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Financial incentives to discontinue long-term benzodiazepine use: patient preferences and willingness to participate

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Abstract

Objectives: Investigate the acceptability of financial incentives for initiating a medically supervised benzodiazepine discontinuation program among people with long-term benzodiazepine use and to identify program features that influence the willingness to participate.

Methods: We designed a discrete choice experiment in which we presented a variety of incentive-based programs to a sample of older adults with long-term benzodiazepine use identified using the outpatient electronic health record of a university-owned health system. We studied four program variables: incentive amount for initiating the program, incentive amount for successful benzodiazepine discontinuation, lottery vs. certain payment, and whether partial payment was given for dose reduction. Respondents reported their willingness to participate in the programs and additional information was collected on demographics, history of use, and anxiety symptoms.

Results: The overall response rate was 28.4%. Among the 126 respondents, all four program variables influenced stated preferences. Respondents strongly preferred guaranteed cash-based incentives as opposed to a lottery, and the dollar amount of both the starting and conditional incentives had a substantial impact on choice. Willingness to participate increased with the amount of conditional incentive. Program participation also varied by gender, duration of use, and income.

Conclusions: Participation in an incentive-based benzodiazepine discontinuation program might be relatively low, but is modifiable by program variables including incentive amounts. These results will be helpful to inform the design of future trials of benzodiazepine discontinuation programs. Further research is needed to assess the financial viability and potential cost-effectiveness of such economic incentives.

Keywords: benzodiazepines, addiction, older adults, financial incentives, behavioral economics

Strengths and limitations of this study

- This study is the first to provide evidence on the acceptability of financial incentives for benzodiazepine discontinuation in older adults with history of long-term benzodiazepine use
- It provides insights into the preferences of this group of patients and will be helpful to inform the design of future trials of benzodiazepine discontinuation programs
- Our findings are limited by the relatively small number of participants and the focus on one study site
- As we are using a stated preferences method, it is not clear whether patients would make the exact same choices when faced with the real-life decision

Introduction

Benzodiazepines are frequently used to treat insomnia and anxiety disorders. In 2013, 8.6% of Americans age 65 or above filled one or more benzodiazepine prescription (Bachhuber et al., 2016). While short-term use for panic disorder and insomnia are supported by some clinical practice guidelines, (Bandelow et al., 2008, Health and Care, 2011, Unit, 2008) long-term use is associated with serious risks, including overdose (Bachhuber et al., 2016), misuse and use disorder, (Ashton, 1995) falls, (Xing et al., 2014) motor vehicle crashes, (Movig et al., 2004) cognitive impairment, (Barker et al., 2004) and dementia, (de Gage et al., 2012) particularly in older adults. Despite known risks associated with long-term use, discontinuing therapy with benzodiazepines can be very difficult because of physiological dependence as well as the potential for return of the symptoms that prompted benzodiazepine initiation. (Ashton, 1995) While withdrawal symptoms can be mitigated in part by a slow taper (Vikander et al., 2010), many patients are resistant to initiation of the taper. (Cook et al., 2007) Strategies such as providing patient education about the risks of benzodiazepine use have proven only modestly effective in encouraging discontinuation of therapy. (Voshaar et al., 2006)

In this context, giving people monetary incentives conditional on achieving reduction in use and discontinuation might be a useful approach. Behavioral economic theory suggests that individuals exhibit present-bias, i.e. they tend to put a disproportionate weight on the present when making decisions. (O'Donoghue and Rabin, 2000) Repeated choices (e.g., smoking the next cigarette) whose long-term consequences are likely to be underweighted in the decision-making process can lead to persistent unhealthy habits. Therefore, giving people monetary incentives conditional on achieving a specific health-related goal can make the benefits of behavior change immediate and more salient. This type of strategy is increasingly used and has been shown effective in several contexts. (Heil et al., 2008, Long et al., 2012, Volpp et al., 2008a, Volpp et al., 2008b, Volpp et al., 2009)

Besides setting a monetary value that rewards a well-defined outcome, incentive design entails a careful consideration of a variety of features. Insights from behavioral economics, including

loss aversion and the overweighting of small probabilities, suggest that characteristics of payments such as their frequency (regular vs. one-off), certainty (guaranteed payments vs. lotteries), or their nature (cash vs. vouchers), must be carefully considered as they can influence take-up and success. Given this, surprisingly little is known about the influence of incentive design on the willingness to participate in incentive-based programs and how to adapt the design to different populations/behaviors to maximize take-up. Identifying effective incentives becomes even more challenging when considering compulsive and potentially harmful behaviors that may be perceived as acceptable and safe such as the use of physician-prescribed drugs. Thus, there is a clear gap in knowledge about optimal incentive structure to present to individuals to induce program participation and healthy behavior change, and there is almost no work exploring what would be necessary to change behaviors that may not necessarily be perceived as unhealthy by patients. This study presents a unique opportunity to narrow this gap by focusing on patients with long-term prescription benzodiazepine use.

In this study, we used discrete choice experiments (DCE) to investigate the acceptability of financial incentives for initiating a medically supervised benzodiazepine discontinuation program among long-term benzodiazepine users and to identify program features that influence the willingness to participate. More specifically, we randomly presented a variety of incentive-based programs that differed according to a set of key features (e.g. incentive amount, lottery vs. certain payment) to a sample of older adults (age 50+) with long-term benzodiazepine use. We then asked respondents to report their willingness to participate in the programs and collected additional information on demographics, history of use, and anxiety symptoms. We used discrete choice modeling to investigate the trade-offs that individuals make between program features as well as patient factors that affect willingness to participate.

Methods

Data collection

We identified potential subjects from the patient population of the primary care and behavioral health outpatient practices of a university-owned health system. Eligible participants were aged 50 or older, with an anxiety diagnosis at any point as an outpatient or with anxiety listed on their active problem list within the electronic health record. Additionally, eligible participants must have had at least three benzodiazepine prescription orders in the previous 12 months, with the most recent prescription within 90 days of our initial screening for study participants. Those with a history of a seizure disorder were excluded. Before contacting any participants, we reached out to each provider to give them the opportunity to opt out any of their patients who they did not wish to participate in the study.

We contacted the remaining eligible participants by phone from May 2015 through August 2015. Contacted individuals who were no longer taking their benzodiazepine medication(s) were

excluded as ineligible. Research staff obtained verbal consent by phone and subsequently randomized each participant to either version A or B of the study questionnaire. Stamped and addressed envelopes were provided with the questionnaires for participants to easily return the surveys. Upon sending back the survey, all participants were mailed a retail gift card worth $20. This study was deemed exempt from review by the University of Pennsylvania Institutional Review Board (protocol 820106).

Design of the choice experiment

DCEs have been used extensively to value goods and services for which there is no formal market or only incomplete markets (de Bekker-Grob et al., 2012). In health and health care these techniques have been applied to address a wide variety of research questions including the elicitation of patients' preferences, the valuation of health outcomes and the trade-offs between health and non-health benefits of specific interventions. (de Bekker-Grob et al., 2012, Olsen and Smith, 2001, Pesko et al., 2016) Importantly, recent studies have used DCEs to investigate the design of financial incentive programs (Farooqui et al., 2014, Wanders et al., 2014). DCEs rely on random utility theory and are based on the assumption that the value of goods or services is best described by the sum of its attributes (or characteristics) and that people's choices are driven by the relative value of these characteristics. By presenting respondents with a series of choices between alternatives and by experimentally varying the characteristics of these alternatives, one is able to assess the trade-offs respondents make between product/service characteristics and to measure their influence on choices. A DCE consists of several interdependent steps: defining the attributes and their levels, experimental and survey design, data collection and statistical modeling. (de Bekker-Grob et al., 2012)

We developed an initial list of potential attributes and levels of the tapering program via a review of the literature on the design of financial incentives for behavior change. (Adams et al., 2014) We then refined this list in a series of team meetings and through analysis of pilot data. In the final survey, we described hypothetical tapering programs using four characteristics: cash reward to start the program, the incentive amount received conditional on successful discontinuation, whether the conditional incentive was given in the form of a certain cash payment or via a lottery, and whether unsuccessful participants would still be rewarded for only cutting their use by half. These attributes and their respective levels are presented in Table 1. The next step consisted of combining attributes to form choice sets used to reveal patients' preferences. Because it would be infeasible to show respondents all possible combinations of attributes and levels (in our case, this would mean $4^2 \times 2^2 =$ 64 possible combinations), we generated a fractional factorial design using the N-gene software to obtain a reasonable number of choice sets (i.e. 12) that is sufficient to estimate the main effects of interest. We then divided the 12 choice sets into two blocks of 6 choice sets to reduce respondent fatigue. While the number of choice sets was not found to be detrimental to DCE data quality (Hess et al., 2012), we had concerns that this could be an issue in older adults. In each choice set, respondents were asked 1) to choose their preferred tapering program, and 2) to state whether or not they would

enroll if such a program were available to them. As a simple validity check, we also asked respondents if they wanted to be contacted if a similar program started and gave them the opportunity to provide their contact information. An example of choice set is displayed in Figure 1. We also collected information on demographics (i.e. age, gender, education, income, and household size), history of benzodiazepine use, and current level of anxiety (measured using the GAD-7 scale) (Spitzer et al., 2006).

