Cost-Related Medication Underuse Among Chronically Ill Adults: the Treatments People Forgo, How Often, and Who Is at Risk

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Many chronically ill patients take less of their medication than has been prescribed, owing to cost concerns, especially those patients with low incomes, multiple chronic health problems, or no prescription drug coverage.[1–3] The consequences of cost-related medication underuse include increased emergency department visits, psychiatric admissions, and nursing home admissions, as well as decreased health status.[4–6]

Although the public health significance of cost-related medication underuse is becoming clear, we have only a limited understanding of how medication costs affect individuals with differing clinical and socioeconomic characteristics. Recent survey-based studies[1,2] asked respondents to report on cost-related adherence problems without specifying individual treatment types. As a result, investigators have had only a limited ability to identify which medications patients are most likely to underuse. Approximately 73% of older adults who use prescription medications use more than 1, and 29% use 4 or more.[7] Although the clinical significance of cost-related underuse is different when patients cut back on treatment for life-threatening asymptomatic illnesses (e.g., hypertension) versus disabling symptomatic conditions (e.g., back pain), it is unclear whether those who restrict their medication use do so uniformly or are selective in which treatments they forgo. In addition, previous studies that used global measures assume that individuals reporting cost-related underuse are describing a regular practice, rather than isolated events. However, there has been little research to determine whether this assumption is accurate.

The paucity of data on cost-related medication adherence problems has important implications not only for estimating their clinical significance, but also for understanding the extent to which adherence problems vary across socioeconomic groups. For example, non-White patients may be more likely than Whites to discontinue pharmacotherapy for

depression,[8] and thus may be especially likely to forgo antidepressant treatment when facing cost pressures. However, general measures of medication underuse may miss problems specifically associated with antidepressants or other therapeutic categories. In addition, global estimates of the relationship between out-of-pocket costs and underuse may mask important differences across treatments. Individuals may be more sensitive to cost pressures when taking medications that they perceive as having little impact on their health or longevity, while patients who believe that their treatment is essential might maintain high levels of adherence despite high costs.

For all of these reasons, policymakers and clinicians need more extensive information about chronically ill patients' cost-related underuse of prescription medications. Accordingly, we surveyed chronically ill adults to ascertain the prevalence, frequency, and risk factors for cost-related medication adherence problems. The study builds on previous research by describing (1) the relationships among global measures of cost-related medication underuse, measures documenting underuse of specific treatments, and measures identifying individuals who frequently experience adherence problems; and (2) variation in the importance of socioeconomic risk factors for underuse across treatment types.

Objectives. We sought information about the cost-related underuse of medications—which medications are underused, by whom, and how often.

Methods. Chronically ill adults were asked to identify how often they underused prescription medication for 16 health conditions because of the cost.

Results. Eighteen percent of respondents cut back on medication use owing to cost in the previous year, and 14% used less medication at least monthly. Although rates of underuse varied substantially across treatments, prescription coverage and out-of-pocket costs were determinants of underuse across medication types.

Conclusions. Many chronically ill adults frequently cut back on medications owing to cost. Patients are selective about the treatments they forgo. Out-of-pocket costs and inadequate prescription coverage may lead to adherence problems for many important medication types. (*Am J Public Health.* 2004;94:1782–1787)

METHODS

Study Participants

The study was based on surveys completed in November and December 2002 by a nationwide panel of adults living in the United States. The panel was instituted in 1999, with continual enrollment since that time to replace dropouts and to maintain appropriate representation across sociodemographic groups. Panel members were identified and recruited with random-digit dialing and a sampling frame consisting of all US households with an assigned telephone number. Potential panel members were offered free WebTV and Internet access in exchange for completing short on-line surveys several times per month. At the time of this study, the panel recruitment rate was 48% and it included more than 40000 members. Researchers have compared the panel's characteristics to the US Census Bureau's Current Population Survey, the National Health Interview Survey, and an independent random-digit dialing sample. On most sociodemographic parameters (e.g., race/ethnicity and gender), key health behaviors (e.g., smoking), and the prevalence of chronic illnesses, the panel has consistently been found to be within a few percentage points of other national estimates.[9,10] However, compared with

census data, the panel has more married individuals (64% vs 60%), fewer households with incomes >$75 000 (18% vs 25%), and among those ≥50 years of age, fewer individuals with at least some college education (55% vs 59%).[11,12]

