

THE OREGON HEALTH INSURANCE EXPERIMENT: EFFECT ON MEDICATIONS

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Analysis Plan
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INTRODUCTION

In 2008, Oregon held a lottery to allocate a limited number of Medicaid slots to low-income uninsured adults on a waiting list. This lottery provides researchers with the opportunity to evaluate the causal effect of Medicaid coverage on a range of outcomes. The lottery, data collection, and fundamental empirical strategy are described in detail elsewhere (see nber.org/Oregon for previous analysis plans and publications).

In 2013, the U.S. spent an estimated \$271.3 billion, or 9.3% of total health expenditure, on prescription drugs.¹ While federal Medical law does not require Medicaid to cover prescription drugs, currently all states provide pharmacy coverage to Medicaid enrollees.² In Oregon, the lotteried health insurance plan, Oregon Health Plan (OHP) Standard, includes drug coverage with no copayments.¹

As part of the Oregon Health Insurance Experiment study, a snapshot of the medications in study participants' possession was cataloged approximately 2 years after the lottery. Previous analysis examined the effect of Medicaid on overall medication possession as well as possession of medications for a few specific conditions (diabetes, high cholesterol, high blood pressure), finding that Medicaid increased the number of prescriptions overall from 1.8 in the control group to 2.5 among those with Medicaid coverage.³ The goal of the analysis described here is to provide a more detailed evaluation of the effect of Medicaid on medication use.

This document pre-specifies our planned analysis of outcomes related to medication utilization. It has been created before comparing these particular outcomes for treatment and control groups in order to minimize issues of data mining and specification searching. It was, however, constructed after completion of analyses using the lottery to estimate the effects of insurance on a range of other outcomes, including health care use and limited measures of medication use.³⁻⁶ The methods proposed here follow those of our prior quantitative analyses very closely.

METHODS

Data

This analysis uses a medication catalog compiled in the course of in-person interviews conducted in the Portland metro area approximately two years after the Oregon lottery. The data set is described in more detail elsewhere, including collection protocols and coverage.^{3,4,6} Here we give only a brief description, focusing on the new outcome variables. Substantial additional detail on the construction and cleaning of the medication data is available in the accompanying Data Appendix.

Participants were asked to bring all current medications in their containers to the interview. Interviewers cataloged medication information with the assistance of a commercially available

¹ OHP generates a Preferred Drug List that includes drugs deemed to be effective, safe, and high value. Preferred drugs and non-preferred mental health drugs are covered without prior authorization; others can be covered with authorization.

prescription drug database (First DataBank). If participants did not have medication containers available, the information was recorded from the participants' memory or a computer-generated list from their prescribing provider if available. For participants who could not remember medication information, follow-up telephone calls were made when they were home and could look at their medications. Our measures of medication "utilization" thus capture only point-in-time medication possession.

Table 1 describes the 13,617 medications that we observed in the control group. We classified medications along two dimensions. First, we group them into an exhaustive list of categories based on the First DataBank Enhanced Therapeutic Classification (ETC) system. These categories reflect the broadest classes of therapeutic uses, including both generics and branded drugs. For example, ibuprofen would fall into the broad category "Analgesics, Anti-inflammatory or Antipyretic". Analgesic medications represent the largest share of medications in the control group (22%), followed by central nervous system medications (which include antidepressants) (18%) and cardiovascular medications (16%). For analysis, we have combined the smallest categories (representing less than 1% of the medications each) into an "other" category, representing 3% of control group medications. A list of these medications is shown in Table A3.

Some medications fall into multiple categories. These medications are shown in Table A4, and represent 7.8% of the control group medications. For example, aspirin can be used as an analgesic or as a blood thinner; variants of aspirin represent more than 45% of the cross-listed medications. For the most part we group medications that fall into multiple therapeutic categories as "cross-listed," with two exceptions: (1) Any medication with an anti-infective indication is included in the anti-infective category; (2) We treated the category "chemicals-pharmaceutical adjuvants" as secondary, grouping medications based on the other therapeutic class(es) into which they fell. The categories in Table 1 are thus mutually exclusive and exhaustive.

Second, in addition to categorizing medications based on therapeutic class, we also divided medications into those available through prescription (Rx), either originally prescribed to the respondent or obtained from someone else (such as a friend or family member who was not a health care provider), versus those obtained over-the-counter (OTC). Some medicines are OTC in some formulations or doses but Rx in others (such as 200 mg ibuprofen vs. 800 mg ibuprofen or ibuprofen combined with codeine). Whenever possible, we classified based on the specific medication in the respondent's possession. In some cases, however, only a general drug name was recorded, making OTC/Rx ambiguous for certain drugs. In those cases we classify the drugs as "either/or." In a small number of cases, insufficient information was recorded to classify the medication at all, in which case we categorize them as "undetermined." Two-thirds of the medications observed in the control group were Rx (prescribed to the participant or someone else) and a quarter were OTC.

