

Vital Signs: Disparities in Antihypertensive Medication Nonadherence Among Medicare Part D Beneficiaries — United States, 2014

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Abstract

Introduction: Nonadherence to taking prescribed antihypertensive medication (antihypertensive) regimens has been identified as a leading cause of poor blood pressure control among persons with hypertension and an important risk factor for adverse cardiovascular disease outcomes. CDC and the Centers for Medicare and Medicaid Services analyzed geographic, racial-ethnic, and other disparities in nonadherence to antihypertensives among Medicare Part D beneficiaries in 2014.

Methods: Antihypertensive nonadherence, defined as a proportion of days a beneficiary was covered with antihypertensives of <80%, was assessed using prescription drug claims data among Medicare Advantage or Medicare fee-for-service beneficiaries aged ≥65 years with Medicare Part D coverage during 2014 (N = 18.5 million). Analyses were stratified by antihypertensive class, beneficiaries' state and county of residence, type of prescription drug plan, and treatment and demographic characteristics.

Results: Overall, 26.3% (4.9 million) of Medicare Part D beneficiaries using antihypertensives were nonadherent to their regimen. Nonadherence differed by multiple factors, including medication class (range: 16.9% for angiotensin II receptor blockers to 28.9% for diuretics); race-ethnicity (24.3% for non-Hispanic whites, 26.3% for Asian/Pacific Islanders, 33.8% for Hispanics, 35.7% for blacks, and 38.8% for American Indians/Alaska Natives); and state of residence (range 18.7% for North Dakota to 33.7% for the District of Columbia). Considerable county-level variation in nonadherence was found; the highest nonadherence tended to occur in the southern United States (U.S. Census region nonadherence = 28.9% [South], 26.7% [West], 24.1% [Northeast], and 22.8% [Midwest]).

Conclusions and Implications for Public Health Practice: More than one in four Medicare Part D beneficiaries using antihypertensives were nonadherent to their regimen, and certain racial/ethnic groups, states, and geographic areas were at increased risk for nonadherence. These findings can help inform focused interventions among these groups, which might improve blood pressure control and cardiovascular disease outcomes.

Introduction

Hypertension is a leading risk factor for cardiovascular disease (1). Use of prescribed antihypertensive medication (antihypertensives), in conjunction with diet and lifestyle modifications to lower blood pressure among persons with hypertension substantially decreases their risk for adverse cardiovascular disease outcomes (1,2). Approximately 70% of U.S. adults aged ≥65 years have hypertension, only about half of whom have their blood pressure controlled (i.e., <140/90 mm Hg) (3).

Medication nonadherence, or not following a health care professional's instructions concerning taking prescribed antihypertensives (e.g., take one tablet twice daily), is a leading reason for poor blood pressure control among persons treated for hypertension, a strong risk factor for adverse cardiovascular disease outcomes, and a cause of excessive health care costs (2,4). The reasons for nonadherence to chronic disease medications, including antihypertensives,

are numerous and complex. They include factors involving the patients, their health care professionals, and the policies and procedures of health systems and payers (5).

In 2006, the Centers for Medicare and Medicaid Services (CMS) implemented the Medicare Part D prescription drug benefit program,* a United States federal government program to subsidize the costs of prescription drugs and prescription drug insurance premiums for Medicare beneficiaries, which has increased the affordability and accessibility of prescription medications among U.S. adults aged ≥65 years and the disabled. The program has decreased out-of-pocket prescription medication spending by about \$150 per year per beneficiary and

*The Medicare Part D prescription drug benefit program was established by the Medicare Modernization Act of 2003. This entitlement went into effect in 2006, and provides voluntary coverage to disabled and older adults (<https://www.medicare.gov/part-d/>).

increased medication use by a mean of one to three more prescriptions per year per beneficiary (6). In 2015, approximately 39 million beneficiaries were enrolled in Medicare Part D, 61% of whom were enrolled in stand-alone prescription drug plans (PDPs) that supplement Original Medicare[†] coverage and 39% of whom were enrolled in Medicare Advantage[§] prescription drug (MA-PD) plans (7). The implementation of the Medicare Part D program has been associated with up to a 13.5% improvement in antihypertensive adherence among beneficiaries (8). However, antihypertensive nonadherence continues to pose a threat to this population's health, especially among certain demographic groups (9).

This study used the most currently available data to describe antihypertensive nonadherence among Medicare Part D beneficiaries, and assessed nonadherence stratified by multiple factors, including antihypertensive class and beneficiaries' state and county of residence, type of prescription drug plan, and treatment and demographic characteristics, to help identify and inform targeted interventions among the groups and regions most at risk.

Methods

Administrative data and prescription drug event data for all Medicare Part D beneficiaries in 2014 were accessed via the CMS Chronic Conditions Data Warehouse.[¶] Among 30.0 million beneficiaries aged ≥ 65 years as of January 1, 2014, 10.5 million were excluded from analysis, including 1.1 million who were long-term institutionalized residents (e.g., resided in nursing home); 0.9 million who did not have continuous enrollment in full fee-for-service (FFS) Medicare (i.e., Part A and Part B coverage within Original Medicare) with additional PDP coverage or in a MA-PD plan during January 1–December 31, 2014 or until their death in 2014; and 8.5 million who did not have at least one antihypertensive prescription filled in 2014, leaving 19.5 million beneficiaries for analysis.

[†] Original Medicare is administered directly through the federal government and includes the potential to enroll in both Part A and Part B. If a drug benefit is desired, the beneficiary must buy separate coverage through a Prescription Drug Plan from a private insurance company. Typically, beneficiaries pay a monthly premium covering 25.5% of the cost of the benefit and the Medicare Trust Funds subsidizes the remaining 74.5% (<https://www.medicare.gov/sign-up-change-plans/decide-how-to-get-medicare/original-medicare/how-original-medicare-works.html>).

[§] Medicare Advantage plans are sold by private insurance companies, but are subsidized by the Medicare Trust Funds. At a minimum, they must provide Part A and Part B coverage. Beneficiaries who also want a drug benefit, typically select a plan that provides both health and drug coverage, called a Medicare Advantage Prescription Drug Plan (<https://www.medicare.gov/sign-up-change-plans/medicare-health-plans/medicare-advantage-plans/how-medicare-advantage-plans-work.html>).

