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Regional variation in healthcare usage for Medicare beneficiaries: a cross-sectional study based on the health and retirement study

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ABSTRACT

Objectives To investigate whether regional variation changes with different beneficiary health insurance coverage types.

Design A cross-sectional study of the Health and Retirement Study (HRS) in 2018 was used.

Setting Medicare beneficiaries only covered by Medicare (group 1) are compared with those covered by Medicare and other health insurance (group 2). Outcomes included healthcare usage measures: (1) whether beneficiaries have a hospital stay and (2) the number for those with at least one stay; (3) whether beneficiaries have a doctor's visit and (4) the number for those with at least one visit. We compared healthcare usage in both groups across the five regions: (1) New England and Mid-Atlantic; (2) East North Central and West North Central; (3) South Atlantic; (4) East South Central and West South Central; (5) Mountain and Pacific. We used logistic regression for binary outcomes and negative binomial regression for count outcomes in each group.

Participants We identified 8749 Medicare beneficiaries, of which 4098 in group 1 and 4651 in group 2.

Results Residents in all non-reference regions had a significantly lower probability of seeking a doctor's visit in group 1 (OR with 95% CI 0.606 (0.374 to 0.982), 0.619 (0.392 to 0.977), 0.472 (0.299 to 0.746) and 0.618 (0.386 to 0.990) in the order of above regions, respectively), which is not significant in group 2. Residents in most non-reference regions (except South Atlantic) had a significantly fewer number of seeking a hospital stay in group 2 (incident rate ratio (IRR) with 95% CI 0.797 (0.691 to 0.919), 0.740 (0.643 to 0.865), 0.726 (0.613 to 0.859) in the order of above regions, respectively), which is not significant in group 1.

Conclusion Regional variation in the likelihood of having a doctor's visit was reduced in Medicare beneficiaries covered by supplemental health insurance. Regional variation in hospital stays was accentuated among Medicare beneficiaries covered by supplemental health insurance.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ This nationwide study provides a large sample size to explore the regional variation.
⇒ Our study was limited to general doctor's visits and hospital stays and we could not study any other specific healthcare services.
⇒ We cannot identify these specific Medicare plans in our data, which limits our ability to assess the extent to which our estimated regional variations are driven by these different Medicare plans.
⇒ We combined nearby regions to increase the sample size in selected region classifications, and each region has many states, so these average estimates may mask variation across states within the same region.
⇒ Data were collected through a survey, which may lead to a recall bias.

INTRODUCTION

Equal access to healthcare is important to reduce health disparity.[1] People should be given the same chance of getting appropriate treatment if they share the same type and degree of health need.[2] The 2010 Patient Protection and Affordable Care Act (PPACA) was a substantial healthcare reform aiming to change the healthcare payment system and to improve quality of care while reducing cost.[3] Since equal access is not the primary goal of this healthcare reform, the concern of important geographic variation in the use of healthcare services have been raised.[4]

Medicare aims to cover all elderly individuals who are over 65 years, as well as individuals less than 65 years of age with disabilities and renal disease. Medicare experienced many changes in the PPACA healthcare reform. Since Medicare is managed by the federal government with nearly the same standard across the nation, regional variation may be a primary factor for unequal access to healthcare. Individuals in some regions will have barriers to access necessary health resources. This unequal access to healthcare may be related to possible inefficiencies and inequality in the supply of healthcare. Since many Medicare beneficiaries are also covered by other health insurance, an interesting

question arises, 'does regional variation change across beneficiaries with different types of health insurance coverage?'. In the past few years, regional variations have been identified by some studies. These studies can be described as two types. The first type is to identify regional variations and the second type is to identify the factors related to regional variations. In terms of the first type studies, an evidence reveals that regional variation in imaging costs is greater than imaging usage.[5] One study suggests that the usage of skilled nursing facility and hospital care among Medicare Advantage beneficiaries has greater regional variations than traditional Medicare beneficiaries.[6] Another study suggests that the number of days of care per capita can be substantially different in two regions even though the two regions have similar per capita costs of care.[7] Moreover, regional variation in Medicare spending and usage are substantial at the state level, even though state differences in demographic, demand and supply factors are controlled.[8] In terms of the second type studies, socioeconomic characteristics have been proved to play a significant role in regional difference in admission rates and lengths of stay.[9] Convenient public transportation can be used to address geographic barriers to healthcare in rural area.[10] Some studies also suggest that regional variation is associated with bed availability, clinician workforce and races.[11–13] However, these studies have some limitations. Many studies only explore regional variation in specific healthcare types, which cannot be extrapolated the results to other types of healthcare services. Moreover, many studies were conducted over decades ago, but Medicare has experienced important changes in recent years. Thus, these studies may be limited to reflect the current situation.

Therefore, it is necessary to revisit the question of regional variation in health usage among Medicare beneficiaries post-PPACA. Our new study bridges this research gap. We aim to identify (1) whether regional variation still exists among Medicare beneficiaries and (2) whether regional variation changes across Medicare beneficiaries with different types of health insurance coverage.

METHOD

Source of data

The HRS (Health and Retirement Study) is sponsored by the National Institute on Aging (grant number NIA U01AG009740) and is conducted by the University of Michigan. Data in our study are based on the HRS in 2018.[14] HRS is a nationally longitudinal survey, which has been fielded every 2 years since 1992. This dataset concentrates on middle-aged and elderly individuals, which is representative of the middle-aged and elderly population over the country. It provides information on a broad array of domains including income and wealth; health, cognition and use of healthcare services; work and retirement; and family connections. The samples of HRS are drawn based on a multi-stage area probability design, involving geographical stratification, clustering and oversampling of certain demographic groups. HRS includes data for over 37 000 individuals over age 50 and 23 000 households in the USA.[15]