Statistical Analysis

For a full description of the Analytic Specifications used, please see analysis plans at www.nber.org/oregon.^{7,8} We sketch out the key points here.

Our analytic approach begins with an intent-to-treat (ITT) model comparing outcomes for all those who were selected in the lottery (the study treatment group) to all those who were on the list but not selected (the study control group), or the effect of winning the lottery. We estimate the ITT by fitting the following OLS equation:

$$y_{ih} = \beta_0 + \beta_1 \text{LOTTERY}_{ih} + X_{ih} \beta_2 + \varepsilon_{ih} \quad (1)$$

Here i denotes an individual and h denotes a household. *LOTTERY* is an indicator variable for whether or not household h was selected by the lottery. The coefficient on *LOTTERY* (β_1) gives the effect of being able to apply for OHP Standard through the Oregon lottery. X_{ih} includes indicator variables for the number of individuals in the household listed on the lottery sign-up form; although the state randomly sampled from individuals on the list, the entire household of any selected individual was considered selected and eligible to apply for insurance. As a result, selected (treatment) individuals are disproportionately drawn from households of larger household size.

The intent-to-treat estimates from equation (1) provide an estimate of the causal effect of winning the lottery (i.e. winning the opportunity to apply for OHP Standard). We are also interested in the impact of insurance coverage itself. We model this as follows:

$$y_{ih} = \pi_0 + \pi_1 \text{INSURANCE}_{ih} + X_{ih} \pi_2 + v_{ih} \quad (2)$$

Here *INSURANCE* is a measure of insurance coverage and all other variables are as defined in equation (1). We estimate equation (2) by two stage least squares (2SLS), using the following first stage equation:

$$\text{INSURANCE}_{ih} = \delta_0 + \delta_1 \text{LOTTERY}_{ih} + X_{ih} \delta_2 + \mu_{ih} \quad (3)$$

We interpret the coefficient on insurance from instrumental variable estimation of equation (2) as the local average treatment effect of insurance, or LATE.⁴ In other words, our estimate of π_1 identifies the causal impact of insurance among the subset of individuals who obtain insurance upon winning the lottery but who would not obtain insurance without winning the lottery.

We cluster all standard errors on the household identifier since the treatment is at the household level. All regressions are weighted to account for survey design, as described elsewhere.^{7,8} We explore the sensitivity of our results to an alternate specification using logistic regression and calculating average marginal effects for all binary outcomes and using negative binomial regression and calculating average marginal effects for all continuous outcomes.

ANALYSIS

Study Population and Medicaid Lottery

This analysis draws on data collected from the Oregon Health Insurance Experiment in-person survey sample. There were 12,229 respondents to the in-person survey, of whom 190 did not

complete the medication catalog, leaving a sample of 12,039 for this analysis. Table 2 summarizes demographic characteristics (age, gender, and race) for this sample, including the treatment group selected in the lottery and the control group not selected. There are no statistically significant differences in these characteristics between the treatment and control groups, consistent with prior analyses.^{3,4,6}

Table 3 reports the effect of being selected in the lottery on Medicaid coverage for the in-person sample. In our analysis, we define Medicaid coverage as being covered at any point between March 10, 2008 (the date of the first lottery notifications) and the sampling date. This definition of Medicaid includes both the lotteried Medicaid program (OHP Standard) and other non-lotteried Medicaid programs. The results indicate that winning the lottery increased the probability of being covered by Medicaid at any point during the study period by 24.3 percentage points among in-person survey responders. The lottery affected coverage through increasing enrollment in OHP Standard.

Medication Utilization

Table 4 reports the effect of lottery selection (ITT) and Medicaid coverage (LATE) on prescription medication utilization (measured by current possession of a medication). Both theory and prior analysis suggest that Medicaid coverage should increase medication use.³ 49% of the control group possessed a prescription medication, with an average of 1.6 prescription medications per control group member.ⁱⁱ The bottom panel breaks out prescriptions by the source through which they were obtained. Only a small number of prescriptions possessed by the respondents were not originally prescribed to the respondents themselves.

We focus first on prescription medications here because we expect Medicaid to have the greatest effect on the price and availability of those medications. However, to the extent that encounters with health care providers increase patients' awareness of their health needs and use of appropriate OTC medications (as well as providing additional implicit income that might be devoted to OTC medication purchases), those might increase as well. In Table 5 we show the effect of the lottery and Medicaid on use of both prescription and OTC medications. 67% of the control group were in possession of at least one prescription or OTC medication, with an average of 2.4 medications per control group member.

Robustness

In Table 6 we explore the sensitivity of the results in Table 4 to alternate functional forms. We estimate negative binomial regressions for the continuous outcomes and logistic regressions for the binary outcomes and calculate average marginal effects. Second, we assess sensitivity to covariates.

ⁱⁱ Note that this definition is slightly different from that used in our previous analyses, incorporating refinements to medication categorization described in the Data Appendix; summary statistics are thus also slightly different from those in previous analyses.