[¶] The CMS Chronic Condition Warehouse was accessed via the CMS Virtual Research Data Center (<https://www.ccwdata.org/web/guest/home>).

Analyses were limited to beneficiaries with two or more antihypertensive prescriptions filled (fills) within the same pharmacologic therapeutic class on different service dates within a measurement period of >90 days** (N = 18.5 million). Therapeutic classes were identified using the Uniform System of Classification^{††} schema and included the following: angiotensin converting enzyme inhibitors and angiotensin II receptor blockers, which were assessed individually and collectively with direct renin inhibitors as renin-angiotensin system antagonists; beta blockers; calcium channel blockers; diuretics; and other antihypertensives.^{§§}

Nonadherence was measured using the proportion of days covered (PDC) metric (10), which represents the percentage of days a beneficiary had access to the prescribed medication from the date of the first antihypertensive fill through the end of 2014 or the beneficiary's death in 2014.^{¶¶} To align with current standards, beneficiaries with a PDC $<80\%$ were considered nonadherent (10). Among beneficiaries taking multiple antihypertensives, overall PDC was calculated as an average of the PDCs calculated for each therapeutic class.^{***} Nonadherence was calculated by plan type, and in the FFS-PDP population, among beneficiaries with and without a diagnosis of hypertension (i.e., had or had not received an administrative billing code for hypertension^{†††}). Factors assessed for relationship with nonadherence were age, sex, race/ethnicity, low-income subsidy status^{§§§} (which includes persons eligible for both

** Reflects a standard recommended by the Pharmacy Quality Alliance and used by CMS to help ensure an adequate amount of time to effectively assess adherence among beneficiaries.

†† IMS Uniform System of Classification is a standard for pharmaceutical product classification (https://www.imshealth.com/files/web/IMSH%20Institute/USC_Classification_Process_2011.pdf).

§§ Other antihypertensives include selective aldosterone receptor inhibitors, peripheral vasodilators, alpha blockers, and centrally acting agents.

¶¶ The PDC measure is endorsed by the National Quality Forum and is the preferred method of measuring medication adherence by the Pharmacy Quality Alliance. A PDC was calculated for each class for which a beneficiary met the inclusion criteria. If multiple prescriptions for the same target medication (i.e., same generic ingredient) were dispensed on different days such that the prescriptions overlapped, the start date for the new prescription accounted for the remaining medication from the previous fill. Days' supply that extended beyond the end of the measurement period was not included in the PDC calculation. All analyses were performed using SAS Version 9.4 (SAS Institute Inc, Cary, North Carolina). See Supplemental Document 1 (<https://stacks.cdc.gov/view/cdc/40808>) for the SAS coding used to perform the analyses in this study.

*** Beneficiaries' overall PDC is the average of their PDCs for renin-angiotensin system antagonists, beta blockers, calcium channel blockers, diuretics, and other antihypertensives. If the average PDC is $<80\%$, they are considered nonadherent for the combined use of all antihypertensives.

††† The definition CMS used to determine if a FFS-PDP beneficiary ever received an administrative billing code for hypertension while enrolled with FFS coverage can be found at <https://www.ccwdata.org/web/guest/condition-categories>. Hypertension status could not be determined among MA-PD beneficiaries.

§§§ Beneficiaries who receive a low-income subsidy include those who are automatically deemed eligible, as well as those who apply and are determined eligible (https://www.cms.gov/Medicare/Eligibility-and-Enrollment/LowIncSubMedicarePresCov/index.html?redirect=/LowIncSubMedicarePresCov/03_MedicareLINET.asp).

Medicare and Medicaid), end-stage renal disease (ESRD) classification, initial entitlement eligibility designation (i.e., age ≥ 65 years or disability and/or ESRD), and whether any of the antihypertensives filled were for fixed-dose combinations (i.e., >1 antihypertensive within each pill). The maximum number of antihypertensive classes on hand at any one time was used as a proxy for blood pressure treatment intensity; the number of unique prescription medications used to treat any condition as a proxy for health status; the number of non-antihypertensive prescription medications filled as a proxy for overall medication burden; and the number of antihypertensive prescribers as a proxy for continuity of care for blood pressure management.⁵⁵⁵

Descriptive analyses included calculating the mean annual total and out-of-pocket spending on antihypertensives per beneficiary and the percentage of overall beneficiary prescription medication spending attributed to antihypertensives. For antihypertensives, mean days' supply per fill (i.e., the mean number of days a prescription fill would last based on the amount of medication supplied), percentage of fills with generic rather than brand-name medications, and the percentage of fills with fixed-dose combinations were calculated. Nonadherence was stratified by beneficiaries' U.S. Census Region and state or territory of residence and mapped by county of residence using a spatial empirical Bayesian smoothing technique to enhance estimate stability. The data used in these analyses represent 100% of the beneficiaries who met the inclusion criteria; therefore, no statistical testing was needed to assess for differences among subgroups for the previously described variables.

Results

Among the 18.5 million Medicare Part D beneficiaries who were prescribed antihypertensives, 4.9 million (26.3%) were nonadherent (Table 1). Nonadherence varied by race (24.3% [whites], 26.3% [Asian/Pacific Islanders], 33.8% [Hispanics], 35.7% [blacks], 38.8% [American Indians/Alaska Natives]); low-income subsidy status (32.1% [low-income subsidy], 25.4% [no subsidy]); and reason for initial entitlement,

⁵⁵⁵ The maximum number of antihypertensive classes on hand at any one time in 2014 variable was grouped in three categories (one antihypertensive class, two antihypertensive classes, and three or more antihypertensive classes). The health status proxy describes the number of unique prescriptions filled, by generic medication name, and was grouped into quartiles with the fourth quartile representing beneficiaries with potentially the worst health status (i.e., taking the most unique types of medication). The overall medication burden proxy describes the number of non-antihypertensive prescription medications filled for in 2014, and was grouped into quartiles with the fourth quartile representing beneficiaries with the greatest medication burden (i.e., most number of fills per year). The continuity of care for blood pressure management proxy describes the number of unique antihypertensive prescribers in 2014, and was grouped into three categories (one antihypertensive prescriber, two antihypertensive prescribers, and three or more antihypertensive prescribers). The larger the number of unique prescribers the potentially less the continuity of care.