Statistical modelling

We started by describing our patient population and respondents' choice patterns. We then estimated conditional logit models that take into account the within-individual correlation in choices and analyzed the "forced choice" data to assess the trade-offs made by individuals between the various program characteristics, i.e. to assess the relative importance of these characteristics when making choices. Then, we exploited the additional information provided by respondents in each choice set to model the probability of program take-up, i.e. whether respondents would enroll if such program were available to them. In these binary logit models, the dependent variable was equal to One if the respondent 1) chose the program in the choice set, and 2) answered "yes" to the enrollment question. We complemented our analyses by predicting program take-up among survey respondents for a range of incentive amounts for successful discontinuation. This was done by calculating the choice probabilities of each option using Model 1 in Table 4 and by averaging them by incentive amount. All analyses were performed using Stata 12 (StataCorp. 2011. Stata Statistical Software: Release 12. College Station, TX: StataCorp LP).

Results

In total we identified 1,108 potentially eligible participants. Of those, we could not reach 567 (reasons included being opted out by provider, invalid phone number, and not answering the phone after 3 attempts), 245 refused to participate, and 37 were ineligible as they were no longer taking benzodiazepines (Figure 2). We mailed the survey to the 285 remaining individuals and 143 returned their survey, giving rise to a 28.4% overall response rate (143 ÷ (1,108 – 567 – 37)) and a 50.2% response rate to the mailed survey among those who provided consent, which is in line with other DCE studies in health using postal surveys (Watson et al., 2016). We further excluded 17 respondents due to incomplete responses to the choice questions. Therefore, 126 respondents provided complete and usable survey responses.

The majority of respondents were women (62%) and the average age of respondents was 63 years old (Table 2). On average, respondents have been taking benzodiazepines for 10 years, with history of use ranging from 1 to 50 years. The majority of people took benzodiazepines daily or almost daily; only 19% took benzodiazepines once per week or less. Interestingly, 45% of

respondents had previously tried to stop taking benzodiazepines. Most respondents (63%) had only minimal or mild anxiety as measured by the GAD-7 scale.

As an initial investigation of respondents' preferences, we summarized their general choice patterns. As explained above and shown in Figure 1, respondents were first asked to choose their preferred program and then asked to state their willingness to enroll if such a program were available. Responses to this second questions provided insight into the general willingness to enroll in incentive program in this population. Results showed that about 50% of respondents always (i.e. in all 6 choice sets presented) answered "yes" to the question "Would you enroll in the program you picked above if you had the opportunity?" Conversely about 30% of respondents always answered "no" to that question. On average, the proportion of "yes" responses across all respondents and choice sets was 67%, which reflects a fairly high potential enrollment rate among survey respondents. Interestingly, 57% of respondents who answered "yes" to the question "Would you enroll in the program you picked above if you had the opportunity?" at least once expressed an interest in being contacted if such program started, and shared their contact information.

The results from the conditional logit models shown in Table 3 suggest that all studied attributes had an influence on choices. More precisely, as we would expect, the higher the monetary amount for both incentives (start and completion), the higher the probability the respondent would choose that program. We also observed that respondents tended to favor programs that offer a reward even if complete discontinuation was not achieved. Finally, respondents in our sample were more likely to choose a program that offers a cash reward rather than a lottery with equal expected value. While these results are informative in verifying that respondents are trading-off between program characteristics in a rational way, the model coefficients cannot be directly interpreted or transformed into odds ratios, and this model does not inform us about respondents' willingness to participate.

We therefore turn to the estimation of logit models that incorporate the information from the second question (i.e. "would you enroll?"). In these models, the dependent variable reflects willingness to enroll in the program and equals one if the respondents 1) chose this program in the choice set and 2) answered "yes" to the question "Would you enroll in the program you picked above if you had the opportunity?" (Table 4). Model 1 does not include respondent characteristics. The estimates suggest that respondents had more than twice the odds of stating that they would enroll (OR: 2.38, 95% CI: 1.69-3.35) if the program offers an incentive of $1,500 rather than $200, conditional on discontinuation. They are also more likely to state they would enroll if the program offers half the incentive if the required dose is also cut in half (OR: 1.74, 95% CI: 1.36-2.21), and had a three-fold odds of stating they would enroll if the incentive is offered as a certain cash amount as opposed to a lottery with equal expected value (OR: 2.99, 95% CI: 2.34-3.82). The second column of Table 4 shows results from a similar model that includes respondents' characteristics. There was too much imprecision in the coefficient for age to make any inference about that variable. Men had a 44% higher odds of being willing to enroll than women (OR: 1.44, 95% CI: 1.10-1.90). Perhaps not

surprisingly, respondents with a longer history of benzodiazepine use had a lower willingness to enroll. Respondents in the lower income group were more likely to be willing to enroll as compared to those with higher income (OR: 1.66, 95% CI: 1.11-2.32). Figure 3 shows the predicted willingness to enroll when the incentive amount for successful discontinuation is varied. The predicted enrollment rate among respondents was around 50% with an incentive of $200 and reached 80% when the incentive is set at $1,500.

Discussion

These results suggest that the enrollment rate among survey respondents for a behavioral economics trial encouraging benzodiazepine taper and discontinuation might range from 50% if the incentive for successful discontinuation was $200 and up to 80% if the incentive were $1,500. However, as only 28.4% of eligible patients agreed to participate and returned the survey, the real-world enrollment rate among eligible patients might be closer to 14% (28% × 50%) to 22% (28% × 80%). The choice models indicate that all four studied program characteristics (amount of cash incentive to start the program, amount of incentive provided conditional on successful discontinuation, half of the incentive received if the dose is cut in half, and incentive format) influenced the probability of choosing a given program. We found that respondents strongly favored cash incentives rather than lotteries of equal expected value, and that offering an incentive for reducing the dose by half is likely to increase enrollment. Further, willingness to participate was higher among men and low-income respondents and lower for respondents with a longer history of benzodiazepine use.

We conducted this choice experiment following best practice guidelines (Bridges et al., 2011) and within the population of interest, i.e. older adults taking benzodiazepines. While our study offers valuable insight into the acceptability and potential take-up of incentive programs for benzodiazepine discontinuation, it has several limitations. First, while stated preferences surveys have been widely used in health services research, it is important to keep in mind that we are analyzing hypothetical choices and therefore should interpret our results with caution, as real-world decisions may differ. Nevertheless, DCEs have been shown to provide relatively accurate predictions of behavior, with 80% agreement found between stated and revealed preferences (Lambooij et al., 2015, Salampessy et al., 2015). Also, beyond predicting choices, DCEs are helpful in understanding the relative importance of the various characteristics of the product or service under study. Second, we had an overall response rate of only 28.4%, which may reflect reluctance of people with long-term benzodiazepine use to discontinue (Cook et al., 2007). Finally, to keep the survey at a reasonable level of complexity and to reduce respondent burden, we did not state other potentially relevant features of an incentive program, such as program length, contacts with providers or formal record of behavior change.

This study is the first to provide insight into the acceptability potential use of financial incentives for benzodiazepine discontinuation. Knowing that potential participants are sensitive to the

incentive amount for initiating the program and for successful completion, lottery vs. certain payment, and partial payment for dose reduction will be helpful in informing the design of future trials. An economic evaluation of such a program would be helpful to assess the financial viability of such program and the potential return on investment/cost-effectiveness. In other words, are the benefits to patients in terms of avoided health care costs and improved quality of life from discontinuing benzodiazepines large enough to justify a monetary investment? Recent research has shown that the health benefits (quality of life gained) of some types of drugs are likely to be offset by an increase in future costs, even when limiting the analysis to one category of long-term costs (fall-related costs in this case) (Tannenbaum et al., 2015). A comprehensive cost-effectiveness modeling study might help better understand the potential returns of such investments, both in terms of avoided future costs and increase long-term quality of life.

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Conflict of interest

The authors have no conflicts in the cover letter as well as in the manuscript, as noted above

Author contributions

JM and DM led the design of the choice experiment. MB JF MR and SH contributed to the design of the choice experiment. JM performed the statistical analyses and drafted the methods and results sections. MB drafted the introduction. All authors contributed to the interpretation of results and manuscript write-up, and read and approved the final version of the manuscript.

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The Sponsor had no role in the design, analysis, and interpretation phases of the project.

