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The Effect Of Veterans Health Administration Coverage On Cost-Related Medication Nonadherence

ABSTRACT High out-of-pocket drug spending worsens adherence and outcomes, especially for patients who are poor, chronically ill, or members of minority groups. The Veterans Health Administration (VHA) system provides drugs at minimal cost, which could reduce cost-related medication nonadherence. Using data for 2013–17 from the National Health Interview Survey, we evaluated the association of VHA coverage with such nonadherence. Although people with VHA coverage were older and in worse health and had lower incomes than those with other coverage, VHA patients had lower rates of cost-related medication nonadherence: 6.1 percent versus 10.9 percent for non-VHA patients, an adjusted 5.9-percentage-point difference. VHA coverage was associated with especially large reductions in nonadherence among people with chronic illnesses and with reduced racial/ethnic and socioeconomic disparities in nonadherence. The VHA pharmacy benefit is a model for reform to address the crisis in prescription drug affordability.

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Medication nonadherence worsens clinical outcomes[1–3] and can inflate health care spending by increasing complications.[4,5] It increases hospitalizations among people with cardiovascular disease,[4] ketoacidosis among those with insulin-dependent diabetes,[6] and exacerbations among those with obstructive lung disease.[7,8] Although nonadherence is associated with many factors,[9,10] out-of-pocket prescription drug spending is one cause,[3,9,11] and studies of health reforms and medication access have used "cost-related medication nonadherence" as an outcome.[12–15]

Cost-related medication nonadherence is defined as the underuse of prescribed drugs as a result of financial pressures and is measured by asking people whether they skipped medication doses, took less medicine, or failed to fill (or delayed filling) prescriptions because of cost.[9,10,16] Such measures have good reliability[16] and are associated with worse health outcomes.[1] Cost-related medication nonadherence is disproportionately experienced by disadvantaged populations,[10] including racial/ethnic minority groups and low-income people.[10,17,18] More generous drug coverage could reduce such nonadherence and attenuate health disparities.

The Veterans Health Administration (VHA) offers a model of prescription drug acquisition and provision that could improve adherence, while controlling drug spending.[19–21] The VHA can purchase drugs at 24 percent off the nonfederal average manufacturer price and sometimes obtains deeper discounts through price negotiations with manufacturers,[22] resulting in prices about 40 percent lower than those paid by Medicare Part D drug plans.[21] The VHA's Pharmacy Benefits Management Services program directly dispenses drugs prescribed by VHA providers and operates safety monitoring and "academic detailing" programs to improve prescribing.[22] The VHA also provides drugs with low or no cost

sharing. Monthly copayments range from $5 (for preferred generic drugs) to $11 (for brand-name drugs), with an annual total cap of $700.[23] However, some veterans are exempted from payments, such as "Priority Group 1" (those with major service-connected conditions) or low-income veterans.

Several studies have examined potential savings for payers through the adoption of the VHA drug pricing model,[21,24] but few have assessed the potential benefits to patients of its drug coverage with low cost sharing. Two 2004 studies, one confined to several hospital systems and one using a web-based survey, found that VHA coverage reduced cost-related medication nonadherence among chronically ill people.[25,26] However, these studies predated the implementation of the Medicare Part D program and the Affordable Care Act and hence have limited contemporary relevance. They also provided no data on whether VHA coverage reduced racial disparities in cost-related medication nonadherence, one possible mechanism underlying the observation that the VHA achieves more equitable health outcomes than the private sector does.[27]

Using nationally representative survey data, we assessed whether VHA coverage is associated with less cost-related medication nonadherence than other types of coverage are. We also evaluated whether VHA coverage is associated with reductions in racial/ethnic and income-related disparities in adherence.

Study Data And Methods

DATA AND POPULATION We analyzed data for 2013–17 from the National Health Interview Survey (NHIS), a nationally representative survey of the civilian, noninstitutionalized US population conducted by the Census Bureau for the Centers for Disease Control and Prevention. We identified 106,853 adults ages eighteen and older who reported receiving any prescription in the past year (appendix exhibit A1).[28] We excluded people with unknown coverage status ($n = 287$) and, in all but one sensitivity analysis, the uninsured ($n = 7,269$). We also excluded those whose Medicare ($n = 4,190$) or private insurance ($n = 2,528$) plans lacked drug benefits (for details on study population formation, see appendix exhibit A1).[28]

EXPOSURES, MEASURES, AND OUTCOMES The primary exposure was type of insurance. For our main analyses we compared people with VHA coverage to those with other insurance. Although many VHA enrollees have other forms of coverage, most who take prescription drugs obtain them through the VHA,[29] which likely reflects the generally greater generosity of the VHA drug benefit. Hence, we included all respondents with VHA coverage in the VHA group, whether or not they also had other insurance.

