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Working paper

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Abstract

This paper explores different empirical strategies to examine the effect of cost sharing for prescription drugs in some dimensions of medication-related quality, namely the probability of inappropriate prescription drug use among United States seniors. Using data from 1996 to 2005, we explore various specifications that correct for sample selection, endogeneity¸ and unobserved heterogeneity. We find a small, but measurable, negative price elasticity for inappropriate drug use with respect to self-reported average out-of-pocket costs for all drugs consumed. That is, user fees reduce the use of potentially inappropriate medications, however the elasticity of cost sharing is lower than that of drugs in general and the price elasticity is relatively close to zero, suggesting that any quality improvements from co-payments are small.

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1. Introduction

As prescription drugs comprised 14.7% of total health care spending growth in the US from 1994-2004 (KFF, 2006a), third-party payers have increasingly emphasized demand-side cost sharing as a tool to shift pharmaceutical expenditures to patients[1]. Examples of current initiatives include the 2005 Deficit Reduction Act (KFF, 2006b), which allows states to charge Medicaid beneficiaries higher co-payments for prescription drugs and multi-tier formularies under private insurance plans (Huskamp et al., 2003), which steer beneficiaries toward cheaper therapeutic alternatives. Although appreciable cost savings might arise from mitigating insurance risk selection and promoting efficient treatments, user fees may also reduce the consumption of both appropriate and inappropriate drug treatments, potentially affecting health care quality[2]. While attention has been devoted to the effect of cost sharing on overall prescription drug use (Gemmill et al., 2008, Rice and Matsuoka (2004) and/or Gibson et al. (2005)), little is known about the relationship between prescription drug cost sharing and the quality of care, particularly measured through consumption of inappropriate medications[3]. It is important for policymakers to be aware of any unintended and suboptimal consequences of increased cost sharing, namely the proliferation of inappropriate prescriptions. In this paper we define inappropriate prescriptions as medications that entail more potential risks than

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[1] In this particular study we adopt a broad definition of cost sharing, which covers all types of out-of-pocket expenditures and may include co-payments, coinsurance, deductibles, prescription limits, tiered co-payments, and other mechanisms to monitor consumer demand.

[2] Quality can be defined as the degree to which health services for individuals and populations increase the likelihood of desired health outcomes and are consistent with current professional knowledge (Lohr, 1990).

[3] Indeed, a decrease in consumption of inappropriate drug is taken to be an improvement in quality, yet rather than focusing on appropriate modifications we examine inappropriate dimensions of quality one.

benefits (Beers et al., 1991) or alternatively, medications that are prescribed contrary to accepted medical standards.

Given that inappropriate prescriptions ultimately diminish the quality of the health care system and may increase overall health expenditures, this is an important issue to address empirically. As pointed out by the Institute of Medicine (2006), medication errors are surprisingly common and undoubtedly costly to patients, their families, employers, hospitals, health-care providers, and insurance companies.

Although the quality of care is pertinent to all groups of the population, the elderly are of particular interest given the nature of their illnesses, the therapeutic effects of medications, and the costs of medicating this population. The elderly are a visible health target as they account for more than 30% of all prescription drug expenditures in the US while only comprising 13% of the population (Higashi et al., 2004). Poor medication-related quality of care can potentially harm a significant portion of the elderly and decrease the efficacy of health care (Hanlon et al., 2001). The elderly are more likely to experience multiple health problems, and the use of numerous medications, regardless of age, increases the risk of adverse drug reactions[4] (ADEs), although aspects of the aging process also increase the risk of these events (Gurwitz and Avorn, 1991)[5]. During the diagnosis and treatment of ADEs, individuals may incur out-of-pocket expenses and lose valuable time, while third-party payers may incur significant costs, particularly if the individual is hospitalized.

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[4] Adverse drug events (ADEs) are as noxious and unintended reactions caused by a medication.

[5] Examples include a reduction in hepatitic blood flow and liver size, increased body fat at the expense of lean body mass, and other age-related changes that may alter the pharmacokinetic and pharmacodynamic properties of drugs.

To date there are few studies that have investigated the impact of insurance coverage or cost sharing on the quality of care, and few studies have examined the behavioral processes that lead to inappropriate prescribing from a physician and consumer perspective. Most studies either use one cross section or have exploratory or experimental aims but do not attempt to estimate the specific functional form of the process, even as a reduced form. Analyses seldom consider possible biases such as the potential endogeneity of insurance, selection issues, and unobservables behind the demand for health care.

The purpose of this paper is to empirically examine whether the level of cost sharing for prescription drugs influences the consumption of inappropriate medications. Following form economic theory, a patient consumes a drug if the user cost of the drug is lower the (perceived) marginal benefit (MB). The MB of each of inappropriate medication is negative. Hence, people should not consume these drugs even if they were free. However, individuals or their agents (doctors) might not be aware of the inappropriateness of some medications, and hence an increase in user cost might exert unexpected – both positive and negative- effects on the utilization of inappropriate prescriptions.

Drawing from an empirical model that contains information on individual needs and characteristics, we estimate the prevalence of inappropriate consumption among elderly Americans by focusing on 33 frequently prescribed molecules for which clinical guidelines suggest that their effect on elderly patients is of a questionable nature and constitutes poor quality of care. This is a conservative (narrow) definition to capture “basic” dimension of quality[6]. We use the most recent unbalanced panel data from the Medical Expenditure Panel Survey (MEPS) and test for potential biases such as sample selection, an endogenenous co-payment variable, and unobserved heterogeneity.

The rest of the paper is organized as follows: the next section presents the conceptual framework and briefly summarizes the existing literature on the area. Section 3 discusses the data and empirical strategy, and Section 4 describes the results of our analysis. Section 5 provides the concluding remarks.

2. Related Literature and Background

The process whereby a patient receives an inappropriate medication begins when the patient experiences a health shock and the physician determines the most adequate treatment based on an observation of the patient’s health status and the severity of illness. By choosing the physician as his agent, the patient intends for the physician to make treatment decisions which maximize his utility. The patient then purchases a prescribed medication based on the out-of-pocket price, a budget restriction (income), and other intangible costs (such as time spent at the pharmacy and perceptions of medication side effects). Whether the chosen drug is appropriate is determined jointly with the prescription drug decision.