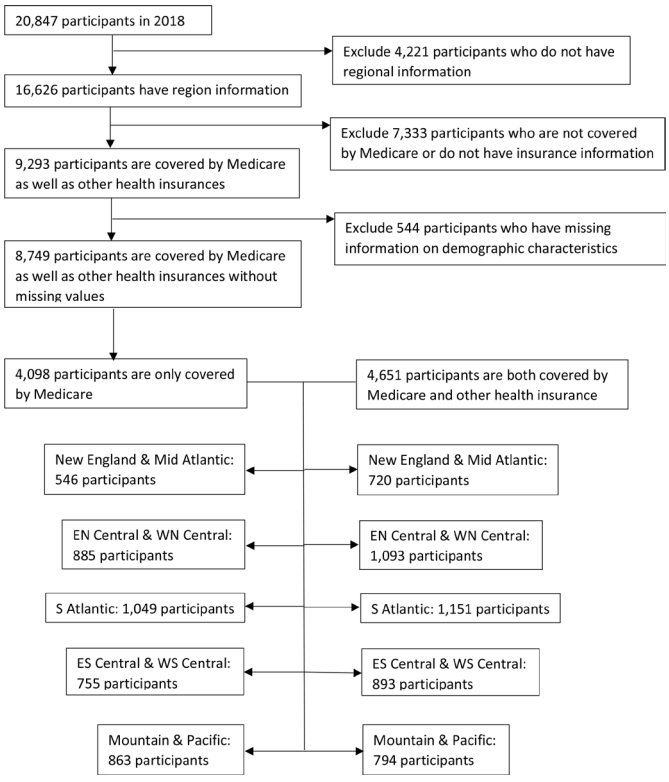

Figure 1 Flow chart for study participant from the 2018 Health and Retirement Study survey. EN, East North; ES, East South; S, South; WN, West North; WS, West South.

Study design

Figure 1 shows the flow chart for the analytic sample used in this study. There were 20 847 respondents in the 2018 HRS. There were 4221 participants with a missing value in residence region and these participants were excluded first. There were 7333 participants that had a missing value in Medicare coverage or not covered by Medicare and these participants were dropped as well. Additionally, we dropped 544 participants with missing value on demographic characteristics. The final analytic sample included 8749 HRS respondents with reported Medicare coverage. We separated Medicare beneficiaries into two mutually exclusive groups based on health insurance coverage type: (1) there were 4098 participants are only covered by Medicare (henceforth, group 1) and (2) there were 4651 participants are covered by both Medicare and supplemental health insurance (eg, Medicaid, VA/CHAMPUS and private health insurance) (henceforth, group 2). We did not exclude individuals who were covered by long-term care insurance from the Medicare-only group due to a large number of individuals with chronic diseases.

Dependent variables

We constructed four dependent variables. Two dummy variables for whether the individual had any hospital stay or doctor's visit in the last 2 years. The other two variables

measured the number of hospital stays for survey respondents with an inpatient visit in the previous 2 years and the number of doctor's visits for those with an outpatient visit during the previous 2 years.

Independent variables

Our primary independent variable of interest was the Medicare beneficiaries' region of residence, defined based on their reported state of residence: (1) New England Division and Middle Atlantic Division; (2) East North Central Division and West North Central Division; (3) South Atlantic Division; (4) East South Central Division and West South Central Division; (5) Mountain Division and Pacific Division.

Other variables

Other variables included patient demographic characteristics: gender, age, educational level, total household annual income per capita (PCI), employment status and chronic disease conditions. Specific, we used Pew's study to categorise our income groups.[16] We categories PCI into three groups: lower income (<$13 367), middle income ($13 367–$40 133) and upper income (>$40,133).

Statistical analysis

We compared characteristics of Medicare-only covered beneficiaries and beneficiaries with Medicare and supplemental insurance. Means and proportions were compared using χ^2 tests. We modelled healthcare usage of Medicare beneficiaries using multivariate regression models. Logistic regressions were used to model binary outcomes (any hospital stay, any doctor's visit in the past 2 years). The model specification is $\ln\left(\frac{p(x)}{1-p(x)}\right) = \alpha + \beta \cdot \text{region} + \gamma\theta$, α represents the intercept, $p(x)$ represents the probability that individuals seek a doctor visit or a hospital stay and $\gamma\theta$ represents individual-level demographic, socioeconomic and health characteristics. Negative binomial regressions were used to model count outcomes. To better reflect the variation of healthcare usage, we used the country map to visualise hospital stays and doctor visits. The model specification is $\log(\text{count of doctor visits or hospital stays}) = \alpha + \beta \cdot \text{region} + \gamma\theta$, α represents the intercept, and $\gamma\theta$ represents individual-level demographic socioeconomic and health characteristics.

In order to visualise the relative difference directly, we graphed event ratios instead of the exact events in the national map as figure 2 shows. We set the New England and Mid Atlantic region as the reference group (ie, event ratio=1). The event ratio for other regions was calculated as hospital stays (in other regions)/hospital stays (the New England and Mid Atlantic region) or doctor's visits (in other regions)/doctor visits (the New England