Key Points

- Cardiovascular disease (heart disease and stroke) is the leading cause of death in the United States.
- Hypertension, or high blood pressure, is a primary risk factor for heart disease and stroke, and approximately 70% of adults aged ≥ 65 years have the condition. Only about half of persons with high blood pressure have it under control (i.e., blood pressure $<140/90$ mm Hg).
- Nonadherence, or not following a health care professional's instructions concerning taking their prescribed blood pressure medicine, is a well-known reason for uncontrolled high blood pressure and an important risk factor for adverse cardiovascular disease outcomes and increased health care costs.
- In this study, 26.3% (4.9 million) Medicare Part D beneficiaries aged ≥ 65 years using blood pressure medicine were considered nonadherent.
- Different groups and geographic regions had a high proportion of beneficiaries classified as nonadherent. For example, 24.3% of whites, 26.3% of Asian/Pacific Islanders, 33.8% of Hispanics, 35.7% of blacks, and 38.8% of American Indians or Alaska Natives were classified as being nonadherent. In addition, socioeconomic status classifications showed differences, with 32.1% of persons with a low-income subsidy being classified as nonadherent, compared with 25.4% of persons with no subsidy. The highest nonadherence prevalence tended to occur in the southern United States.
- Factors and opportunities were identified that could be addressed by prescribers, health systems, and payers to improve adherence, including, especially among older adults, simplifying their blood pressure medication regimen.
- Additional information is available at <http://www.cdc.gov/vitalsigns>.

which was highest (42.4%) among beneficiaries with disability and ESRD.

Nonadherence was slightly higher among older age groups and when a second class of antihypertensive was added (27.2%) compared with a single class (23.2%), and was slightly lower among beneficiaries with any fixed-dose combination medication use (Table 1). Nonadherence increased with decreases in health status and as the number of antihypertensive prescribers increased. There was little relationship between the overall medication burden proxy or plan type (FFS-PDP versus MA-PD) and nonadherence. Nonadherence differed by medication class, ranging from 16.9% (angiotensin II receptor

TABLE 1. National antihypertensive medication nonadherence among Medicare Part D beneficiaries aged ≥65 years, by demographic and treatment characteristics — United States, 2014

Category	No. beneficiaries	AHM fills			Annual AHM spending			
		Total (millions)	Percent fixed-dose combinations	Mean days' supply per fill	Total spending per beneficiary (\$)	Out-of-pocket spending per beneficiary (\$)	Percent of out-of-pocket spending attributed to AHM	Percent nonadherent*
Total	18,500,811	215.9	8.9	53.9	318[†]	92[†]	18.4	26.3
Sex								
Female	11,019,771	131.4	9.4	52.4	333	91	18.9	26.7
Male	7,481,040	84.4	8.2	56.2	297	93	17.6	25.8
Age								
65–74	10,083,964	111.5	10.5	55.3	305	88	17.7	25.4
75–84	6,187,631	74.9	7.9	53.7	335	95	17.8	27.0
≥85	2,229,216	29.4	5.4	49.0	333	100	20.2	29.0
Race/Ethnicity								
White, non-Hispanic	14,302,318	160.1	8.4	56.0	309	100	17.8	24.3
Black	1,715,144	24.9	10.7	47.0	382	79	24.1	35.7
Asian/Pacific Islander	571,551	6.3	9.9	54.6	392	57	22.0	26.3
American Indian/Alaska Native	50,261	0.7	3.7	41.0	267	60	15.5	38.8
Hispanic	1,635,662	21.5	10.6	45.9	307	48	19.9	33.8
Other	143,919	1.6	9.5	56.1	353	83	20.1	26.5
Unknown	81,956	0.9	10.9	56.5	318	93	18.5	22.6
Initial Medicare entitlement reason								
Age ≥65	16,575,264	189.3	9.2	54.7	318	95	18.8	25.7
Disability	1,900,602	26.2	7.1	48.0	320	66	14.0	32.0
ESRD	12,934	0.2	1.2	47.0	427	90	12.2	40.7
Disability and ESRD	12,011	0.2	1.0	44.8	440	84	12.8	42.4
ESRD								
No	18,369,467	213.8	9.0	54.0	318	92	18.4	26.1
Yes	131,344	2.1	0.9	43.4	392	80	12.6	55.9
Income status								
Standard	15,875,135	175.0	9.2	56.6	307	104	18.3	25.4
LIS or Medicaid dual eligible	2,625,676	40.8	7.8	42.3	386	19	19.4	32.1
Fixed-dose combination use[§]								
No	14,951,894	175.6	0.0	53.9	282	86	17.0	27.0
Yes	3,548,917	40.2	47.9	53.8	469	118	24.7	23.4
Maximum treatment intensity[¶]								
1 AHM	5,170,222	29.1	0.1	55.7	141	47	11.1	23.3
2 AHMs	6,610,125	66.3	11.4	55.0	264	81	16.9	27.2
3 AHMs	4,667,463	73.1	10.5	53.6	427	121	21.9	27.9
≥4 AHMs	2,053,001	47.4	8.6	51.6	693	173	27.4	27.8
Health status proxy quartile^{**}								
Quartile 1	5,498,142	45.6	13.9	59.3	234	79	32.4	21.8
Quartile 2	4,465,520	48.5	9.7	56.8	299	94	21.4	23.8
Quartile 3	4,345,870	55.3	7.8	53.9	344	100	16.7	27.0
Quartile 4	4,191,279	66.6	5.9	48.2	422	99	12.2	34.4
Medication burden proxy quartile^{††}								
Quartile 1	4,926,566	38.8	12.5	68.4	253	83	40.2	26.4
Quartile 2	4,528,839	46.4	10.3	59.6	299	91	23.6	25.0
Quartile 3	4,812,272	60.5	8.6	52.4	337	97	16.8	26.2
Quartile 4	4,233,134	70.0	6.3	43.4	393	99	11.2	27.8
Continuity of care for blood pressure management proxy^{§§}								
1 prescriber	11,082,496	109.8	11.1	57.1	285	85	18.4	22.7
2 prescribers	4,961,460	63.3	7.8	52.6	340	98	18.3	29.4
≥3 prescribers	2,456,855	42.8	4.8	47.5	423	113	18.4	36.8
Prescription drug plan type								
FFS-PDP	10,265,439	122.4	8.7	53.1	350	103	18.2	26.3
MA-PD	8,235,372	93.4	9.2	55.0	278	79	18.6	26.4

See table footnotes on next page.