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Table 1: Control Group Medication Distribution

Group	Number of Medications	Percent of Medications by Category (%)	Number of Meds Prescribed to Self	Number of Meds Prescribed to Someone Else	Number of Over-the-Counter Meds	Number of Meds that Could Be Rx or OTC	Number of Undetermined Meds
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Analgesic, Anti-inflammatory or Antipyretic	3,012	22.12	982	84	1,909	0	37
Central Nervous System Agents	2,427	17.82	2,315	26	16	0	70
Cardiovascular Therapy Agents	2,158	15.85	2,076	2	41	2	37
Respiratory Therapy Agents	1,278	9.39	765	33	353	6	121
Cross-Listed	1,055	7.75	339	6	604	61	45
Endocrine	993	7.29	921	2	22	0	48
Gastrointestinal Therapy Agents	867	6.37	210	3	303	265	86
Other	423	3.11	237	4	35	19	128
Electrolyte Balance-Nutritional Products	404	2.97	57	0	287	4	56
Locomotor System	287	2.11	272	11	0	0	4
Anti-Infective Agents	272	2.00	236	8	5	9	14
Unknown (No therapeutic code)	272	2.00	0	0	0	0	272
Contraceptives	169	1.24	144	0	4	0	21
TOTAL	13,617	100.00	8,554	179	3,579	366	939
Percent by type (%)	100.00		62.82	1.31	26.28	2.69	6.90

Notes: Column (1) reports the distribution of control group medications across exhaustive categories of therapeutic use, corresponding to the highest level categories of the First DataBank Enhanced Therapeutic Classification (ETC) System. Columns (3) through (7) decompose each therapeutic category into mutually exclusive dispensing methods. Most medications were classified as prescription (“Rx”) or over-the-counter (“OTC”), but some did not contain enough information for classification - either because Rx/OTC status depends on dose or formulation information that was not captured (“Either/or”) or because key identifying information was missing (“Undetermined”).

Table 2: Sample Characteristics

	Controls	Lottery Winners	P-Value
	(1)	(2)	(3)
N	5,746	6,293	
Age (Years)	39.09	39.33	0.34
Female (%)	56.93	56.41	0.56
White (%)	68.97	69.28	0.77
<i>F-Statistic for Above Variables</i>			0.44
P-Value			0.72

Notes: The first column shows the weighted mean value for control individuals who entered the lottery but were not selected, the second column reports the regression-adjusted weighted mean value for those randomly selected by the lottery to be able to apply for Medicaid coverage, and the third column shows the p-value of the difference between the means. Information on age and gender was measured at the time of lottery sign up; data on race were collected in the in-person survey approximately two years later. The sample is weighted using the in-person survey weights. The final rows report the pooled F-statistic and p-value from testing treatment-control balance on the above variables jointly. N=5,746 (treatment); N=6,293 (control).

Table 3: Insurance Coverage (First Stage Estimates)

	Control Mean (1)	Estimated FS (2)
Ever on Medicaid	18.36	24.26 (0.91)
Ever on OHP Standard	3.34	26.45 (0.71)
Number of Months on Medicaid	2.54 (6.47)	4.18 (0.16)
On Medicaid at the End of the Period	13.23	11.44 (0.79)

Notes: The first column reports the control mean for alternate definitions of “MEDICAID,” and the second column reports the estimated first-stage (FS) coefficient (with standard error in parentheses) on LOTTERY (equation 3 in text) using the specified definition of “MEDICAID.” All regressions include indicators for the number of household members on the lottery list, cluster standard errors by household, and include sampling weights. In all analyses of the effect of Medicaid coverage (LATE) in the paper, we use the definition in the first row: “On Medicaid at any point in the study period.” N=12,039.

Table 4: Intent-to-Treat Effect of Lottery and Local Average Treatment Effect of Medicaid on Prescription Medications

	Percent with Any Medications				Number of Medications			
	Mean Value in Control Group	Effect of Lottery Selection (ITT)	Effect of Medicaid Coverage (LATE)	P-Value	Mean Value in Control Group	Effect of Lottery Selection (ITT)	Effect of Medicaid Coverage (LATE)	P-Value
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
All Medications	49.28 (50.00)				1.56 (2.40)			
<i>By Therapeutic Use</i>								
Analgesic, Anti-inflammatory or Antipyretic	15.71 (36.40)				0.19 (0.47)			
Central Nervous System Agents	23.44 (42.37)				0.42 (0.90)			
Cardiovascular Therapy Agents	18.52 (38.85)				0.37 (0.92)			
Respiratory Therapy Agents	9.33 (29.09)				0.15 (0.53)			
Cross-Listed	5.42 (22.65)				0.06 (0.27)			
Endocrine	11.20 (31.54)				0.16 (0.52)			
Gastrointestinal Therapy Agents	4.06 (19.74)				0.05 (0.24)			
Other	3.88 (19.32)				0.04 (0.22)			
Electrolyte Balance-Nutritional Products	0.96 (9.76)				0.01 (0.10)			
Locomotor System	4.62 (21.00)				0.05 (0.23)			
Anti-Infective	3.67 (18.81)				0.04 (0.24)			
Contraceptives	2.65 (16.07)				0.03 (0.16)			
<i>By Source of Prescription</i>								
Prescribed to Self	45.91 (49.84)				1.48 (2.38)			
Prescribed to Someone Else	2.72 (16.27)				0.03 (0.20)			
Source of Prescription Unknown	2.89 (16.76)				0.04 (0.33)			

