year) observations	4,403,545	2,027,580	1,079,580	1,032,576
No. of sample persons	1,563,631	741,823	376,322	349,788
Population share, %	100	84.8	7.5	4.9
No. ED visits per person-year				
0	71.4	71.5	68.6	72.7
1	17.0	17.3	17.7	16.4
2	6.1	6.1	6.8	5.8
3	2.6	2.5	3.1	2.5
4	1.3	1.2	1.6	1.2
5	0.7	0.6	0.9	0.6
≥6	0.9	0.8	1.4	0.9
Age, %, y				
66–74	47.2	46.0	53.6	54.2
75–84	37.7	38.2	33.9	35.2
≥85	15.2	15.8	12.5	10.7
Women, %	59.0	58.8	61.9	57.7
No. of chronic conditions (maximum=23), %				
None	14.1	13.7	14.7	18.7
1–2	25.7	26.3	22.1	21.3
3–5	40.4	40.7	40.3	37.0
≥6	19.7	19.3	22.9	23.0
Zip codes without racial/ethnic diversity				
No. of annual (person-year) observations	307,027	123,131	81,216	84,374
No. of sample persons	117,823	52,368	29,693	28,659
Population share, %	100	91.4	4.9	2.3
No. ED visits per person-year				
0	70.9	72.1	66.1	72.5
1	17.1	17.1	18.4	16.3
2	6.2	5.9	7.4	5.8
3	2.8	2.5	3.6	2.6
4	1.4	1.1	1.9	1.2
5	0.7	0.5	1.0	0.7
≥6	1.0	0.7	1.7	1.0
Age, %, y				
66–74	49.9	49.6	51.0	54.7
75–84	36.4	36.6	35.5	35.3
≥85	13.7	13.8	13.6	10.0
Female, %	55.6	55.3	62.0	52.9
No. of chronic conditions (maximum=23), %				
None	15.9	15.8	13.4	19.9
1–2	28.3	28.7	23.8	21.4
3–5	39.1	39.0	43.2	35.6
≥6	16.7	16.5	19.6	23.0

*Other than the number of sample persons and number of annual observations, all other summary statistics are based on adjustment for stratified sampling. For instance, although share of non-Hispanic blacks (N=406,015) out of the total sample (N=1,681,454) is 24.1%, after adjustment for stratified sampling this share is 7.1%.
[†]The counts include the "other" race/ethnic group, for which we have not reported the summary statistics.

Table 2. Adjusted ED visit rate and ED visit rate ratios.*

Study Population (Zip Codes)	Whites, Non-Hispanic		Blacks, Non-Hispanic		Hispanics	
	ED Visit Rate (No. ED Visits/100 Person-Years)	95% CI	ED Visit Rate Ratio: Blacks vs Whites	95% CI	ED Visit Rate Ratio: Hispanics vs Whites	95% CI
Zip codes with racial/ethnic diversity						
Adjusted for location	45.4	45.1–45.6	1.34	1.33–1.36	1.23	1.22–1.24
Not adjusted for location	45.9	45.5–46.3	1.31	1.30–1.34	1.08	1.06–1.11
Zip codes without racial/ethnic diversity						
Adjusted for location	49.5	48.4–50.1	1.36	1.31–1.42	1.22	1.17–1.26
Not adjusted for location	49.9	48.4–51.3	1.32	1.25–1.39	0.96	0.76–1.16
Overall sample						
Adjusted for location	46.1	45.8–46.4	1.35	1.33–1.36	1.23	1.22–1.24
Not adjusted for location	46.7	46.4–47.0	1.30	1.29–1.32	1.06	1.04–1.07

*Estimates adjusted for location are based on a linear regression model with race/ethnicity, age, sex, comorbidity, and year as covariates and with indicators (fixed effects) for each zip code. Estimates not adjusted for location are based on linear regression model with race/ethnicity, age, sex, comorbidity, and year as covariates. All regression models used sampling weights to adjust for stratified sampling. CI estimates are based on robust standard errors adjusted for clustering at zip code (zip codes with diversity) or hospital referral region (zip codes without diversity).

needed ED care for blacks (1.55, 95% CI 1.52 to 1.58; and 1.29, 95% CI 1.28 to 1.31) and Hispanics (1.28, 95% CI 1.26 to 1.30; and 1.22, 95% CI 1.21 to 1.23). Among whites, 28.9 ED visits (63.8% of all ED visits) were treat-and-release visits. The ED visit rate ratio for treat-and-release visits was higher than that for ED visits leading to hospitalization for both blacks and Hispanics.