TABLE 1. (Continued) National antihypertensive medication nonadherence among Medicare Part D beneficiaries aged ≥65 years, by demographic and treatment characteristics — United States, 2014

Abbreviations: AHM = antihypertensive medication; ESRD = end-stage renal disease; FFS-PDP = Medicare fee-for-service prescription drug plan; LIS = low-income subsidy; MA-PD = Medicare Advantage prescription drug plan.

* Nonadherence is defined as patients not following their health care professional's instructions concerning taking their prescribed medication. Using the proportion of days covered methodology, beneficiaries were considered nonadherent if they had access to AHM for <80% of the days from the date of their first AHM fill through the end of 2014 or until their death in 2014.

† Amounts to \$5.9 billion in total spending on AHM fills, including almost \$2.1 billion in beneficiary out-of-pocket spending.

‡ Filled for a fixed-dose AHM combination medication (i.e., has >1 AHM per pill) at any point during 2014.

¶ Maximum number of AHM classes on hand at any one time as a proxy for blood pressure treatment intensity.

** Based on the number of unique prescriptions filled, by generic medication name, in 2014 as a proxy for overall health status.

†† Based on the number of non-AHM prescription medications filled for in 2014 as a proxy for overall medication burden.

§§ Number of unique AHM prescribers in 2014 as a proxy for continuity of care for blood pressure management (i.e., the greater the number of unique prescribers the potentially less the continuity).

blockers) to 28.9% (diuretics); 20.4% of beneficiaries who were prescribed renin-angiotensin system antagonists, the medication category used in the CMS Part C and D Star Ratings Program,^{****} were nonadherent (Table 2).

At the state level, beneficiaries in North Dakota (18.7%), Wisconsin (18.8%), and Minnesota (18.9%) had the lowest nonadherence, and beneficiaries in Washington, D.C. (33.7%), Mississippi (32.8%), and Louisiana (31.5%) had the highest (Table 3; Supplemental Figure 1 [<https://stacks.cdc.gov/view/cdc/40807>]). Nonadherence was higher in the U.S. territories of Puerto Rico (39.6%) and the Virgin Islands (46.9%) than within the states (range: 18.7%–33.7%). At the county level, considerable variation in nonadherence was found (range: 15.9% to 56.2%). The greatest nonadherence tended to occur in the southern United States (nonadherence, by U.S. Census region, of 28.9% for the South, 26.7% for the West, 24.1% for the Northeast, and 22.8% for the Midwest) (Figure).

In 2014, the 215.9 million antihypertensive fills accounted for almost \$5.9 billion in total spending, of which \$2.1 billion (35.6%) was borne by beneficiaries (Table 1). On average, per-person out-of-pocket spending for antihypertensives was about \$92 per year, reflecting 18.4% of beneficiaries' overall annual prescription medication spending. Total annual spending on antihypertensives differed by beneficiary characteristics (Table 1), medication class (Table 2), and beneficiary state of residence (Table 3). The highest mean annual total spending occurred among beneficiaries using a maximum of four or more antihypertensive classes at one time (\$693 per year), using angiotensin II receptor blockers (\$476 spending per year on that class alone), and living in New Jersey (\$472 per year). Overall, 95.5% of antihypertensive fills were for generic formulations. Fixed-dose combination fills accounted for 8.9%

of antihypertensive fills (Table 1), with thiazide diuretics, a specific type of diuretic, being the antihypertensive most often prescribed in combination (46.5% of fills) (Table 2). Mean days' supply per fill was 53.9 days and varied by beneficiary characteristics (Table 1), including state of residence (Table 3).

Conclusions and Comments

More than one fourth of Medicare Part D beneficiaries aged ≥65 years were nonadherent to their antihypertensive regimen. Uncontrolled blood pressure is a main risk factor for the first and third leading causes of death (heart disease and stroke, respectively) among adults aged ≥65 years (1).^{†††} Although multiple factors contribute to the high proportion of uncontrolled blood pressure among persons in this age group (11), persons who are adherent to their antihypertensives are 45% more likely to achieve blood pressure control and have up to a 38% decreased risk for having a cardiovascular event compared with persons who are nonadherent (2,4).

Several groups had higher antihypertensive nonadherence, including blacks and American Indians/Alaska Natives, who are also at higher risk for poor blood pressure control and cardiovascular morbidity and mortality compared with other racial and ethnic groups (1). Moreover, beneficiaries living in the southern United States had the highest nonadherence. These differences in nonadherence could play a role in persistent disparities in blood pressure control and cardiovascular disease outcomes in these groups and regions (1,12). Although still suboptimal, if the average nonadherence rate of 18.9% among Medicare Part D beneficiary populations in the three states with the lowest nonadherence rates (North Dakota, Wisconsin, and Minnesota) were to be achieved in all states, the national nonadherence rate would decrease by about one third, and 1.4 million more beneficiaries would be taking their antihypertensives as directed.

^{****} The Medicare Part C and D Star Ratings Program includes a medication adherence measure for renin-angiotensin system antagonists medication based on the Pharmacy Quality Alliance measure specifications (<https://www.cms.gov/Medicare/Prescription-Drug-Coverage/PrescriptionDrugCovGenIn/PerformanceData.html>). See Supplemental Table 1 (<https://stacks.cdc.gov/view/cdc/40806>) for renin-angiotensin system antagonist nonadherence results by U.S. state and territory.

^{†††} The leading cause of death among U.S. adults aged ≥65 years in 2014 was obtained from CDC WONDER Online Database (<http://wonder.cdc.gov/ucd-icd10.html>). Data are from the Multiple Cause of Death Files, 1999–2014, as compiled from data provided by the 57 vital statistics jurisdictions through the Vital Statistics Cooperative Program.