Notes: ITT columns present estimates of the effect of lottery selection on medication use. LATE columns present effect of Medicaid coverage on medication use, using lottery selection as an instrument for Medicaid coverage in a two-stage least squares estimation. All regressions include indicators for the number of household members on the lottery list, cluster standard errors by household, and include sampling weights. Only prescription drugs are included in the analysis. N=12,039.

Table 5: Intent-to-Treat Effect of Lottery and Local Average Treatment Effect of Medicaid on All Medications

	Percent with Any Medications				Number of Medications			
	Mean Value in Control Group	Effect of Lottery Selection (ITT)	Effect of Medicaid Coverage (LATE)	P-Value	Mean Value in Control Group	Effect of Lottery Selection (ITT)	Effect of Medicaid Coverage (LATE)	P-Value
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
All Medications	67.37 (46.89)				2.36 (3.04)			
<i>By Therapeutic Use</i>								
Analgesic, Anti-inflammatory or Antipyretic	39.07 (48.79)				0.52 (0.76)			
Central Nervous System Agents	23.82 (42.60)				0.42 (0.91)			
Cardiovascular Therapy Agents	18.81 (39.08)				0.38 (0.94)			
Respiratory Therapy Agents	14.12 (34.83)				0.22 (0.64)			
Cross-Listed	15.08 (35.79)				0.18 (0.49)			
Endocrine	11.62 (32.05)				0.17 (0.54)			
Gastrointestinal Therapy Agents	12.10 (32.62)				0.15 (0.47)			
Other	5.91 (23.59)				0.07 (0.31)			
Electrolyte Balance-Nutritional Products	5.03 (21.86)				0.07 (0.33)			
Locomotor System	4.62 (21.00)				0.05 (0.23)			
Anti-Infective	4.00 (19.60)				0.05 (0.26)			
Unknown (No therapeutic code)	3.73 (18.96)				0.04 (0.29)			
Contraceptives	2.88 (16.73)				0.03 (0.17)			
<i>By Distribution Mode*</i>								
Rx Prescribed to Self	45.91 (49.84)				1.48 (2.38)			
Rx Prescribed to Someone Else	2.72 (16.27)				0.03 (0.20)			
Over-the-Counter	42.80 (49.48)				0.62 (0.90)			
Either Rx or OTC	5.54 (22.89)				0.06 (0.28)			
Undetermined	11.67 (32.11)				0.16 (0.56)			

Notes: ITT columns present estimates of the effect of lottery selection on medication use. LATE columns present effect of Medicaid coverage on medication use, using lottery selection as an instrument for Medicaid coverage in a two-stage least squares estimation. All regressions include indicators for the number of household members on the lottery list, cluster standard errors by household, and include sampling weights. *Distribution modes are mutually exclusive. Most medications were classified as prescription (“Rx”) or over-the-counter (“OTC”), but some did not contain enough information for classification - either because Rx/OTC status depends on dose or formulation information that was not captured (“Either/or”) or because key identifying information was missing (“Undetermined”). N=12,039.