The appropriateness of a prescription drug can be conceptualized as a specific quality dimension of drug treatment, and we explore two competing hypothesis. First, from a health care consumer perspective, in the doctor-patient agency relationship the

[6] Alternative definition could counter-indications and account for co-morbidities.

physician compares the marginal benefit of a medication for a specific condition against the marginal benefits of alternative treatments. The physician might take the patient's financial situation into consideration, but the physician's own utility and the third-party payer's utility are also likely to play a role. For each prescribed medication, the patient then makes a marginal net benefit comparison, foregoing medications where the marginal cost exceeds the marginal benefit. Given that an inappropriate medication has a poor safety it profile; inappropriate medications should yield none or a lower marginal net benefit than other more appropriate medications. Hence, holding the prices of all medications constant, the patient should be more likely to forego an inappropriate medication (in this case assuming the patient correctly values the marginal net benefit). A second possibility is the 'quality hypothesis' which posits that an inverse relationship between the level of cost sharing and the quality of medical care provided exists (Wong et al., 2001). The intuition is that patients are unable to distinguish between appropriate and inappropriate medications and when faced with greater out-of-pocket costs, they opt for lower-priced substitutes, which are more likely to be of lower quality[7]. The latter has been found for inpatient or outpatient care but limited evidence exists in the case of drugs.

As discussed above, the elderly are particularly vulnerable to the consequences of inappropriate prescriptions, although the determinants and side effects are different for the elderly residing in nursing homes and other institutional settings than for those who obtain their medications from office-based physicians or outpatient settings. As our sample consists of the non-institutionalized elderly, a less frail group of the population, only the results of the literature which examine the non-institutionalized

[7] Additionally, the physician may be a poor agent for the patient by substituting lower-priced inappropriate medications for the patient. As a result, the quantity of inappropriate medications demanded increases.

individuals who obtain their medications from office-based physicians or outpatient settings will be discussed here. The literature has found that being female (Aparasu and Fliginger, 1997; Goulding, 2004; Willcox et al., 1994; Zhan et al., 2001), married (Hanlon et al., 2002), and in poor health (Hanlon et al., 2002; Willcox et al., 1994; Zhan et al., 2001) are associated with a greater likelihood of receiving an inappropriate medication. Mixed results were found for age (Aparasu and Fliginger, 1997; Goulding, 2004; Hanlon et al., 2002; Mort and Aparasu, 2000), race/ethnicity (Aparasu and Fliginger, 1997; Hanlon et al., 2002; Zhan et al., 2001), and Medicaid status (Aparasu and Fliginger, 1997; Mort and Aparasu, 2000; Willcox et al., 1994).

Other studies have considered changes in the use of discretionary medications among individuals of various ages. Data from the RAND experiment (Foxman et al., 1987), which looked at non-elderly participants across six sites in the US, indicated that individuals with higher coinsurance rates decreased their use of both effective and ineffective antibiotics. Using aggregate data from New Hampshire, Soumerai et al. (1987) determined that a limit on the number of reimbursable prescriptions, which is essentially 100% coinsurance, reduced the number of essential and discretionary medications obtained among low-income Medicaid recipients. McManus et al. (1996) found that among elderly Australians, the introduction of a $2.50 (Australian dollars) co-payment decreased both essential and discretionary prescriptions. These findings suggest that when considering a reduced form of the agency relationship, higher co-payments are likely to reduce inappropriate prescription drug use.

3. Data and empirical strategy

3.1. Explicit criteria for inappropriate medication use

Various medical experts have developed lists of medications considered inappropriate for the elderly. The Beers et al. (1991) investigation (known as the "Beers list") convened a panel of thirteen nationally recognized medical experts to create a list of criteria for inappropriate medications using the Delphi technique. Because the Beers list was intended for the institutionalized elderly, typically the frailest in the population, later lists identified drugs that should be avoided by the community-dwelling elderly (Fick et al., 2003; Zhan et al., 2001). While it is not possible to identify inappropriate medications in a dataset from the Beers list or the Fick et al. (2003) list, the Zhan et al. (2001) list is also based on a panel of medical experts and is the most conducive to empirical analysis. Although the existing lists attract critics because of the impossibility of capturing all factors that influence the effectiveness of prescriptions in the elderly (Anderson et al., 1997), the medical community generally accepts these criteria (Fick et al., 2003), and evidence suggests that these types of lists successfully predict ADEs in elderly outpatients (Chang et al., 2005).

3.2. Econometric Strategy

To correct for various biases that could affect the results, we followed an evolving econometric strategy and investigated several specifications. The first specification entails a reduced form of the drug consumption decision through a simple probit regression conditioned upon positive prescription use[8]. Alternative specifications allow us to deal with potential selection bias, endogeneity, and unobserved heterogeneity.

[8] MEPS is designed as a rotating sample, and thus the repeated sampling of individuals in the sample merits the use of clustering to adjust the standard errors

The initial specification accounts for the non-linearity of the data through a simple two-part probit (Wooldridge, 2002):

$$E(I_i|X_i) = \gamma X_i + v_i \qquad I_i = I_I^* \text{ for } D_i = 1 \qquad (1)$$

$$I_i \text{ is not observed for } D_i = 0$$

$$E(D_i|Z_i) = \alpha Z_i + u_i \qquad (2).$$

The variables from equations (1) and (2) represent the following: I_i is a binary indicator of inappropriate drug use which we don't fully observe (I*) and we assume is proxied by the variable we constructed, X_i are the explanatory variables that explain I_i and return coefficients γ, and v_i is the error term. In equation (2) D_i is the binary indicator of prescription drug use, Z_i are the covariates that explain D_i and return coefficients α, while u_i is the error term. Given that we assume a normal distribution, the probit model specifies the following conditional probabilities for equations (1) and (2), respectively:

$$p(I = 1|X) = \Phi(\gamma X) = \int_{-\infty}^{\gamma X} \varphi(X)dX \qquad (3)$$

$$p(D = 1|Z) = \Phi(\gamma Z) = \int_{-\infty}^{\gamma Z} \varphi(Z)dZ \qquad (4),$$

where $\Phi(\cdot)$ refers to the standard cumulative distribution function.

An important aspect of our analysis is the unbalanced panel nature of the data, which allows us to consider some cross-sectional time variability in the data. To account for repeated observations and considering asymptotic theory in the presence of a large number of clusters and small cluster sizes (Wooldridge, 2006), the model can be rewritten as:

$$E(I_{igt} | Z_{igt}) = \gamma Z_{igt} + c_g + v_{igt} \quad (5)$$

$$E(D_{igt} | X_{igt}) = \alpha X_{igt} + k_g + u_{igt} \quad (6).$$

where Z_{igt} and X_{igt} are the individual-specific determinants of inappropriate drug use and positive prescription use that may differ over time, c_g and k_g are the unobserved cluster effects, and v_{igt} and u_{igt} are the idiosyncratic disturbance terms. Failing to account for the individual-specific error term in each equation may mean that the error terms $(c_g + v_{it})$ and $(k_g + u_{it})$ are correlated among observations within clusters, and there may also be temporal heteroskedasticity and endogeneity. The use of cluster regression allows us to differentiate the between- and within-cluster regression effects affecting the standard errors for intra-group correlation (Wooldridge, 2006). Therefore, the variance matrices were adjusted to make the estimations robust, implying that the model is defined as follows:

$$P(I_{igt} = 1 | Z_{igt}, c_g) = \Phi(\gamma Z_{igt} + c_g) \quad (7)$$

$$P(D_{igt} = 1 | X_{igt}, k_g) = \Phi(\alpha X_{igt} + k_g) \quad (8).$$

Given that other aspects of the data could be biasing the results, it is important to explore alternative specifications. Following Wooldridge (2002) and Heckman (1979), a potential concern is sample selection as we only observe inappropriate prescription use for a limited sample. To correct for this potential bias, one specification we consider is a Heckman approach that accounts for the binary nature of both the participation and outcome variables (Heckit). As mentioned before, another potential bias is endogeneity because unobserved variables such as the quality of insurance coverage could be correlated with both the consumption of inappropriate medications and the co-payment rate. Again following Wooldridge (2002), we correct for endogeneity using an instrumental variables approach. A third possibility is that of unobserved heterogeneity. We take advantage of repeated sampling through the use of a fixed effects estimator as it may be important to control for unobserved individual-specific factors.