TABLE 2. National antihypertensive medication nonadherence among Medicare Part D beneficiaries aged ≥65 years, by medication class and plan type, United States, 2014

AHM class/ Plan type	Beneficiaries		AHM fills				Annual AHM spending		
	No.	Percent with diagnosis of hypertension*	Total (millions)	Percent generic	Percent fixed-dose combinations	Mean days' supply per fill	Total spending per beneficiary (\$)	Out-of-pocket spending per beneficiary (\$)	Percent nonadherent [†]
ACEI	7,410,281	—	42.0	99.8	18.1	57.1	82	30	18.5
FFS-PDP	3,932,634	98.2	22.7	99.8	18.7	56.3	84	34	18.2
MA-PD	3,477,647	—	19.4	99.9	19.4	58.0	80	26	18.9
ARB	4,890,687	—	29.7	78.4	32.4	53.6	476	98	16.9
FFS-PDP	2,790,168	99.0	17.0	74.3	32.7	53.7	543	114	16.7
MA-PD	2,100,519	—	12.7	84.0	31.9	53.5	389	78	17.2
RASA[§]	12,819,640	—	73.5	90.7	24.2	55.4	236	57	20.4
FFS-PDP	7,010,872	98.5	40.7	88.6	24.2	54.9	271	66	20.2
MA-PD	5,808,768	—	32.8	93.4	24.2	55.9	194	45	20.6
BB	9,645,375	—	54.3	95.1	2.5	54.1	139	48	23.4
FFS-PDP	5,458,653	97.6	31.3	94.1	2.4	53.2	152	54	23.1
MA-PD	4,186,722	—	22.9	96.4	2.6	55.4	122	41	23.8
CCB	7,144,600	—	40.5	97.0	8.0	53.0	176	49	22.9
FFS-PDP	3,992,363	98.9	23.0	96.5	8.3	52.4	183	53	22.5
MA-PD	3,152,237	—	17.6	97.6	7.7	53.7	167	45	23.4
Diuretic	9,969,492	—	56.6	97.4	28.8	53.7	111	35	28.9
FFS-PDP	5,603,616	98.1	32.6	97.0	27.5	52.8	119	38	28.9
MA-PD	4,365,876	—	24.1	98.0	30.6	54.9	101	31	28.9
TD[¶]	6,874,909	—	35.1	96.0	46.5	57.4	135	39	27.2
FFS-PDP	3,762,961	98.3	19.4	95.2	46.1	56.8	149	44	27.1
MA-PD	3,111,948	—	15.6	97.0	47.0	58.2	118	34	27.3
Other AHM**	1,847,807	—	10.4	99.8	<0.1	50.5	170	42	35.9
FFS-PDP	985,786	97.7	5.7	99.7	0.1	48.8	184	44	36.5
MA-PD	862,021	—	4.7	99.9	<0.1	52.7	153	40	35.1

Abbreviations: ACEI = angiotensin converting enzyme inhibitor; AHM = antihypertensive medication; ARB = angiotensin II receptor blocker; BB = beta blocker; CCB = calcium channel blocker; FFS-PDP = Medicare fee-for-service prescription drug plan; MA-PD = Medicare Advantage prescription drug plan; RASA = renin-angiotensin system antagonist; TD = thiazide diuretic.

* Diagnosed hypertension status was only available for beneficiaries with FFS-PDP coverage.

[†] Nonadherence is defined as patients not following their health care professional's instructions concerning taking their prescribed medication. Using the proportion of days covered methodology, beneficiaries were considered nonadherent if they had access to AHM for <80% of the days from the date of their first AHM fill through the end of 2014 or until their death in 2014.

[§] RASAs include ACEIs, ARBs, and direct renin inhibitors.

[¶] Thiazide diuretics, which also include thiazide-like diuretics (e.g. chlorthalidone), are a type of diuretic and are commonly used as a first-line medication to treat hypertension.

** Other AHMs include selective aldosterone receptor inhibitors, peripheral vasodilators, alpha blockers, and centrally acting agents.

Factors and opportunities have been identified that prescribers, health systems, and payers can address to improve medication adherence. For older adults, who are often taking multiple chronic disease medications (13), including 72% of beneficiaries in this study taking two or more antihypertensives, an important factor in improving adherence is simplification of the antihypertensive regimen. Some strategies include decreasing pill count through the use of fixed-dose combination medications (14,15), which were underused among most beneficiary groups in this study; limiting the number of pharmacy visits needed by increasing the days' supply per fill (e.g., prescribing 90-day versus 30-day allotments), which had wide variability among beneficiary groups, and synchronizing fills for all medication (14); and using reminder devices and technology aids that encourage patients to follow their recommended medication schedule (16). These strategies can be implemented by health care teams that are using standardized

hypertension treatment approaches to manage patients' blood pressure (15). These teams might include physicians and physician assistants, nurses and nurse practitioners, pharmacists, and community health workers, and their collective work can help ensure patients' medication regimens and adherence are regularly assessed and their blood pressure controlled. Coordinated care might help overcome the finding of increased nonadherence when patients have more prescribers managing their antihypertensive regimens.

Additional interventions to improve adherence include engaging patients in medication regimen decision making using motivational counseling techniques and educating patients about the risks associated with uncontrolled blood pressure (17); encouraging the use of home blood pressure monitoring (18); maximizing use of generic medication (19); leveraging health information technologies that allow for e-prescribing, additional patient engagement, and clinical-decision support

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Table 3. Antihypertensive medication nonadherence among Medicare Part D beneficiaries aged ≥65 years, by state and territory, United States, 2014