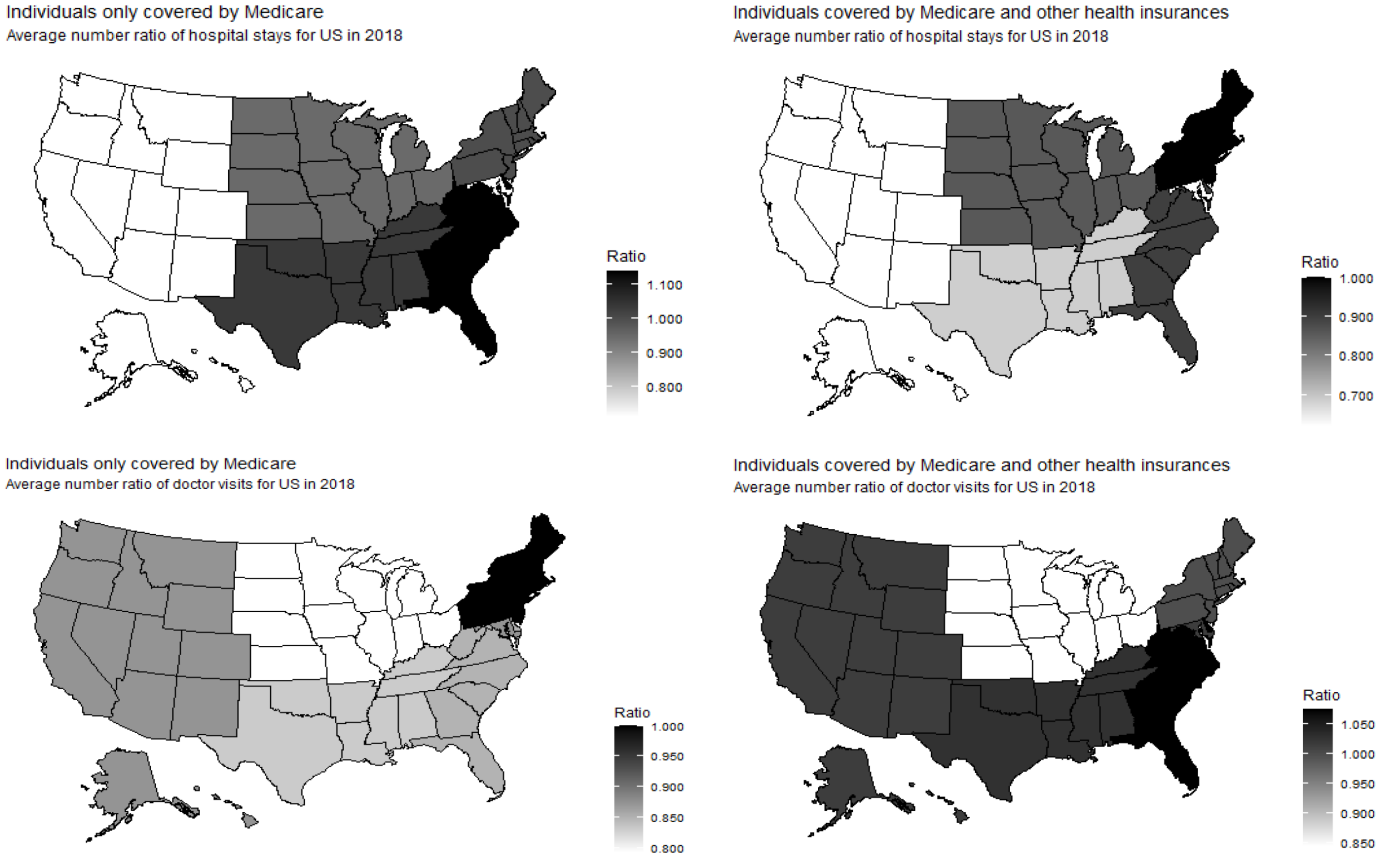

Figure 2 Average number ratio of hospital stays/doctor visits.

and Mid Atlantic region), separately. All our analyses are conducted with R V.4.1.1.

Patient and public involvement

We report no patient or public involvement in the design or implementation of the study.

RESULTS

Demographic characteristics

Among individuals who were only covered by Medicare, 546, 885, 1,049, 755 and 863 individuals were in New England and Mid Atlantic regions, EN Central and WN Central regions, S Atlantic regions, ES Central and WS Central regions, and Mountain and Pacific regions, respectively. Among individuals who are both covered by Medicare and other health insurances, 720, 1093, 1151, 893 and 794 individuals are in each region category, respectively. ES and WS central regions had the highest percentage of individuals who were below age 65 (16.82%) and the lowest percentage of individuals who were over age 85 (11.39%). Mountain and Pacific regions had the lowest percentage of individuals who were below 65 years (8.23%) and the highest percentage of individuals who were over 85 years (12.86%) (table 1).

Beneficiaries with less than a high school education were more concentrated in ES and WS central regions (29.93%) and less concentrated in EN and WN central regions (12.54%). Beneficiaries with a graduate degree were more concentrated in Mountain and Pacific regions (9.73%), but less concentrated in ES and WS central regions (5.83%). Considering the distribution of beneficiaries according to chronic diseases conditions reporting, ES and WS central regions had the highest percentage of individuals with more than one chronic disease (80.26%). Mountain and Pacific regions had the lowest percentage of individuals with more than one chronic disease (71.15%). ES and WS central regions had the highest percentage of lower-income (<$13 367) individuals (89.8%), while Mountain and Pacific regions had the lowest percentage of lower-income individuals (83.55%). In contrast, South Atlantic regions had the lowest percentage of upper-income (>$40 133) individuals (4.58%), while Mountain and Pacific regions had the highest percentage of upper income individuals (10.2%).

Among Medicare beneficiaries with supplemental insurances, there were significant variations in demographics across all residence regions (table 1). Considering the distribution of healthcare usage across regions, individuals living in the New England and Mid Atlantic regions had the highest number of hospital stays, while individuals living in the Mountain and Pacific regions had the lowest number of hospital stays (figure 2). Individuals living in the South Atlantic regions had the highest number of doctor's visits, while individuals living in the East North and West North Central regions had the lowest number of doctor's visits (figure 2).

ES and WS central regions had the highest percentage of individuals who were below 65 years (16.35%) and the lowest percentage of individuals who were over 85 years (10.41%) (table 1). EN and WN central regions had the lowest percentage of individuals who were below 65 years (12.08%) and the highest percentage of individuals who were over 85 years (16.1%). The percentage of individuals without a high school degree was highest in ES and WS central regions (25.08%) and lowest in EN and WN central regions (10.16%). Conversely, the percentage of people with a graduate degree was highest in Mountain and Pacific regions (12.22%) and lowest in ES and WS central regions (6.72%). The percentage of individuals with at least one chronic condition was highest in ES and WS central regions (81.63%) and lowest in Mountain and Pacific regions (71.91%). Considering annual household income per capita, the percentage of individuals with lower income was highest in ES and WS central regions (89.25%) and lowest in Mountain and Pacific regions (81.99%). The percentage of individuals with higher income was highest in Mountain and Pacific regions (9.45%) and lowest in ES and WS central regions (4.48%).

Logistic regression results

In terms of hospital stays, logistic regressions suggested that individuals living in Mountain and Pacific region were less likely to have a hospital stay than those residing in New England and Mid-Atlantic region among Medicare-only covered beneficiaries (OR=0.766, 95% CI 0.594 to 0.987). However, there were no significant differences in the probability of having a hospital stay across different regions among Medicare beneficiaries with supplemental insurances (table 2).