3.3. The data

For the analysis we use the 1996-2005 Medical Expenditure Panel Survey, a nationally representative sample of the US civilian, non-institutionalized population with a degree of over sampling of Hispanics and blacks (AHRQ, 2007). Each year, data is collected from a new sample of households, which creates overlapping panels of survey data. Individuals under the age of 65 were excluded as Medicare, the public health insurance program for the elderly, establishes 65 as the eligibility threshold, and the inappropriate drug lists discussed above are intended for this population. The raw data consisted of 306,238 observations, and after removing individuals under the age of 65 (272,711 observations) and excluding observations with missing data (783 observations), the final sample consisted of 32,744 observations[9]. Of these 32,744 observations, 14,297 individuals were sampled twice.

There is no explicit variable for the co-payment in MEPS, although the survey does contain information about the individual's out-of-pocket pharmaceutical expenditures and the total number of prescriptions (including initial prescriptions and refills) purchased in a given year. We subsequently computed an average annual co-payment variable by dividing the respondent's annual out-of-pocket drug expenditures by his

[9] All of these totals include both observations for individuals that appeared twice in MEPS. Note that individuals in the MEPS sample can at most be sampled twice.

total drug consumption. Although this variable proxies the co-payment as individuals face deductibles, coverage limits, or out-of-pocket maximums, it is an indicator of the average generosity of the respondent's prescription drug coverage. Copayment are to an extent choice variable to instrument given that individuals choose insurance option on that basis, and accordingly expectations of out of pocket expenditure as a proportion of total expenditure. Similarly, when in some of the drugs, generics are available, different insurance policies adopt different policies to substitute drugs by cheaper generics, which explains difference in effective cost sharing. This is a similar idea as the one used in Wang *et al* (2007) where they call this, the proportion of the annual drug cost paid by the insurance plan, which acts as a proxy for insurance plan cost sharing with patients.

3.4. The variables

The dependent variable was constructed from criteria published in the literature. The Zhan et al. (2001) list contained 33 medications (Table A1 in the Appendix) that were considered inappropriate regardless of dosage, frequency of administration, or duration, and based on this list; we constructed a dependent variable that indicated whether the patient had obtained at least 1 of the 33 medications listed as inappropriate for the elderly. These conditions are reasonable measure of prescription drug appropriateness using data from the period employed.

The main treatment variable for the analysis was the co-payment. Given the usual negative relationship between price and quantity, we might expect a higher co-payment to reduce the demand for inappropriate medications. An alternative scenario is that the price is a signal of quality and the patient may substitute medications of lower quality when faced with higher co-payments, increasing the demand for inappropriate medications.

Age can have an ambiguous effect on inappropriate prescriptions. On the one hand, age increases the depreciation rate of an individual's health stock, increasing the need for prescription drugs (Grossman, 1999), including inappropriate prescription drugs. On the other hand, elderly individuals are more at risk for adverse drug reactions, and doctors may be less apt to prescribe drugs that could be potentially inappropriate in these individuals. Similarly, gender is important as men and women face different prevalences of specific conditions such as cardiovascular disease. Women may also invest more in health because of greater risk aversion. Regarding ethnicity, non-white individuals tend to live in poorer areas where health care may be of lower quality, and their physicians may be less informed about the appropriateness of particular prescriptions. As for marital status, married individuals may be less likely to receive an unsuitable drug because one spouse may scrutinize the medications that the other receives.

Other treatment variables that result from the agency relationship are the individual's socio-economic status (measuring ability to pay) and health status (capturing health need). Disposable income is an important determinant in that more affluent individuals may be willing to pay higher prices for medication-related quality. There might also be a relationship between income and access to higher quality medical care if the physicians of wealthier individuals are more knowledgeable of suitable medications. In line with the income variable, individuals with more education may be more informed about inappropriate medications or may be more likely to have conversations with their physicians regarding the appropriateness of their medication regimes. Urban area may convey information on access to certain medications and the information that physicians and patients have on the value of treatments.

In terms of health variables, we account for the severity of the patient's health conditions along with reported health status. Individuals who are in poor health, have been diagnosed with one of the leading causes of death, or who face at least one limitation to an activity of daily living are more likely to have a condition that can be treated by a potentially inappropriate medicine and thus have a greater chance of receiving one of these prescriptions. Similarly, severity is used to tests whether it affects co-payments.

Finally, it is important to include time controls as the rate of inappropriate medications may be naturally declining over time, although in part that can be attributed to the fact that over time medications become older and are substituted by new ones.

4. Results

4.1. Descriptive evidence

The descriptive statistics (Table 1) reveal that the average co-payment was $22.39 (in 1996 dollars), and the average age of a respondent was 74.38. Most respondents were female (59.9%), and a little over half (52.1%) of the sample was married. Blacks and Hispanics each made up about 12% of the sample, while only 3.1% of the sample was of another race or ethnicity. The average annual disposable income was $16,991 (in 1996 dollars). About 45% of the sample had a high school degree, while an additional

19% had received education above a high school degree. Around 75% of the sample lived in an urban area. While 8.2% of the sample was in poor health, 19.2% was in fair health, and 32.9% was in good health. About 38% of respondents had been diagnosed with one of the leading causes of death, and 8.3% of individuals faced at least one limitation to an activity of daily living.

[INSERT TABLE 1 ABOUT HERE]

Table 2 also contains information on the percentage of the sample that obtained at least one prescription and the percentage of the sample with at least one inappropriate prescription (conditioned upon already having a prescription). While most of the sample had obtained at least one prescription, there were more differences regarding inappropriate prescriptions. One interesting observation was that a higher percentage of females had obtained an inappropriate prescription. Additionally, the use of inappropriate prescriptions seemed to decline with income, and those in poor health were more likely to obtain this type of medication. Also, the prevalence of inappropriate medications decreased over time.

[INSERT TABLE 2 ABOUT HERE]

We also graphed the annual prevalence of inappropriate prescriptions for the entire elderly sample (Figure 1). The graph reveals that inappropriate prescriptions declined from 1996 to 1998, with a large drop in 1999. Since then inappropriate prescription use has declined somewhat.