We used information from panel members' enrollment surveys to identify all 5644 individuals aged 50 and older who reported that they used prescription medication for diabetes, depression, heart problems, hypertension, or high cholesterol. After 3 personalized e-mail requests, 4264 people (76%) completed the on-line informed consent form and questionnaire. Of these, 185 participants were excluded from the current analyses because they reported in their survey that they were no longer taking medication for any of the 5 index conditions, and 24 additional respondents were excluded because they were missing data on income. The final sample included 4055 respondents.

Among individuals sampled for the current study, respondents were more likely than nonrespondents to be White (88% vs 81%, $P<.001$), older (mean age 65 vs 63 years, $P<.001$), and to have some college education (66% vs 60%, $P<.001$). Respondents and nonrespondents were similar with regard to gender ($P=.29$), home ownership ($P=.44$), marital status ($P=.16$), and income ($P=.41$). In all analyses, we used poststratification weights to correct the distribution of respondents to match the distribution of the US population on age, sex, race/ethnicity, education, region, and metropolitan residence.[13]

Survey Items and Variable Creation

Respondents reported whether they used prescription medication for each of 16 chronic conditions: arthritis; asthma; chronic back pain or sciatica; high cholesterol; chronic obstructive pulmonary disease (chronic bronchitis, emphysema, or COPD); depression; diabetes; heartburn, acid reflux, or irritable bowel syndrome; atherosclerosis (blocked arteries in the heart, angina, or chest pain from heart disease); heart failure; high blood pressure or hypertension; myocardial infarction (heart attack); migraine headache; osteoporosis; stomach or duodenal ulcers; and stroke. On a condition-by-condition basis, participants were asked: "In

the past 12 months, have you ever taken less of this medication than prescribed by your doctor *because of the cost* [emphasis in the survey]?" Respondents reporting cost-related underuse were asked: "Thinking specifically about your [condition] medication, in the past 12 months, how often did you do each of the following, *because of the cost*?" Using a 5-point ordinal response set in which 1 = "at least once a week" and 5 = "never," respondents reported the frequency with which they "took fewer pills or a smaller dose," "did not fill a prescription at all," "put off or postponed getting a prescription filled," "used herbal medicines or vitamins when [they] felt sick rather than take [their] prescription medication," and "took the medication less frequently than recommended to 'stretch out' the time before getting a refill."

We created 4 measures of cost-related medication underuse. The first measure was treatment-specific and identified all respondents who reported cost-related underuse associated with each medication type. The second measure identified individuals reporting some type of underuse (e.g., "taking fewer pills or a smaller dose") for each medication type at least once per month. The third measure identified respondents who reported any cost-related underuse in the previous year (i.e., for any of their medications). This measure is similar to those used in previous survey-based studies.[1,2] Finally, the fourth measure identified individuals reporting some form of underuse for 1 or more of their medications at least once per month.

The socioeconomic variables we examined as possible predictors of cost-related adherence problems were participants' race/ethnicity (White vs non-White), age, gender, education level (high school degree or less vs some college or more), and annual household income (<$20 000, $20 000–$39 999, $40 000–$59 999, or ≥$60 000). We also examined 3 indices of respondents' out-of-pocket medication cost pressures: total number of current prescription medications (1–2, 3–6, or ≥7), monthly out-of-pocket prescription drug costs ($0–$50, $51–$99, or ≥$100), and whether the respondent reported having prescription drug coverage (any vs none).