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Table 1 – Attributes and levels

Attributes	Levels	Levels used for the "opt-out" option
Cash reward to start the program (take up)	$0, $10, $20, $50	$0
Incentive received conditional on successful discontinuation	$200, $400, $600, $1500	$0
Half of the incentive received if use is cut in half	Yes, No	No
Incentive format	Certain cash amount, lottery with a 1 in 10 chance of winning	Certain cash amount

Table 2 – Respondent characteristics (N=126)

Variables	Mean (IQR)
Demographic characteristics	
Age	63.4 (57-69)
Male	38%
Education: high school or less	27%
Income: less than $25,000/year	14%
Use of BZD	
Number of years of use	9.8 (4-15)
Frequency of use	
Once per week or less	19%
1-3 times per week	18%
Almost every day	13%
Every day	33%
Multiple times per day	16%
Ever tried to stop using BZD	45%
Anxiety (GAD-7)	
Minimal (>4)	30%
Mild (4-9)	33%
Moderate (10-14)	21%
Severe (>=15)	16%
Choice patterns	
Would you enroll?	
Always "yes"	49%
Always "no"	29%
Average number of "yes" (out of 6)	3.67
Proportion of "yes" (in all choice situations)	67%
Validity check	
Would you like to be contacted if such program started?	
"Yes" in the full sample	45%
"Yes" among those who answered always "no" to the question "Would you enroll?"	15%
"Yes" among those who answered "yes" at least once to the question "Would you enroll?"	57%

Table 3 – Baseline conditional logit model

Program feature	Coefficient.	95% Confidence Interval
Incentive for enrolling	0.0038	0.0014-0.0061
Incentive for successful benzodiazepine cessation	0.0003	0.0002-0.0005
Half incentive for reducing dose by half	0.3374	0.1776-0.4972
Cash rather than lottery	0.6602	0.4996-0.8208
N	**126**	
Pseudo-R2	**0.1065**	

Table 4 – Logit models for the willingness to enroll

	Model 1: excluding respondent characteristics		Model 2: including respondent characteristics	
Program feature	**Odds Ratio**	**95% CI**	**Odds Ratio**	**95% CI**
Incentive for enrolling (baseline: $0)				
$30	1.31	0.89-1.93	1.40	0.92-2.12
$50	1.96	1.37-2.81	2.02	1.37-2.97
$100	1.76	1.21-2.57	1.89	1.25-2.85
Incentive for successful benzodiazepine cessation (baseline: $200)				
$400	1.37	0.93-2.01	1.40	0.93-2.11
$600	1.82	1.25-2.66	1.88	1.25-2.81
$1,500	2.38	1.69-3.35	2.55	1.78-3.67
Half incentive for reducing dose by half	1.74	1.36-2.21	1.81	1.40-2.34
Cash rather than lottery	2.99	2.34-3.82	3.09	2.38-4.00
Age in years (continuous)	-	-	0.99	0.98-1.01
Years of use (continuous)	-	-	0.98	0.97-0.99
Gender (male)	-	-	1.48	1.13-1.92
Education: high school or less	-	-	1.87	0.54-6.5
Income: less than $25,000/year	-	-	1.61	1.11-2.32
Anxiety: severe	-	-	1.08	0.74-1.56
N	**126**		**115[a)]**	

a) Model 2 includes only 115 respondents due to missing data on some of the individual characteristics

Figures and legends

Figure 1: Example of choice question

Figure 2: Sample flow-chart

Figure 3: Predicted willingness to enroll by incentive amount for successful discontinuation - Estimated choice probabilities obtained using Model 1 in Table 4, and averaged by incentive amount

Which program do you prefer?

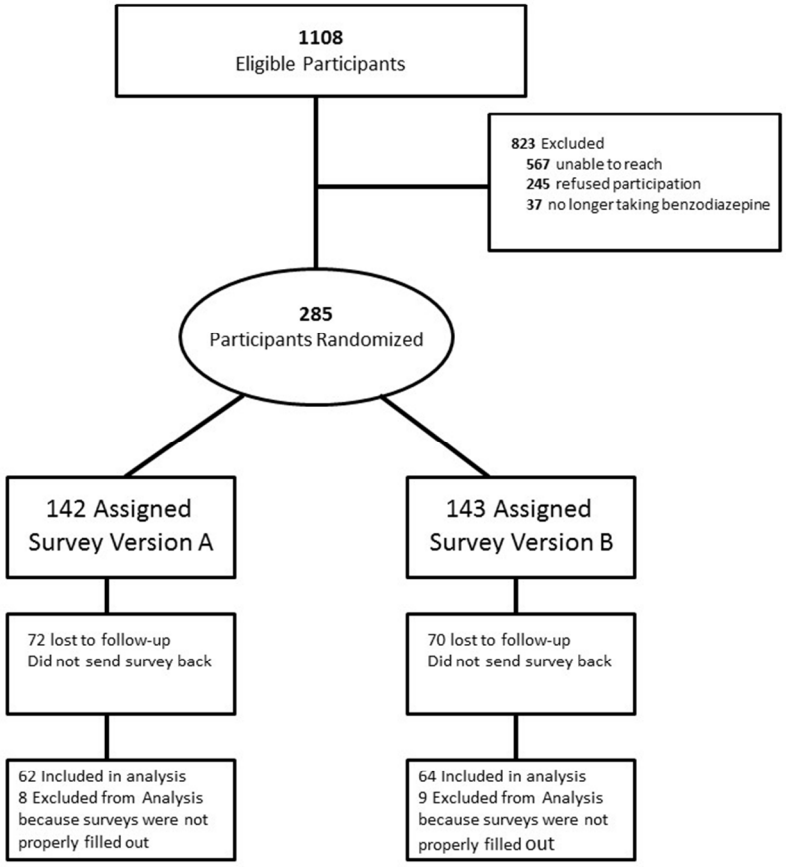
Program features	Program A	Program B
Reward for starting the program	$100 in cash	$50 in cash
Reward if you are able to completely stop using antianxiety medications by the end of the program	You enter a lottery and have a 1 in 10 chance of winning $4000 in cash	$600 in cash
Reward if you are unable to completely stop using antianxiety medications but still achieve to cut your use in half by the end of the program.	You enter a lottery and have a 1 in 10 chance of winning $2000 in cash	You don't receive any reward
Please mark which program you prefer (MARK ONLY ONE):	X	

Would you enroll in the program you picked above if you had the opportunity?

□ YES □ NO

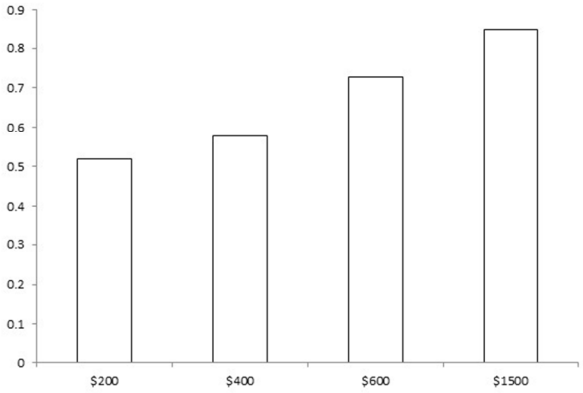
Example of choice question

254x190mm (96 x 96 DPI)



Sample flow-chart

215x279mm (96 x 96 DPI)



Predicted willingness to enroll by incentive amount for successful discontinuation - Estimated choice probabilities obtained using Model 1 in Table 4, and averaged by incentive amount

254x190mm (96 x 96 DPI)

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Financial incentives to discontinue long-term benzodiazepine use: patient preferences and willingness to participate

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Financial incentives to discontinue long-term benzodiazepine use: patient preferences and willingness to participate

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Abstract

Objectives: Investigate the acceptability of financial incentives for initiating a medically supervised benzodiazepine discontinuation program among people with long-term benzodiazepine use and to identify program features that influence willingness to participate.

Methods: We designed a discrete choice experiment in which we presented a variety of incentive-based programs to a sample of older adults with long-term benzodiazepine use identified using the outpatient electronic health record of a university-owned health system. We studied four program variables: incentive amount for initiating the program, incentive amount for successful benzodiazepine discontinuation, lottery vs. certain payment, and whether partial payment was given for dose reduction. Respondents reported their willingness to participate in the programs and additional information was collected on demographics, history of use, and anxiety symptoms.

Results: The overall response rate was 28.4%. Among the 126 respondents, all four program variables influenced stated preferences. Respondents strongly preferred guaranteed cash-based incentives as opposed to a lottery, and the dollar amount of both the starting and conditional incentives had a substantial impact on choice. Willingness to participate increased with the amount of conditional incentive. Program participation also varied by gender, duration of use, and income.

Conclusions: Participation in an incentive-based benzodiazepine discontinuation program might be relatively low, but is modifiable by program variables including incentive amounts. These results will be helpful to inform the design of future trials of benzodiazepine discontinuation programs. Further research is needed to assess the financial viability and potential cost-effectiveness of such economic incentives.

Keywords: benzodiazepines, addiction, older adults, financial incentives, behavioral economics

Strengths and limitations of this study

- This study is the first to provide evidence on the acceptability of financial incentives for benzodiazepine discontinuation in older adults with a history of long-term benzodiazepine use
- It provides insights into the preferences of this group of patients and will be helpful to inform the design of future trials of benzodiazepine discontinuation programs
- Our findings are limited by the relatively small number of participants and the focus on one study site
- As we are using a stated preferences method, it is not clear whether patients would make the exact same choices when faced with the real-life decision

Introduction

Benzodiazepines are frequently used to treat insomnia and anxiety disorders. In 2013, 8.6% of Americans age 65 or above filled one or more benzodiazepine prescription [1]. While short-term use for panic disorder and insomnia are supported by some clinical practice guidelines, [2-4] long-term use is associated with serious risks, including overdose [1], misuse and use disorder [5], falls [6], motor vehicle crashes [7], cognitive impairment [8], and dementia [9], particularly in older adults. Despite known risks associated with long-term use, discontinuing therapy with benzodiazepines can be very difficult because of physiological dependence as well as the potential for return of the symptoms that prompted benzodiazepine initiation [5]. While withdrawal symptoms can be mitigated in part by a slow taper [10], many patients are resistant to initiation of the taper [11]. Strategies such as providing patient education about the risks of benzodiazepine use have proven only modestly effective in encouraging discontinuation of therapy [12].