Age was significantly associated with hospital stays. Among Medicare-only covered beneficiaries, individuals aged over 85 were significantly more likely to have a hospital stay (OR=1.480, 95% CI 1.109 to 1.975), compared with individuals under 65 years. Among Medicare beneficiaries with supplemental insurance, individuals aged between 65 and 74 were less likely to have a hospital stay (OR=0.722, 95% CI 0.586 to 0.889). The results also suggested that education was not significantly related to hospital stays in both groups. The results also suggested that individuals with one chronic disease (OR=1.813, 95% CI 1.158 to 2.839) and with more than one chronic disease (OR=3.579, 95% CI 2.369 to 5.406) were more likely to have a hospital stay in group 1. In group 2, individuals with one chronic disease (OR=1.659, 95% CI 1.098 to 2.506) and with more than one chronic disease (OR=3.832, 95% CI 2.618 to 5.609) were also more likely to have a hospital stay. In terms of employment status, there were no significant differences in group 1. However, unemployment (OR=1.963, 95% CI 1.316 to 2.929) and retired (OR=1.609, 95% CI 1.181 to 2.192) individuals were more likely to have a hospital stay. In terms of household income, results suggested that only middle-income (≥13 367 and ≤$40 133) individuals

Table 1 Descriptive statistics

	Individuals who are only covered by Medicare (N=4098)										Individuals who are covered by Medicare and other health insurance (N=4651)									
Region	New England and Mid-Atlantic		EN Central and WN Central		S Atlantic		ES Central and WS Central		Mountain and Pacific		New England and Mid Atlantic		EN Central and WN Central		S Atlantic		ES Central and WS Central		Mountain and Pacific	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Total	546	13.32	885	21.6	1049	25.6	755	18.42	863	21.065	720	15.48	1093	23.5	1151	24.75	893	19.2	794	17.07
Age																				
<65	60	10.99	75	8.47	118	11.25	127	16.82	71	8.23	111	15.42	132	12.08	142	12.34	146	16.35	105	13.22
65–74	198	36.26	317	35.82	386	36.8	271	35.89	354	41.02	286	39.72	429	39.25	462	40.14	365	40.87	346	43.58
75–84	187	34.25	360	40.68	418	39.85	271	35.89	327	37.89	228	31.67	356	32.57	414	35.97	289	32.36	245	30.86
>85	101	18.5	133	15.03	127	12.11	86	11.39	111	12.86	95	13.19	176	16.1	133	11.56	93	10.41	98	12.34
Gender																				
Male	229	41.94	373	42.15	424	40.42	311	41.19	367	42.53	281	39.03	445	40.71	472	41.01	326	36.51	357	44.96
Female	317	58.06	512	57.85	625	59.58	444	58.81	496	57.47	439	60.97	648	59.29	679	58.99	567	63.49	437	55.04
Race																				
NH white	364	66.67	699	78.98	595	56.72	351	46.49	513	59.44	464	64.44	864	79.05	740	64.29	482	53.98	504	63.48
NH black	115	21.06	146	16.5	323	30.79	223	29.54	71	8.23	151	20.97	186	17.02	309	26.85	216	24.19	56	7.05
Hispanic	53	9.71	21	2.37	96	9.15	161	21.32	229	26.54	90	12.5	15	1.37	68	5.91	173	19.37	188	23.68
Other	14	2.56	19	2.15	35	3.34	20	2.65	50	5.79	15	2.08	28	2.56	34	2.95	22	2.46	46	5.79
Education																				
Less than high school education	101	18.5	111	12.54	204	19.45	226	29.93	152	17.61	137	19.03	111	10.16	190	16.51	224	25.08	142	17.88
High school/ GED	288	52.75	530	59.89	571	54.43	370	49.01	435	50.41	363	50.42	674	61.67	591	51.35	474	53.08	376	47.36
Undergraduate	103	18.86	170	19.21	192	18.3	115	15.23	192	22.25	152	21.11	213	19.49	227	19.72	135	15.12	179	22.54
Graduate	54	9.89	74	8.36	82	7.82	44	5.83	84	9.73	68	9.44	95	8.69	143	12.42	60	6.72	97	12.22
Chronic disease																				
No chronic disease	36	6.59	60	6.78	57	5.43	32	4.24	68	7.88	52	7.22	68	6.22	60	5.21	32	3.58	61	7.68
Only one chronic disease	96	17.58	141	15.93	167	15.92	117	15.5	181	20.97	127	17.64	212	19.4	179	15.55	132	14.78	162	20.4
More than one chronic disease	414	75.82	684	77.29	825	78.65	606	80.26	614	71.15	541	75.14	813	74.38	912	79.24	729	81.63	571	71.91

Continued

Table 1 Continued

Region	Individuals who are only covered by Medicare (N=4098)										Individuals who are covered by Medicare and other health insurance (N=4651)									
	New England and Mid-Atlantic		EN Central and WN Central		S Atlantic		ES Central and WS Central		Mountain and Pacific		New England and Mid Atlantic		EN Central and WN Central		S Atlantic		ES Central and WS Central		Mountain and Pacific	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Employment status																				
Full-time	19	3.48	40	4.52	54	5.15	31	4.11	55	6.37	50	6.94	68	6.22	72	6.26	64	7.17	56	7.05
Part-time	65	11.9	100	11.3	115	10.96	76	10.07	100	11.59	71	9.86	113	10.34	122	10.6	77	8.62	75	9.45
Unemployed	34	6.23	30	3.39	52	4.96	52	6.89	43	4.98	56	7.78	50	4.57	59	5.13	66	7.39	53	6.68
Retired	428	78.39	715	80.79	828	78.93	596	78.94	665	77.06	543	75.42	862	78.87	898	78.02	686	76.82	610	76.83
Household income																				
Lower income	468	85.71	755	85.31	932	88.85	678	89.8	721	83.55	631	87.64	894	81.79	976	84.8	797	89.25	651	81.99
Middle income	39	7.14	62	7.01	69	6.58	42	5.56	54	6.26	51	7.08	97	8.87	96	8.34	56	6.27	68	8.56
Upper income	39	7.14	68	7.68	48	4.58	35	4.64	88	10.2	38	5.28	102	9.33	79	6.86	40	4.48	75	9.45

EN, East North; ES, East South; GED, General Educational Development; NH, non-Hispanic; S, South; WN, West North; WS, West South.