Our secondary analyses compared VHA coverage to other specific types of insurance. We constructed mutually exclusive coverage categories using the following hierarchy: VHA coverage; other government or state-sponsored coverage, including non-VHA military coverage; Medicaid, including the Children's Health Insurance Program; Medicare; and private coverage. We also performed three sensitivity analyses using different classification schemes. One gave precedence to private plans before all other plans except VHA coverage; another ranked VHA coverage last (that is, it included people as having that coverage only if they had no other coverage); and the third included the uninsured but was otherwise similar to our main analysis.

Finally, we examined the impact of VHA coverage on racial/ethnic and income disparities in cost-related medication nonadherence. Because nearly 7,000 people had missing data on family income, we used the NHIS's multiple-imputation income files, which provide income as a continuous variable. For the income disparity analysis, however, we categorized family income into four groups: $0–$34,999, $35,000–$74,999, $75,000–$99,999, and $100,000 or more. We repeated all analyses with a "complete-case approach," excluding people with missing incomes. Since the results were similar, they are not reported in this article. For racial/ethnic disparity analyses, we excluded people who were not white, black, or Hispanic.

Finally, to assess cost-related medication nonadherence among people with chronic conditions, we identified people with obstructive lung disease, defined as a reported diagnosis of chronic obstructive pulmonary disease (COPD), emphysema, chronic bronchitis, or current asthma; cardiovascular disease, or a diagnosis of coronary heart disease, angina pectoris, heart attack, other heart condition/disease, or stroke; diabetes, including a diagnosis of prediabetes; or a history of cancer.

We examined four outcomes. Participants were asked whether in the past twelve months they had "needed…[a prescription drug], but didn't get it because [they] couldn't afford it"; "skipped medication doses to save money"; "took less medicine to save money"; and "delayed filling a prescription to save money." These or similar questions have been analyzed in previous studies using the NHIS[13,15] or the Medicare Current Beneficiary Survey.[12] Following previous work,[13] we created a composite outcome—any cost-related medication nonadherence—to de-

scribe people with any (versus those with none) of the four outcomes.

ANALYSIS PLAN We tabulated the sociodemographic characteristics of the VHA and non-VHA groups and tested differences using univariate linear regression for continuous variables and Pearson chi-square tests for categorical variables.

We next estimated the effect of VHA coverage versus non-VHA coverage using linear probability regression, with and without controlling for covariates. Linear regression was chosen to facilitate the interpretation of interaction terms. As a robustness check, we repeated analyses of the main effects of VHA coverage on the composite outcome using logistic regression models. These results were consistent with those of our main analyses and are not reported in this article.

Our models for the main effect of VHA coverage were adjusted for age (continuous), sex, family income (continuous), race/ethnicity (Hispanic, white, black, Asian, or other, with all not listed as Hispanic assumed to be non-Hispanic), marital status (married or unmarried), family size (with the highest category seven family members or more), health status (poor or fair versus good or better health), employment status (worked for pay in the previous year), and dummy variables for each of the chronic conditions. We repeated the analysis of the composite outcome for each of the four chronic disease subgroups, and also analyzed the overall sample using the five- and six-category insurance variables, again using the composite outcome only. Only 2.8 percent ($n = 676$) of the final study population had missing data for one or more covariates (apart from income, which was imputed); these people were excluded from adjusted analyses (appendix exhibit A1).[28]

Finally, to assess how VHA coverage affected disparities in medication adherence, we calculated the frequency of cost-related medication nonadherence stratified by coverage type (VHA versus non-VHA) and race/ethnicity or income. We then performed linear regressions that included an interaction term between VHA coverage and either race/ethnicity or income category. We adjusted these models for age, sex, marital status, and family size, together with the main effects of race/ethnicity and income. However, we omitted health variables, which we conceptualized as at least partially "downstream" of race/ethnicity and income. We excluded income and employment from our racial/ethnic disparity analysis because adjustment for these variables would have removed a likely mediator between race/ethnicity and inferior health outcomes. In a sensitivity analysis, we included income. We excluded employment from our income disparity anal-

Characteristics of people with Veterans Health Administration (VHA) and non-VHA coverage, 2013–17