In this context, giving people monetary incentives conditional on achieving reduction in use and discontinuation might be a useful approach. Behavioral economic theory suggests that individuals exhibit present-bias, i.e. they tend to put a disproportionate weight on the present when making decisions [13]. Repeated choices (e.g., smoking the next cigarette) whose long-term consequences are likely to be underweighted in the decision-making process can lead to persistent unhealthy habits. Therefore, giving people monetary incentives conditional on achieving a specific health-related goal can make the benefits of behavior change immediate and more salient. This type of strategy is increasingly used and has been shown effective in several contexts [14-18].

Besides setting a monetary value that rewards a well-defined outcome, incentive design entails a careful consideration of a variety of features. Insights from behavioral economics, including loss aversion and the overweighting of small probabilities, suggest that characteristics of payments such as their frequency (regular vs. one-off), certainty (guaranteed payments vs. lotteries), or their nature (cash vs. vouchers), must be carefully considered as they can influence take-up and success. In

general, we would expect that higher incentive levels would lead to higher utility and higher predicted uptake. However, this is not always the case [19]. Previous research suggests that certain rewards are preferred to uncertain ones (such as lotteries) [20]. For this reason, and because discounting may be applied to future rewards, we might also expect that incentivized individuals would prefer incentives to be paid during the program rather than all at program end [21]. However, surprisingly little is known about the influence of incentive design on the willingness to participate in incentive-based programs and how to adapt the design to different populations/behaviors to maximize take-up. Identifying effective incentives becomes even more challenging when considering compulsive and potentially harmful behaviors that may be perceived as acceptable and safe such as the use of physician-prescribed drugs. Thus, there is a clear gap in knowledge about optimal incentive structure to present to individuals to induce program participation and healthy behavior change, and there is almost no work exploring what would be necessary to change behaviors that may not necessarily be perceived as unhealthy by patients. This study presents a unique opportunity to narrow this gap by focusing on patients with long-term prescription benzodiazepine use.

In this study, we used discrete choice experiments (DCE) to investigate the acceptability of financial incentives for initiating a medically supervised benzodiazepine discontinuation program among long-term benzodiazepine users and to identify program features that influence the willingness to participate. More specifically, we randomly presented a variety of incentive-based programs that differed according to a set of key features (e.g. incentive amount, lottery vs. certain payment) to a sample of older adults (age 50+) with long-term benzodiazepine use. We then asked respondents to report their willingness to participate in the programs and collected additional information on demographics, history of use, and anxiety symptoms. We used discrete choice modeling to investigate the trade-offs that individuals make between program features as well as patient factors that affect willingness to participate.

Methods

Data collection

We identified potential subjects from the patient population of the primary care and behavioral health outpatient practices of a university-owned health system. Eligible participants were aged 50 or older, with an anxiety diagnosis at any point as an outpatient or with anxiety listed on their active problem list within the electronic health record. Additionally, eligible participants must have had at least three benzodiazepine prescription orders in the previous 12 months, with the most recent prescription within 90 days of our initial screening for study participants. Those with a history of a seizure disorder were excluded. Before contacting any participants, we reached out to each provider to give them the opportunity to opt out any of their patients who they did not wish to participate in the study.

We contacted the remaining eligible participants by phone from May 2015 through August 2015. Contacted individuals who were no longer taking their benzodiazepine medication(s) were excluded as ineligible. Research staff obtained verbal consent by phone and subsequently randomized each participant to either version A or B of the study questionnaire. Stamped and addressed envelopes were provided with the questionnaires for participants to easily return the surveys. Upon sending back the survey, all participants were mailed a retail gift card worth $20. This study was deemed exempt from review by the University of Pennsylvania Institutional Review Board (protocol 820106).

Design of the choice experiment

DCEs have been used extensively to value goods and services for which there is no formal market or only incomplete markets [22]. In health and health care these techniques have been applied to address a wide variety of research questions including the elicitation of patients' preferences, the valuation of health outcomes and the trade-offs between health and non-health benefits of specific [22-24]. Importantly, recent studies have used DCEs to investigate the design of financial incentive programs [19, 25]. DCEs rely on random utility theory and are based on the assumption that the value of goods or services is best described by the sum of its attributes (or characteristics) and that people's choices are driven by the relative value of these characteristics. By presenting respondents with a series of choices between alternatives and by experimentally varying the characteristics of these alternatives, one is able to assess the trade-offs respondents make between product/service characteristics and to measure their influence on choices. A DCE consists of several interdependent steps: defining the attributes and their levels, experimental and survey design, data collection and statistical modeling [22].

We developed an initial list of potential attributes and levels of the tapering program via a review of the literature on the design of financial incentives for behavior change [26]. We then refined this list in a series of team meetings and through analysis of pilot data. In the final survey, we described hypothetical tapering programs using four characteristics: cash reward to start the program, the incentive amount received conditional on successful discontinuation, whether the conditional incentive was given in the form of a certain cash payment or via a lottery, and whether unsuccessful participants would still be rewarded for only cutting their use by half. These attributes and their respective levels are presented in Table 1. The next step consisted of combining attributes to form choice sets used to reveal patients' preferences. Because it would be infeasible to show respondents all possible combinations of attributes and levels (in our case, this would mean $4^2 \times 2^2 = 64$ possible combinations), we generated a fractional factorial design using the N-gene software to obtain a reasonable number of choice sets (i.e. 12) that is sufficient to estimate the main effects of interest. We then divided the 12 choice sets into two blocks of 6 choice sets to reduce respondent fatigue. While the number of choice sets was not found to be detrimental to DCE data quality [27], we had concerns that this could be an issue in older adults. In each choice set, respondents were asked 1) to choose

their preferred tapering program, and 2) to state whether or not they would enroll if such a program were available to them. As a simple validity check, we also asked respondents if they wanted to be contacted if a similar program started and gave them the opportunity to provide their contact information. An example of choice set is displayed in Figure 1. We also collected information on demographics (i.e. age, gender, education, income, and household size), history of benzodiazepine use, and current level of anxiety (measured using the GAD-7 scale) [28].

Statistical modeling

We started by describing our patient population and respondents' choice patterns. We then estimated simple conditional logit models to assess the trade-offs made by individuals between the various program characteristics, i.e. to assess the relative importance of these characteristics when making choices. We jointly modeled program choice and take-up by including an alternative-specific constant (ASC) for the opt-out option. Due to the limitation of the conditional logit model, which assumes homogeneous preferences in the population, we then estimated more flexible latent class logit models that identify a set of unobserved 'classes', or groups of individuals based on observed choice patterns. Separate parameter vectors (and variances) are estimated for each class, which allows for preference heterogeneity across the classes [29-32]. Our preferred model, based on the Akaike Information Criteria (AIC), included 2 classes. A feature of the latent class model is that, while we cannot directly observe a respondent's class membership, we can regress the probability of class membership on a set of individual characteristics to understand the composition of population classes. We complemented our analyses by predicting program take-up among survey respondents for a range of incentive amounts for successful discontinuation. This was done by calculating the choice probabilities of each option, including the opt-out, using Model 2 in Table 3. All analyses were performed using Stata 12 (StataCorp. 2011. Stata Statistical Software: Release 12. College Station, TX: StataCorp LP).

Results

In total we identified 1,108 potentially eligible participants. Of those, we could not reach 567 (reasons included being opted out by provider, invalid phone number, and not answering the phone after 3 attempts), 245 refused to participate, and 37 were ineligible as they were no longer taking benzodiazepines (Figure 2). We mailed the survey to the 285 remaining individuals and 143 returned their survey, giving rise to a 28.4% overall response rate (143 ÷ (1,108 – 567 – 37)) and a 50.2% response rate to the mailed survey among those who provided consent, which is in line with other DCE studies in health using postal surveys [33]. We further excluded 17 respondents due to incomplete responses to the choice questions. Therefore, 126 respondents provided complete and usable survey responses.

The majority of respondents were women (62%) and the average age of respondents was 63 years old (Table 2). On average, respondents have been taking benzodiazepines for 10 years, with

history of use ranging from 1 to 50 years. The majority of people took benzodiazepines daily or almost daily; only 19% took benzodiazepines once per week or less. Interestingly, 45% of respondents had previously tried to stop taking benzodiazepines. Most respondents (63%) had only minimal or mild anxiety as measured by the GAD-7 scale.

As an initial investigation of respondents' preferences, we summarized their general choice patterns. As explained above and shown in Figure 1, respondents were first asked to choose their preferred program and then asked to state their willingness to enroll if such a program were available. Responses to this second questions provided insight into the general willingness to enroll in incentive program in this population. Results showed that about 50% of respondents always (i.e. in all 6 choice sets presented) answered "yes" to the question "Would you enroll in the program you picked above if you had the opportunity?" Conversely about 30% of respondents always answered "no" to that question. On average, the proportion of "yes" responses across all respondents and choice sets was 67%, which reflects a fairly high potential enrollment rate among survey respondents. Interestingly, 57% of respondents who answered "yes" to the question "Would you enroll in the program you picked above if you had the opportunity?" at least once expressed an interest in being contacted if such program started, and shared their contact information.

