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Willingness-to-Pay for Pharmaceutical Retail Convenience: Evidence from a Contingent Choice Experiment

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1 Abstract

Importance Restrictions on retail purchases of psuedoephdrine have been the primary regulatory approach for reducing the social costs of methamphetamine production and use, but may impose costs on legitimate users of nasal decongestants. This is the first study to evaluate the costs to consumer welfare of restricting access to medications.

Objective Our objective was to measure the inconvenience cost consumers place on restrictions for cold medication purchases including identification requirements, purchase limits, over-the counter availability, prescription requirements, and the active ingredient.

Design We conducted a contingent choice experiment that presented participants with randomized, hypothetical product prices and combinations of restrictions that reflect the range of public policies. We used a conditional logit model to calculate willingness-to-accept each restriction.

Setting Online.

Participants Amazon Mechanical Turk workers.

Main outcomes and measures Willingness-to-pay and willingness-to-accept.

Results Respondents' willingness-to-accept prescription requirements was $21.51 and behind-the-counter restrictions was $15.93 per box of pseudoephedrine product. Participants were willing to pay $8.55 per box to purchase pseudoephedrine-based products over phenylephrine-based products.

Conclusions and relevance Restricting access to medicines as a means of reducing the social costs of non-medical use can imply large inconvenience costs for legitimate consumers. These results are relevant to retail access restrictions on other medications.

2 Introduction

Methamphetamine (meth) use is a significant social ill that has been linked to personal consequences ranging from dropping out of school (1) to heart attacks (2), and social consequences from violent behavior (3) to increased infectious disease transmission (4). Methamphetamine can be easily synthesized in small batches from precursor ingredients found in widely available nasal decongestant medicines containing pseudoephedrine (pseudo) (5).[1] Due to these social costs, policies were enacted since the early 1990s to curtail domestic access to pseudo in an effort to reduce domestic meth synthesis and, ultimately, consumption via the policy's effect on meth availability and meth prices.

As increased sales of pseudo has been linked with increased meth production (6), regulations have placed legal constraints on retail sales at pharmacies. Retail pharmacy regulations controlling consumer purchase of pseudo are usually bundled constraints along numerous dimensions. For instance, the federal Combat Methamphetamine Epidemic Act of 2005 restricted retail purchases to no more than nine grams of pseudo per month, required consumers to present proof of identification at point of purchase, and moved pseudo behind the counter. Oregon and Mississippi enacted "prescription-only" laws in 2006 and 2010, respectively, that further restricted access. And approximately a dozen states have passed laws that require pharmacies to record all identifying information from consumer purchases of pseudo into a centralized shared database for realtime tracking.

Each of these constraints impacts the legal consumer of pseudo in some unknown way by raising the marginal cost of purchase. Requiring identification may have direct costs, as well as potential equity issues, since presenting identification may be more burdensome to consumers with lower-income (7). Purchase limits may impose inconvenience costs such as additional time or costs for travel. Prescription requirements include direct costs, travel costs, time costs to both patient and prescribing doctor, and can be substantial (8).

[1] While meth can be synthesized from either ephedrine or pseudoephedrine, contemporary regulations target both chemicals. Therefore, for simplicity, we refer to both pseudoephedrine and ephedrine as pseudoephedrine, or "pseudo".

A full evaluation of these interventions would compare the benefits of each of these strategies, including potential reduced methamphetamine use, with the harms.

Previous work has speculated the existence of substantial costs of access restrictions to medications in general to consumer welfare (9), (10). Studies have explored the consequences of interactions of prescription requirements and insurance status on consumer costs (11), (12). This is the first study, however, to measure the inconvenience burden to consumers associated with medication access restrictions.

In this paper, we aim to identify the costs to consumers of identification requirements, purchase limits, behind-the-counter requirements, or prescription requirements. We use a contingent choice experiment and model responses with a conditional logit to calculate willingness-to-accept each restriction.

3 Methods

3.1 The choice experiment

We asked 1,915 survey participants to suppose they were interested in buying cold medicine. Each participant was asked to choose an option from a set of four for treating a cold: two pseudo based product options with different restrictions, a phenylephrine-based (phenyl) product with no restrictions, or making no purchase.[2] We included the phenyl alternative to pseudo to capture some measure of how willing consumers would be to substitute away from pseudo medications to possibly less effective and less restricted phenyl medications. Each participant was presented with 10 randomly ordered sets of four randomly ordered alternatives.