ANALYSIS

We calculated the prevalence of cost-related medication underuse using each of the 4 measures for the sample as a whole and among respondents who used the 16 specific medication types. We then fit logistic regression models predicting cost-related underuse for the 10 most common treatments as a function of respondents' race/ethnicity, gender, age, education, income, number of prescriptions, total monthly out-of-pocket medication costs, and prescription drug coverage. Because the primary mechanism by which prescription coverage might affect adherence problems is by lowering out-of-pocket costs, we constructed an alternate set of models controlling for all of the same covariates with the exception of out-of-pocket costs. These alternate models more fully capture the association between reported benefits and underuse. The study was underpowered to construct multivariate models predicting cost-related adherence problems associated with less common medication types and to examine multivariate predictors of underuse occurring at least once per month. All analyses were conducted with Stata version 8.1.[14]

RESULTS

Respondent Characteristics

Twenty-four percent of respondents (weighted) reported 7 or more prescription medications (Table 1). Although 83% of respondents (weighted) reported some prescription drug coverage, half of the weighted sample had monthly out-of-pocket medication costs of at least $51, and 25% had monthly costs of $100 or more. As shown in Table 2, the most common medications were for treating hypertension (70%), high cholesterol (50%), arthritis (28%), heartburn (25%), diabetes (24%), and depression (21%).

Participants reporting monthly medication costs of $100 or more were more likely than those with lower costs to report no prescription drug coverage (33% vs 11%, $P<.0001$). Respondents who had incomes <$20 000 per year were more than twice as likely to report no medication coverage than those with incomes of at least $60 000 (21% vs 8%, $P<.0001$). Compared with younger partici-

TABLE 1—Sociodemographic Characteristics and Medication Cost Burden

	N	% of Survey Sample	% of Weighted Sample
Overall	4055	100	100
Race/ethnicity			
Non-White	479	12	20
White	3576	88	80
Gender			
Female	2011	50	55
Male	2044	50	45
Age, y			
50–54	685	17	15
55–64	1437	35	34
≥65	1933	48	51
Education level			
High school or less	1370	34	55
Some college	2685	66	45
Annual income, $			
<20 000	695	17	23
20 000–39 999	1161	29	32
40 000–59 999	980	24	22
≥60 000	1219	30	23
Number of medications			
≥7	947	23	24
3–6	2051	51	51
1–2	1057	26	25
Monthly out-of-pocket medication cost, $			
≥100	974	24	25
51–99	994	25	25
0–50	2087	51	50
Prescription drug coverage			
Any	3487	86	83
None	568	14	17

and stomach ulcers (all treatment-specific restriction rates ≥20%).

When examining the frequency of medication underuse, we found that 14% of all respondents (78% of those who reported cutting back on medication owing to cost) were under-using some medication at least once per month. At least 10% of respondents who used prescription medication for arthritis, heartburn, depression, back pain, COPD, asthma, migraine headaches, and stomach ulcers cut back on their use of those specific medications at least monthly. More than 25% of respondents taking medication to treat depression, back pain, COPD, asthma, migraine headaches, stomach ulcers, and stroke restricted use of 1 or more of their medications at least monthly.

Sociodemographic Predictors of Cost-Related Underuse

The general pattern of risk factors for cost-related underuse was similar across the 10 most common medication types (Table 3). Controlling for out-of-pocket medication costs and other socioeconomic variables, respondents older than 65 years of age were consistently less likely to cut back on medication use owing to cost than those between ages 50 and 54. Respondents' race/ethnicity, gender, and educational attainment were not significantly associated with underuse in any of the multivariate models. Odds ratios for these covariates, as well as all 95% confidence intervals, are available from the corresponding author on request.

Respondents' incomes and monthly out-of-pocket medication costs were each independently associated with cost-related underuse of treatments for numerous health problems. For 9 of the 10 most common medication types, respondents with annual incomes of less than $20 000 had higher relative odds of cost-related adherence problems than those with incomes of at least $60 000. Statistically significant odds ratios comparing lower- to higher-income respondents ranged from 3.0 (for antidepressants) to 6.4 (for medication treating heart disease). Respondents with monthly out-of-pocket medication costs of $100 or more had greater odds of underuse for 9 of the top 10 medication types, than respondents with monthly costs of $0–$50.

pants, those 65 years or older were more likely to report no prescription drug coverage (23% vs 10%, *P*<.0001), monthly medication costs of $100 or more (28% vs 23%, *P*=.007), and annual incomes <$20 000 (25% vs 20%, *P*=.03). Ninety-three percent of respondents reported some form of health insurance coverage, including private insurance (67%), Medicare (59%), Medicaid (12%), or use of Veterans Affairs health care facilities (9%).