[INSERT FIGURE 1 ABOUT HERE]

4.2. Simple econometric specification

A number of different specifications for the model were tested, and the results of these specifications are listed in Tables 3-4. Clustering was used to account for repeated observations. An important consideration was the non-observability of inappropriate prescriptions for respondents that did not consume any prescription medications during a given year. To account for this occurrence, we employed a two-part model, although we did consider the possibility of sample selection bias.

[INSERT TABLE 3 ABOUT HERE]

The first model (Table 3) was a simple two-part probit that did not account for any potential biases such as sample selection, endogeneity, or unobserved heterogeneity. Based on the simple probit model, the predicted probability of an average individual in the sample obtaining an inappropriate prescription was 19.23%. For the co-payment variable, the sign was negative and significant, and the associated price elasticity of demand was –0.030 (p=0.009). The results of the other variables indicated that age exhibited a significant and negative effect, while males were 5.9% less likely than females to receive an inappropriate medication. Compared with being unmarried, married individuals were less likely to receive an inappropriate prescription, although this was only significant at the 10% level. Blacks and Hispanics were 2.4% and 4.3% less likely than whites to receive an inappropriate medication, although the result for individuals of other races or ethnicities was not significant.

Income was also an important predictor with an income elasticity of –0.020 (p=0.040). Education was less important, with neither education variable being significant. In terms of location, those who lived in an urban area experienced a lower likelihood of obtaining an inappropriate medication.

As we would expect from the agency framework, health status plays an important role in the quality of care. Perhaps the most alarming result was that respondents who reported being in poor health were 15.6% more likely to receive an inappropriate medication than those in very good or excellent health. The trend was less dramatic for individuals in fair or good health. Finally, the year variables were generally significant and decreasing over time.

4.3. Alternative econometric specifications

Given the potential for biases from sample selection, endogeneity, and/or unobserved heterogeneity, it is important to consider alternative specifications for inappropriate medication use[10]. Table 4 lists the coefficients and standard errors from three different models: (i) a sample selection model that conditions inappropriate medication use on positive prescription consumption, (ii) an instrumental variables probit to account for the potential endogeneity of the co-payment variable, and (iii) a fixed effects probit.

[INSERT TABLE 4 ABOUT HERE]

[10] One particular effect is that of disentangling the individual's willingness to pay for drugs (e.g. the propensity of the patient to purchase expensive innovative drugs or therapeutic products that are not covered by insurance schemes) form cost sharing.

The first model considered a selection correction. While the null hypothesis of selection (that ρ=0) is rejected at the 5% level, it is worth noting that the coefficient on the co-payment variable is only slightly larger in magnitude to the coefficient under the simple probit specification[11]. The coefficients on the other variables are also relatively similar to the coefficients in the simple probit model. Given that only 10.4% of the sample did not consume any prescriptions during the entire period (1996-2005), it is unlikely that there is much bias from the non-observability of inappropriate use among those that do not consume any medications. Thus, there seems to be little reason to prefer the sample selection specification over the simple two-part probit.

The second model in Table 4 is an instrumental variables probit to account for the potential endogeneity of the co-payment variable. In searching for instruments we considered sources of variation in the co-payment variable that were theoretically relevant and empirically valid. One potential institutional instrument lies in the fragmentation of US insurance coverage. The non-linearity of the co-payment variable (due to differing deductibles, co-payments, etc.) also implies that we can only obtain an average co-payment, and accordingly, controlling for different consumption patterns is important. Because of these possibilities, we considered a number of instruments, but the two strongest were: the Gini coefficient for the primary sampling unit (psu) within which the elderly respondent resided and whether the respondent had employer-sponsored health insurance coverage. The first instrument, the Gini coefficient within the psu, was a measure of the inequality within the area where each individual resided. Wealthier groups are likely have more generous health insurance

[11] Note that because of the unobservability of the co-payment variable for individuals with no prescription drug consumption in a given year, we did not include the co-payment variable in the first-stage of the Heckit approach. As an alternative specification, we predicted the non-observable values of the co-payment variable using the standard Heckman approach, and the results barely changed and the difference in coefficients was not statistically significant.

coverage such that a high Gini coefficient likely correlates with lower co-payments. Not surprisingly, the coefficient on this variable was negative and significant (p=0.001) as a predictor of the co-payment. The second instrument, whether the individual had employer-sponsored insurance, was expected to indicate more generous prescription drug coverage in comparison to those with other forms of private insurance or no insurance. As expected, the coefficient on this variable was negative and significant (p=0.000) as a predictor of the co-payment. The instruments meet the traditional conditions of validity and relevance. As for the former, we find that neither of the instruments was a significant predictor of inappropriate prescription drug use (p=0.114 for the Gini coefficient variable, and p=0.643 for the employer union health insurance variable). According to the Sargan test for overidentification, we were unable to reject the null hypothesis that the instruments were not independent of the error term in the main equation (p=0.097). Furthermore, an F-test for weak instrument instruments (Staiger and Stock, 1997) was significantly high at F=81.81.

Based on two different specification tests, we could not reject the null hypothesis of exogeneity. The value of the Wald test was $\chi^2(1)$=0.14 (p=0.708), while the Smith-Blundell test yielded a value of $\chi^2(1)$=0.263 (p=0.608). In any case, most of the variables do not change significantly under the IV specification, with the exception of the co-payment variable, which increases slightly in magnitude and becomes insignificant. Overall, it appears that an instrumental variables specification is not appropriate for the chosen outcome variable in this study.

A third specification that we considered was a fixed effects approach. A number of time-invariant variables did not return coefficients, and these were excluded from the model. The Hausman test for a fixed effects versus a pooled specification indicated that a fixed effects specification was more appropriate (χ^2 (19)=37.80, p=0.006), while the Hausman test for a fixed effects versus a random effects specification also indicated that a fixed effects model was more appropriate (χ^2 (19)=87.45, p=0.000). An interesting result from the fixed effects logit model is that the co-payment is positive but only significant at the 10% level.

A problem with the fixed effects model is the loss of information. That is, this specification restricts the sample to individuals that have changed from having at least one inappropriate prescription to having none of the 33 inappropriate prescriptions or vice versa during the two years that the individual was in the sample. As a result, 25,610 observations were dropped from the sample under this specification. Thus, if we want to consider only the “switchers” in the sample, this specification is useful; however, for policy purposes, where were are also interested in individuals who do not change their inappropriate prescription status, this specification is of less use.

4.4. Robustness checks

As important as the specification of the model is a robustness check of the included predictors. Table 5 provides the price and income elasticity results for different combinations of covariates.