(OR=0.618, 95% CI 0.447 to 0.854) were significantly less likely to have a hospital stay compared with lower-income individuals in group 1. However, there was no significant differences related to household income in group 2 (table 2).

In terms of doctor's visit, logistic regressions suggested that individuals in EN Central and WN Central region (OR=0.606, 95% CI 0.374 to 0.982), S Atlantic region (OR=0.619, 95% CI 0.392 to 0.977), ES Central and WS Central region (OR=0.472, 95% CI (0.299 to 0.746)) and Mountain and Pacific region (OR=0.618, 95% CI (0.386 to 0.99)) were less likely to have a doctor's visit than those residing in New England and Mid-Atlantic region among Medicare-only covered beneficiaries. However, there were no significant differences in the probability of having a doctor's visit among Medicare beneficiaries with supplemental insurances (table 2).

There was no significant relationship between age and doctor's visits in both groups. Females were more likely to have a doctor's visit in both group 1 (OR=1.321, 95% CI (1.042 to 1.676)) and group 2 (OR=1.427, 95% CI (1.084 to 1.88)). Education was significantly related to doctor's visits in both group 1 and group 2. In group 1, individuals with a high school degree (OR=2.142, 95% CI (1.627 to 2.821)), a college degree (OR=3.147, 95% CI (2.082 to 4.755)) and a graduate degree (OR=2.875, 95% CI (1.639 to 5.042)) were more likely to have a doctor's visit, compared with individuals without a high school degree. In group 2, the results were similar. Individuals with a high school degree (OR=1.955, 95% CI (1.403 to 2.724)), a college degree (OR=2.712, 95% CI (1.677 to 4.384)) and a graduate degree (OR=5.095, 95% CI (2.25 to 11.535)) were more likely to have a doctor's visit, compared with individuals without a high school degree.

Results suggested that individuals with one chronic condition (OR=2.438, 95% CI (1.558 to 3.815) in Medicare-only covered individuals and OR=2.925, 95% CI (1.72 to 4.974) in Medicare beneficiaries with supplemental insurance) and those with more than one chronic condition (OR=3.891, 95% CI (2.606 to 5.81) in Medicare-only covered individuals and OR=3.845, 95% CI (2.433 to 6.078) in Medicare beneficiaries with supplemental insurance were more likely to have a doctor's visit. We did not notice significant associations between the outcome variables and employment status in both groups, and between the outcome variables and household income in group 2. However, middle-income (≥$13 367 and ≤$40 133) individuals were more likely to have a doctor's visit (OR=2.44, 95% CI (1.054 to 5.648)) among Medicare beneficiaries with supplemental insurance, compared with lower-income individuals (table 2).

Negative binomial regression results

In terms of hospital stays, results suggested that there was no difference in the incident rate among different regions among Medicare-only covered beneficiaries. However, individuals in EN Central and WN Central region (IRR=0.797, 95% CI (0.691 to 0.919)), ES Central and WS

Table 2 Logistic regression results

	Individuals who are only covered by Medicare (N=4089) and individuals who are covered by Medicare and other health insurances (N=4642) in hospital stay				Individuals who are only covered by Medicare (N=3641) and individuals who are covered by Medicare and other health insurances (N=3910) in doctor visit			
Have a visit last 2 years (no=0, yes=1)	Medicare only (group 1)		Medicare and other health insurances (group 2)		Medicare only (group 1)		Medicare and other health insurances (group 2)	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Region								
New England and Mid Atlantic	Ref		Ref		Ref		Ref	
EN Central and WN Central	0.999	0.784 to 1.272	1.103	0.896 to 1.359	0.606†	0.374 to 0.982	1.072	0.671 to1.713
S Atlantic	1.11	0.879 to 1.402	1.012	0.824 to 1.244	0.619†	0.392 to 0.977	0.893	0.576 to 1.383
ES Central and WS Central	0.921	0.714 to 1.187	0.871	0.7 to 1.084	0.472*	0.299 to 0.746	0.909	0.585 to 1.414
Mountain and Pacific	0.766†	0.594 to 0.987	0.918	0.73 to 1.154	0.618†	0.386 to 0.99	1.316	0.804 to 2.152
Age								
<65	Ref		Ref		Ref		Ref	
65–74	0.821	0.637 to 1.058	0.722*	0.586 to 0.889	0.887	0.578 to 1.363	0.884	0.568 to 1.375
75–84	1.046	0.813 to 1.344	0.882	0.713 to 1.091	0.996	0.643 to 1.541	0.967	0.607 to 1.543
>85	1.48*	1.109 to 1.975	1.261‡	0.982 to 1.62	0.77	0.466 to 1.273	0.621‡	0.37 to 1.043
Gender								
Male	Ref		Ref		Ref		Ref	
Female	0.755*	0.654 to 0.871	1.002	0.879 to 1.143	1.321†	1.042 to 1.676	1.427†	1.084 to 1.88
Race								
NH white	Ref		Ref					
NH black	0.85‡	0.704 to 1.026	0.961	0.807 to 1.144	0.477*	0.35 to 0.65	0.563*	0.389 to 0.813
Hispanic	0.822	0.647 to 1.044	0.767†	0.603 to 0.976	0.283*	0.204 to 0.394	0.281*	0.189 to 0.418
Other	1.451‡	0.985 to 2.138	1.303	0.911 to 1.862	0.684	0.356 to 1.314	1.086	0.42 to 2.808
Education								
Less than high school education	Ref		Ref		Ref		Ref	
High school/GED	1.079	0.888 to 1.312	1.156	0.958 to 1.396	2.142*	1.627 to 2.821	1.955*	1.403 to 2.724
Undergraduate	1.167	0.917 to 1.485	1.123	0.892 to 1.414	3.147*	2.082 to 4.755	2.712*	1.677 to 4.384
Graduate	0.87	0.631 to 1.199	0.912	0.687 to 1.21	2.875*	1.639 to 5.042	5.095*	2.25 to 11.535
Chronic disease								