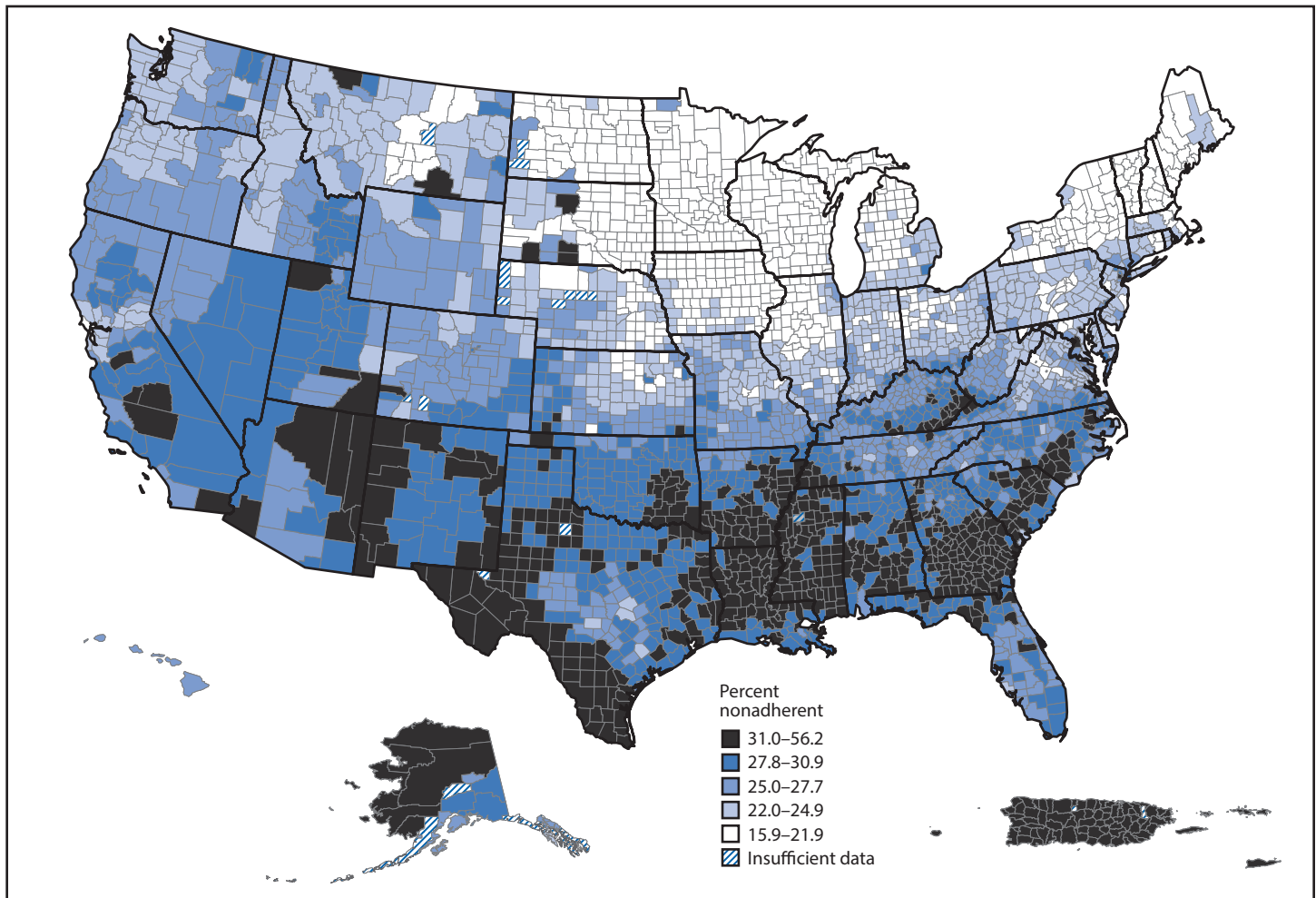
State/Territory	No. beneficiaries	AHM fills			Annual AHM spending				Percent nonadherent [†]
		Total (millions)	Mean maximum treatment intensity*	Percent fixed-dose combinations	Mean days' supply per fill	Total spending per beneficiary (\$)	Out-of-pocket spending per beneficiary (\$)	Percent of out-of-pocket spending attributed to AHM	
Alabama	314,946	4.02	2.33	11.5	49.6	303	89	16.9	29.9
Alaska	12,929	0.19	2.17	5.7	41.0	370	97	19.6	29.0
Arizona	358,006	3.63	2.11	6.0	59.6	278	95	18.1	28.2
Arkansas	180,717	2.57	2.27	10.4	43.7	294	91	17.9	30.4
California	1,941,483	20.56	2.16	7.2	58.6	307	81	19.5	27.1
Colorado	223,556	2.20	2.04	7.7	59.3	242	94	17.9	26.3
Connecticut	218,472	2.31	2.15	8.3	59.2	392	104	21.7	23.1
Delaware	62,885	0.55	2.20	10.4	71.0	399	109	19.5	23.0
DC	18,920	0.25	2.35	8.6	48.5	395	83	23.9	33.7
Florida	1,424,739	16.33	2.23	8.7	55.0	304	78	17.1	27.7
Georgia	487,641	6.44	2.30	11.0	46.8	334	106	18.2	31.0
Hawaii	84,596	0.87	2.03	10.5	55.5	362	82	21.7	25.5
Idaho	81,219	0.87	2.12	8.0	57.0	263	91	17.3	25.2
Illinois	622,034	7.31	2.25	8.1	55.6	320	102	18.3	23.8
Indiana	404,132	4.56	2.27	9.9	57.5	318	112	18.2	23.9
Iowa	216,867	2.75	2.19	7.4	51.6	253	97	17.2	19.7
Kansas	167,235	2.06	2.18	8.7	50.9	284	101	16.4	25.0
Kentucky	290,743	3.95	2.30	8.7	47.9	328	102	18.1	27.7
Louisiana	272,341	3.89	2.38	10.8	45.1	381	101	18.6	31.5
Maine	93,689	0.92	2.11	4.2	64.9	266	66	18.1	20.7
Maryland	257,600	2.55	2.26	9.5	64.7	362	107	20.1	25.4
Massachusetts	369,603	4.49	2.14	3.8	53.7	297	85	19.4	21.9
Michigan	688,611	6.70	2.22	8.5	65.9	260	89	17.7	23.3
Minnesota	326,243	3.33	2.16	6.0	64.2	224	89	17.6	18.9
Mississippi	181,510	2.66	2.36	12.6	42.8	339	94	18.2	32.8
Missouri	389,448	5.02	2.22	7.4	49.8	296	92	17.3	25.3
Montana	55,376	0.63	2.10	6.8	54.1	242	87	16.5	23.3
Nebraska	66,971	0.71	2.10	5.2	60.4	285	99	18.6	20.5
Nevada	532,767	5.49	2.22	11.2	60.5	472	117	21.5	25.3
New Hampshire	103,182	1.06	2.08	7.0	56.9	261	77	17.9	29.8
New Jersey	1,243,971	15.11	2.23	9.6	52.3	404	83	20.2	25.3
New Mexico	615,702	8.05	2.24	10.4	47.4	307	93	17.4	28.1
New York	42,929	0.54	2.24	7.3	53.5	272	109	17.5	18.7
North Carolina	108,367	1.49	2.20	8.7	46.4	302	111	17.9	22.6
North Dakota	135,396	1.38	2.15	8.6	59.1	250	73	15.6	28.2
Ohio	807,252	9.16	2.24	8.9	56.8	297	99	18.5	23.9
Oklahoma	212,004	2.50	2.27	9.6	53.0	327	102	17.4	29.6
Oregon	246,556	2.69	2.10	5.3	57.0	242	88	17.5	23.9
Pennsylvania	934,545	11.72	2.17	8.5	49.7	352	102	19.1	24.0
Puerto Rico	290,517	4.72	2.27	13.5	35.3	256	48	21.6	39.6
Rhode Island	72,279	1.04	2.18	6.7	44.6	298	84	18.4	22.9
South Carolina	307,134	3.80	2.27	13.1	49.0	350	100	17.7	29.6
South Dakota	51,359	0.65	2.18	7.0	51.2	268	100	16.7	21.0
Tennessee	427,203	5.38	2.29	9.2	51.0	302	91	17.1	28.0
Texas	1,184,240	13.31	2.26	11.3	54.3	354	94	17.8	30.8
USVI	6,041	0.09	2.28	17.7	36.1	280	138	29.3	46.9
Utah	94,690	0.89	2.08	11.2	60.5	246	96	15.6	28.7
Vermont	38,691	0.40	2.07	4.9	62.4	272	83	19.6	19.1
Virginia	387,911	4.57	2.24	9.6	53.9	313	100	17.8	25.7
Washington	326,047	3.48	2.11	4.7	58.8	237	88	17.4	24.1
West Virginia	137,169	1.78	2.28	8.9	50.3	332	95	18.6	25.8
Wisconsin	348,628	3.85	2.19	6.9	59.9	274	98	18.4	18.8
Wyoming	26,660	0.30	2.12	7.9	54.4	283	107	17.6	25.5