LIMITATIONS

We recognize several limitations of our study. Our data cover only patients aged 66 years and older, and hence generalizability of the study findings may be limited because of systematic differences in ED use among younger adults. Our study does not include Medicare enrollees in the managed care plans. Comparison of ED use indicates significantly lower rates among managed care enrollees relative to fee-for-service enrollees.[35] Whether racial/ethnic differences in ED use vary among managed care enrollees is not known. The approach used to identify primary-care-treatable ED visits, although developed with expert opinion, has not been validated. Determining primary care treatability of ED visits is complicated by lack of data on patient symptoms[36,37] and lack of a criterion standard for primary care treatability; however, it is not clear whether

Table 3. Adjusted ED visit rate and ED visit rate ratios by number of ED visits.*

Number of ED Visits	Whites, Non-Hispanic		Blacks, Non-Hispanic		Hispanics	
	Frequency (Incidence) Rate, %	95% CI	IRR: Blacks vs Whites	95% CI	IRR: Hispanics vs Whites	95% CI
Adjusted for collocation						
Dichotomous outcome of 1 ED visit per person-year	16.6	16.5–16.7	1.06	1.05–1.08	1.06	1.05–1.07
Dichotomous outcome of 2 to 3 ED visits per person-year	7.76	7.69–7.83	1.26	1.25–1.29	1.22	1.21–1.24
Dichotomous outcome of >3 ED visits per person-year	2.03	1.99–2.06	1.79	1.74–1.84	1.47	1.44–1.52
Not adjusted for collocation						
Dichotomous outcome of 1 ED visit per person-year	16.7	16.59–16.82	1.06	1.04–1.07	0.99	0.97–1.01
Dichotomous outcome of 2 to 3 ED visits per person-year	7.85	7.77–7.94	1.24	1.21–1.26	1.09	1.06–1.11
Dichotomous outcome of >3 ED visits per person-year	2.07	2.03–2.12	1.71	1.65–1.77	1.22	1.16–1.28

The outcome measure is a dichotomous indicator (0/1) of the number of ED visits during a person-year. The number of observations remains the same for all outcomes, so a dichotomous indicator of 2 to 3 visits assigns a value of 1 if ED visits are 2 to 3 and assigns a value of 0 for all other observations with ED visits outside this range. Estimates adjusted for location are based on a linear regression model with race/ethnicity, age, sex, comorbidity, and year as covariates and with indicators (fixed effects) for each zip code. Estimates not adjusted for location are based on linear regression model with race/ethnicity, age, sex, comorbidity, and year as covariates. All regression models used sampling weights to adjust for stratified sampling. CI estimates are based on robust standard errors adjusted for clustering at zip code (zip codes with diversity) or hospital referral region (zip codes without diversity).
*Estimates are for zip codes with racial/ethnic diversity.

Table 4. Adjusted ED visit rate and ED visit rate ratios by age, sex, and chronic condition.*

Patient Characteristics	Whites, Non-Hispanic		Blacks, Non-Hispanic		Hispanics	
	ED Visit Rate (No. ED Visits/ 100 Person-Years)	95% CI	ED Visit Rate Ratio: Blacks vs Whites	95% CI	ED Visit Rate Ratio: Hispanics vs Whites	95% CI
Age, y						
66–74	33.6	33.2–33.9	1.44	1.41–1.46	1.27	1.25–1.29
75–84	49.8	49.3–50.2	1.33	1.30–1.35	1.23	1.21–1.25
≥85	71.4	70.7–72.1	1.21	1.18–1.23	1.17	1.15–1.20
Sex						
Men	41.0	40.6–41.3	1.36	1.34–1.38	1.23	1.21–1.25
Women	48.5	48.1–48.9	1.32	1.30–1.34	1.23	1.22–1.24
No. of chronic conditions						
None	6.9	6.7–7.1	1.16	1.10–1.23	1.04	0.99–1.08
1–2	18.1	17.8–18.4	1.44	1.40–1.48	1.33	1.30–1.37
3–5	38.0	37.6–38.2	1.35	1.33–1.37	1.27	1.25–1.29
≥6	124.1	123.1–125.1	1.28	1.26–1.30	1.16	1.14–1.18
Chronic condition						
Hypertension	62.5	62.1–62.9	1.32	1.30–1.33	1.21	1.20–1.23
Hyperlipidemia	56.0	55.6–56.4	1.35	1.33–1.37	1.22	1.20–1.23
Ischemic heart disease	78.1	77.5–78.8	1.35	1.33–1.37	1.20	1.18–1.22
Diabetes	64.5	63.8–65.2	1.33	1.31–1.36	1.24	1.22–1.26
Rheumatoid arthritis/osteoarthritis	69.2	68.6–69.9	1.33	1.31–1.35	1.19	1.17–1.21
Anemia	89.8	89.0–90.7	1.27	1.25–1.29	1.18	1.16–1.20