[INSERT TABLE 5 ABOUT HERE]

The robustness checks indicate that the price elasticity is about the same while the income elasticity is somewhat higher when only the main demographic variables are included in the model. As more covariates are added, the co-payment fluctuates somewhat, with the largest drop in the price elasticity occurring when the year variables are added to model. Interestingly, the largest drop in the income elasticity occurs when the health variables are added to the model. We also tried other covariates such as whether the individual was retired and the mental health status of the beneficiary in the model, but none of these were significant.

As an additional set of robustness checks, we included a number of interaction effects between the co-payment and health status, income and health status, the co-payment and income, and the co-payment and type of health insurance coverage[12]. The only significant interaction effect was the one between the co-payment and the type of insurance coverage. Table 6 lists the price elasticity results of including the interaction effect between health insurance coverage and the co-payment in the regression.

[INSERT TABLE 6 ABOUT HERE]

The interaction between the co-payment and public health insurance coverage yielded a price elasticity of –0.021, compared with a price elasticity of –0.029 for individuals with Medicare only. The interaction between the co-payment and beneficiaries with private insurance coverage was not significant, leaving a price elasticity of –0.029 for this group.

[12] Because the sample is of those over the age of 64, all of the sample was eligible for Medicare coverage. Thus, we assume that all individuals in the sample at least have Medicare coverage.

5. Discussion

This study has examined the relationship between cost sharing for prescription drugs and one relevant dimension of health care: quality. Given the potential for pitfalls such as selection bias, endogeneity, and unobserved heterogeneity, a number of different specifications were considered. The simple two-part probit model was identified as the preferred specification as the results generally did not change much across the sample selection correction and other robustness checks. The results are particularly relevant given that the factors which influence the quality of care are increasingly under scrutiny both in inpatient care (Picone et al., 2003) and in other sources of care such as pharmaceuticals.

We find a small, but measurable, negative price elasticity for inappropriate drug use with respect to self-reported average out-of-pocket costs for all drugs consumed. Put differently, older adults with higher levels of cost sharing for prescribed medicines were less likely to use drugs on the inappropriate list of drugs identified by the Beers (1991) process. The hypothesized positive substitution effect is less than the negative income effect, suggesting that cost sharing could be a useful tool for encouraging appropriate use of prescribed medicines. That is, higher levels of prescription drug cost sharing actually decrease inappropriate drug use with a relatively inelastic price elasticity of demand of -0.024 (p=0.004). This result is in line with other studies in the literature which have found that higher cost sharing leads patients to decrease the use of both effective and ineffective medications (Foxman et al., 1987; Soumerai et al., 1987). There are few estimates of the price elasticity of demand for prescription drugs among the elderly. Coulson and Stuart (1995) found an elasticity of –0.34 for low-income seniors in the US state of Pennsylvania, while Li et al. (2007) obtained price elasticity values ranging from –0.20 to –0.11 for seniors with rheumatoid arthritis in British Columbia, Canada. The negative relationship between price and inappropriate drug use leads us to reject the 'quality hypothesis'. However, the fact that our estimate of the price elasticity of demand for inappropriate drugs is lower than the price elasticity of demand for prescription drugs in general is alarming. It implies that seniors are less likely to cut back on known inappropriate medications than other medications when faced with higher prices. Hence, the "quality hypothesis" argument connote be ruled out. Furthermore, if the agency relationship works two ways, one might argue that direct to consumer advertising might be responsible to senior pushing for inappropriate medication that are heavily advertised.

Interestingly, there were slight differences in the price elasticity of demand for inappropriate drugs between individuals with public insurance coverage and individuals with private insurance coverage or Medicare only. Beneficiaries with public insurance coverage were slightly less sensitive than beneficiaries with Medicare only to increases in the prices of inappropriate medications. The implication is that public programs, such as Medicaid, can do more to steer physicians and pharmacists away from prescribing and dispensing these medications.

Furthermore, we find that the medication-related quality of care is a normal good, which may reflect the ability of more affluent individuals to obtain suitable information on their health-related conditions (Kenkel, 1991). Another possibility is that higher-income individuals obtain a higher quality of care through their physicians and thus receive fewer inappropriate prescriptions as a result.

Another finding was that inappropriate prescription use has been declining over time. It is possible that initiatives to curtail suboptimal prescribing and increase health care quality, such as drug utilization reviews and the publication of articles regarding these specific inappropriate prescriptions, occurred over the period. "Learning by doing" may also exist whereby new prescription drug information is disseminated heterogeneously among physicians over time, or physicians learn from previous mistakes and experience. A third explanation may be that physicians naturally switch patients to newer medications when these become available, as Newhouse (1992) argues that improvements in medical technologies and greater use of these technologies are the major drivers of health expenditure increases.

The predicted prevalence of inappropriate drug use is also alarming. The two-part model predicts that from 1996 to 2005, an elderly individual had a 19% chance of being prescribed an inappropriate medication, although by 2004 this figure had dropped to about 17%. Both probabilities are relatively high given the amount of literature discussing the attributes of these specific drugs. The persistence of inappropriate prescribing raises questions as to why physicians fail to prescribe safer alternatives such as acetaminophen for pain. Some doctors may be unaware of the risks, while others may trust their own assessment of the patient's risk over the literature. Also, drugs such as propoxyphene and diazepam may be addictive for some patients (Medical Economics Company Inc., 2005), contributing to persistent demand. The implication is that policymakers and third-party payers need to consider methods of reducing the prevalence of these medications, such as drug utilization reviews and more restrictive formularies.

One important limitation of this research is that the list of inappropriate medications is a few years old and newer drugs on the market may also be inappropriate. To obtain an updated list would require a panel of experts, a task which is beyond the focus of this paper. Nonetheless, the intent of this paper is to consider whether selected lists of medications that have been clearly indicated as inappropriate multiple times in the literature are influenced by cost sharing. It is likely that the effect is the same or even more dramatic for other inappropriate medications that were not included in the study. Another limitation is our inability to measure any direct effects of the physician[13]. Finally, we rely on a broad measurement of cost sharing that integrates co-payments, co-insurance and deductibles along with out-of pockets payments. Disentangling the specific effect of different cost sharing mechanisms stands out as a useful exercise to carry out. One caveat we cannot rule out is that retail price of inappropriate drugs might be different from that of appropriate drugs. Another caveat lies in that our measure of co-payment might be affected by the individual's behavior in taking less expensive drugs although, we believe that given that the level of cost sharing is to some extent the results of individuals choice, both the co-payment and the low drug choice is likely to be the results of the same latent variable measuring scarcity. Finally, our results do not tell us whether the effect on inappropriate use of medications comes from physician prescribing, pharmacist dispensing or patient use of drugs, this is hence a question for further analysis to carry out.

[13] Had the MEPS database included information on the doctor, we could have tested whether the interaction between the physician's prescription decision and the patient's consumption decision based on the price was significant.