Continued

Table 2 Continued

	Individuals who are only covered by Medicare (N=4089) and individuals who are covered by Medicare and other health insurances (N=4642) in hospital stay				Individuals who are only covered by Medicare (N=3641) and individuals who are covered by Medicare and other health insurances (N=3910) in doctor visit			
Have a visit last 2 years (no=0, yes=1)	Medicare only (group 1)		Medicare and other health insurances (group 2)		Medicare only (group 1)		Medicare and other health insurances (group 2)	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
No chronic disease	Ref		Ref		Ref		Ref	
Only one chronic disease	1.813*	1.158 to 2.839	1.659†	1.098 to 2.506	2.438*	1.558 to 3.815	2.925*	1.72 to 4.974
More than one chronic disease	3.579*	2.369 to 5.406	3.832*	2.618 to 5.609	3.891*	2.606 to 5.81	3.845*	2.433 to 6.078
Employment status								
Full-time	Ref		Ref		Ref		Ref	
Part-time	1.025	0.668 to 1.573	1.046	0.721 to 1.518	1.008	0.529 to 1.923	1.647	0.784 to 3.458
Unemployed	1.112	0.676 to 1.83	1.963*	1.316 to 2.929	0.805	0.384 to 1.69	2.004	0.874 to 4.599
Retired	1.22	0.835 to 1.781	1.609*	1.181 to 2.192	0.989	0.561 to 1.744	1.531	0.828 to 2.832
Household income								
Lower income	Ref		Ref		Ref		Ref	
Middle income	0.618†	0.447 to 0.854	0.854	0.663 to 1.1	0.657‡	0.412 to 1.047	2.44†	1.054 to 5.648
Upper income	0.949	0.702 to 1.283	0.963	0.738 to 1.255	0.925	0.542 to 1.578	1.157	0.602 to 2.223

We show ORs and 95% CI here. Counts do not sum to 4098 or 4651 due to missing values for some of the independent variables.

*Significant at 1% level (two-tailed test).
†Significant at 5% level (two-tailed test).
‡Significant at 10% level (two-tailed test).
EN, East North; ES, East South; GED, General Educational Development; NH, non-Hispanic; S, South; WN, West North; WS, West South.

Central region (IRR=0.740, 95% CI (0.634 to 0.865)) and Mountain and Pacific region (IRR=0.726, 95% CI (0.613 to 0.859)) had fewer incident rates of hospital stays than those residing in New England and Mid-Atlantic region in group 2 (table 3).

Individuals aged 65–74 years (IRR=0.802, 95% CI (0.672 to 0.957)), 75–84 years (IRR=0.781, 95% CI (0.658 to 0.927)) and over age 85 (IRR=0.785, 95% CI (0.646 to 0.954)) had significantly fewer incident rates of hospital stays in group 1, compared with individuals under 65 years. In group 2, the results were similar. Individuals who were aged 65–74 years (IRR=0.757, 95% CI (0.658 to 0.870)), 75–84 years (IRR=0.663, 95% CI (0.575 to 0.764)) and over age 85 (IRR=0.644, 95% CI (0.545 to 0.761)) had significantly fewer incident rates of hospital stays. In group 1, individuals with a high school degree had a significantly lower incident rate of hospital stays (IRR=0.824, 95% CI (0.721 to 0.943)), compared with individuals without a degree. In group 2, retired individuals (IRR=1.562, 95% CI (1.185 to 2.058)) had a higher incident rate of hospital stays, compared with individuals with a full-time job. However, we found that variables not significantly related to changes in the incident rate of hospital stays included chronic diseases, and household income in both groups, education in group 2, employment status in group 1 (table 3).

In terms of doctor's visit, the results suggested that individuals in EN Central and WN Central region (IRR=0.743, 95% CI (0.668 to 0.826)), S Atlantic region (IRR=0.847, 95% CI (0.763 to 0.939)), ES Central and WS Central region (IRR=0.846, 95% CI (0.755 to 0.947)) and Mountain and Pacific region (IRR=0.806, 95% CI (0.722 to 0.900)) had lower incident rates of doctor's visits than those residing in New England and Mid-Atlantic region in group 1. In group 2, results suggested that individuals in EN Central and WN Central region (IRR=0.884, 95% CI (0.797 to 0.981)) had a lower incident rate of doctor's visits than individuals residing in New England and Mid-Atlantic region. However, individuals in S Atlantic region (IRR=1.157, 95% CI (1.043 to 1.283)) and Mountain and Pacific region (IRR=1.140, 95% CI (1.017 to 1.278)) had a higher incident rate of doctor's visits than those residing in New England and Mid-Atlantic region in group 2 (table 3).

There was a significant relationship between age and doctor's visits in both groups. Individuals who were aged 65–74 years (IRR=0.748, 95% CI (0.665 to 0.840)), 75–84 years (IRR=0.733, 95% CI (0.651 to 0.824)) and over age 85 (IRR=0.717, 95% CI (0.626 to 0.822)) had significantly lower incident rates of doctor's visits in group 1, compared with individuals under 65 years. Individuals who were aged 65–74 years (IRR=0.719, 95% CI (0.646 to 0.801)), 75–84 years (IRR=0.686, 95% CI (0.614 to 0.767)) and over age 85 (IRR=0.781, 95% CI (0.686 to 0.890)) had significantly lower incident rates of doctor's visits in group 2. In terms of education, individuals with a college degree (IRR=1.174, 95% CI (1.052 to 1.310)) and a graduate degree (IRR=1.230, 95% CI (1.073 to 1.411) in group 1; IRR=1.208, 95% CI (1.054 to 1.385) in group 2) had higher incident rates of doctor's visit, compared with individuals without a degree. In terms of chronic disease, the results suggested that individuals with one chronic disease (IRR=1.712, 95% CI (1.450 to 2.021) in group 1; IRR=1.467, 95% CI (1.243 to 1.731) in group 2) and with more than one chronic disease (IRR=2.261, 95% CI (1.941 to 2.634) in group 1; IRR=2.262, 95% CI (1.939 to 2.639) in group 2) had more incident rate of doctor's visits. In terms of employment status, the results were similar between group 1 and group 2. Unemployed individuals (IRR=1.706, 95% CI (1.363 to 2.135) in group 1; IRR=1.351, 95% CI (1.090 to 1.674) in group 2) and retired individuals (IRR=1.358, 95% CI (1.152 to 1.602) in group 1; IRR=1.283, 95% CI (1.089 to 1.513) in group 2) had more incident rate of doctor's visits, compared individuals with a full-time job. Household income was not significantly related to incident rate of doctor's visits in both groups (table 3).