These estimates are using the sample from zip codes with racial/ethnic diversity. A separate regression model was estimated for each group, stratified by age, sex, and disease burden. Estimates are based on linear regression models with race/ethnicity, age, sex, comorbidity, and year as covariates and with indicators (fixed effects) for each zip code; the covariate(s) corresponding to each stratum was excluded (for example, age was not included as a covariate for each age group estimation). All regression models used sampling weights to adjust for stratified sampling. CI estimates are based on robust standard errors adjusted for clustering at zip code.
*Estimates are for zip codes with racial/ethnic diversity.

this leads to systematic differences in categorization of ED visits by race/ethnicity. The Centers for Medicare & Medicaid Services chronic condition categorization that we used does not include potentially important predictors of ED use, including substance use. We recognize that zip codes can be large and allow significant heterogeneity among residents in access to providers.

DISCUSSION

Our study highlights 3 main findings. First, although white Medicare enrollees aged 66 years and older had 46 ED visits per 100 person-years, black and Hispanic rates were 35% and 23% higher, respectively. Second, the extent of higher use among minorities was larger for people who have more frequent ED visits. Third, this pattern of higher ED use among the minority groups was found in every subgroup by age, sex, and comorbid condition, in metropolitan and rural areas, and in all regions grouped by zip code poverty rate; an exception was the subgroup with no diagnosed comorbidity, wherein ED visit rates were

similar among Hispanics and whites. The extent of differences varied, with larger differences among the youngest, least morbid, and individuals residing in areas with high poverty. Racial/ethnic differences were also higher for ED visits categorized as primary care treatable and not leading to inpatient admission.

To our knowledge, these are the first estimates of differences in ED use by race/ethnicity taking residential location into account. Of 38,423 zip codes where the study-eligible Medicare population of greater than 20 million lived, only 40.6% included at least one Hispanic, black, and white enrollee. Without adjustment for differences in residential location, ED visit rate estimates among blacks and Hispanics remained higher than that among whites, but the differences were smaller. Among Hispanics, ED visit rate without location adjustment was 6% higher (relative to that of whites) and with location adjustment was 23% higher. Our findings differ from 2 previous estimates from different surveys of significantly lower ED use among Hispanics, relative to that for

Table 5. Adjusted ED visit rate and ED visit rate ratios by area characteristics.*

Area Characteristics	Whites, Non-Hispanic		Blacks, Non-Hispanic		Hispanics	
	ED Visit Rate (No. ED Visits/ 100 Person-Years)	95% CI	ED Visit Rate Ratio: Blacks vs Whites	95% CI	ED Visit Rate Ratio: Hispanics vs Whites	95% CI
Areas grouped by zip code poverty rate, quintile						
1 (lowest poverty)	44.3	43.7–44.9	1.26	1.23–1.30	1.13	1.10–1.16
2	45.2	44.6–45.9	1.28	1.25–1.32	1.14	1.11–1.17
3	46.5	46.0–47.0	1.28	1.25–1.31	1.12	1.09–1.15
4	46.6	46.0–47.2	1.28	1.25–1.32	1.12	1.10–1.15
5 (highest poverty)	46.3	45.7–46.9	1.31	1.29–1.34	1.20	1.17–1.22
Test of linear trend by race/ethnicity						
Change in ED visit rate ratio associated with residing in one-higher-poverty-quintile zip code	Not applicable		0.65	0.25–1.05	0.85	0.49–1.21
P value			.001		<.001	
Areas grouped by metropolitan/ rural area classification						
Metropolitan areas	44.5	44.2–44.7	1.34	1.32–1.35	1.23	1.21–1.24
Micropolitan areas	49.9	49.0–50.9	1.36	1.31–1.42	1.25	1.20–1.29
Rural areas	52.2	51.1–53.4	1.39	1.32–1.46	1.37	1.31–1.44