The results from the conditional logit models shown in Table 3 suggest that all studied attributes had an influence on choices. More precisely, as we would expect, the higher the monetary amount for both incentives (start and completion), the higher the probability the respondent would choose that program. We also observed that respondents tended to favor programs that offer a reward even if complete discontinuation was not achieved. Finally, respondents in our sample were more likely to choose a program that offers a cash reward rather than a lottery with equal expected value. While we did not include any choice set aimed at testing respondents' rationality, we formally investigated attribute dominance (i.e. whether for some respondents, choices were driven by a single attribute) [34]. We identified 3 respondents that systematically chose the program with the highest incentive, but have decided not to exclude these as this does not necessarily reflect irrational behavior.

When heterogeneity in preferences is investigated using the latent class model (Model 2), we identify two distinct classes (or types) of respondents. Class 1 respondents have a high ASC, i.e. a strong preference for opting-out – these individuals can be considered as "non-traders" as it is highly unlikely that they will enroll. We don't observe any significant impact of program attributes in this group. These respondents represent 35.5% of the sample, which is in line with the observed rate of 30% in the choice patterns described above. Conversely, Class 2 respondents are responsive to all program characteristics and are highly likely to choose to enroll. The attributes coefficients are of similar magnitude than in the conditional logit model. The latent class logit framework allows to include individual characteristics directly in the model and assess their impact on probability of class membership. In other words, we model the probability for respondents to belong to the group of "non-traders" (i.e. Class 1). We find that male and lower income respondents were less likely to be non-

traders (they are less likely to opt-out) and, perhaps not surprisingly, that respondents with a longer history of benzodiazepine use were more likely to opt-out. Figure 3 shows the predicted choices when the incentive amount for successful discontinuation is varied. The predicted enrollment rate among respondents was around 55.8% with an incentive of $200 and reached 74.0% when the incentive is set at $2,000.

Discussion

These results suggest that the enrollment rate among survey respondents for a behavioral economics trial encouraging benzodiazepine taper and discontinuation might range from 56% if the incentive for successful discontinuation was $200 and up to 74% if the incentive were $2,000. However, as only 28.4% of eligible patients agreed to participate and returned the survey, the real-world enrollment rate among eligible patients might be lower. The choice models indicate that all four studied program characteristics (amount of cash incentive to start the program, amount of incentive provided conditional on successful discontinuation, half of the incentive received if the dose is cut in half, and incentive format) influenced the probability of choosing a given program. The expectations regarding the design features of the incentive scheme were largely supported by the results. We found that respondents strongly favored cash incentives rather than lotteries of equal expected value, and that offering an incentive for reducing the dose by half is likely to increase enrollment. Further, willingness to participate was higher among men and low-income respondents and lower for respondents with a longer history of benzodiazepine use.

We conducted this choice experiment following best practice guidelines [35] and within the population of interest, i.e. older adults taking benzodiazepines. While our study offers valuable insight into the acceptability and potential take-up of incentive programs for benzodiazepine discontinuation, it has several limitations. First, while stated preferences surveys have been widely used in health services research, it is important to keep in mind that we are analyzing hypothetical choices and therefore our results should be interpreted with caution, as real-world decisions may differ, especially if the setting – in particular features of the health system – differs widely from the U.S. context. Nevertheless, DCEs have been shown to provide relatively accurate predictions of behavior, with 80% agreement found between stated and revealed preferences [36, 37]. Also, beyond predicting choices, DCEs are helpful in understanding the relative importance of the various characteristics of the product or service under study. Second, we had an overall response rate of only 28.4%, which may reflect reluctance of people with long-term benzodiazepine use to discontinue [11]. Third, as we opted for a paper-based survey, we cannot be certain that respondents did not receive support from relatives to complete it. Finally, to keep the survey at a reasonable level of complexity and to reduce respondent burden, we did not state other potentially relevant features of an incentive program, such as program length, contacts with providers or formal record of behavior change.

This study is the first to provide insight into the acceptability of financial incentives for benzodiazepine discontinuation. Knowing that potential participants are sensitive to the incentive amount for initiating the program and for successful completion, prefer certain vs. lottery payment, and prefer partial payment for dose reduction will be helpful in informing the design of future trials. Naturally, even if the intervention were effective in bringing about benzodiazepine discontinuation or dose reduction in a substantial number of participants, the long-term effects on health outcomes such as falls, automobile crashes, cognitive decline, and quality of life would need to be demonstrated. Further, an economic evaluation of such a program would be helpful to assess its financial viability and the potential return on investment/cost-effectiveness. In other words, from a health system perspective, are the benefits to patients in terms of avoided health care costs and improved health outcomes from discontinuing benzodiazepines large enough to justify a monetary investment? Recent research has shown that the health benefits (quality of life gained) of some types of drugs are likely to be offset by an increase in future costs, even when limiting the analysis to one category of long-term costs (fall-related costs in this case) [38]. A comprehensive cost-effectiveness modeling study might help to better understand the potential returns of such investments, both in terms of avoided future costs and increase long-term quality of life.

Acknowledgments

Conflict of interest

The authors have no conflicts in the cover letter as well as in the manuscript, as noted above

Author contributions

JM and DM led the design of the choice experiment. MB JF MR and SH contributed to the design of the choice experiment. JM performed the statistical analyses and drafted the methods and results sections. MB drafted the introduction. All authors contributed to the interpretation of results and manuscript write-up, and read and approved the final version of the manuscript.

Sponsor's role

The Sponsor had no role in the design, analysis, and interpretation phases of the project.

Data sharing statement

Our informed consent document does not permit sharing of patient-level data.

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Table 1 – Attributes and levels

Attributes	Levels	Levels used for the "opt-out" option
Cash reward to start the program (take up)	$0, $10, $20, $50	$0
Incentive received conditional on successful discontinuation	$200, $400, $600, $1500	$0
Half of the incentive received if use is cut in half	Yes, No	No
Incentive format	Certain cash amount, lottery with a 1 in 10 chance of winning	Certain cash amount

Table 2 – Respondent characteristics (N=126)

Variables	Mean (IQR)
Demographic characteristics	
Age	63.4 (57-69)
Male	38%
Education: high school or less	27%
Income: less than $25,000/year	14%
Use of BZD	
Number of years of use	9.8 (4-15)
Frequency of use	
Once per week or less	19%
1-3 times per week	18%
Almost every day	13%
Every day	33%
Multiple times per day	16%
Ever tried to stop using BZD	45%
Anxiety (GAD-7)	
Minimal (>4)	30%
Mild (4-9)	33%
Moderate (10-14)	21%
Severe (>=15)	16%
Choice patterns	
Would you enroll?	
Always "yes"	49%
Always "no"	29%
Average number of "yes" (out of 6)	3.67
Proportion of "yes" (in all choice situations)	67%
Validity check	
Would you like to be contacted if such program started?	
"Yes" in the full sample	45%
"Yes" among those who answered always "no" to the question "Would you enroll?"	15%
"Yes" among those who answered "yes" at least once to the question "Would you enroll?"	57%

Table 3 – Choice models

	Model 1: Conditional logit		Model 2: Latent class logit			
Utility function			**Class 1 ("non-traders")**		**Class 2**	
	Coefficient	95% Confidence Interval	Coefficient	95% Confidence Interval	Coefficient	95% Confidence Interval
Opt-out ASC[a)]	0.6064	0.3274-0.8855	5.4439	3.2462-7.6417	-1.8744	-2.4692- -1.2797
Incentive for enrolling	0.0044	0.0016-0.0072	0.0126	-0.0103-0.0356	0.0049	0.0018-0.0081
Incentive for successful benzodiazepine cessation	0.0004	0.0002-0.0006	0.0007	-0.0008-0.0022	0.0005	0.0003-0.0007
Half incentive for reducing dose by half	0.3576	0.1623-0.5529	0.8525	-1.2748-2.9798	0.3947	0.1825-0.6070
Cash rather than lottery	0.7207	0.5213-0.9200	1.0786	-0.9806-3.1378	0.7362	0.5208-0.9517
Probability of Class 1 membership						
Age in years (continuous)			-0.0098	-0.0485-0.0288		
Years of use (continuous)			0.0418	0.0002-0.0739		
Gender (male)			-0.7132	-1.6357- -0.0093		
Education: high school or less			0.2782	-0.5978-1.1541		
Income: less than $25,000/year			-0.6573	-1.8428- -0.0528		
Anxiety: severe			-0.0789	-0.0848-0.6900		
			Class share:	**0.355**		**0.645**
N	**126**					

a) Alternative-specific constant

Figures and legends

Figure 1: Example of choice question

Figure 2: Sample flow-chart

Figure 3: Predicted enrollment by incentive amount for successful discontinuation - Estimated choice probabilities obtained using Model 2 in Table 3

Which program do you prefer?