DISCUSSION

In our study, we used four health outcomes as the healthcare usage metrics: (1) the probability of hospital stay, (2) the probability of doctor's visit, (3) the frequency of hospital stay and (4) the frequency of doctor's visit. The regional variation is identified as the healthcare usage metrics are different among different regions even though we have controlled demographic, health and socioeconomic characteristics. Based on our results, our analysis has identified significant regional variation in healthcare usage among Medicare beneficiaries.

In terms of the logistic regression results in hospital stay, all ORs are not significant in both groups except Mountain and Pacific regions in group 1. In this case, we can conclude that regional variation does not exist most regions on the probability of a hospital stay. In terms of the logistic regression results in doctor's visit, all ORs are significant in group 1, while all ORs are insignificant in group 2. Therefore, regional variation exists in group 1, while it does not exist in group 2. We can also conclude that if Medicare beneficiaries are covered by other health insurance, regional variation can be reduced and even eliminated on the probability of doctor visit.

In terms of the negative binomial regression results in hospital stay, all ORs are not significant in group 1, while all ORs are significant in group 2 except South Atlantic regions. In this case, regional variation exists in most regions in group 2, but it does not exist in group 1. Therefore, we can conclude that if Medicare beneficiaries are covered by other health insurance, regional variation can be reduced and even eliminated on the frequency of hospital stay. In terms of the negative binomial regression results in doctor's visit, all ORs are significant in both groups except ES Central and WS Central regions in group 2. In this case, regional variation exists in most regions in both groups and the coverage of health insurance does not affect the frequency of doctor's visits.

Table 3 Negative binomial regression results

	Individuals who are only covered by Medicare (N=1126) and individuals who are covered by Medicare and other health insurances (N=1462) in hospital stay				Individuals who are only covered by Medicare (N=3032) and individuals who are covered by Medicare and other health insurances (N=3307) in doctor's visit			
Visit times of last 2 years (visit ≥1)	Medicare only (group 1)		Medicare and other health insurances (group 2)		Medicare only (group 1)		Medicare and other health insurances (group 2)	
	IRR	95% CI	IRR	95% CI	IRR	95% CI	IRR	95% CI
Region								
New England and Mid Atlantic	Ref		Ref		Ref		Ref	
EN Central and WN Central	0.902	0.756 to 1.076	0.797*	0.691 to 0.919	0.743*	0.668 to 0.826	0.884†	0.797 to 0.981
S Atlantic	1.047	0.886 to 1.236	0.903	0.784 to 1.039	0.847*	0.763 to 0.939	1.157*	1.043 to 1.283
ES Central and WS Central	1.058	0.882 to 1.270	0.740*	0.634 to 0.865	0.846*	0.755 to 0.947	0.997	0.893 to 1.115
Mountain and Pacific	0.882	0.728 to 1.069	0.726*	0.613 to 0.859	0.806*	0.722 to 0.900	1.140†	1.017 to 1.278
Age								
<65	Ref		Ref		Ref		Ref	
65–74	0.802†	0.672 to 0.957	0.757*	0.658 to 0.870	0.748*	0.665 to 0.840	0.719*	0.646 to 0.801
75–84	0.781*	0.658 to 0.927	0.663*	0.575 to 0.764	0.733*	0.651 to 0.824	0.686*	0.614 to 0.767
>85	0.785†	0.646 to 0.954	0.644*	0.545 to 0.761	0.717*	0.626 to 0.822	0.781*	0.686 to 0.890
Gender								
Male	Ref		Ref		Ref		Ref	
Female	1.111†	1.002 to 1.233	0.872*	0.793 to 0.957	1.002	0.940 to 1.068	1.043	0.977 to 1.113
Race								
NH white	Ref		Ref		Ref		Ref	
NH black	0.937	0.819 to 1.072	1.035	0.916 to 1.170	0.932	0.857 to 1.015	0.823*	0.754 to 0.898
Hispanic	1.066	0.898 to 1.265	1.066	0.893 to 1.272	1.011	0.904 to 1.129	0.929	0.817 to 1.057
Other	0.813	0.605 to 1.093	1.081	0.853 to 1.371	1.359*	1.135 to 1.628	1.172‡	0.974 to 1.410
Education								
Less than high school education	Ref		Ref		Ref		Ref	
High school/GED	0.824*	0.721 to 0.943	1.117	0.976 to 1.277	1.048	0.957 to 1.149	0.929	0.842 to 1.025
Undergraduate	0.859	0.724 to 1.020	0.914	0.773 to 1.081	1.174*	1.052 to 1.310	0.933	0.830 to 1.048
Graduate	0.873	0.689 to 1.107	0.934	0.750 to 1.162	1.230*	1.073 to 1.411	1.208*	1.054 to 1.385
Chronic disease								
No chronic disease	Ref		Ref		Ref		Ref	
Only one chronic disease	0.829	0.549 to 1.252	0.983	0.671 to 1.440	1.712*	1.450 to 2.021	1.467*	1.243 to 1.731
More than one chronic disease	1.109	0.760 to 1.619	1.261	0.884 to 1.799	2.261*	1.941 to 2.634	2.262*	1.939 to 2.639