Characteristic	Non-VHA coverage ($n = 89,970$)	VHA coverage ($n = 2,556$)
Mean age, years (SE)****	51.5 (0.11)	61.6 (0.41)
Sex****		
Male	42.2%	89.2%
Female	57.8	10.8
Race/ethnicity****		
Hispanic	10.8%	7.9%
White	72.7	74.4
Black	10.9	14.8
Asian	4.9	1.5
Other	0.8	1.3
Marital status***		
Married	56.3%	52.1%
Not married	43.7	47.9
Family size (members)****		
1	20.9%	31.5%
2	38.3	47.0
3	16.5	11.3
4	13.9	5.9
5	6.5	2.8
6	2.5	0.9
7 or more	1.6	0.7
Health status****		
Good or better	83.2%	65.7%
Fair or poor	16.8	34.3
Chronic disease		
Obstructive lung disease****	16.1%	21.3%
Cardiovascular disease****	18.1	36.7
Diabetes****	16.2	31.2
Cancer history****	12.5	20.5
Employment status****		
Did not work for pay in previous year	39.0%	66.2%
Worked for pay in previous year	61.1	33.8
Family income[a]****		
$0–$34,999	27.9%	41.6%
$35,000–$74,999	29.7	37.5
$75,000–$99,999	13.2	9.4
$100,000 or more	29.1	11.5
Type of insurance[b]		
VHA	0.0%	100.0%
Other public	5.1	0.0
Medicaid	14.0	0.0
Medicare	23.8	0.0
Private	57.2	0.0

SOURCE Authors' analysis of data for 2013–17 from the National Health Interview Survey. **NOTES** There were missing data on marital status for 152 people, on health status for 41 people, on obstructive lung disease for 265 people, on cardiovascular disease for 167 people, on diabetes for 59 people, on cancer history for 75 people, on employment status for 39 people, and on income for 6,959 people. Chronic diseases are explained in the text. All not listed as Hispanic are assumed to be non-Hispanic. Significance was measured with Pearson chi-square tests of homogeneity across VHA and other coverage groups. [a]Proportions are from our analysis of multiple-imputed income data. An analysis that excluded people with missing income data yielded very similar proportions. The p value reflects the results of a Pearson chi-square test performed on unimputed data ($n = 85,567$). [b]Insurance status was designed to be mutually exclusive and hierarchical, as explained in the text. ***$p < 0.01$ ****$p < 0.001$

ysis. The coefficient of each of our interaction terms represents the adjusted percentage-point change in cost-related medication nonadherence associated with VHA coverage (versus other coverage) for blacks or Hispanics relative to whites, and people with lower incomes versus those with the highest incomes.

All analyses were performed with Stata/SE, version 15.1, using weights provided by the NHIS and procedures to account for the complex survey design and analyses of multiple-imputed data. The Institutional Review Board of Cambridge Health Alliance exempted this study from review.

LIMITATIONS Our analysis had several limitations. First, our findings of reduced cost-related medication nonadherence among VHA enrollees might have reflected residual (or unmeasured) confounding, not the VHA pharmacy benefit design. However, compared to people with other coverage, those with VHA coverage were older, poorer, and sicker, characteristics associated with more cost-related medication nonadherence—which suggests that any residual confounding by health or socioeconomic status would likely have biased our findings toward the null. Nonetheless, patients who use the VHA system may have lower out-of-pocket spending for doctor visits and hospitalizations,[30] which could free up household funds and decrease cost-related nonadherence.

Second, we could not determine whether peo-

ple were forgoing medically necessary medications. However, previous studies have indicated that cost sharing causes patients to forgo both "essential" and other medications.[3,31]

Third, it is possible that doctors prescribed less expensive medications to veterans than to other people—which, together with the low cost sharing in the VHA's benefit design, could have contributed to our results.

Study Results

Appendix exhibit A1 diagrams the formation of the study cohort.[28] Our final study population included 89,970 adults with non-VHA coverage and 2,556 with VHA coverage. Those with VHA coverage were older and more likely to be male, black, unmarried, from smaller families, in fair or poor health, unemployed, and low income (exhibit 1). They also had higher rates of chronic disease.

VHA coverage was associated with less cost-related medication nonadherence for each indicator (exhibit 2). Only 6.1 percent of people with VHA coverage reported any cost-related medication nonadherence, compared to 10.9 percent of those with other coverage (adjusted difference: −5.9 percentage points; 95% confidence interval: −7.2, −4.7).

Differences between people with VHA and those with non-VHA coverage in rates of cost-related medication nonadherence were substan-

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EXHIBIT 2

Cost-related medication nonadherence among people with Veterans Health Administration (VHA) and non-VHA coverage, 2013–17

	Unadjusted			Adjusted[a]
	Non-VHA	VHA	Absolute percentage-point difference	Absolute percentage-point difference
Overall sample (N = 92,526)				
Couldn't afford Rx drug	6.61%	4.18%	−2.43****	−3.59****
Skipped medication doses to save money	5.01	2.38	−2.63****	−3.35****
Took less medicine to save money	5.24	2.90	−2.34****	−3.10****
Delayed filling Rx to save money	6.82	3.47	−3.35****	−3.81****
Any of the above	10.88	6.09	−4.79****	−5.92****
Any cost-related medication nonadherence, by chronic disease group				
Obstructive lung disease (n = 16,020)	19.86%	6.40%	−13.46****	−11.66****
Cardiovascular disease (n = 19,222)	14.37	6.10	−8.27****	−7.45****
Diabetes (n = 16,614)	16.14	4.58	−11.56****	−10.08****
Cancer history (n = 13,002)	10.27	5.99	−4.28***	−4.36***