[*Table 1 approximately here.*]

[2] Phenyl decongestants (such as Sudafed Pressure and Pain) are widely available in retail pharmacies and marketed as an effective over-the-counter alternative to pseudo-based nasal decongestants (such as Sudafed 12-Hour). On a molecular level, these chemicals differ in how much is metabolized by the body and which receptors are affected. Only 38% of phenyl is absorbed for effective use by the body compared with 100% for pseudo. Pseudo is a stimulant that releases adrenaline, whereas phenyl does not have this effect. Whereas the efficacy of pseudo as a nasal decongestant is supported by numerous controlled trials, there is little evidence that oral phenyl performs better than placebo (13). See Eccles (14) for a detailed comparison between pseudo- and phenyl-based nasal decongestants.

The pseudo options were presented with restrictions including requiring identification at the point of purchase, purchase limit, requiring a prescription, or being behind-the-counter. After eliminating illogical combinations of restrictions we arrived at the seven salient alternatives shown in Table 1. The alternatives we presented to respondents were 1) pseudo requiring identification and prescription, 2) pseudo requiring identification and with a one box per month limit, 3) pseudo with a one box per month limit, 4) pseudo requiring identification, 5) pseudo without restrictions, 6) phenyl without restrictions, and 7) no purchase.

Each of the purchased options was presented with an out-of-pocket price, which we modeled as a draw from a base price distribution and accompanying discount factor. The base prices were drawn from a uniform distribution between $6 and $30 independently for each option. To account for the compensating differentials buyers would require for potential restrictions, we further applied a discount to pseudo. The discount was drawn from a uniform distribution that was between $1 and $1 less than the base price. For example, a pseudo option with a randomized base price of $13 could have a discount of $4. The respondent was only presented with the final price, in this case $9. Figure 1 shows an example choice screen used in the experiment. At the start of the survey we asked respondents what their out-of-pocket expense was when they went to the doctor's office, for use in later analysis.

[*Figure 1 approximately here.*]

We used this Choice Experiment (CE) method instead of directly asking participants to report monetary values for each restriction. Direct question surveys can lead to respondents valuing whole items instead of the attributes of the choices (15). The CE method allows us to calculate a value for each specific attribute. It is also efficient at drawing information from respondents by allowing us to elicit values for several potential permutations of precursor restrictions in each test. For a thorough review of the CE method in health applications see de Bekker-Grob et al. (16) and for detailed descriptions of choice experiment design see Hensher et al. (17) and Louviere et al. (18).

3.2 Mechanical Turk

We administered our survey online using Amazon Mechanical Turk over two weeks in May 2014. Mechanical Turk provides an online marketplace that connects occasional internet workers (here survey respondents) with labor purchasers. We paid each respondent $1, which is slightly higher than the typical compensation (19). Results from field and laboratory surveys and experiments have been replicated using Mechanical Turk (20). Survey responses from Mechanical Turk are typically more representative than from other online survey mechanisms or convenience samples of college students (21). We further refined the representativeness of our analysis by calculating survey weights for our respondents (22) to replicate the characteristics of the general population from the 2012 5-year American Community Survey (ACS). The ACS is administered annual by the U.S. Census Bureau to 3 million households. The ACS 5-year release contains the most recent 5-years of data. We balanced respondents in our sample with those in the ACS according to gender, race, highest education completed, number in the household, marital status, and census division. The standardized differences in these attributes between our sample and the ACS are shown in Table 2.

[*Table 2 approximately here.*]

3.3 Conditional logit

We used the conditional logit to model consumer responses to product attributes for cold medication. The conditional logit model can estimate how the attributes of a choice influence the probability of being chosen from among several alternatives. Specifically we modeled the probability of choice j out of J total choices as:

$$p_{ij}=Pr\left[y_i=j\right]=\frac{\exp(\beta_P P_{ij}+\sum_{n=1}^{N}\beta_{R_n}R_{ijn})}{\sum_{k=1}^{J}\exp(\beta_P P_{ik}+\sum_{n=1}^{N}\beta_{R_n}R_{ikn})},$$

where p_{ij} is the probability individual *i* makes choice *j*. Each choice is defined by a price given by P_{ij} and a set of restriction indicators each represented by R_{ijn}. The impact of price on the probability of choice was captured by the β_P parameter and the impact of the n^{th} restriction on choice was captured by the parameter β_{R_n}. For choices involving prescription-only restrictions we included the self-reported copay amounts as part of the price when modeling the impact of price on choice in the conditional logit models. We recovered willingness-to-accept a particular restriction from the ratio of our estimate of the restriction parameter to the price parameter, namely $WTAP_{R_n} = -\beta_{Rn}/\beta_P$. Standard errors for the willingness-to-pay estimates were calculated with the delta method (23). We used robust standard errors that accounted for within-respondent error correlation. To simplify the choice modeling, we disregard choices that result in non-purchase. In order to test for potential heterogeneity in demand for decongestants between those with and without experience with the medicine, we estimated an alternative specification that restricted the population to respondents who had purchased pseudo decongestants in the last year.