Abbreviation: AHM = antihypertensive medication; DC = District of Columbia; USVI = U.S. Virgin Islands.

* Mean of the maximum number of AHM classes on hand at any one time per beneficiary; proxy for blood pressure treatment intensity.

† Nonadherence is defined as patients not following their health care professional's instructions concerning taking their prescribed medication. Using the proportion of days covered methodology, beneficiaries were considered nonadherent if they had access to AHM for <80% of the days from the date of their first AHM fill through the end of 2014 or their death in 2014.

FIGURE. Antihypertensive medication nonadherence* among Medicare Part D beneficiaries aged ≥ 65 years, by county — United States, Puerto Rico, and U.S. Virgin Islands, 2014[†]



* Nonadherence is defined as patients not following their health care professional's instructions concerning taking their prescribed medication. Using the proportion of days covered methodology, beneficiaries were considered nonadherent if they had access to antihypertensive medication for $<80\%$ of the days from the date of filling their first antihypertensive medication prescription through the end of 2014 or until their death in 2014.

[†] Additional maps of nonadherence by beneficiaries' race/ethnicity and for renin-angiotensin system antagonists and diuretics are available on the Interactive Atlas for Heart Disease and Stroke at <https://www.cdc.gov/dhdsp/maps/atlas/>.

that informs prescribing decisions (15,16); and implementing payment reforms that decrease spending, such as limiting deductibles and copayments (20). Although annual out-of-pocket antihypertensive spending for most beneficiaries was low (around \$100 per year), it represented almost one fifth of their total prescription medication spending and might be a barrier to adherence among certain groups.

CMS has taken steps to decrease cost-sharing in the Medicare Part D coverage gap (i.e., 'donut hole', where beneficiaries who meet a specific spending threshold are responsible for a higher percentage of prescription medication spending) (21), which could reduce nonadherence. In addition, CMS has included medication adherence measures as part of the Part C and D Star Ratings Program to encourage health plans that participate in Medicare Part D to support improved adherence for specific

medications, including antihypertensives. Plans achieve this through using interventions such as medication therapy management programs to review beneficiaries' medication regimens and follow up with those who are nonadherent.

The findings in this report are subject to at least six limitations. First, PDC assesses only the availability of medication and not the actual taking of medication. However, use of measures, like PDC, which rely on administrative data to assess nonadherence have typically correlated well with self-reported nonadherence, plasma medication levels, physiologic markers, and cardiovascular disease outcomes (2,22), and might better assess nonadherence among older adults than self-reported or other objective measures (22). Second, because the PDC calculation excludes patients with only one antihypertensive fill and does not include persons who are prescribed medication

but never initiate treatment, it probably underestimates non-adherence. Approximately 300,000 beneficiaries in this study had only one filled prescription within a class; in general, up to one fourth of prescriptions for newly prescribed antihypertensives are never filled (23). Third, nonadherence might be overestimated among beneficiaries who switched antihypertensive classes based on their clinician's recommendation (e.g., because of side effects) or sometimes directly purchased low-priced generic antihypertensives without involvement of their prescription drug plan, but were considered nonadherent. Fourth, periods when beneficiaries were hospitalized were not censored because hospitalization data were not available for beneficiaries with MA-PD plans; however, the effect of this on nonadherence rates is small based on earlier research and guidance (10). Fifth, proxy measures used here might not accurately reflect their intended purpose. For example, a higher number of antihypertensive prescribers per patient might indicate better team-based care rather than splintered care, and methodologies accounting for these increasingly popular models of care should be considered in future analyses. Finally, subpopulation comparisons were not adjusted for other factors and should be addressed in future studies.

More than one fourth of Medicare Part D beneficiaries assessed were nonadherent to their antihypertensive therapy. This was the first study to identify considerable geographic variation in antihypertensive nonadherence at the county level. Although recognized as challenging, improving adherence to antihypertensives is an effective way to improve blood pressure control and reduce cardiovascular events in this population, which is already at high risk for having cardiovascular disease. This study identified multiple groups at increased risk for non-adherence and potentially modifiable risk factors. Strategies to improve adherence range from individual patient engagement and intervention to systematic health system changes, and coordinated approaches are important to improving adherence and the cardiovascular health of this population.