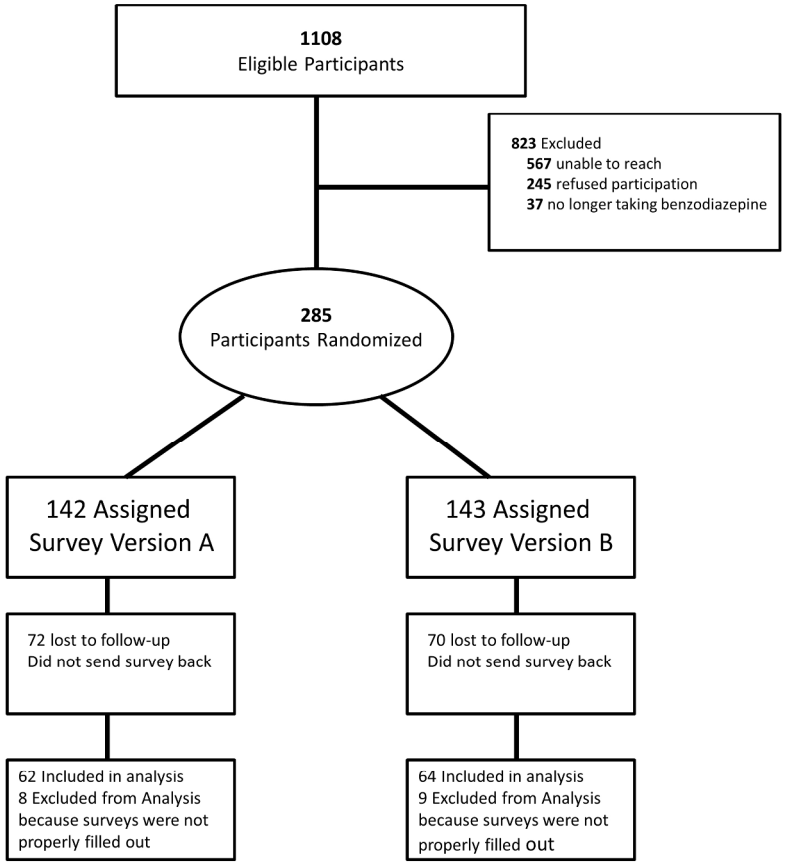
Program features	Program A	Program B
Reward for starting the program	$100 in cash	$50 in cash
Reward if you are able to completely stop using antianxiety medications by the end of the program	You enter a lottery and have a 1 in 10 chance of winning $4000 in cash	$600 in cash
Reward if you are unable to completely stop using antianxiety medications but still achieve to cut your use in half by the end of the program.	You enter a lottery and have a 1 in 10 chance of winning $2000 in cash	You don't receive any reward
Please mark which program you prefer (MARK ONLY ONE):	X	

Would you enroll in the program you picked above if you had the opportunity?

□ YES □ NO

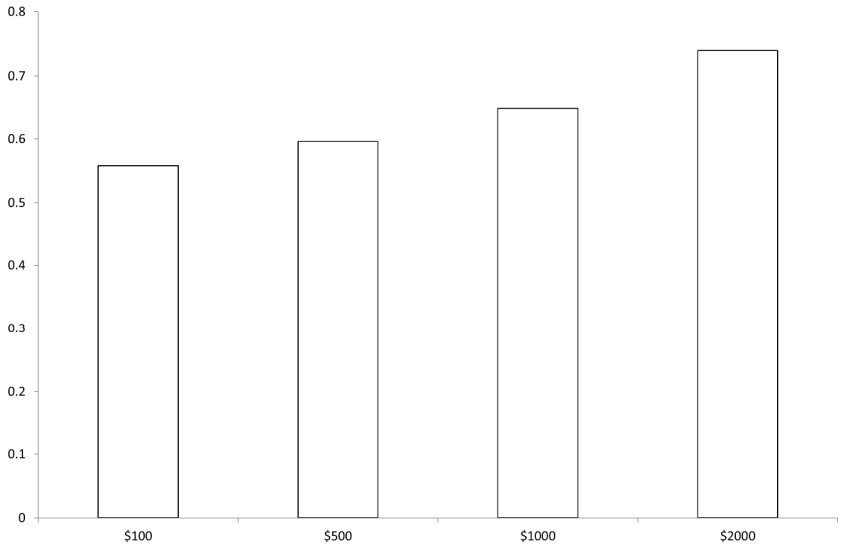
Example of choice question

254x190mm (300 x 300 DPI)



Sample flow-chart

215x279mm (300 x 300 DPI)



Predicted enrollment by incentive amount for successful discontinuation - Estimated choice probabilities obtained using Model 2 in Table 3

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Financial incentives to discontinue long-term benzodiazepine use: patient preferences and willingness to participate

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Financial incentives to discontinue long-term benzodiazepine use: patient preferences and willingness to participate

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Abstract

Objectives: Investigate the acceptability of financial incentives for initiating a medically supervised benzodiazepine discontinuation program among people with long-term benzodiazepine use and to identify program features that influence willingness to participate.

Methods: We conducted a discrete choice experiment in which we presented a variety of incentive-based programs to a sample of older adults with long-term benzodiazepine use identified using the outpatient electronic health record of a university-owned health system. We studied four program variables: incentive amount for initiating the program, incentive amount for successful benzodiazepine discontinuation, lottery vs. certain payment, and whether partial payment was given for dose reduction. Respondents reported their willingness to participate in the programs and additional information was collected on demographics, history of use, and anxiety symptoms.

Results: The overall response rate was 28.4%. Among the 126 respondents, all four program variables influenced stated preferences. Respondents strongly preferred guaranteed cash-based incentives as opposed to a lottery, and the dollar amount of both the starting and conditional incentives had a substantial impact on choice. Willingness to participate increased with the amount of conditional incentive. Program participation also varied by gender, duration of use, and income.

Conclusions: Participation in an incentive-based benzodiazepine discontinuation program might be relatively low, but is modifiable by program variables including incentive amounts. These results will be helpful to inform the design of future trials of benzodiazepine discontinuation programs. Further research is needed to assess the financial viability and potential cost-effectiveness of such economic incentives.

Keywords: benzodiazepines, addiction, older adults, financial incentives, behavioral economics

Strengths and limitations of this study

- This study is the first to provide evidence on the acceptability of financial incentives for benzodiazepine discontinuation in older adults with a history of long-term benzodiazepine use
- It provides insights into the preferences of this group of patients and will be helpful to inform the design of future trials of benzodiazepine discontinuation programs
- Our findings are limited by the relatively small number of participants and the focus on one study site
- As we are using a stated preferences method, it is not clear whether patients would make the exact same choices when faced with the real-life decision

Introduction

Benzodiazepines are frequently used to treat insomnia and anxiety disorders. In 2013, 8.6% of Americans age 65 or above filled one or more benzodiazepine prescription [1]. While short-term use for panic disorder and insomnia are supported by some clinical practice guidelines, [2-4] long-term use is associated with serious risks, including overdose [1], misuse and use disorder [5], falls [6], motor vehicle crashes [7], cognitive impairment [8], and dementia [9], particularly in older adults. Despite known risks associated with long-term use, discontinuing therapy with benzodiazepines can be very difficult because of physiological dependence as well as the potential for return of the symptoms that prompted benzodiazepine initiation [5]. While withdrawal symptoms can be mitigated in part by a slow taper [10], many patients are resistant to initiation of the taper [11]. Strategies such as providing patient education about the risks of benzodiazepine use have proven only modestly effective in encouraging discontinuation of therapy [12].

In this context, giving people monetary incentives conditional on achieving reduction in use and discontinuation might be a useful approach. Standard economic theory suggests that giving people monetary incentives conditional on achieving a specific health-related goal can make the net benefits of behavior change positive, immediate and more tangible for some individuals, and therefore increase the likelihood of seeing the target population adopt healthier behaviors [13]. While this type of strategy is increasingly used and has been shown effective in several contexts [14-19], no studies have explored the use of incentives in benzodiazepine use. Besides setting a monetary value that rewards a well-defined outcome, incentive design entails a careful consideration of a variety of features, especially in the case of behaviors involving repeated choices whose long term consequences are likely to be underweighted in the decision making process and can lead to persistent unhealthy habits. Characteristics of payments such as their frequency (regular vs. one-off) [20], certainty (guaranteed payments vs. lotteries) [21], or their nature (cash vs. vouchers), must be considered as they can influence take-up and success. Also, individuals often exhibit decision-making biases such as

loss aversion, present bias [22] or the overweighting of small probabilities and previous work has shown that financial incentives designed around these biases are particularly effective in influencing behaviors [23]. However, relatively little is known about the influence of incentive design on the willingness to participate in incentive-based programs and how to adapt the design to different populations/behaviors to maximize take-up, especially in the case of older adults. Previous work in this population group has shown that even small incentives are likely to increase stated uptake of a physical activity program and that cash incentives were preferred over vouchers [24]. A recent UK study on acceptability of financial incentives targeted a range of behaviors showed that lottery-based incentives were not deemed acceptable and that older people preferred programs with no incentives [25] Identifying effective incentives becomes even more challenging when considering compulsive and potentially harmful behaviors that may be perceived as acceptable and safe such as the use of physician-prescribed drugs in general and benzodiazepine use in particular. Thus, there is a clear gap in knowledge about optimal incentive structure to present to older individuals to induce program participation for healthy behavior change. This study presents a unique opportunity to narrow this gap by focusing on patients with long-term prescription benzodiazepine use.

In this study, we used a discrete choice experiment (DCE) to investigate the acceptability of financial incentives for initiating a medically supervised benzodiazepine discontinuation program among long-term benzodiazepine users and to identify program features that influence the willingness to participate. More specifically, we randomly presented a variety of incentive-based programs that differed according to a set of key features (e.g. incentive amount, lottery vs. certain payment) to a sample of older adults (age 50+) with long-term benzodiazepine use. We then asked respondents to report their willingness to participate in the programs and collected additional information on demographics, history of use, and anxiety symptoms. We used discrete choice modeling to investigate the trade-offs that individuals make between program features as well as patient factors that affect willingness to participate.