SOURCE Authors' analyses of data for 2013–17 from the National Health Interview Survey. **NOTES** Chronic diseases are explained in the text. [a]Adjusted models are linear probability regressions adjusted for age, sex, income (continuous), race/ethnicity, marital status, family size, health status, obstructive lung disease, cardiovascular disease, diabetes, cancer history, employment status, and coverage status (VHA versus non-VHA coverage). For adjusted analyses, numbers of people were 91,850 for the overall sample, 15,929 for obstructive lung disease, 19,066 for cardiovascular disease, 16,481 for diabetes, and 12,910 for cancer history. ***$p < 0.01$ ****$p < 0.001$

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tially larger among people with three of the four chronic diseases—who, as expected, more frequently reported cost barriers to medication use. Among people with obstructive lung disease, 6.4 percent of those with VHA coverage versus 19.9 percent of those with other coverage had any cost-related medication nonadherence (adjusted difference: −11.7 percentage points; 95% CI: −14.2, −9.1). The comparable figures were 6.1 percent versus 14.4 percent for people with cardiovascular disease, 4.6 percent versus 16.1 percent for those with diabetes, and 6.0 percent versus 10.3 percent for those with a cancer history.

Appendix exhibit A2 presents results of the sensitivity analyses using different hierarchies of insurance coverage.[28] People with VHA coverage had less cost-related medication nonadherence than those with other coverage, no matter how the insurance hierarchy was constructed. Not surprisingly, the uninsured group had the most cost-related medication nonadherence (42.6 percent).

People with lower incomes reported more cost-related medication nonadherence than those in higher income groups did, and within each group, those with VHA coverage reported less nonadherence than those with other coverage did. For instance, among people with non-VHA coverage, skipping medication doses to save money was reported by 2.1 percent of those in the highest income group versus 7.8 percent of those in the lowest group, while for people with VHA coverage, the comparable figures were 1.0 percent and 3.9 percent, respectively (exhibit 3). In the adjusted analysis that included an interaction term between income group and coverage status, VHA coverage modified the effect of low income on cost-related medication nonadherence. The interaction term coefficients indicated that VHA coverage reduced adjusted differences in cost-related medication nonadherence for those in lower income groups relative to those in the highest income group (the reduction in unadjusted differences was similar). For instance, compared to other coverage, VHA coverage was associated with a 6.0 absolute percentage-point reduction in any nonadherence for those in the lowest income group relative to those in the highest group (95% CI: −9.6, −2.4).

Substantial racial/ethnic disparities in cost-related medication nonadherence were consistently present among people with non-VHA coverage, but not among VHA enrollees. For instance, among those with non-VHA coverage, 5.9 percent of whites couldn't afford a prescription drug, versus 8.6 percent of Hispanics and 10.6 percent of blacks (exhibit 4). However, no significant racial/ethnic differences were pres-

ent among people with VHA coverage. In adjusted analyses that included an interaction term between coverage and race/ethnicity, we found that VHA coverage modified the effect of black race for two cost-related nonadherence outcomes (the reduction in unadjusted differences were similar). For instance, VHA coverage reduced the black-white absolute disparity in skipping medication doses to save money by 2.3 adjusted percentage points (95% CI: −4.2, −0.3). In contrast, VHA coverage modified the effect of Hispanic ethnicity for only one outcome (inability to afford a prescription drug). In a sensitivity analysis that also adjusted for income (appendix exhibit A3),[28] none of the interaction terms be-

EXHIBIT 3

Cost-related medication nonadherence among people with Veterans Health Administration (VHA) and non-VHA coverage, by family income, 2013–17