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References

1. Mozaffarian D, Benjamin EJ, Go AS, et al.; Writing Group Members; American Heart Association Statistics Committee; Stroke Statistics Subcommittee. Heart Disease and Stroke Statistics—2016 update. *Circulation* 2016;133:e38–360. <http://dx.doi.org/10.1161/CIR.0000000000000350>

2. Ho PM, Bryson CL, Rumsfeld JS. Medication adherence: its importance in cardiovascular outcomes. *Circulation* 2009;119:3028–35. <http://dx.doi.org/10.1161/CIRCULATIONAHA.108.768986>
3. Gillespie CD, Hurvitz KA. Prevalence of hypertension and controlled hypertension—United States, 2007–2010. *MMWR Suppl* 2013;62(No. SS-3).
4. Mazzaglia G, Ambrosioni E, Alacqua M, et al. Adherence to antihypertensive medications and cardiovascular morbidity among newly diagnosed hypertensive patients. *Circulation* 2009;120:1598–605. <http://dx.doi.org/10.1161/CIRCULATIONAHA.108.830299>
5. Gellad WFGK, McGlynn EA. A review of barriers to medication adherence: a framework for driving policy options. Santa Monica, CA: Rand Corporation; 2009. http://www.rand.org/content/dam/rand/pubs/technical_reports/2009/RAND_TR765.pdf
6. Lau DT, Briesacher BA, Touchette DR, Stubbings J, Ng JH. Medicare Part D and quality of prescription medication use in older adults. *Drugs Aging* 2011;28:797–807. <http://dx.doi.org/10.2165/11595250-000000000-00000>
7. The Henry J. Kaiser Family Foundation. The Medicare Part D Prescription Drug Benefit. Menlo Park, CA: The Henry J. Kaiser Family Foundation; 2015. <http://kff.org/medicare/fact-sheet/the-medicare-prescription-drug-benefit-fact-sheet/>
8. Zhang Y, Lave JR, Donohue JM, Fischer MA, Chernew ME, Newhouse JP. The impact of Medicare Part D on medication adherence among older adults enrolled in Medicare-Advantage products. *Med Care* 2010;48:409–17. <http://dx.doi.org/10.1097/MLR.0b013e3181d68978>
9. Blackwell SA, Baugh DK, Montgomery MA, Ciborowski GM, Waldron CJ, Riley GF. Noncompliance in the use of cardiovascular medications in the Medicare Part D population. *Medicare Medicaid Res Rev* 2011;1:E1–27. <http://dx.doi.org/10.5600/MMRR.001.04.A05>
10. Nau D. Proportion of days covered (PDC) as a preferred measure of medication adherence. Springfield, VA: Pharmacy Quality Alliance (no date). <http://www.pqaalliance.org/images/uploads/files/PQA%20PDC%20vs%20%20MPR.pdf>
11. Egan BM, Zhao Y, Axon RN, Brzezinski WA, Ferdinand KC. Uncontrolled and apparent treatment resistant hypertension in the United States, 1988 to 2008. *Circulation* 2011;124:1046–58. <http://dx.doi.org/10.1161/CIRCULATIONAHA.111.030189>
12. Patel MM, Datu B, Roman D, et al. Progress of health plans toward meeting the million hearts clinical target for high blood pressure control—United States, 2010–2012. *MMWR Morb Wkly Rep* 2014;63:127–30.
13. Maher RL, Hanlon J, Hajjar ER. Clinical consequences of polypharmacy in elderly. *Expert Opin Drug Saf* 2014;13:57–65. <http://dx.doi.org/10.1517/14740338.2013.827660>
14. Choudhry NK, Fischer MA, Avorn J, et al. The implications of therapeutic complexity on adherence to cardiovascular medications. *Arch Intern Med* 2011;171:814–22.
15. Jaffe MG, Lee GA, Young JD, Sidney S, Go AS. Improved blood pressure control associated with a large-scale hypertension program. *JAMA* 2013;310:699–705. <http://dx.doi.org/10.1001/jama.2013.108769>
16. Vollmer WM, Owen-Smith AA, Tom JO, et al. Improving adherence to cardiovascular disease medications with information technology. *Am J Manag Care* 2014;20:SP502–10.
17. Gwady-Sridhar FH, Manias E, Lal L, et al. Impact of interventions on medication adherence and blood pressure control in patients with essential hypertension: a systematic review by the ISPOR medication adherence and persistence special interest group. *Value Health* 2013;16:863–71. <http://dx.doi.org/10.1016/j.jval.2013.03.1631>
18. Community Preventive Services Task Force. The community guide. Cardiovascular disease prevention and control: self-measured blood pressure monitoring interventions for improved blood pressure control—when used alone. Atlanta, GA: Community Preventive Services Task Force; 2015. www.thecommunityguide.org/cvd/SMBP-alone.html

19. Shrank WH, Hoang T, Ettner SL, et al. The implications of choice: prescribing generic or preferred pharmaceuticals improves medication adherence for chronic conditions. *Arch Intern Med* 2006;166:332–7. <http://dx.doi.org/10.1001/archinte.166.3.332>
20. Njie GJ, Finnie RK, Acharya SD, et al.; Community Preventive Services Task Force. Reducing medication costs to prevent cardiovascular disease: a community guide systematic review. *Prev Chronic Dis* 2015;12:E208. <http://dx.doi.org/10.5888/pcd12.150242>
21. Fung V, Mangione CM, Huang J, et al. Falling into the coverage gap: Part D drug costs and adherence for Medicare Advantage prescription drug plan beneficiaries with diabetes. *Health Serv Res* 2010;45:355–75. <http://dx.doi.org/10.1111/j.1475-6773.2009.01071.x>
22. Sattler EL, Lee JS, Perri M 3rd. Medication (re)fill adherence measures derived from pharmacy claims data in older Americans: a review of the literature. *Drugs Aging* 2013;30:383–99. <http://dx.doi.org/10.1007/s40266-013-0074-z>
23. Fischer MA, Choudhry NK, Brill G, et al. Trouble getting started: predictors of primary medication nonadherence. *Am J Med* 2011;124:1081.e9–22. <http://dx.doi.org/10.1016/j.amjmed.2011.05.028>