Prevalence of Cost-Related Underuse Based on Different Measures

Overall, 18% of respondents reported at least one episode of cost-related medication underuse in the previous year (Table 2).

Global rates of underuse ranged from 16% among respondents with prescriptions for antihypertensive medication to 36% among respondents with prescriptions for medication treating stomach ulcers. The majority of respondents taking each condition-specific medication reported cost-related underuse of that specific treatment type, although many reported cutting back only on medications for other conditions. For example, 20% of respondents who used asthma medication reported under-using that treatment, while 32% of these respondents reported under-using some medication in the previous year. Cost-related adherence problems were most common for medications treating arthritis, depression, back pain, asthma, migraine headaches,

TABLE 2—Unadjusted Rates of Cost-Related Medication Underuse, Measured With Different Approaches

Medical Condition	% of Sample	Treatment-Specific (%)		Any Medication (%)	
		Ever in the Previous Year	At Least Monthly	Ever in the Previous Year	At Least Monthly
All respondents	100	NA	NA	18	14
Hypertension	70	9	7	16	12
High cholesterol	50	12	8	18	14
Arthritis	28	20	13	28	22
Heartburn	25	18	10	27	22
Diabetes	24	11	7	19	15
Depression	21	21	14	32	26
Heart disease	20	9	5	20	14
Previous myocardial infarction	15	9	7	17	14
Back pain	14	23	15	34	30
Osteoporosis	10	17	9	24	20
Heart failure	9	10	8	17	15
Chronic obstructive pulmonary disease	9	15	11	30	28
Asthma	8	20	12	32	29
Migraines	5	21	13	31	28
Stomach ulcer	5	21	11	36	29
Stroke	4	13	8	31	28

Note. NA = not applicable. Estimates were calculated using sampling weights without adjustment for sociodemographic or clinical covariates.

Statistically significant odds ratios associated with high out-of-pocket costs ranged from 2.9 (for arthritis medications) to 4.6 (for medication treating hypertension).

Controlling for out-of-pocket costs, respondents who reported no prescription drug coverage were significantly more likely to report cost-related underuse of medications for hypertension, hyperlipidemia, heartburn, and back pain (all *P*<.05). As expected, the association between prescription drug coverage and cost-related adherence problems was greater when estimated based on the alternate multivariate models that did not adjust for out-of-pocket costs. Specifically, respondents without prescription coverage had at least 3 times greater odds of reporting underuse of medications treating hypertension, heartburn, coronary artery disease after a heart attack, and back pain; and patients without prescription drug coverage had 1.9 to 2.8 times higher odds of reporting underuse of all remaining medications shown in Table 3. *P*-values for adjusted odds ratios in the alternate models were <.05, except in the model predicting

TABLE 3—Logistic Regression Models Predicting Cost-Related Underuse of Specific Medication Types