Family income	Unadjusted (N = 92,526)		Adjusted difference in income-group disparities (n = 92,374)
	Non-VHA (n = 89,970)	VHA (n = 2,556)	
COULDN'T AFFORD A PRESCRIPTION DRUG			
$0–$34,999	11.59%	6.09%	−4.51***
$35,000–$74,999	7.02	3.37	−2.78
$75,000–$99,999	4.61	1.83	−2.38
$100,000 or more	2.32	1.81	Ref
SKIPPED MEDICATION DOSES TO SAVE MONEY			
$0–$34,999	7.79%	3.88%	−2.68**
$35,000–$74,999	5.66	1.76	−2.63***
$75,000–$99,999	4.08	0.00	−3.03****
$100,000 or more	2.09	0.96	Ref
TOOK LESS MEDICINE TO SAVE MONEY			
$0–$34,999	8.45%	4.96%	−2.11
$35,000–$74,999	5.85	1.82	−2.63***
$75,000–$99,999	3.74	0.43	−2.10**
$100,000 or more	2.21	0.96	Ref
DELAYED FILLING A PRESCRIPTION TO SAVE MONEY			
$0–$34,999	10.56%	5.25%	−4.31***
$35,000–$74,999	7.77	2.74	−3.98***
$75,000–$99,999	5.62	0.37	−4.51***
$100,000 or more	2.79	1.92	Ref
ANY OF THE ABOVE			
$0–$34,999	17.25%	8.98%	−6.01***
$35,000–$74,999	11.96	4.73	−5.07***
$75,000–$99,999	8.41	2.42	−4.43**
$100,000 or more	4.79	3.05	Ref

SOURCE Authors' analyses of data for the 2013–17 from the National Health Interview Survey. **NOTES** Adjusted models are linear probability regressions adjusted for age, sex, marital status, family size, income group, race/ethnicity, coverage status (VHA versus non-VHA coverage), and the interaction term between income group and coverage status. Note that these models differ from those presented in exhibit 2, as described in the Study Data and Methods section; consequently, the final n for adjusted analyses presented here differs from that provided in exhibit 2, given that slightly fewer individuals were dropped for missing data for covariates. The estimates are the coefficients of the interaction term (multiplied by 100 to give percentage points), which represent the adjusted difference in cost-related medication nonadherence between people with VHA and non-VHA coverage in the given income group, relative to the difference for those in the highest income group. The unadjusted differences are similar. **p < 0.05 ***p < 0.01 ****p < 0.001

EXHIBIT 4

Cost-related medication nonadherence among people with Veterans Health Administration (VHA) and non-VHA coverage, by race/ethnicity, 2013–17

	Unadjusted		
Race/ethnicity	Non-VHA (n = 84,987)	VHA (n = 2,479)	Adjusted difference in racial/ethnic disparities (n = 87,325)
COULDN'T AFFORD A PRESCRIPTION DRUG			
White	5.88%	4.28%	Ref
Hispanic	8.56	2.84	−3.59**
Black	10.63	4.90	−3.88**
SKIPPED MEDICATION DOSES TO SAVE MONEY			
White	4.76%	2.51%	Ref
Hispanic	5.59	2.36	−0.69
Black	6.80	2.17	−2.28**
TOOK LESS MEDICINE TO SAVE MONEY			
White	5.01%	2.97%	Ref
Hispanic	5.42	2.33	−0.79
Black	7.18	3.20	−1.76
DELAYED FILLING A PRESCRIPTION TO SAVE MONEY			
White	6.55%	3.42%	Ref
Hispanic	7.39	4.40	0.67
Black	9.31	3.75	−2.25*
ANY OF THE ABOVE			
White	10.02%	5.88%	Ref
Hispanic	12.95	5.07	−3.01
Black	15.95	8.43	−3.07

SOURCE Authors' analyses of data for 2013–17 from the National Health Interview Survey. NOTES Unadjusted p values (not shown) were calculated based on Pearson chi-square tests within each coverage group (non-VHA and VHA) for the overall effect of race/ethnicity on cost-related medication nonadherence. For the non-VHA group, $p < 0.001$ for each nonadherence outcome; for the VHA group, $p \geq 0.28$ for each nonadherence outcome. Adjusted models are linear probability regressions adjusted for age, sex, marital status, family size, race/ethnicity, coverage status (VHA versus non-VHA coverage), and the interaction term between race/ethnicity and coverage status. The estimates are the coefficients of the interaction term (multiplied by 100 to give percentage points), which represent the adjusted difference in cost-related medication nonadherence between people with VHA and non-VHA coverage for blacks or Hispanics, relative to the difference for whites. The unadjusted differences are similar. For the overall interaction term (not shown), only the p values for "couldn't afford a prescription drug" ($p = 0.01$) and "skipped medication doses to save money" ($p = 0.07$) were less than 0.1. Appendix exhibit A3 shows the results of an income-adjusted model (see note 28 in text). All not listed as Hispanic are assumed to be non-Hispanic. *$p < 0.10$ **$p < 0.05$

tween race/ethnicity and coverage type was significant, which suggests that the VHA's reduction of black-white disparities was mostly mediated by leveling differences between income groups.[28]

Discussion

VHA coverage was associated with less cost-related medication nonadherence relative to other coverage, especially for people with chronic conditions, and was also associated with smaller racial/ethnic and income-based disparities in such nonadherence.