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Tables

Table 1. Means and standard deviations

Explanatory variable	Definition	Mean	Standard error
prescription drug co-payment	the average amount per prescription paid out-of-pocket by the patient	22.393	0.137
age	the age of the respondent	74.375	0.036
male	the respondent was a man	0.409	0.003
married	the individual was married	0.521	0.003
black	the individual reported being black	0.124	0.002
hispanic	the individual reported being Hispanic	0.118	0.002
other race/ethnicity	the individual reported being of another race or ethnicity than white, black, or Hispanic	0.031	0.001
disposable income	the amount of income remaining after total out-of-pocket prescription drug costs are subtracted out	16991	104
high school degree	the individual reported having a high school degree but not a higher degree	0.449	0.003
above high school degree	the individual reported having some education beyond high school	0.186	0.002
urban area	the individual reported living in an urban area	0.745	0.002
poor health	the individual is reported to be in poor health	0.082	0.002
fair health	the individual is reported to be in fair health	0.192	0.002
good health	the individual is reported to be in good health	0.329	0.003
morbidity	the individual has been diagnosed with at least one of these diseases: asthma, coronary heart disease, stroke, chronic obstructive pulmonary disease, malignant cancer, and diabetes	0.380	0.003
limitation to activities of daily living	the individual faces at least one limitation to an activity of daily living	0.083	0.002

Table 2. Inappropriate prescription patterns

Explanatory variable	Percent of sample with at least one prescription	Percent of sample with at least one inappropriate prescription[a]
drug copay < $6.36	N/A	19.67
drug copay, $6.36 - $15.78	N/A	21.37
drug copay, $15.78 - $31.63	N/A	21.11
drug copay > $31.63	N/A	17.84
age <=75	87.99	19.98
age, 76 – 85	91.53	20.04
age > 85	91.95	20.29
male	87.43	16.50
female	91.17	22.38
married	89.69	18.46
not married	89.58	21.75
white	90.72	20.24
black	88.56	20.39
hispanic	85.87	18.53
other race/ethnicity	83.09	19.18
disposable income < $6,161	90.94	22.88
disposable income, $6,161 - $11,173	89.34	20.95
disposable income, $11,173 - $21,658	89.14	19.53
disposable income > $21,658	89.14	16.72
less than high school degree	88.60	22.34
high school degree	89.97	19.60
above high school degree	90.89	16.64
urban area	89.32	18.66
non-urban area	90.58	18.66
poor health	96.26	32.17
fair health	95.97	25.32
good health	90.85	19.57
very good or excellent health	84.22	14.69
morbidity	97.73	23.10
no morbidity	84.68	17.87
limitation to activity of daily living	95.82	29.77
no limitation to activity of daily living	89.08	19.08
year is 1996	87.52	24.42
year is 1997	86.71	25.32
year is 1998	88.14	22.45
year is 1999	88.77	19.22
year is 2000	88.97	19.26
year is 2001	89.61	18.73
year is 2002	90.71	19.21
year is 2003	91.08	18.81
year is 2004	92.09	17.05
year is 2005	91.34	17.79

[a]calculated on the sample with at least one prescription drug

Figure 1. Percent of inappropriate prescriptions, 1996-2005

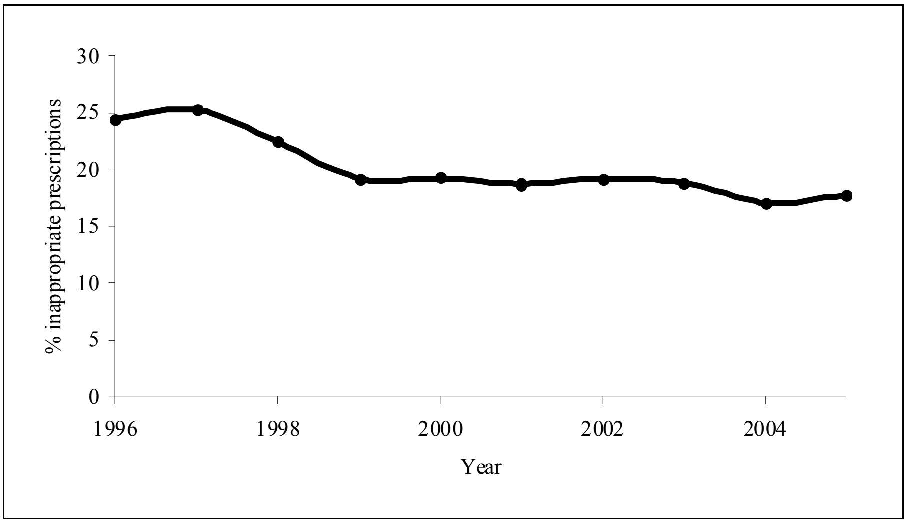

Table 3. Determinants of inappropriate prescription drug use, simple probit

Explanatory variable	Coefficient (S.E)	Marginal effect (S.E)
prescription drug co-payment	-0.030§ (0.010)	-0.008§ (0.003)
age 75-84	-0.053§ (0.022)	-0.014§ (0.006)
age >84	-0.091§ (0.036)	-0.024§ (0.009)
male	-0.218§ (0.023)	-0.059§ (0.006)
married	-0.043* (0.023)	-0.012* (0.006)
black	-0.092§ (0.033)	-0.024§ (0.009)
hispanic	-0.166§ (0.035)	-0.043§ (0.009)
other race/ethnicity	-0.036 (0.062)	-0.010 (0.016)
(log) disposable income	-0.008§ (0.004)	-0.002§ (0.001)
high school degree	-0.023 (0.024)	-0.006 (0.007)
above high school degree	-0.049 (0.032)	-0.013 (0.008)
urban area	-0.144§ (0.023)	-0.041§ (0.007)
poor health	0.490§ (0.036)	0.156§ (0.013)
fair health	0.335§ (0.026)	0.099*** (0.008)
good health	0.179§ (0.022)	0.050§ (0.006)
morbidity	0.128§ (0.020)	0.035§ (0.006)
limitation to activity of daily living	0.156§ (0.034)	0.045§ (0.010)
year is 1997	0.016 (0.031)	0.004 (0.009)
year is 1998	-0.081* (0.042)	-0.022§ (0.011)
year is 1999	-0.162§ (0.043)	-0.042§ (0.010)
year is 2000	-0.166§ (0.042)	-0.043§ (0.010)
year is 2001	-0.186§ (0.040)	-0.048§ (0.009)
year is 2002	-0.181§ (0.038)	-0.047§ (0.009)
year is 2003	-0.196§ (0.040)	-0.050§ (0.009)
year is 2004	-0.259§ (0.040)	-0.065§ (0.009)
year is 2005	-0.226§ (0.040)	-0.057§ (0.009)
constant	-0.498§ (0.062)	
N	29,351	
Log-pseudolikelihood	-14,197	
Wald statistic	732.7	
Prob > χ^2	0.000	

§significant at the 5% level, *significant at the 10% level,

Table 4. Determinants of inappropriate prescription drug use, alternative specifications