These estimates use the sample from zip codes with racial/ethnic diversity. A separate regression model was estimated for each quintile. Estimates are based on linear regression models with race/ethnicity, age, sex, comorbidity conditions, and year as covariates and with indicators (fixed effects) for each zip code. All regression models used sampling weights to adjust for stratified sampling. CI estimates are based on robust standard errors adjusted for clustering at zip code. To test for linear trend in ED visit rate by quintile and race/ethnicity, we estimated a regression model with all samples combined and including a covariate of the interaction of quintile (continuous) and race/ethnicity, along with other covariates. The P values associated with each interaction term are reported. Metropolitan statistical areas are one or more counties with a core urban area of at least 50,000 persons, whereas micropolitan statistical areas have core urban areas of between 10,000 and 50,000 persons; the remaining areas are categorized as rural. Major metropolitan statistical areas are a subgroup of 11 metropolitan statistical areas with more than one metropolitan division, defined as one or more counties containing a single core of at least 2.5 million population; these are metropolitan statistical areas that contain Chicago; Dallas; Detroit; Los Angeles; Miami; New York; Philadelphia; San Francisco; Seattle; Washington, DC; and Boston.
*Estimates are for zip codes with racial/ethnic diversity.

whites.[3,6] Because those estimates are for all adults, they are not directly comparable with our estimates for Medicare enrollees; however, the lack of adjustment for geographic location and varied insurance coverage effects in those studies may partly explain the differences in findings for Hispanics in our study. Corresponding estimates for

Table 6. Adjusted ED visit rate and ED visit rate ratios by primary-care-treatable and patient disposition status.*

ED Visit Characteristics	Whites, Non-Hispanic		Blacks, Non-Hispanic		Hispanics	
	ED Visit Rate (No. ED Visits/ 100 Person-Years)	95% CI	ED Visit Rate Ratio: Blacks vs Whites	95% CI	ED Visit Rate Ratio: Hispanics vs Whites	95% CI
Primary care treatability status						
Primary care treatable	9.8	9.7–9.9	1.55	1.52–1.58	1.28	1.26–1.30
ED care needed	35.4	35.2–35.6	1.29	1.28–1.31	1.22	1.21–1.23
Patient disposition status						
Treat-and-release ED visit	28.9	28.7–29.2	1.43	1.41–1.45	1.27	1.26–1.29
ED visit with hospitalization	16.4	16.3–16.5	1.20	1.18–1.22	1.16	1.15–1.18

These estimates use the sample from zip codes with racial/ethnic diversity. A separate regression model was estimated for each group, stratified by primary care treatability and patient disposition status. Categorization of ED visits as primary care treatable or ED care needed is based on the Minnesota algorithm (as explained in the "Materials and Methods" section). Estimates are based on linear regression models with race/ethnicity, age, sex, comorbidity conditions, and year as covariates and with indicators (fixed effects) for each zip code. All regression models used sampling weights to adjust for stratified sampling. CI estimates are based on robust standard errors adjusted for clustering at zip code.
*Estimates are for zip codes with racial/ethnic diversity.

blacks from both previous studies are consistent with our findings.

Our findings indicate that even with stable and widely covered insurance coverage, ED use is higher among blacks and Hispanics. In understanding the factors underlying differential use, our findings offer insights on assessing the relative merit of important determinants of ED use among elderly enrollees previously identified.[21,38,39] First, even individuals with stable insurance have barriers to primary care access. Presence of a regular place of care is a commonly used measure of primary care access; however, among individuals aged 65 years and older, there is little difference in this measure by race/ethnicity, with greater than 98% reporting the presence of a regular place of care[40] and less than 3% reporting the ED as a regular place of care.[38,41,42] More relevant for understanding racial/ethnic differences in ED use could be timely access to care. Even individuals with a regular place of care may experience difficulty with timely access in case of urgent need, leading to the ED as an alternative.[14,38,42,43] One study using data for all ages found that among individuals who reported having a physician's office (or clinic or health center) as their regular place of care, barriers to timely access—identified by queries on "could not get through on the telephone," "could not obtain appointment soon enough," "waiting too long in the physician's office", "not open when you could go," and "no transportation"—were associated with higher ED use compared with individuals without a barrier (33.3% versus 22.2%).[43] As a consequence of these barriers, there is considerable ED use for health problems that are identified, after discharge, as primary care treatable. To the extent that these barriers are more prevalent among minorities, recent efforts by insurers to deny payment of claims for primary-care-treatable ED visits may more adversely affect minority Medicare enrollees[44,45]; furthermore, the effectiveness of such interventions is unclear.[46]