The rising prices of prescription drugs have spawned myriad reform proposals.[32,33] However, although manufacturers' pricing affects the costs paid by insurers (and the uninsured), insurers' decisions regarding benefit design largely determine out-of-pocket spending for people with coverage. Except for Medicaid, most insurers impose substantial drug cost sharing. In many private insurance plans, out-of-pocket medication expenses can total thousands of dollars annually, especially for patients requiring "specialty drugs" such as cancer chemotherapy or biologics. Some plans even put low-price generics (for example, metformin) into high drug tiers that carry large copays.[34] People with Medicare Part D coverage face a $415 deductible and 25 percent coinsurance for prescription drugs until they reach a "catastrophic coverage" threshold of $5,100, at which point limited out-of-pocket spending is still required.[35] Consequently, seniors with hepatitis C face about $5,000 in out-of-pocket spending, on average, for the direct-acting antiviral ledipasvir-sofosbuvir[36]—far higher than the $33 charge for a three-month course in the VHA. Similarly, seniors with COPD have out-of-pocket spending for inhalers that exceeds $1,600 per year,[37] also many times higher than the costs for veterans, who may pay multiple $11 monthly copays. Hence, our findings of lower rates of cost-related medication nonadherence among VHA enrollees is not surprising.

Despite the VHA's relatively generous coverage, its drug spending may be lower than that of private insurers because it pays much lower prices.[21] As do health systems in several nations, the VHA uses a unified national formulary and a mix of government regulation and bargaining with manufacturers to purchase drugs at prices lower than those paid by the US private sector[20,21,24] and similar to prices in Australia.[38]

However, policy makers, and others, sometimes contend that the VHA formulary may be overly restrictive. For instance, Medicare Part D formularies typically cover 85 percent of the top 200 drugs, while the VHA's formulary covers 59 percent.[24] However, such statistics could be misleading. The VHA covers nonformulary medications when clinical circumstances dictate, effectively the same as private coverage of drugs that require prior authorization but are deemed "on-formulary."[39]

Moreover, for some costly medications, the VHA may actually provide greater access than private insurers do. For instance, the VHA made costly direct-acting antivirals for hepatitis C widely available soon after their January 2014 introduction, which allowed it to treat more than half of all infected veterans within four years.[40] In contrast, private insurers issue "absolute denials" for more than half of direct-acting antiviral prescriptions received by specialty pharmacies.[41]

Several studies have linked higher out-of-pocket drug spending to worsened outcomes. When a Fortune 500 company reduced copays for cardiovascular drugs, medication adherence improved, while rates of hospitalizations and emergency department visits fell.[42] Similarly, in the Post–Myocardial Infarction Free Rx Event and Economic Evaluation trial, post–myocardial infarction patients (especially black patients) randomly assigned to coverage with no copays for cardiovascular medications had better adherence and fewer recurrent vascular events.[3,18]

As previous researchers have done,[10] we identified lower income as a risk factor for cost-related medication nonadherence. We observed higher rates of cost-related nonadherence among poor versus nonpoor VHA enrollees, presumably because even small copays may reduce adherence (the VHA exempts some but not all low-income people from copays). Similarly, when Oregon imposed small copays on Medicaid enrollees in 2003, prescription drug use fell 17 percent.[43] The extreme price-sensitivity of low-income patients underscores the potential benefits of first-dollar prescription drug coverage, as implemented in Wales.