Explanatory variable	Probit with selection: Coefficient (S.E)	Probit with endogenous co-payment: Coefficient (S.E)	Fixed effects logit: Coefficient (S.E)
prescription drug co-payment	-0.049§ (0.010)	-0.066 (0.095)	0.089* (0.052)
age 75-84	-0.062§ (0.023)	-0.052** (0.023)	-0.214 (0.231)
age >84	-0.103§ (0.037)	-0.087** (0.038)	0.219 (0.395)
male	-0.200§ (0.028)	-0.226§ (0.031)	
married	-0.051§ (0.023)	-0.040* (0.024)	
black	-0.085§ (0.034)	-0.100§ (0.040)	
hispanic	-0.149§ (0.038)	-0.177§ (0.045)	
other race/ethnicity	-0.012 (0.064)	-0.050 (0.073)	
(log) disposable income	-0.010§ (0.004)	-0.009§ (0.004)	-0.013 (0.020)
high school degree	-0.027 (0.024)	-0.017 (0.028)	
above high school degree	-0.062* (0.033)	-0.043 (0.037)	
urban area	-0.141§ (0.023)	-0.146§ (0.024)	-0.067 (0.394)
poor health	0.447§ (0.048)	0.488§ (0.036)	0.369§ (0.173)
fair health	0.289§ (0.044)	0.333§ (0.027)	0.155 (0.127)
good health	0.153§ (0.030)	0.179§ (0.022)	0.257§ (0.099)
morbidity	0.075* (0.044)	0.129§ (0.021)	0.180 (0.151)
limitation to activity of daily living	0.146§ (0.034)	0.152§ (0.036)	0.137 (0.184)
year is 1997	0.023 (0.031)	0.020 (0.033)	0.219* (0.116)
year is 1998	-0.077* (0.042)	-0.075* (0.045)	0.044 (0.197)
year is 1999	-0.161§ (0.042)	-0.155§ (0.047)	-0.150 (0.256)
year is 2000	-0.165§ (0.042)	-0.156§ (0.049)	0.031 (0.294)
year is 2001	-0.186§ (0.039)	-0.175§ (0.049)	0.067 (0.333)
year is 2002	-0.185§ (0.039)	-0.170§ (0.048)	0.069 (0.352)
year is 2003	-0.199§ (0.040)	-0.182§ (0.055)	0.058 (0.376)
year is 2004	-0.267§ (0.040)	-0.250§ (0.048)	-0.090 (0.396)
year is 2005	-0.234§ (0.040)	-0.219§ (0.045)	0.199 (0.416)
constant	-0.337§ (0.098)	-0.398 (0.277)	
N	29,351	29,351	3,741
Log-pseudolikelihood	-23,656	-53,524	-1,280
Wald or LR χ^2 statistic	469.91	729.3	33.41
Prob > χ^2	0.000	0.000	0.022

§significant at the 5% level, *significant at the 10% level,

Table 5. Robustness checks of the simple probit model for inappropriate prescription drug use

Price elasticity	-0.029§ (0.008)	-0.027§ (0.008)	-0.034§ (0.008)	-0.030§ (0.008)	-0.024§ (0.008)	-0.024§ (0.008)
Income elasticity	-	-0.045§ (0.010)	-0.040§ (0.010)	-0.017§ (0.010)	-0.020§ (0.010)	-0.020§ (0.010)
prescription drug co-payment variable	✓	✓	✓	✓	✓	✓
age variables	✓	✓	✓	✓	✓	✓
gender variable	✓	✓	✓	✓	✓	✓
marital status variable	✓	✓	✓	✓	✓	✓
race/ethnicity variables	✓	✓	✓	✓	✓	✓
income variable		✓	✓	✓	✓	✓
education variables		✓	✓	✓	✓	✓
urban area variable			✓	✓	✓	✓
health variables				✓	✓	✓
year variables					✓	✓
retirement variable					✓	
mental health variable						✓
constant	✓	✓	✓	✓	✓	✓

§significant at the 5% level, *significant at the 10% level,

Table 6. Interaction effect between the co-payment and insurance coverage

Type of health insurance coverage	Price elasticity
Non-Medicare public	-0.021§
Private	-0.029§
Medicare only	-0.029§

§significant at the 5% level, *significant at the 10% level,

Appendix

Table A1. Medications considered in the analysis and the reasons for their inclusion

Medication	Reason for Inappropriateness
Always avoid	
barbiturates	Are highly addictive and cause more side effects than most other sedative or hypnotic drugs in the elderly.
flurazepam	Has a long half-life in the elderly, producing prolonged sedation and increasing the risk of falls and fractures.
meprobomate	A highly addictive and sedating antiolytic.
chlorpropamide	Has a long half-life in the elderly and can cause prolonged and seious hypoglycemia. It is the only oral hypoglycemic agent that causes syndrome of inappropriate antidiuretic hormone secretion (SIADH)
meperidine	May cause confusion, is not an effective oral analgesic, and has many disadvantages compared to other narcotic drugs.
pentazocine	Causes central nervous system side effects more commonly than other narcotic drugs. Is also a mixed antagonist and antagonist.
trimethobenzamide	One of the least effective antiemetic medications, yet it can cause extrapyramidal side effects.
belladonna alkaloids	Gastrointestinal antispasmodic drugs are anticholinergic and generally produce toxic effects in the elderly. Their effectiveness at doses tolerated by the elderly is questionable.
dicyclomine	Gastrointestinal antispasmodic drugs are anticholinergic and generally produce toxic effects in the elderly. Their effectiveness at doses tolerated by the elderly is questionable.
hyoscymine	Gastrointestinal antispasmodic drugs are anticholinergic and generally produce toxic effects in the elderly. Their effectiveness at doses tolerated by the elderly is questionable.
propantheline	Gastrointestinal antispasmodic drugs are anticholinergic and generally produce toxic effects in the elderly. Their effectiveness at doses tolerated by the elderly is questionable.
Sometimes avoid	
chlordiazepoxide	Has a long half-life in the elderly, producing prolonged sedation and increasing the risk of falls and fractures.
diazepam	Has a long half-life in the elderly, producing prolonged sedation and increasing the risk of falls and fractures.
propoxyphene	Offers few analgesic advantages over acetaminophen, yet has the adverse effects of other narcotic drugs.
carisoprodol	Most muscle relaxants and antispasmodic drugs are poorly tolerated by the elderly, leading to anticholinergic side effects, sedation, and weakness. Their effectiveness at doses tolerated by the elderly is questionable.
chlorzoxazone	Most muscle relaxants and antispasmodic drugs are poorly tolerated by the elderly, leading to anticholinergic side effects, sedation, and weakness. Their effectiveness at doses tolerated by the elderly is questionable.
cyclobenzaprine	Most muscle relaxants and antispasmodic drugs are poorly tolerated by the elderly, leading to anticholinergic side effects, sedation, and weakness. Their effectiveness at doses tolerated by the elderly is questionable.
metaxalone	Most muscle relaxants and antispasmodic drugs are poorly tolerated by the elderly, leading to anticholinergic side effects, sedation, and weakness. Their effectiveness at doses tolerated by the elderly is questionable.
methocarbamol	Most muscle relaxants and antispasmodic drugs are poorly tolerated by the elderly, leading to anticholinergic side effects, sedation, and weakness. Their effectiveness at doses tolerated by the elderly is questionable.