Second, our finding of reduced racial/ethnic differences in ED use among individuals older and with multiple comorbid conditions suggests that more extensive and intensive integration with outpatient care providers may lead to less dissimilarity in ED use by race/ethnicity. Greater ED use among the younger minority Medicare enrollees may be influenced by persistence in care-seeking behaviors developed before transition to Medicare, wherein lack of insurance or poor acceptance of Medicaid by outpatient care providers motivates higher ED use for a range of health problems, including those that may be addressed in a primary care setting. Among individuals with outpatient care access, previous work indicates that greater continuity and coordination of outpatient care

(eg, patient-centered medical homes, accountable care organizations) is associated with less ED use[47-50]; the extent to which coordinated care among Medicare enrollees differs by race/ethnicity is not known.

Need for emergency care is identified as a key determinant of ED use because older adults have higher morbidity.[39] Our finding of higher ED use among older enrollees and those with higher morbidity burden is consistent with this rationale. However, differences in need may not be a key factor in accounting for the higher rate of ED use among minority Medicare enrollees, given that the margin of higher ED use decreases with age and morbidity burden. This margin is also higher for ED visits identified as primary care treatable and treat-and-release cases, suggesting that unobserved morbidity or severity may not be a key underlying factor.

An important policy implication of our findings is that the provision of insurance coverage alone is unlikely to eliminate the higher rates of ED use among blacks and Hispanics relative to whites. Further study of ED use in the populations with stable insurance is needed to better understand the extent to which the higher ED use is due to other barriers to timely access to primary care and identify suitable policy interventions to mitigate these barriers. In summary, in the Medicare-covered population, blacks and Hispanics used substantially more ED services than whites, even after accounting for comorbidity burden and residential area. The differences were larger in areas with higher poverty and for primary-care-treatable ED visits, indicating that minority groups may have other barriers to timely access to primary care services compared with whites.