"Drugs don't work," Surgeon General C. Everett Koop once remarked, "in patients who don't take them."[2] Eliminating out-of-pocket spending is one of the few interventions proven to increase medication adherence.[5] Our findings suggest that drug coverage modeled on the VHA approach, which is often cited as a model for controlling drug prices, could also improve adherence and population health and reduce health disparities. ∎
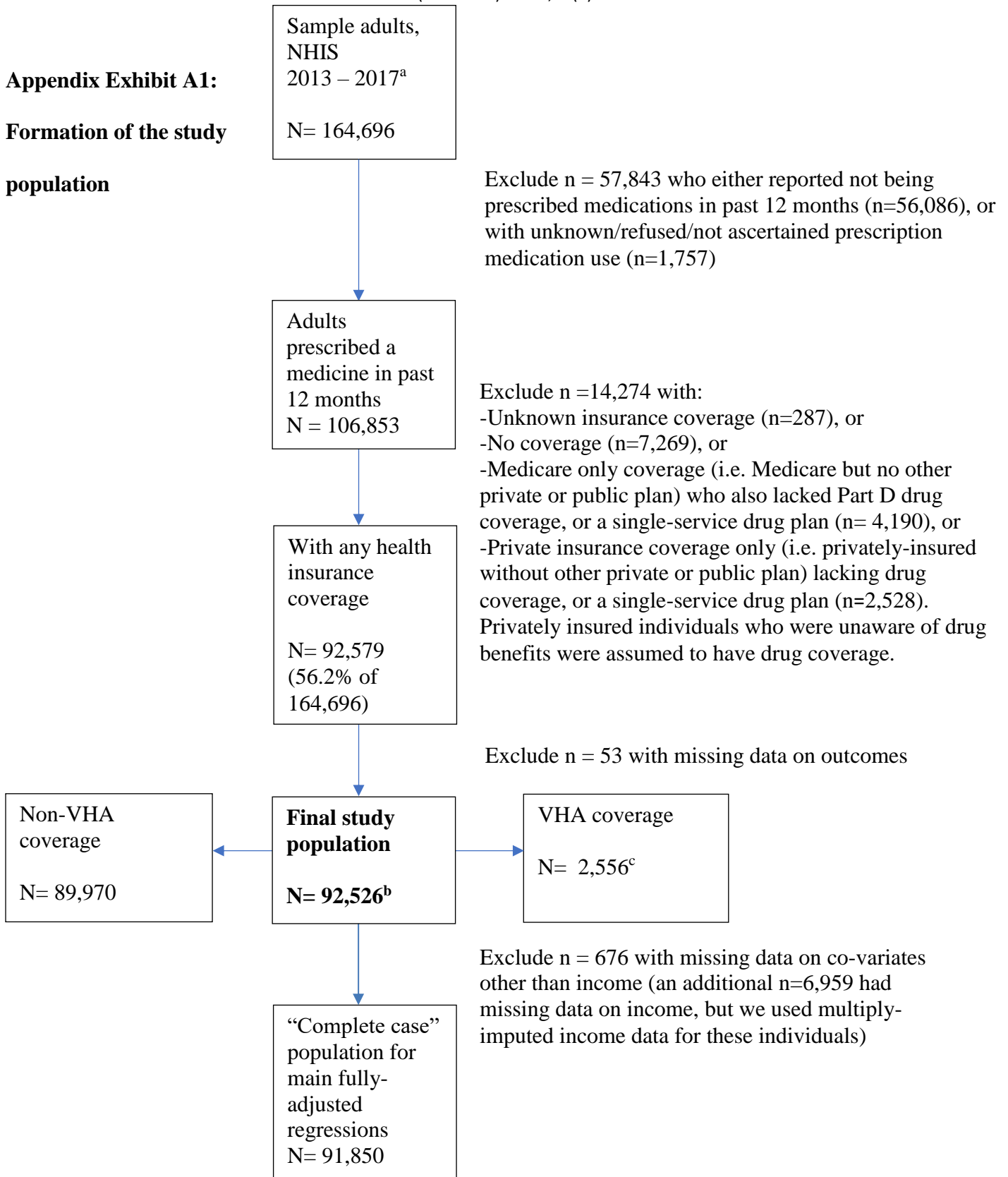
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Appendix Exhibit A1:

Formation of the study

population

Sample adults, NHIS 2013 – 2017[a]

N= 164,696

Exclude n = 57,843 who either reported not being prescribed medications in past 12 months (n=56,086), or with unknown/refused/not ascertained prescription medication use (n=1,757)

Adults prescribed a medicine in past 12 months
N = 106,853

Exclude n =14,274 with:
-Unknown insurance coverage (n=287), or
-No coverage (n=7,269), or
-Medicare only coverage (i.e. Medicare but no other private or public plan) who also lacked Part D drug coverage, or a single-service drug plan (n= 4,190), or
-Private insurance coverage only (i.e. privately-insured without other private or public plan) lacking drug coverage, or a single-service drug plan (n=2,528). Privately insured individuals who were unaware of drug benefits were assumed to have drug coverage.

With any health insurance coverage

N= 92,579
(56.2% of 164,696)

Exclude n = 53 with missing data on outcomes

Non-VHA coverage

N= 89,970

Final study population

N= 92,526[b]

VHA coverage

N= 2,556[c]

Exclude n = 676 with missing data on co-variates other than income (an additional n=6,959 had missing data on income, but we used multiply-imputed income data for these individuals)

"Complete case" population for main fully-adjusted regressions
N= 91,850

Source: Authors' analysis of the NHIS. NHIS = National Health Interview Survey.
[a] The NHIS performs in-person interviews with approximately 35,000 families annually; one "sample adult" in each family is randomly selected to complete a more extensive interview.[29] Since 2011, sample adults have been asked a series of questions about prescription drug cost-related medication non-adherence, although the questions were slightly revised in 2013. Hence, we chose 2013 as our first year of data.
[b] n= 87,466 for race/ethnicity subgroup analyses excluding those with Asian or "other" race.
[c] Coverage type is determined in the NHIS via a battery of questions; those who report "military healthcare" are asked a question about specific types of military coverage, including VHA. We divided the study population into two groups: those reporting specifically VHA coverage ("VHA") in response to that question, and those with any type of coverage except for VHA coverage ("non-VHA").