Medication	Reason for Inappropriateness
Some indications	
amitriptyline	Rarely the antidepressant of choice for the elderly because of its strong anticholinergic and sedating properties.
doxepin	Rarely the antidepressant of choice for the elderly because of its strong anticholinergic and sedating properties.
indomethacin	Produces the most central nervous system adverse effects of all the available nonsteroidal anti-inflammatory drugs.
dipyridamole	Frequently causes orthostatic hypotension in the elderly and has been proven beneficial only in patients with artificial heart valves.
ticlopidine	Is no better than aspirin in preventing clotting and is considerably more toxic.
methyldopa	May cause bracycardia and exacerbate depression in the elderly.
reserpine	Imposes risks such as depression, impotence, sedation, and orthostatic hypotension.
disopyramide	The most potent negative inotrope of all antiarrhythmic drugs and may induce heart failure in the elderly. Also, it is stronly anticholinergic.
oxybutynin	Most muscle relaxants and antispasmodic drugs are poorly tolerated by the elderly, leading to anticholinergic side effects, sedation, and weakness. Their effectiveness at doses tolerated by the elderly is questionable.
chlorpheniramine	Many antihistamines have potent anticholinergic properties.
cyproheptadine	Many antihistamines have potent anticholinergic properties.
diphenhydramine	Many antihistamines have potent anticholinergic properties.
hydroxyzine	Many antihistamines have potent anticholinergic properties.
promethazine	Many antihistamines have potent anticholinergic properties.

Source: Beers et al (1991)

The Medical Expenditure Panel Survey is publicly available from the Agency for Healthcare Research and Quality at http://www.meps.ahrq.gov/mepsweb/. The database consists of a number of linkable files with the main file being the Household Component (HC). The HC contains information about demographic and socio-economic characteristics, health status and conditions, utilization of medical care services, charges and payments for medical care, access to care, and health insurance coverage. The Medical Provider Component (MPC) of MEPS is also appropriate as this portion of the survey contains information collected from medical providers and pharmacies identified by HC respondents. The MPC comprises information on the medical and financial characteristics of reported medical and pharmacy events. To construct the database, we merged three MEPS files: a database of full-year population characteristics, a database of medical conditions, and a database of prescription events.

Table A2. Data information table

Variable	Information
inappropriate drug use	Consumption of each of the 33 potentially inappropriate drugs was calculated for each individual in the sample. If the individual consumed at least one of these 33 drugs during a given year, the dummy variable indicating inappropriate drug use was given the value of "1". If he did not consume any inappropriate medications during a given year, the dummy variable was given the value of "0"
prescription drug co-payment	The total out-of-pocket cost of all prescriptions that an individual consumes is given in the MEPS database. The total number of prescriptions (including initial prescriptions and refills) is also given in the MEPS database. The prescription drug co-payment was calculated by dividing the total out-of-pocket prescription cost by the total number of prescriptions consumed in a given year.
age	The age variable is given in the MEPS database.
male	The gender variable is given in the MEPS database
married	The marital status variable is given in the MEPS database and broken into 6 categories: married, widowed, divorced, separated, never married, or under 16 and not applicable. If the individual reported being married, the married variable was given a value of "1". For all other categories of the marital status variable, the married variable was given a value of "0".
black	If the individual reports being black but not Hispanic, this variable is coded "1" and "0" otherwise.
hispanic	If the individual reports being Hispanic, this variable is coded "1" and "0" otherwise.
other race/ethnicity	If the individual reports being of another race or ethnicity, this variable is coded "1" and "0" otherwise.
disposable income	The total income in a given year for the respondent adjusted for inflation (using the Consumer Price Index). The total out-of-pocket medical expenses for the respondent (adjusted for inflation) is then subtracted from this.
high school degree	This variable takes a value of "1" if the individual reports having a high school diploma or GED equivalent. The variable takes the value of "0" otherwise.
above high school degree	This variable takes a value of "1" if the individual reports having a Bachelor's degree, Master's degree, doctoral degree, or other degree. It takes the value of "0" otherwise.
urban area	If the respondent reports living in an urban area, this variable takes the value of "1" and "0" otherwise.
poor health	If the respondent reports being in poor health, this variable takes the value of "1" and "0" otherwise.
fair health	If the respondent reports being in fair health, this variable takes the value of "1" and "0" otherwise.
good health	If the respondent reports being in good health, this variable takes the value of "1" and "0" otherwise.
morbidity	Using the medical conditions file of MEPS, individuals with asthma, coronary heart disease, stroke, coronary obstructive pulmonary disease, malignant cancer, and diabetes were identified as these are the leading causes of death according to the CDC (2006). This information was then merged with the main population characteristics MEPS file. If the individual reported having at least one of these medical conditions, the morbidity variable was given a value of "1". If the individual did not report having any of these medical conditions, the morbidity variable was given a value of "0".
limitation to activities of daily living	If the individual reported having at least one limitation to an activity of daily living (a variable that was given in the MEPS database), this variable took a value of "1" and "0" otherwise.

Table A3. Determinants of positive prescription drug use

Explanatory variable	Coefficient (S.E)
age 75-84	0.160§ (0.027)
age >84	0.205§ (0.046)
male	-0.294§ (0.026)
married	0.133§ (0.027)
black	-0.163§ (0.039)
hispanic	-0.289§ (0.039)
other race/ethnicity	-0.373§ (0.061)
(log) disposable income	0.014§ (0.005)
high school degree	0.120§ (0.029)
above high school degree	0.259§ (0.038)
urban area	-0.040 (0.029)
poor health	0.609§ (0.056)
fair health	0.685§ (0.038)
good health	0.314§ (0.024)
morbidity	0.917§ (0.033)
limitation to activity of daily living	0.182§ (0.057)
year is 1997	-0.071§ (0.035)
year is 1998	-0.020 (0.049)
year is 1999	0.051 (0.049)
year is 2000	0.073 (0.048)
year is 2001	0.098§ (0.046)
year is 2002	0.157§ (0.045)
year is 2003	0.171§ (0.047)
year is 2004	0.240§ (0.048)
year is 2005	0.184§ (0.048)
constant	0.579§ (0.067)
N	32,744
Log-pseudolikelihood	-9,468
Wald statistic	1,601
Prob > χ^2	0.000

§significant at the 5% level, *significant at the 10% level,

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