Table 6: Robustness Analysis

	Mean Value in Control Group	Effect of Lottery Selection: Primary Spec	P-Value	Effect of Lottery Selection: Alternate Spec	P-Value	Adding Lottery List Variables to Primary Spec	P-Value
	(1)	(2)	(3)	(4) ¹	(5)	(6) ²	(7)
Percent with Any Prescription Medications	49.28 (50.00)						
Number of Prescription Medications	1.56 (2.40)						
Percent with Any Prescription Analgesic, Anti-inflammatory or Antipyretic Medications	15.71 (36.40)						
Number of Prescription Analgesic, Anti-inflammatory or Antipyretic Medications	0.19 (0.47)						
Percent with Any Prescription Central Nervous System Agent Medications	23.44 (42.37)						
Number of Prescription Central Nervous System Agent Medications	0.42 (0.90)						
Percent with Any Prescription Cardiovascular Therapy Agent Medications	18.52 (38.85)						
Number of Prescription Cardiovascular Therapy Agent Medications	0.37 (0.92)						
Percent with Any Prescription Respiratory Therapy Agent Medications	9.33 (29.09)						
Number of Prescription Respiratory Therapy Agent Medications	0.15 (0.53)						
Percent with Any Prescription Cross-Listed Medications	5.42 (22.65)						
Number of Prescription Cross-Listed Medications	0.06 (0.27)						
Percent with Any Prescription Endocrine Medications	11.20 (31.54)						
Number of Prescription Endocrine Medications	0.16 (0.52)						
Percent with Any Prescription Gastrointestinal Therapy Agent Medications	4.06 (19.74)						
Number of Prescription Gastrointestinal Therapy Agent Medications	0.05 (0.24)						
Percent with Any Prescription Other Medications	3.88 (19.32)						
Number of Prescription Other Medications	0.04 (0.22)						
Percent with Any Prescription Electrolyte Balance-Nutritional Products	0.96 (9.76)						
Number of Prescription Electrolyte Balance-Nutritional Products	0.01 (0.10)						
Percent with Any Prescription Locomotor System Medications	4.62 (21.00)						
Number of Prescription Locomotor System Medications	0.05 (0.23)						
Percent with Any Prescription Anti-Infective Medications	3.67 (18.81)						
Number of Prescription Anti-Infective Medications	0.04 (0.24)						
Percent with Any Prescription Contraceptive Medications	2.65 (16.07)						
Number of Prescription Contraceptive Medications	0.03 (0.16)						

Notes: All regressions include indicators for the number of household members on the lottery list, cluster standard errors by household, and include sampling weights. N=12,039.

¹ Alternate Specification is logistic for binary outcomes (i.e., percent with medications) and negative binomial for continuous outcomes (i.e., number of medications).

² Lottery list variables include age, sex, whether English is the preferred language; whether the individuals signed themselves up for the lottery; whether they provided a phone number on signup; whether they gave their address as a PO box; whether they signed up the first day the lottery list was open; and the median household income of residents in their ZIP code in the 2000 census.

OREGON HEALTH INSURANCE EXPERIMENT MEDICATION CATALOG DATA APPENDIX

In 2008, Oregon held a lottery to allocate a limited number of Medicaid slots to low-income uninsured adults on a waiting list. This lottery provided researchers with the opportunity to evaluate the causal effect of Medicaid coverage on a range of outcomes. The lottery, data collection, and fundamental empirical strategy are described in detail elsewhere (see nber.org/Oregon for previous analysis plans and publications).

As part of the Oregon Health Insurance Experiment study, a snapshot of the medications in study participants' possession was cataloged approximately 2 years after the lottery. This document provides additional detail on the resulting medication database.

Data Collection

Medication data were collected during the course of the in-person survey fielded in the greater Portland metro area approximately 2 years after the lottery. Participants were asked to bring all of their current medications in their containers with them to the interview. The interviewer recorded the name of the medication, dosage, and frequency directly from the containers supplied by the participant. Respondents were also asked whether medications were originally prescribed to themselves or to someone else. Medication information was entered with the assistance of a commercially available prescription drug database (First DataBank). If the participant did not have medication containers available, the information was recorded from a computer-generated list of medications the participant had from the prescribing provider if available. If neither was available, the list was recorded from the participant's memory. If the participant could not remember medication information, the interviewer asked permission to call the participant later so that the participant could give that information while at home looking at the bottle. Interviewers then scheduled a time for the phone call; if the participant did not answer, the interviewer would make at least two more attempts to contact the participant by phone.

Our medication data thus capture only medication possession at a specific point in time, not adherence or prescriptions that lapsed or went unfilled. Data on these medications are presented in the accompanying tables. We restrict the data in these tables to the control group of people on the lottery list who were not selected in the lottery, reserving analysis of the treatment group pending completion of analysis plans for these data. As shown in Table A1, we recorded a total of 13,617 medications from the control group. Table A2 shows these medications collapsed to the person-level. 67.4% of the control group had at least one medication, and the average number of medications held by control group members was 2.36.

Medication Classification

We classified medications along two dimensions. First, we group them into an exhaustive list of categories based on the First DataBank Enhanced Therapeutic Classification (ETC) system, shown in Table A1. These categories reflect the broadest classes of therapeutic uses, including both generics and branded drugs. For example, ibuprofen would fall into the broad category

“Analgesics, Anti-inflammatory or Antipyretic”. Analgesic medications represent the largest therapeutic category of medications in the control group (22%). Within each of these broad medication categories are more specific subcategories. For example, ibuprofen is in the subcategory “NSAIDs, COX Non-Specific Inhibitors - Propionic Acid Derivatives” (which also includes naproxen, Excedrin, etc.).

In Table A1 we have combined the smallest categories (representing less than 1% of total control group medications each) into an “other” category, representing 3% of control group medications. A list of these medications is shown in Table A3.