REFERENCES

1. Agency for Healthcare Research and Quality. *2017 National Healthcare Quality and Disparities Report*. Rockville, MD: Agency for Healthcare Research & Quality; 2018.
2. Institute of Medicine. *Unequal Treatment: Confronting Racial and Ethnic Disparities in Health Care*. Washington, DC: National Academies Press; 2002.
3. Tang N, Stein J, Hsia RY, et al. Trends and characteristics of US emergency department visits, 1997-2007. *JAMA*. 2010;304:664-670.
4. Institute of Medicine. *Hospital-Based Emergency Care: At the Breaking Point*. Washington, DC: National Academies Press; 2007.
5. Hampers LC, Cha S, Gutglass DJ, et al. Language barriers and resource utilization in a pediatric emergency department. *Pediatrics*. 1999;103(6 pt 1):1253-1256.
6. Gindi RM, Black LI, Cohen RA. Reasons for emergency room use among US adults aged 18-64: National Health Interview Survey, 2013 and 2014. *Natl Health Stat Rep*. 2016;(90):1-16.
7. Niska R, Bhuiya F, Xu J. National Hospital Ambulatory Medical Care Survey: 2007 emergency department summary. *Natl Health Stat Rep*. 2010;(26):1-31.
8. Jha AK, Fisher ES, Li Z, et al. Racial trends in the use of major procedures among the elderly. *N Engl J Med*. 2005;353:683-691.
9. Moore BJ, Stocks C, Owens PL. *Trends in Emergency Department Visits, 2006-2014*. Rockville, MD: Agency for Healthcare Research & Quality; 2017.
10. Asplin BR, Rhodes KV, Levy H, et al. Insurance status and access to urgent ambulatory care follow-up appointments. *JAMA*. 2005;294:1248-1254.
11. Shen YC, Hsia RY. Does decreased access to emergency departments affect patient outcomes? analysis of acute myocardial infarction population 1996-2005. *Health Serv Res*. 2012;47(1 pt 1):188-210.
12. Fishman J, McLafferty S, Galanter W. Does spatial access to primary care affect emergency department utilization for nonemergent conditions? *Health Serv Res*. 2016;53:489-508.
13. Rising KL, Karp DN, Powell RE, et al. Geography, not health system affiliations, determines patients' revisits to the emergency department. *Health Serv Res*. 2017;53:1092-1109.
14. Guttman N, Zimmerman DR, Nelson MS. The many faces of access: reasons for medically nonurgent emergency department visits. *J Health Polit Policy Law*. 2003;28:1089-1120.
15. Hsia RY, Kellermann AL, Shen Y. Factors associated with closures of emergency departments in the United States. *JAMA*. 2011;305:1978-1985.
16. Pines JM, Mutter RL, Zocchi MS. Variation in emergency department admission rates across the United States. *Med Care Res Rev*. 2013;70:218-231.
17. Hanchate AD, Paasche-Orlow MK, Dyer KS, et al. Geographic variation in use of ambulance transport to the emergency department. *Ann Emerg Med*. 2017;70:533-543.
18. Williams DR, Collins C. Racial residential segregation: a fundamental cause of racial disparities in health. *Public Health Rep*. 2001;116:404-416.
19. Dartmouth Medical School. *The Dartmouth Atlas of Health Care in the United States*. Hanover, NH: Center for the Evaluative Clinical Sciences, Dartmouth Medical School; 2016.
20. US Census Bureau. *American Community Survey*. Washington, DC: US Census Bureau; 2017.
21. McCusker J, Karp I, Cardin S, et al. Determinants of emergency department visits by older adults: a systematic review. *Acad Emerg Med*. 2003;10:1362-1370.
22. McBean AM. *Medicare Race and Ethnicity Data*. Minneapolis, MN: National Academy of Social Insurance; 2004.
23. Ayanian JZ, Landon BE, Zaslavsky AM, et al. Racial and ethnic differences in use of mammography between Medicare Advantage and traditional Medicare. *J Natl Cancer Inst*. 2013;105:1891-1896.
24. Eicheldinger C, Bonito A. More accurate racial and ethnic codes for Medicare administrative data. *Health Care Financ Rev*. 2008;29:27-42.
25. Bonito AJ, Bann C, Eicheldinger C, et al. Creation of new race-ethnicity codes and socioeconomic status (SES) indicators for Medicare beneficiaries. Available at: https://archive.ahrq.gov/research/findings/final-reports/medicareindicators/. Accessed November 1, 2017.
26. Centers for Medicare & Medicaid Services. Chronic Conditions Data Warehouse: CCW condition algorithms (rev. 01/2016). Available at: https://www.ccwdata.org/web/guest/condition-categories. Accessed June 1, 2017.
27. Centers for Medicare & Medicaid Services. Chronic conditions among Medicare beneficiaries, chartbook, 2012 edition. Available at: https://www.cms.gov/research-statistics-data-and-systems/statistics-trends-and-reports/chronic-conditions/downloads/2012chartbook.pdf. Accessed June 1, 2017.
28. Goodman RA, Posner SF, Huang ES, et al. Defining and measuring chronic conditions: imperatives for research, policy, program, and practice. *Prev Chronic Dis*. 2013;10:E66.
29. ResDAC. Identifying dual eligible Medicare beneficiaries in the Medicare beneficiary enrollment files. Available at: https://www.resdac.org/articles/identifying-dual-eligible-medicare-beneficiaries-medicare-beneficiary-enrollment-files. Accessed September 30, 2018.
30. Jeffery MM, Bellolio MF, Wolfson J, et al. Validation of an algorithm to determine the primary care treatability of emergency department visits. *BMJ Open*. 2016;6:e011739.
31. Hansen BE. Econometrics. Available at: https://www.ssc.wisc.edu/~bhansen/econometrics/2018. Accessed August 12, 2018.
32. StataCorp. Stata14 help for margins. Available at: https://www.stata.com/help.cgi?margins. Accessed August 9, 2018.
33. Cameron AC, Trivedi PK. *Microeconometrics: Methods and Applications*. New York, NY: Cambridge University Press; 2005.
34. StataCorp. *Stata Statistical Software: Release 14*. College Station, TX: StataCorp LP; 2016.
35. Landon BE, Zaslavsky AM, Saunders RC, et al. Analysis of Medicare Advantage HMOs compared with traditional Medicare shows lower use of many services during 2003-09. *Health Aff (Millwood)*. 2012;31:2609-2617.
36. Raven MC, Lowe RA, Maselli J, et al. Comparison of presenting complaint vs discharge diagnosis for identifying "nonemergency" emergency department visits. *JAMA*. 2013;309:1145-1153.