Appendix Exhibit A2: Any cost-related non-adherence by detailed insurance coverage

			Unadjusted			Adjusted[a]	
		Percent	Absolute percentage point difference vs VHA	P-value		Absolute percentage point difference vs VHA	P-value
Main insurance hierarchy[b]	VHA coverage (n=2,556)	6.09	Reference			Reference	
	Other public (n=4,932)	8.80	2.71	0.001		3.57	<0.001
	Medicaid (n=13,862)	18.11	12.02	<0.001		6.12	<0.001
	Medicare (n= 25,866)	9.31	3.21	<0.001		5.88	<0.001
	Private (n= 45,310)	9.95	3.86	<0.001		6.31	<0.001
Alternate hierarchy #1	VHA coverage (n=2,556)	6.09	Reference			Reference	
	Private (n=62,457)	9.27	3.18	<0.001		5.30	<0.001
	Other public (n= 4,513)	9.22	3.13	<0.001		3.49	<0.001
	Medicaid (n=13,321)	18.15	12.06	<0.001		5.94	<0.001
	Medicare (n= 9,679)	13.83	7.74	<0.001		8.76	<0.001
Alternate hierarchy #2	Other public (n=4,937)	8.79	0.61	0.645		2.52	0.067
	Medicaid (n=13,975)	18.04	9.86	<0.001		5.01	<0.001
	Medicare (n= 27,197)	9.11	0.93	0.463		4.57	0.001
	Private (n= 45,527)	9.93	1.75	0.158		5.21	<0.001
	VHA coverage (n=890)	8.18	Reference			Reference	
Alternate hierarchy #3 (main hierarchy + uninsured)	VHA coverage (n=2,556)	6.09	Reference			Reference	
	Other public (n=4,932)	8.80	2.71	0.001		3.72	<0.001
	Medicaid (n=13,862)	18.11	12.02	<0.001		6.00	<0.001
	Medicare (n=25,866)	9.31	3.21	<0.001		5.64	<0.001
	Private (n= 45,310)	9.95	3.86	<0.001		6.89	<0.001
	Uninsured (n=7,257)	42.58	36.49	<0.001		33.58	<0.001

Source: Authors' analysis of the National Health Interview Survey, 2013-2017

Notes: Medicaid includes SCHIP

[a] Adjusted models are linear probability regressions adjusted for age, sex, income (continuous), race, marital status, family size, health status, obstructive lung disease, cardiovascular disease, cancer history, employment status, and type of coverage. N=91,850 for adjusted analyses using main hierarchy and alternate hierarchies #1 and #2; N=99,055 for adjusted analysis using alternate hierarchy #3.

[b] The mutually-exclusive main hierarchy was constructed in the order listed, such that those with VHA coverage were classified as having VHA coverage even if they had other coverage. Similarly, persons with Medicaid and Medicare (but not VHA or other government coverage) were included in the Medicaid group; those with Medicare and private Medigap coverage were classified as having Medicare; and individuals were categorized as private coverage only if they had no other type of coverage.

Appendix Exhibit A3: Adjusted association of VHA coverage with cost-related nonadherence by race, including adjustment for income (n=80,812)

		Absolute percentage point difference (95% CI)[a]	P-value
Couldn't afford prescription medicine	White	*Reference*	
	Hispanic	-1.72	0.31
	Black	-1.83	0.30
			0.37
Skipped medication to save money	White	*Reference*	
	Hispanic	0.39	0.80
	Black	-1.33	0.20
			0.40
Took less medicine to save money	White	*Reference*	
	Hispanic	0.36	0.80
	Black	-1.51	0.14
			0.28
Delayed filling script to save money	White	*Reference*	
	Hispanic	2.26	0.29
	Black	-0.83	0.49
			0.40
Any of above	White	*Reference*	
	Hispanic	-0.58	0.80
	Black	-1.37	0.48
			0.76

Source: Authors' analysis of the National Health Interview Survey, 2013-2017

[a] Linear probability models adjusted for age, sex, race, marital status, family size, income group ($0 - $34,999; $35,000-$74,999; $75,000-$99,999; $100,000+), coverage (VA coverage vs. any other coverage), and the interaction term between race and coverage. For each outcome, the third adjusted p-value represents the significance of the overall interaction term. These results were produced using unimputed and categorical income data; analysis using imputed income data (with income as a continuous variable) yielded consistent results.

VHA = Veterans Health Administration