Some medications fall into multiple categories. These medications are shown in Table A4, and represent 7.7% of the control group medications. For example, aspirin can be used as an analgesic or as a blood thinner; variants of aspirin represent more than 45% of the cross-listed medications. For the most part we group medications that fall into multiple therapeutic categories as “cross-listed,” with two exceptions: (1) Any medication with an anti-infective indication is included in the anti-infective category; (2) We treated the category “chemicals-pharmaceutical adjuvants” as secondary, grouping medications based on the other therapeutic class(es) into which they fell. The categories in Table A1 and A2 are thus mutually exclusive and exhaustive.

Second, in addition to categorizing medications based on therapeutic class, we also divided medications into those available through prescription (Rx), either originally prescribed to the respondent or obtained from someone else (such as a friend or family member who was not a health care provider), versus those obtained over-the-counter (OTC). Some medicines are OTC in some formulations or doses but Rx in others (such as 200 mg ibuprofen vs. 800 mg ibuprofen or ibuprofen combined with codeine). Whenever possible, we classify based on the specific medication in the respondent’s possession. In some cases, however, only a general drug name was recorded, making OTC/Rx ambiguous for certain drugs. In those cases we classify the drugs as “either/or.” In a small number of cases, insufficient information was recorded to classify the medication at all, in which case we categorize them as “unknown.” As shown in Table A1, 64% of the medications observed in the control group were Rx (either prescribed to the participant or someone else) and 26% were OTC. As shown in Table A2, 49% of control group members have at least one prescription medication. 39% possess an analgesic (although only 16% possess a prescription analgesic); 24% possess a central nervous system medication (which includes antidepressants); and 19% possess a cardiovascular medication.

For both therapeutic classification and distribution types, we imputed missing information for those entries that had not automatically populated through the First DataBank lookup function but could be characterized unambiguously based on the information available. These are shown in Tables A5 and A6.

Table A1: Control Group Medication Distribution

Group	Number of Medications	Examples	Percent of Medications by Category (%)	Number of Meds Prescribed to Self	Number of Meds Prescribed to Someone Else	Number of Over-the-Counter Meds	Number of Either/Or Meds	Number of Undetermined Meds
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Analgesic, Anti-inflammatory or Antipyretic	3,012	ibuprofen, morphine, vicodin	22.12	982	84	1,909	0	37
Central Nervous System Agents	2,427	adderall, amitriptyline, sertraline	17.82	2,315	26	16	0	70
Cardiovascular Therapy Agents	2,158	amlodipine, atenolol, hydrochlorothiazide	15.85	2,076	2	41	2	37
Respiratory Therapy Agents	1,278	albuterol, claritin, loratadine	9.39	765	33	353	6	121
Cross-Listed	1,055	aspirin, clonidine, promethazine	7.75	339	6	604	61	45
Endocrine	993	glipizide, metformin, prednisone	7.29	921	2	22	0	48
Gastrointestinal Therapy Agents	867	dicyclomine, omeprazole, prilosec	6.37	210	3	303	265	86
Other	423	methotrexate, plavix, warfarin	3.11	237	4	35	19	128
Electrolyte Balance-Nutritional Products	404	folic acid, multiple vitamin, vitamin D	2.97	57	0	287	4	56
Locomotor System	287	baclofen, cyclobenzaprine, methocarbamol	2.11	272	11	0	0	4
Anti-Infective Agents	272	amoxicillin, metronidazole, terbinafine	2.00	236	8	5	9	14
Unknown (No therapeutic code)	272	medical marijuana, sleeping pills, move free	2.00	0	0	0	0	272
Contraceptives	169	desogen, levora, nuvaring	1.24	144	0	4	0	21
TOTAL	13,617		100.00	8,554	179	3,579	366	939
Percent by type (%)	100.00			62.82	1.31	26.28	2.69	6.90

Notes: Column (1) reports the distribution of control group medications across exhaustive categories of therapeutic use, corresponding to the highest level categories of the First DataBank Enhanced Therapeutic Classification (ETC) System. Columns (4) through (8) decompose each therapeutic category into mutually exclusive modes of distribution. Most medications were classified as prescription (“Rx”) or over-the-counter (“OTC”), but some did not contain enough information for classification - either because Rx/OTC status depends on dose or formulation information that was not captured (“Either/or”) or because key identifying information was missing (“Undetermined”).