37. Hsia RY, Friedman AB, Niedzwiecki M. Urgent care needs among nonurgent visits to the emergency department. *JAMA Intern Med*. 2016;176:852-854.

38. Young GP, Wagner MB, Kellermann AL, et al. Ambulatory visits to hospital emergency departments: patterns and reasons for use. *JAMA*. 1996;276:460-465.

39. Gruneir A, Silver MJ, Rochon PA. Emergency department use by older adults: a literature review on trends, appropriateness, and consequences of unmet health care needs. *Med Care Res Rev*. 2011;68:131-155.

40. Okoro CA, Strine TW, Young SL, et al. Access to health care among older adults and receipt of preventive services. Results from the Behavioral Risk Factor Surveillance System, 2002. *Prev Med*. 2005;40:337-343.

41. Centers for Disease Control and Prevention. Summary health statistics: National Health Interview Survey 2016. Available at: https://ftp.cdc. gov/pub/Health_Statistics/NCHS/NHIS/SHS/2016_SHS_Table_A-16. pdf2018.

42. DeLia D, Cantor JC, Brownlee S, et al. Patient preference for emergency care: can and should it be changed? *Med Care Res Rev*. 2012;69:277-293.

43. Rust G, Ye J, Baltrus P, et al. Practical barriers to timely primary care access: impact on adult use of emergency department services. *Arch Intern Med*. 2008;168:1705-1710.

44. Abelson R, Sanger-Katz M, Creswell J. As an insurer resists paying for "avoidable" ER visits, patients and doctors push back. Available at: https://www.nytimes.com/2018/05/19/upshot/anthem-insurer-resists-paying-emergency-room-visits-if-avoidable.html?. Accessed June 1, 2017.

45. Kellermann AL, Weinick RM. Emergency departments, Medicaid costs, and access to primary care—understanding the link. *N Engl J Med*. 2012;366:2141-2143.

46. Raven MC, Kushel M, Ko MJ, et al. The effectiveness of emergency department visit reduction programs: a systematic review. *Ann Emerg Med*. 2016;68:467-483.e415.

47. Green LA, Chang HC, Markovitz AR, et al. The reduction in ED and hospital admissions in medical home practices is specific to primary care–sensitive chronic conditions. *Health Serv Res*. 2017;53:1163-1179.

48. Moffett ML, Kaufman A, Bazemore A. Community health workers bring cost savings to patient-centered medical homes. *J Community Health*. 2018;43:1-3.

49. Hsu J, Price M, Vogeli C, et al. Bending the spending curve by altering care delivery patterns: the role of care management within a pioneer ACO. *Health Aff (Millwood)*. 2017;36:876-884.

50. Nyweide DJ, Bynum JP. Relationship between continuity of ambulatory care and risk of emergency department episodes among older adults. *Ann Emerg Med*. 2016;69:407-415.

Images in Emergency Medicine

The *Annals* Web site (www.annemergmed.com) contains a collection of hundreds of emergency medicine-related images, complete with brief discussion and diagnosis, in 18 categories. Go to the Images pull-down menu and test your diagnostic skill today. Below is a selection from the Neurology/Neurosurgery Images.
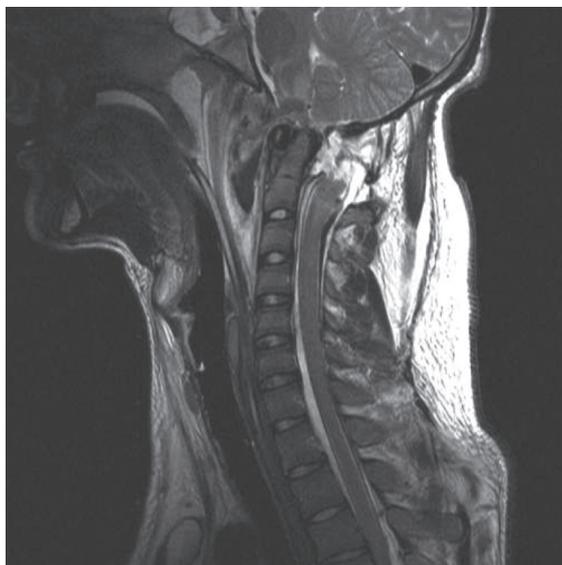
"Long-Term Survival Following Complete Medulla/Cervical Spinal Cord Transection" by Gautschi and Zellweger, April 2007, Volume 49, #1, pp. 540, 545.