Continued

Table 3 Continued

	Individuals who are only covered by Medicare (N=1126) and individuals who are covered by Medicare and other health insurances (N=1462) in hospital stay				Individuals who are only covered by Medicare (N=3032) and individuals who are covered by Medicare and other health insurances (N=3307) in doctor's visit			
Visit times of last 2 years (visit ≥1)	Medicare only (group 1)		Medicare and other health insurances (group 2)		Medicare only (group 1)		Medicare and other health insurances (group 2)	
	IRR	**95% CI**	**IRR**	**95% CI**	**IRR**	**95% CI**	**IRR**	**95% CI**
Employment status								
Full-time	Ref		Ref		Ref		Ref	
Part-time	0.865	0.607 to 1.232	1.115	0.801 to 1.550	1.132	0.942 to 1.360	1.092	0.907 to 1.316
Unemployed	1.002	0.679 to 1.478	1.310	0.942 to 1.820	1.706*	1.363 to 2.135	1.351*	1.090 to 1.674
Retired	1.147	0.841 to 1.564	1.562*	1.185 to 2.058	1.358*	1.152 to	1.283*	1.089 to 1.513
Household income								
Lower income	Ref		Ref		Ref		Ref	
Middle income	0.911	0.702 to 1.181	1.042	0.862 to 1.260	1.133‡	0.997 to	0.951	0.847 to 1.068
Upper income	0.892	0.702 to 1.133	0.941	0.764 to 1.159	0.974	0.859 to	0.931	0.822 to 1.054

We show ORs and 95% CI here. Counts do not sum to 4098 or 4651 due to missing values for some of the independent variables.

*Significant at 1% level (two-tailed test).
†Significant at 5% level (two-tailed test).
‡Significant at 10% level (two-tailed test).
EN, East North; ES, East South; GED, General Educational Development; NH, non-Hispanic; S, South; WN, West North; WS, West South.

One potential explanation may be that narrow provider networks restricted access to care for Medicare beneficiaries.[17–19] Compared with New England and Mid-Atlantic regions, Medicare plans in other regions may not provide large enough provider networks.[18–20] Compared with Medicare beneficiaries with supplemental health insurance, Medicare-only beneficiaries are confronted with restrictions as an important barrier in healthcare access.[17 21] Other barriers to access like lack of transportation may further restrict access to healthcare for certain Medicare beneficiaries.[10] New England and Mid-Atlantic regions have better public transportations than other regions. Therefore, individuals in England and Mid-Atlantic regions may have less barrier to access healthcare usage. Bed availability and the number of physicians will also restrict healthcare usage.[11 22] Moreover, physicians burn out are usually highly related to adverse health outcomes.[23]

We found that, compared with individuals with a full-time job, unemployed and retired individuals were more likely to have healthcare visits and also had a higher number of visits. These results are consistent with findings in other studies that show that individual's health is negatively related to economic profiles.[24 25] These studies also show reverse causality between lower health status and unemployment status. A potential reason is that poor health may cause longer unemployment spells.[26] Some studies also suggest that ill workers are more likely to become unemployed.[27–29] Moreover, this can also be a potential explanation for the regional variation estimated in healthcare usage: regions with different healthcare usage may differ in their population's economic profiles. Unlike findings in previous studies, we found that household income was not significantly related to frequency of healthcare visits.[30 31]

Hospitalisation usually spends more than doctor visits. In order to control healthcare costs, we should concentrate on minimising hospital visit and stay. However, I think doctor visits are high correlated with hospital stays. Hospital stay usually means patients have some serious issues. However, some serious disease can be avoided by early detections. For example, if individuals have more frequencies to health examination, they can detect their diseases earlier and therefore they can avoid diseases becoming more serious. In this case, individuals have more doctor visits can avoid potential hospital stays. As we mentioned earlier, regional variation means individuals in some regions have more or less healthcare usages than other regions even though they have similar demographic, health and socioeconomic characteristics. In other words, there are some regional factors will restrict or encourage individuals to have doctor visits or hospital stays. If individuals' needs of healthcare are restricted, they cannot get treatment in time and therefore cause much more healthcare costs in the future. If individuals' health needs are encouraged, they will consume more health resources even though they do not really need them. This is a waste of healthcare resources. Therefore, the ideal situation is that individuals in different regions have similar healthcare usage if they have similar demographic, health and socioeconomic characteristics. If the regional variation exists, we also have to figure out a way to reduce or solve it. In our study, we have identified regional variations, and we also found that insurance coverage has impact on regional variation. In this case, adjusting insurance coverage could be one potential strategy to reduce regional variations.

POLICY IMPLICATIONS

There are several important implications of our research. First, regional variation broadly exists in Medicare beneficiaries. However, this variation is not in the same direction when considering different healthcare settings among different Medicare beneficiary groups. Second, although household income is not related to healthcare usage, employment status is significantly associated with healthcare usage. Unemployment and retired individuals seek more healthcare in both groups, especially in the outpatient setting. This suggests that unemployed individuals may need more care and potential assistance. Therefore, healthcare programmes and reforms should increase healthcare access for unemployed and retired individuals. Finally, Health insurance coverage plays a role in changing regional variation. For different subgroups, the government can adjust different health insurance coverage to reduce regional variation.

LIMITATIONS

There are some important limitations in this study. First, we combined nearby regions to increase the sample size in selected region classifications. Each region has many states, so these average estimates may mask variation across states within the same region. Second, Medicare has undergone substantial changes including the growth of Medicare Advantage and the introduction of numerous pay-for-performance and value-based programmes.[32 33] We cannot identify these specific plans in the HRS which limits our ability to assess the extent to which our estimated regional variations are driven by these different Medicare plans. Third, data were collected through a survey, which may lead to a recall bias. Fourth, our study was limited to general doctor's visits and hospital stays and we could not study any other specific healthcare services, due to data limitations. Finally, the sample weight this time is not available. Therefore, we cannot adjust our results by sampling weights, which leads to a potential selection bias. Notwithstanding these limitations, our study provides a general landscape of healthcare usage among Medicare beneficiaries.

CONCLUSION

Regional variation exists in healthcare usage for Medicare beneficiaries, and regional variation also changes in

beneficiaries with different types of coverage. Specifically, Regional variation in the likelihood of having a doctor's visit was reduced in Medicare beneficiaries covered by supplemental health insurance. Regional variation in hospital stays was accentuated among Medicare beneficiaries covered by supplemental health insurance. Further studies are needed to elicit the reasons explaining these variations.

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