Table A2: Control Group Medication Possession

	All Medications		Prescription Medications	
	% with Any (1)	Number (2)	% with Any (3)	Number (4)
All Medications	67.37 (46.89)	2.36 (3.04)	49.28 (50.00)	1.56 (2.40)
<i>By Therapeutic Use</i>				
Analgesic, Anti-inflammatory or Antipyretic	39.07 (48.79)	0.52 (0.76)	15.71 (36.40)	0.19 (0.47)
Central Nervous System Agents	23.82 (42.60)	0.42 (0.91)	23.44 (42.37)	0.42 (0.90)
Cardiovascular Therapy Agents	18.81 (39.08)	0.38 (0.94)	18.52 (38.85)	0.37 (0.92)
Respiratory Therapy Agents	14.12 (34.83)	0.22 (0.64)	9.33 (29.09)	0.15 (0.53)
Cross-Listed	15.08 (35.79)	0.18 (0.49)	5.42 (22.65)	0.06 (0.27)
Endocrine	11.62 (32.05)	0.17 (0.54)	11.20 (31.54)	0.16 (0.52)
Gastrointestinal Therapy Agents	12.10 (32.62)	0.15 (0.47)	4.06 (19.74)	0.05 (0.24)
Other	5.91 (23.59)	0.07 (0.31)	3.88 (19.32)	0.04 (0.22)
Electrolyte Balance-Nutritional Products	5.03 (21.86)	0.07 (0.33)	0.96 (9.76)	0.01 (0.10)
Locomotor System	4.62 (21.00)	0.05 (0.23)	4.62 (21.00)	0.05 (0.23)
Anti-Infective	4.00 (19.60)	0.05 (0.26)	3.67 (18.81)	0.04 (0.24)
Contraceptives	2.88 (16.73)	0.03 (0.17)	2.65 (16.07)	0.03 (0.16)
<i>By Distribution Mode*</i>				
Rx Prescribed to Self	45.91 (49.84)	1.48 (2.38)	45.91 (49.84)	1.48 (2.38)
Rx Prescribed to Someone Else	2.72 (16.27)	0.03 (0.20)	2.72 (16.27)	0.03 (0.20)
Over-the-Counter	42.80 (49.48)	0.62 (0.90)		
Either Rx or OTC	5.54 (22.89)	0.06 (0.28)		
Undetermined	11.67 (32.11)	0.16 (0.56)	2.89 (16.76)	0.04 (0.33)

Notes: Table reports the medications possessed by the control group across exhaustive categories of therapeutic use, corresponding to the highest level categories of the First DataBank Enhanced Therapeutic Classification (ETC) System. *Distribution modes are mutually exclusive. Most medications were classified as prescription ("Rx") or over-the-counter ("OTC"), but some did not contain enough information for classification - either because Rx/OTC status depends on dose or formulation information that was not captured ("Either/or") or because key identifying information was missing ("Undetermined"). The "Undetermined" category includes all medications of unknown dispensing method (Rx/OTC) and/or unknown source (self/someone else) on the left, and prescription medications with unknown source on the right. N=5,746.

Table A3: "Other" Medications

Medication	Frequency (1)	Percent (%) (2)
Dermatological	101	23.88
Hematological Agents	73	17.26
Genitourinary Therapy	53	12.53
Alternative Therapy	48	11.35
Ophthalmic Agents	32	7.57
Gout and Hyperuricemia Therapy	28	6.62
Chemical Dependency Agents to Treat	22	5.20
Chemicals-Pharmaceutical Adjuvants	12	2.84
Impotence Agents	10	2.36
Antineoplastics	8	1.89
Mouth-Throat-Dental - Preparations	5	1.18
Immunosuppressive Agents	5	1.18
Multiple Sclerosis Agents	5	1.18
Anorectal Preparations	5	1.18
Eating Disorder Therapy	4	0.95
Otic	4	0.95
Cognitive Disorder Therapy	4	0.95
Biologicals	1	0.24
Antidotes and other Reversal Agents	1	0.24
Metabolic Modifiers	1	0.24
Diagnostic Agents	1	0.24
Total "Other" Medications	423	100.00

Notes: There are 21 categories in the First DataBank Enhanced Therapeutic Classification (ETC) System with representation in the control group of less than 1% each. We group medications under these categories into a single "other" category for analysis.

Table A4: "Cross-Listed" Medications

Medication	Frequency (1)	Percent (%) (2)
aspirin	484	45.88
clonidine	60	5.69
bupropion hcl	59	5.59
promethazine	56	5.31
diphenhydramine hcl	43	4.08
estradiol	37	3.51
fluticasone	29	2.75
benadryl	28	2.65
triamcinolone acetonide	27	2.56
melatonin	16	1.52
doxepin	11	1.04
hydrocortisone	10	0.95
Others	195	18.48
Total Cross-Listed	1,055	100.00
<i>Additional medications falling into multiple categories:</i>		
Anti-infectives	105	
Chemical/Pharmaceutical Adjuvants	711	

Notes: Column (1) presents the frequency of medications that fall into multiple broad therapeutic categories observed in the control group. We group these medications together in the analysis as "cross-listed," rather than in any of the individual categories in which they appear. The exceptions are medications with an anti-infective indication, which are preserved under the anti-infective parent category, and medications with a "chemical/pharmaceutical adjuvant" indication, which are assigned to the other categories into which they fall.