Methods

Data collection

We identified potential subjects from the patient population of the primary care and behavioral health outpatient practices of a university-owned health system. Eligible participants were aged 50 or older, with an anxiety diagnosis at any point as an outpatient or with anxiety listed on their active problem list within the electronic health record. Additionally, eligible participants must have had at least three benzodiazepine prescription orders in the previous 12 months, with the most recent prescription within 90 days of our initial screening for study participants. Those with a history of a seizure disorder were excluded. Before contacting any participants, we reached out to each provider to give them the opportunity to opt out any of their patients who they did not wish to participate in the study.

We contacted the remaining eligible participants by phone from May 2015 through August 2015. Contacted individuals who were no longer taking their benzodiazepine medication(s) were excluded as ineligible. Research staff obtained verbal consent by phone and subsequently randomized each participant to either version A or B of the study questionnaire (see design below). Stamped and addressed envelopes were provided with the questionnaires for participants to easily return the surveys. Upon sending back the survey, all participants were mailed a retail gift card worth $20. The study was considered exempt from institutional review board oversight under exemption category 2 (i.e. research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior, and was deemed exempt by the University of Pennsylvania Institutional Review Board (protocol 820106) as (i) no information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects; and (ii) no disclosure of the human subjects' responses outside the research could reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects' financial standing, employability, or reputation). All survey responses were securely stored and all identifying information was destroyed once the surveys were returned.

Design of the choice experiment

DCEs have been used extensively to value goods and services for which there is no formal market or only incomplete markets [26]. In health and health care these techniques have been applied to address a wide variety of research questions including the elicitation of patients' preferences, the valuation of health outcomes and the trade-offs between health and non-health benefits of specific [26-28]. Importantly, recent studies have used DCEs to investigate the design of financial incentive programs [24, 29-31]. DCEs rely on random utility theory and are based on the assumption that the value of goods or services is best described by the sum of its attributes (or characteristics) and that people's choices are driven by the relative value of these characteristics. By presenting respondents with a series of choices between alternatives and by experimentally varying the characteristics of these alternatives, one is able to assess the trade-offs respondents make between product/service characteristics and to measure their influence on choices. A DCE consists of several interdependent steps: defining the attributes and their levels, experimental and survey design, data collection and statistical modeling [26].

We developed an initial list of potential attributes and levels of the tapering program via a review of the literature on the design of financial incentives for behavior change [32]. We then refined this list in a series of team meetings and through analysis of pilot data. In the final survey, we described hypothetical tapering programs using four characteristics: cash reward to start the program, the incentive amount received conditional on successful discontinuation, whether the conditional incentive was given in the form of a certain cash payment or via a lottery, and whether unsuccessful participants would still be rewarded for only cutting their use by half. These attributes and their

respective levels are presented in Table 1. The next step consisted of combining attributes to form choice sets used to reveal patients' preferences. Because it would be infeasible to show respondents all possible combinations of attributes and levels (in our case, this would mean $4^2 \times 2^2 = 64$ possible combinations), we generated a fractional factorial design using the N-gene software to obtain a reasonable number of choice sets (i.e. 12) that is sufficient to estimate the main effects of interest. We then divided the 12 choice sets into two blocks of 6 choice sets to reduce respondent fatigue, giving rise to two versions of the questionnaire (i.e. A and B). While the number of choice sets was not found to be detrimental to DCE data quality [33], we had concerns that this could be an issue in older adults. In each choice set, respondents were asked 1) to choose their preferred tapering program, and 2) to state whether or not they would enroll if such a program were available to them. As a simple validity check, we also asked respondents if they wanted to be contacted if a similar program started and gave them the opportunity to provide their contact information. An example of choice set is displayed in Figure 1. We also collected information on demographics (i.e. age, gender, education, income, and household size), history of benzodiazepine use, and current level of anxiety (measured using the GAD-7 scale) [34].

Statistical modeling

We started by describing our patient population and respondents' choice patterns. We then estimated simple conditional logit models to assess the trade-offs made by individuals between the various program characteristics, i.e. to assess the relative importance of these characteristics when making choices. We jointly modeled program choice and take-up by including an alternative-specific constant (ASC) for the opt-out option. Due to the limitation of the conditional logit model, which assumes homogeneous preferences in the population, we then estimated more flexible latent class logit models that identify a set of unobserved 'classes', or groups of individuals based on observed choice patterns. Separate parameter vectors (and variances) are estimated for each class, which allows for preference heterogeneity across the classes [35-38]. Our preferred model, based on the Akaike Information Criteria (AIC), included 2 classes. A feature of the latent class model is that, while we cannot directly observe a respondent's class membership, we can model the likelihood of class membership as a function of individual characteristics to understand the composition of population classes. We complemented our analyses by predicting program take-up among survey respondents for a range of incentive amounts for successful discontinuation. This was done by calculating the choice probabilities of each option, including the opt-out, using the latent class model. All analyses were performed using Stata 12 (StataCorp. 2011. Stata Statistical Software: Release 12. College Station, TX: StataCorp LP).

Results

We identified 1,108 potentially eligible participants. Of those, we could not reach 567 (reasons included being opted out by provider, invalid phone number, and not answering the phone after 3 attempts), 245 refused to participate, and 37 were ineligible as they were no longer taking benzodiazepines (Figure 2). We mailed the survey to the 285 remaining individuals and 143 returned their survey, giving rise to a 28.4% overall response rate (143 ÷ (1,108 – 567 – 37)) and a 50.2% response rate to the mailed survey among those who provided consent, which is in line with other DCE studies in health using postal surveys [39]. We further excluded 17 respondents due to incomplete responses to the choice questions. Therefore, 126 respondents provided complete and usable survey responses.

The majority of respondents were women (62%) and the average age of respondents was 63 years old (Table 2). On average, respondents have been taking benzodiazepines for 10 years, with history of use ranging from 1 to 50 years. The majority of people took benzodiazepines daily or almost daily; only 19% took benzodiazepines once per week or less. Interestingly, 45% of respondents had previously tried to stop taking benzodiazepines. Most respondents (63%) had only minimal or mild anxiety as measured by the GAD-7 scale.

As an initial investigation of respondents' preferences, we summarized their general choice patterns. As explained above and shown in Figure 1, respondents were first asked to choose their preferred program and then asked to state their willingness to enroll if such a program were available. Responses to this second questions provided insight into the general willingness to enroll in incentive program in this population. Results showed that about 50% of respondents always (i.e. in all 6 choice sets presented) answered "yes" to the question "Would you enroll in the program you picked above if you had the opportunity?" Conversely about 30% of respondents always answered "no" to that question. On average, the proportion of "yes" responses across all respondents and choice sets was 67%, which reflects a fairly high potential enrollment rate among survey respondents. Interestingly, 57% of respondents who answered "yes" to the question "Would you enroll in the program you picked above if you had the opportunity?" at least once expressed an interest in being contacted if such program started, and shared their contact information.

The results from the conditional logit models shown in Table 3 suggest that all studied attributes had an influence on choices. More precisely, as we would expect, the higher the monetary amount for both incentives (start and completion), the higher the probability the respondent would choose that program. We also observed that respondents tended to favor programs that offer a reward even if complete discontinuation was not achieved. Finally, respondents in our sample were more likely to choose a program that offers a cash reward rather than a lottery with equal expected value. While we did not include any choice set aimed at testing respondents' rationality, we formally investigated attribute dominance (i.e. whether for some respondents, choices were driven by a single attribute) [40]. We identified 3 respondents who systematically chose the program with the highest incentive, but have decided not to exclude these as this does not necessarily reflect irrational behavior.

When heterogeneity in preferences is investigated using the latent class model (Model 2), we identify two distinct classes (or types) of respondents. Class 1 respondents have a high ASC, i.e. a strong preference for opting-out – these individuals can be considered as "non-traders" as it is highly unlikely that they will enroll. We don't observe any significant impact of program attributes in this group. These respondents represent 35.5% of the sample, which is in line with the observed rate of 30% in the choice patterns described above. Conversely, Class 2 respondents are responsive to all program characteristics and are highly likely to choose to enroll. The attributes coefficients are of similar magnitude than in the conditional logit model. The latent class logit framework allows to model the likelihood of class membership as a function of individual characteristics. In other words, we model the probability for respondents to belong to the group of "non-traders" (i.e. Class 1). We find that male and lower income respondents were less likely to be non-traders (they are less likely to opt-out) and, perhaps not surprisingly, that respondents with a longer history of benzodiazepine use were more likely to opt-out. Figure 3 shows the predicted choices when the incentive amount for successful discontinuation is varied. The predicted enrollment rate among respondents was around 55.8% with an incentive of $200 and reached 74.0% when the incentive is set at $2,000.

Discussion

These results suggest that the enrollment rate among survey respondents for a behavioral economics trial encouraging benzodiazepine taper and discontinuation might range from 56% if the incentive for successful discontinuation was $200 and up to 74% if the incentive were $2,000. However, as only 28.4% of eligible patients agreed to participate and returned the survey, the real-world enrollment rate among eligible patients might be lower. The choice models indicate that all four studied program characteristics (amount of cash incentive to start the program, amount of incentive provided conditional on successful discontinuation, half of the incentive received if the dose is cut in half, and incentive format) influenced the probability of choosing a given program. The expectations regarding the design features of the incentive scheme were largely supported by the results. While higher incentives led to higher predicted uptake, the relationship was not linear, as found previously [24]. We also found that respondents strongly favored cash incentives rather than lotteries of equal expected value, and that offering an incentive for reducing the dose by half is likely to increase enrollment. Further, willingness to participate was higher among men and low-income respondents and lower for respondents with a longer history of benzodiazepine use.