4 Results

[*Table 3 approximately here.*]

Table 3 shows the results from the conditional logit model. Column 1 gives the impact of each product attribute (price or restriction) on the probability of choice. Column 2 displays willingness-to-pay or willingness-to-accept each restriction. Willingness to pay for a desirable product attribute is denoted with a negative value in Column 2. The amount respondents would require to be willing to accept an undesirable product attribute is denoted with a positive value. We found respondents were willing to accept behind-the-counter restrictions in exchange for $15.93 on average. The willingness-to-accept a more burdensome prescription requirement was $21.51. Participants were willing-to-accept a substitute phenyl-based medication instead of a pseudo-based one for $8.55, which was less than the value participants placed on the behind-the-counter and prescription restrictions. Requiring identification or

imposing purchase limits both appeared as positive attributes that respondents were willing-to-pay for, though both these counter-intuitive estimates were smaller in magnitude. The model in Columns 3 and 4 is restricted to respondents with recent experience with pseudo. Experienced pseudo purchasers comprised approximately half our sample and placed similar valuations on attributes to the inexperienced survey respondents.

5 Discussion

We administered a choice experiment to assess willingness-to-pay or willingness-to-accept inconvenience when purchasing pseudo-based nasal decongestants. We found respondents required $15.93 to accept behind-the-counter purchases, and $21.51 to accept prescription requirements. We also found consumers were willing to pay $8.55 for pseudo-based products compared to phenyl-based products.

Retail-level regulations on behind-the-counter requirements and prescription requirements may make it more difficult for illegal small-batch meth producers to obtain sufficient amounts of precursor needed to produce meth. But the regulations cannot discriminate between a consumer acquiring pseudo to treat cold symptoms and a consumer acquiring pseudo to manufacture meth, so the burden falls on both legitimate and illegitimate consumers.

There are several important limitations to our study. First, our choice experiment presented respondents with theoretical scenarios with different prices and restrictions. Previous studies have found that respondents do not necessarily pick the option with the maximum payoff (24). Respondents in our study may be picking options without proper attention to price variables in our study. If respondents placed more weight on the prescription or other requirements in our experiment than they would have outside of the experimental setting, we would overestimate the willingness-to-pay to avoid these requirements.

Our study population may impart our results with limited external validity. While we derived weights match the demographics of our survey respondents to those of the United States population, they may have been different on unobservable characteristics. All Mechanical Turk workers have access to a computer and

are comfortable inputting their Social Security Number over the Internet. This may mean that our survey respondents were more comfortable with purchases requiring identification.

The willingness-to-pay estimates can be multiplied by the number of boxes to estimate the annually recurring impact of these restrictions on consumer welfare if all states were to implement behind-the-counter or prescription requirements. While no national estimates of boxes of pseudoephedrine sales exist, annual sales of pseudoephedrine by weight were estimated at 203,734 kg for 2010 (25). A large box of pseudoephedrine contains 96 pills, and each pill contains 30 mg of pseudoephedrine. If all pseudoephedrine went into boxes with this configuration, there were 70,740,972 boxes sold nationwide in 2010. Using the estimates from our model we calculate consumer welfare costs of $1.1 billion for behind-the-counter purchases, and $1.5 billion for prescription requirements. We note that these estimates do not account for the percentage of pseudo that is diverted for meth production and we do not attempt to calculate the benefits of these restrictions in combatting the negative consequences of meth production.

Restricting access to medicines as a means of reducing the social costs of non-medical use can imply large inconvenience costs for legitimate consumers. Here we estimate these costs, though comparisons with the potential benefits of these restrictions need to be conducted on a case-by case basis for each drug. This work has potential implications for estimating the benefits to making other medications available over-the-counter.

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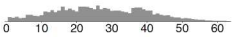
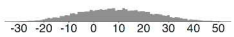
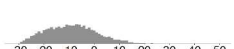
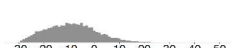
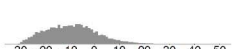
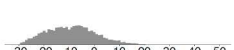
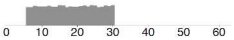
Figure 1: Example choice set screen from contingent choice survey

Suppose you would like to buy cold medicine. (Choice screen 1 of 10)

Which of the following products would you purchase? (Choose one.)