	Hypertension	Cholesterol	Arthritis	Heartburn	Diabetes Mellitus	Depression	Heart Disease	Myocardial Infarction	Back Pain	Osteoporosis
Age ≥ 65 y[a]	0.2***	0.3***	0.5*	0.3**	0.2***	0.4**	0.1***	0.1***	0.7	0.7
Age 55–64 y[a]	0.6*	0.7	1.4	0.9	0.3***	1.1	0.4	0.3	1.6	0.8
Income < $20 000[b]	5.9***	2.7***	3.9***	3.4***	1.6	3.0**	6.4**	5.5**	5.0***	4.8**
Income $20 000–$39 999[b]	3.0***	1.6	3.2**	2.2*	2.1	2.6*	2.5	1.6	2.1	1.7
Income $40 000–$59 999[b]	1.6	0.9	1.9	1.2	1.8	2.1	1.8	2.4	2.0	2.1
3–6 prescriptions[c]	0.8	1.6	1.5	0.8	1.2	0.5	1.3	1.4	0.8	1.5
≥ 7 prescriptions[c]	1.0	1.4	1.5	0.6	2.3	0.3*	1.3	0.9	0.6	4.0
Monthly prescription cost ≥ $100[d]	4.6***	3.8***	2.9***	5.3***	1.8	4.5***	3.8**	4.4**	3.7**	4.5**
Monthly prescription cost $51–$99[d]	2.0*	2.3**	1.2	2.0	1.5	1.7	2.0	1.1	2.3	2.0
No prescription coverage[e]	2.3***	1.8*	1.3	2.1*	2.1	1.8	2.0	2.1	2.2*	1.3
(alternative model)[f]	3.3***	2.3***	1.9*	3.3***	2.3*	2.8***	2.8*	3.8**	3.0**	2.1

Note. Cell entries are odds ratios from multivariate models calculated using sampling weights and adjusting for all covariates shown, as well as respondents' race (White vs other), gender, and education level.
[a] vs age 50–54.
[b] vs income ≥ $60 000/year.
[c] vs 1–2 prescriptions.
[d] vs monthly out-of-pocket cost of $0–$50.
[e] vs any coverage.
[f] Adjusted for all covariates in the primary models with the exception of out-of-pocket medication costs.
P<.05; **P*<.01; ***P*<.001; 2-tailed tests.

underuse of medication treating osteoporosis (P=.16).

DISCUSSION

We found that medication underuse owing to cost is common among older adults with such chronic illnesses as asthma, heart failure, and depression, for which inadequate adherence can quickly lead to serious health problems. Cost-related medication underuse was also reported often among individuals taking medications to prevent adverse events during a longer term, such as treatments for high blood pressure, high cholesterol, and diabetes. Moreover, this study confirms that most patients (78% across medication types) who report cost-related medication adherence problems are consistently under-using prescribed medication, rather than describing relatively infrequent events.

From a public health perspective, these data suggest that more than 1 million of the roughly 11 million adults diagnosed with diabetes[15] (i.e., 11%) may be taking less hypoglycemic medication than prescribed because of the cost, and 750 000 people with diabetes may be cutting back on their hypoglycemic medication at least once per month (7%). Similarly, 2.9 million of the 14.1 million American adults with asthma[16] (20%) may be cutting back on their asthma medication because of cost pressures, and 1.6 million may be cutting back on their asthma medication on a monthly basis (12%). Given the importance of medication adherence for these and other chronic illnesses, interventions that reduce rates of cost-related medication underuse may achieve substantial reductions in chronic disease morbidity at the community level.

From a clinical perspective, these analyses suggest that cost-related adherence problems should be considered as a possible explanation whenever patients fail to respond to pharmacotherapy. When the health of individuals who underuse their medication owing to cost does not improve, typical clinician responses, such as increasing their dose or adding augmentation therapy, are unlikely to improve outcomes. Unfortunately, clinicians may interpret "medication failures" as an indication of patients' lack of commitment to the treatment plan or lack of efficacy for the specific agent. As a result, clinicians may inadvertently exacerbate the underlying problem by discarding the patient's prescription before all of the medication is used to try another drug—a waste that many patients can ill-afford. In contrast, identifying adherence problems resulting from cost pressures may lead to more effective remedies, such as switching to generic or lower-cost branded drugs, providing more doses to lengthen the time between refills, or providing information on medication payment assistance programs. Even if patients' treatment costs cannot be reduced, clinicians should explicitly inquire about potential adherence problems owing to out-of-pocket costs and discuss with patients the importance of adhering to their prescribed regimen. Unfortunately, studies suggest that these discussions frequently do not occur.[17,18]

Many respondents with a given health problem reported cutting back on some of their prescription medications but not the ones to treat that condition. This suggests that individuals are selective about their treatment use (and underuse). Future research should seek to elucidate the treatment-specific factors that patients facing cost pressures weigh when deciding to forgo medication use. Even in the absence of comprehensive payment reforms, there may be important opportunities for clinicians to collaborate with patients in making the most sensible choices about their medication use, given their economic circumstances, values, and health status.