Table A5: Amended Therapeutic Codes

Medication Name	Added ETC 1 ID	Added ETC 1 Parent ID	Added ETC 2 ID	Added ETC 2 Parent ID	Added ETC 3 ID	Added ETC 3 Parent ID	Added Medication Type
acid reducer	443 (Peptic Ulcer - H-2 Antagonists)	2550 (Gastrointestinal Therapy Agents)					OTC
albuterol hfa	367 (Asthma/COPD Therapy - Beta Adrenergic Agents)	2709 (Respiratory Therapy Agents)					OTC
bayer, bayer low dose, bayer low strength	575 (Salicylates)	3645 (Analgesic, Anti-inflammatory or Antipyretic)	5843 (Platelet Aggregation Inhibitors - Salicylates)	2552 (Hematological Agents)			OTC
ciprofloxacin hcl	2740 (Fluoroquinolones)	2549 (Anti-Infective Agents)	3188 (Ophthalmic Antibiotic - Fluoroquinolones)	837 (Ophthalmic Agents)	3235 (Otic - Fluoroquinolones)	885 (Otic)	RX
doxycycline	2741 (Tetracycline Antibiotics)	2549 (Anti-Infective Agents)	4604 (Periodontal Product - Tetracycline-Type, Collagenase Inhibitors)	897 (Mouth-Throat-Dental Preparations)			OTC
fluoxetine, fluoxetine hcl	530 (Antidepressant - Selective Serotonin Reuptake Inhibitors (SSRIs))	2584 (Central Nervous System Agents)					RX
fluticasone propionate, fluticasone propionate nasal spray	301 (Nasal Corticosteroids)	2709 (Respiratory Therapy Agents)					RX
medroxyprogesterone	147 (Progestins)	120 (Endocrine)					RX
oxycodone hcl	583 (Analgesic Narcotic Agonists)	3645 (Analgesic, Anti-inflammatory or Antipyretic)					RX
pseudoephedrine	298 (Systemic Sympathomimetic Decongestants)	2709 (Respiratory Therapy Agents)					RX
ranitidine	443 (Peptic Ulcer - H-2 Antagonists)	2550 (Gastrointestinal Therapy Agents)					RX
tylenol arthritis	577 (Analgesic or Antipyretic Non-Narcotic)	3645 (Analgesic, Anti-inflammatory or Antipyretic)					OTC
hydrocodone		2709 (Respiratory Therapy Agents)					RX
insulin		120 (Endocrine)					RX
ortho evra		136 (Contraceptives)					RX
premarin		120 (Endocrine)					RX
tetracycline		2549 (Anti-Infective Agents)					RX
vitamin b-12, vitamin b12, vitamin b 12		3444 (Electrolyte Balance-Nutritional Products)					OTC

Notes: Some medications without therapeutic categories recorded could be easily classified based on their names. Such medications that appeared at least three times in the data were categorized accordingly.

Table A6: Reclassification of Distribution Types

Reclassified as OTC	Reclassified as Rx
acetaminophen ¹	albuterol (refill)
advil ¹	ambien pak
alka-seltzer	amlodipine besylate (bulk)
aller-tec	aripiprazole
allerclear	atorvastatin
aspirin ¹	baclofen
bayer ¹	bupropion (bulk)
calcium "calcium carbonate"	chlordiazepoxide
calcium with vitamin d	codeine ¹
cetirizine	diltiazem hcl
chlorpheniramine maleate	docusate sodium
chlortab-4	doxycycline hyclate
cholecalciferol (vitamin d3)	drisdol
clotrimazole	duloxetine
cold non-drowsy	escitalopram
cyanocobalamin (vitamin b-12)	flovent
deprizine	glucotrol xl
doxylamine succinate	hydrocodone ¹
ecotrin ¹	hydrocordrone
equate	insulin glargine
excedrin ib	insulin lispro
extra strength pain relief	insulin nph & regular human
extra strength pain reliever	insulin regular human
ferrous sulfate	l-thyroxine
folic acid	levora 0.15/30 (28)
guaifenesin	meloxicam
ibuprofen ¹	metoclopramide
iron	metoprolol tartrate
loratadine	morphine ¹
melatonin	nystatin
miconazole nitrate	oxycodone ¹
midol ¹	proventil (refill)
motrin ¹	quetiapine
multiple vitamin	rizatriptan
naprelan ¹	simethicone
naprosyn ¹	sulfamethoxazole
naproxen ¹	tiotropium bromide
niacin	triamcinolone
nyquil	valium
omega 3 fish oil	ventolin
panadol ¹	
potassium chloride	
prenatal vitamins-iron-fa	
pseudoephedrine hcl	
ranitidine	
st. joseph	
tylenol ¹	
unisom	
unisom sleepgels	
vitamin b-12	
vitamin d	
vitamin d-3	
vitamin d3-menaquinone 7	
wal-dryl allergy	
wal-itin	
wal-zyr	
zantac	
zyrtec	

Notes: Some medications with missing or inaccurate dispensing method information could be unambiguously classified as OTC or Rx based on the names listed above.

¹ All medication names including these words alone or in combination with others were classified accordingly. However, medications containing both OTC and Rx words were classified as Rx (e.g., Tylenol-Codeine).