	Retail price	Active ingredient	ID requirement	Purchase limit	Purchase experience	Representative product image
○	$15	Pseudoephedrine	no ID required	no limit	can buy as easily as Tylenol	
○	No cold medicine product (none of the other options are acceptable).					
○	$11	Pseudoephedrine	no ID required	1 box per month	pharmacy counter purchase	
○	$16	Phenylephrine or other non-pseudoephedrine medicine	no ID required	no limit	can buy as easily as Tylenol	

Table 1: Contingent choice alternatives

Alt. (1)	Active ingredient (2)	Price density (3)	Price difference density (4)	ID required (5)	Purchase limit (6)	Purchase experience (7)
1	Pseudo.			×	set by doctor	R_x
2	Pseudo.			×	1 box/month	BTC
3	Pseudo.				1 box/month	BTC
4	Pseudo.				no limit	OTC
5	Pseudo.			×	no limit	BTC
6	Phenyl.				no limit	OTC
7	[No purchase]					

Notes: Each choice set consisted of a pair of pseudoephedrine alternatives along with the phenylephrine and no-buy alternatives. In the survey, prices for Alternative 1 did not include the doctor co-pay, but all prices used here and in the analysis do include the respondent-reported co-pay for obtaining a prescription from a doctor. Prices were denoted in dollars.

Table 2: Means and standard errors of weighting variables, ACS reference sample, unweighted MTurk sample, weighted MTurk sample

Variables	ACS sample (1)	Unweighted MTurk sample (2)	Weighted MTurk sample (3)	Standardized diff.: (3)−(1) (4)
Female	0.519	0.478	0.519	−0.00000
Asian	0.057	0.084	0.057	−0.00000
Black	0.122	0.078	0.122	−0.00000
White	0.779	0.853	0.779	−0.00000
Hispanic	0.143	0.093	0.143	−0.00000
Household size: 1	0.139	0.191	0.139	0.00000
Household size: 2	0.336	0.291	0.336	0.00000
Household size: 3	0.194	0.236	0.194	0.00000
Household size: 4	0.171	0.176	0.171	−0.00000
Household size: 5	0.088	0.071	0.088	−0.00000
Household size: 6+	0.072	0.035	0.072	0.00000
Up to high school graduate	0.427	0.117	0.427	0.00000
Some college	0.233	0.313	0.233	−0.00000
2-year college degree	0.074	0.111	0.074	0.00000
4-year college degree	0.171	0.358	0.171	−0.00000
Masters degree	0.084	0.089	0.084	0.00000
Doctorate degree	0.011	0.012	0.011	0.00000
Never married/single	0.269	0.569	0.269	0.00000
Married	0.533	0.348	0.533	−0.00000
Separated	0.023	0.014	0.023	−0.00000
Divorced	0.114	0.064	0.114	0.00000
Widowed	0.061	0.005	0.061	0.00000
New England	0.048	0.040	0.048	−0.00000
Middle Atlantic	0.134	0.143	0.134	−0.00000
East North Central	0.150	0.151	0.150	−0.00000
West North Central	0.066	0.056	0.066	−0.00000
South Atlantic	0.196	0.216	0.196	−0.00000
East South Central	0.060	0.057	0.060	0.00000
West South Central	0.114	0.102	0.114	0.00000
Mountain	0.070	0.067	0.070	0.00000
Pacific	0.161	0.168	0.161	0.00000

Notes: The ACS reference sample includes all individuals aged at least 18 years and not living in institutions.

Table 3: Conditional logit models of cold medicine choice, baseline model and with demand interactions, with sampling weights

Attributes	(1) Coefficients	(2) WTAP	(3) Coefficients	(4) WTAP
Total price (dollars)	−0.10***		−0.09***	
	(0.01)		(0.01)	
Purchase experience				
Over-the-counter (reference)				
Behind-the-counter but no prescription	1.66***	15.93***	1.60***	17.35***
	(0.11)	(1.04)	(0.14)	(1.27)
Require doctor's prescription	2.24***	21.51***	2.09***	22.63***
	(0.18)	(1.56)	(0.24)	(2.05)
Active ingredient				
Pseudoephedrine (reference)				
Phenylephrine	0.89***	8.55***	0.59***	6.43***
	(0.11)	(0.98)	(0.13)	(1.33)
ID requirement				
No ID required (reference)				
ID required	−0.16***	−1.55***	−0.13	−1.40
	(0.06)	(0.59)	(0.08)	(0.87)
Purchase limit				
No limit (reference)				
Any limit	−0.51***	−4.91***	−0.54***	−5.84***
	(0.08)	(0.78)	(0.12)	(1.23)
Specification				
Pseudo R^2	0.23		0.22	
N (respondents)	1,867		954	
N (choice sets)	16,947		9,011	
N (alternatives)	50,841		27,033	

Notes: Standard errors that account for arbitrary correlation of errors by respondent in parentheses. Standard errors for willingness-to-accept and willingness-to-pay (WTAP) estimates are calculated with the delta method. Stars indicate statistical significance: * p<0.05, ** p<0.01, *** p<0.001.