In multivariate models, we found that both respondents who used life-sustaining therapies and those who used medications to relieve symptoms were susceptible to adherence problems owing to out-of-pocket medication costs. However the magnitude of the risk gradient varied across medication types. Some treatments may have relatively little association with out-of-pocket costs because individuals are willing to forgo therapy even when costs are low; for other treatment types, individuals may resist even high cost pressures because they believe their medication is worth the investment. Regardless of the reasons, these data suggest that similar levels of prescription benefits will affect patients differently depending on their diagnosis.

Although this study provides a more detailed picture of cost-related medication underuse than many previous studies, it still has important limitations. Studies suggest that individuals are less influenced by social desirability bias when reporting information to a computer than during an in-person or written survey;[19–21] it is still possible, however, that social desirability or recall bias may have led some respondents to underreport or overreport their adherence problems. Individuals taking multiple medications may have difficulty reporting their adherence behavior for specific treatment types or may not accurately associate treatments with their various medical conditions. Finally, potential respondents who were non-White and had less education were somewhat less likely to complete this survey. Although we adjusted for these differences with sampling weights, nonresponse by patients with lower socioeconomic status may have led to an underestimation of the prevalence of cost-related adherence problems, particularly for diseases that are associated with social class and race/ethnicity (e.g., asthma, diabetes, and hypertension).

Measurement problems associated with respondents' reports of their prescription drug coverage may be of particular concern in the current study. Individuals often have a limited understanding of their health insurance benefits and may underestimate their coverage for prescription drugs.[22,23] Moreover, respondents' benefit packages (e.g., annual caps or the size of copayments) undoubtedly varied substantially in this nationwide sample. Finally, individuals with prescription drug coverage in the current market may be sicker than other study participants and may have a greater need for medications. For all of these reasons, the odds ratios shown in Table 3 are likely to underestimate the potential impact of expanding prescription drug payment programs on rates of cost-related medication adherence problems.

Participants in the current study were identified through a nationwide panel with characteristics that are similar to those of other large nationally representative studies. Nevertheless, the process of panel member identification, recruitment, retention, and completion of the current survey could have introduced biases into these results. If panel participants were

more comfortable using the Internet than non-participants, and if this tendency was associated with a greater proclivity to follow their medication regimen as recommended by their clinicians, the current study's estimates of the prevalence of cost-related underuse may underestimate the magnitude of this problem. Also, participants self-identified as having one of the 5 chronic illnesses determining eligibility (as well as the other illnesses in the survey), and these reports were not validated through medical record reviews. We expect that individuals who did not identify that they had a given diagnosis would have had less severe conditions, may have been less likely to be taking prescription medications for that illness, and therefore would be less subject to adherence problems owing to cost.

In summary, we found that large numbers of chronically ill adults in this national study had taken less medication than prescribed during the previous year because of the cost. Most seriously ill individuals, such as those with heart failure or asthma, who reported cost-related adherence problems were cutting back on medication to treat those illnesses. However, individuals did not cut back uniformly on their treatments, and large numbers of respondents reported limiting their medication underuse to medications for other conditions. Most respondents reporting cost-related adherence problems were cutting back frequently, which could result in significantly less medication use than prescribed. Although the relationship between out-of-pocket costs and an individual's propensity to use less treatment varied across medication types, cost and the availability of prescription drug coverage affected a patient's adherence both to medications treating life-threatening conditions and to medications primarily treating symptoms. Increasing prescription drug coverage through Medicare and other types of insurance may significantly improve medication adherence and health outcomes for large numbers of chronically ill adults. ■

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Contributors

J. D. Piette conceived the study and supervised all aspects of its implementation. M. Heisler and T. H. Wagner helped to conceptualize ideas, interpret findings, and review drafts of the article.

Human Participant Protection

This study was approved by human subjects committees at the VA Ann Arbor Healthcare System and Stanford University.

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