We conducted this choice experiment following best practice guidelines [41] and within the population of interest, i.e. older adults taking benzodiazepines. While our study offers valuable insight into the acceptability and potential take-up of incentive programs for benzodiazepine discontinuation, it has several limitations. First, while stated preferences surveys have been widely used in health services research, it is important to keep in mind that we are analyzing hypothetical choices and therefore our results should be interpreted with caution, as real-world decisions may differ, especially

if the setting – in particular features of the health system – differs widely from the U.S. context. Nevertheless, DCEs have been shown to provide relatively accurate predictions of behavior, with 80% agreement found between stated and revealed preferences [42, 43]. Also, beyond predicting choices, DCEs are helpful in understanding the relative importance of the various characteristics of the product or service under study. Second, we had an overall response rate of only 28.4%, which may reflect reluctance of people with long-term benzodiazepine use to discontinue [11]. Third, as we opted for a paper-based survey, we cannot be certain that respondents did not receive support from friends or relatives to complete it. Finally, to keep the survey at a reasonable level of complexity and to reduce respondent burden, we did not state other potentially relevant features of an incentive program, such as program length, contacts with providers or formal record of behavior change.

This study is the first to provide insight into the acceptability of financial incentives for benzodiazepine discontinuation. Knowing that potential participants are sensitive to the incentive amount for initiating the program and for successful completion, prefer certain vs. lottery payment, and prefer partial payment for dose reduction will be helpful in informing the design of future trials. Naturally, even if the intervention were effective in bringing about benzodiazepine discontinuation or dose reduction in a substantial number of participants, the long-term effects on health outcomes such as falls, automobile crashes, cognitive decline, and quality of life would need to be demonstrated. Further, an economic evaluation of such a program would be helpful to assess its financial viability and the potential return on investment/cost-effectiveness. In other words, from a health system perspective, are the benefits to patients in terms of avoided health care costs and improved health outcomes from discontinuing benzodiazepines large enough to justify a monetary investment? Recent research has shown that the health benefits (quality of life gained) of some types of drugs are likely to be offset by an increase in future costs, even when limiting the analysis to one category of long-term costs (fall-related costs in this case) [44]. A comprehensive cost-effectiveness modeling study might help to better understand the potential returns of such investments, both in terms of avoided future costs and increase long-term quality of life.

Acknowledgments

Conflict of interest

The authors have no conflicts in the cover letter as well as in the manuscript, as noted above

Author contributions

JM and DM led the design of the choice experiment. MB JF MR and SH contributed to the design of the choice experiment. JM performed the statistical analyses and drafted the methods and results sections. MB drafted the introduction. All authors contributed to the interpretation of results and manuscript write-up, and read and approved the final version of the manuscript.

Sponsor's role

The Sponsor had no role in the design, analysis, and interpretation phases of the project.

Data sharing statement

Our informed consent document does not permit sharing of patient-level data.

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Table 1 – Attributes and levels

Attributes	Levels	Levels used for the "opt-out" option
Cash reward to start the program (take up)	$0, $10, $20, $50	$0
Incentive received conditional on successful discontinuation	$200, $400, $600, $1500	$0
Half of the incentive received if use is cut in half	Yes, No	No
Incentive format	Certain cash amount, lottery with a 1 in 10 chance of winning	Certain cash amount

Table 2 – Respondent characteristics (N=126)

Variables	Mean (IQR)
Demographic characteristics	
Age	63.4 (57-69)
Male	38%
Education: high school or less	27%
Income: less than $25,000/year	14%
Use of BZD	
Number of years of use	9.8 (4-15)
Frequency of use	
Once per week or less	19%
1-3 times per week	18%
Almost every day	13%
Every day	33%
Multiple times per day	16%
Ever tried to stop using BZD	45%
Anxiety (GAD-7)	
Minimal (>4)	30%
Mild (4-9)	33%
Moderate (10-14)	21%
Severe (>=15)	16%
Choice patterns	
Would you enroll?	
Always "yes"	49%
Always "no"	29%
Average number of "yes" (out of 6)	3.67
Proportion of "yes" (in all choice situations)	67%
Validity check	
Would you like to be contacted if such program started?	
"Yes" in the full sample	45%
"Yes" among those who answered always "no" to the question "Would you enroll?"	15%
"Yes" among those who answered "yes" at least once to the question "Would you enroll?"	57%

Table 3 – Choice models

	Model 1: Conditional logit		Model 2: Latent class logit			
Utility function			**Class 1 ("non-traders")**		**Class 2**	
	Coefficient	95% Confidence Interval	Coefficient	95% Confidence Interval	Coefficient	95% Confidence Interval
Opt-out ASC[a)]	0.6064	0.3274-0.8855	5.4439	3.2462-7.6417	-1.8744	-2.4692- -1.2797
Incentive for enrolling	0.0044	0.0016-0.0072	0.0126	-0.0103-0.0356	0.0049	0.0018-0.0081
Incentive for successful benzodiazepine cessation	0.0004	0.0002-0.0006	0.0007	-0.0008-0.0022	0.0005	0.0003-0.0007
Half incentive for reducing dose by half	0.3576	0.1623-0.5529	0.8525	-1.2748-2.9798	0.3947	0.1825-0.6070
Cash rather than lottery	0.7207	0.5213-0.9200	1.0786	-0.9806-3.1378	0.7362	0.5208-0.9517
Probability of Class 1 membership						
Age in years (continuous)			-0.0098	-0.0485-0.0288		
Years of use (continuous)			0.0418	0.0002-0.0739		
Gender (male)			-0.7132	-1.6357- -0.0093		
Education: high school or less			0.2782	-0.5978-1.1541		
Income: less than $25,000/year			-0.6573	-1.8428- -0.0528		
Anxiety: severe			-0.0789	-0.0848-0.6900		
			Class share:	**0.355**		**0.645**
N	**126**					

a) Alternative-specific constant

Figures and legends

Figure 1: Example of choice question

Figure 2: Sample flow-chart

Figure 3: Predicted enrollment by incentive amount for successful discontinuation - Estimated choice probabilities obtained using Model 2 in Table 3

Which program do you prefer?

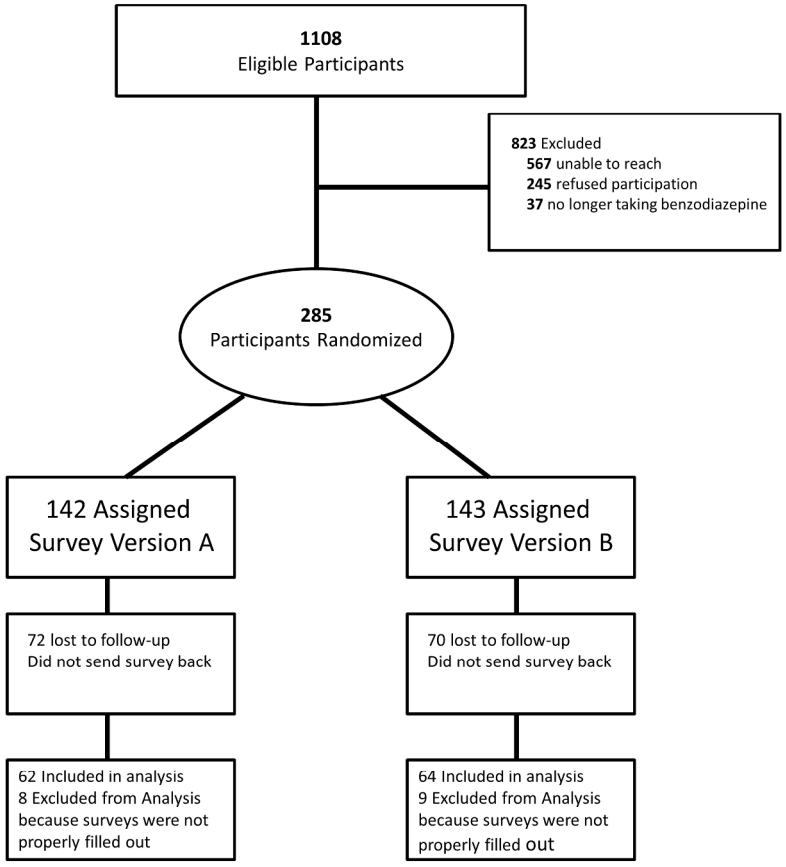
Program features	Program A	Program B
Reward for starting the program	$100 in cash	$50 in cash
Reward if you are able to completely stop using antianxiety medications by the end of the program	You enter a lottery and have a 1 in 10 chance of winning $4000 in cash	$600 in cash
Reward if you are unable to completely stop using antianxiety medications but still achieve to cut your use in half by the end of the program.	You enter a lottery and have a 1 in 10 chance of winning $2000 in cash	You don't receive any reward
Please mark which program you prefer (MARK ONLY ONE):	X	

Would you enroll in the program you picked above if you had the opportunity?

□ YES □ NO

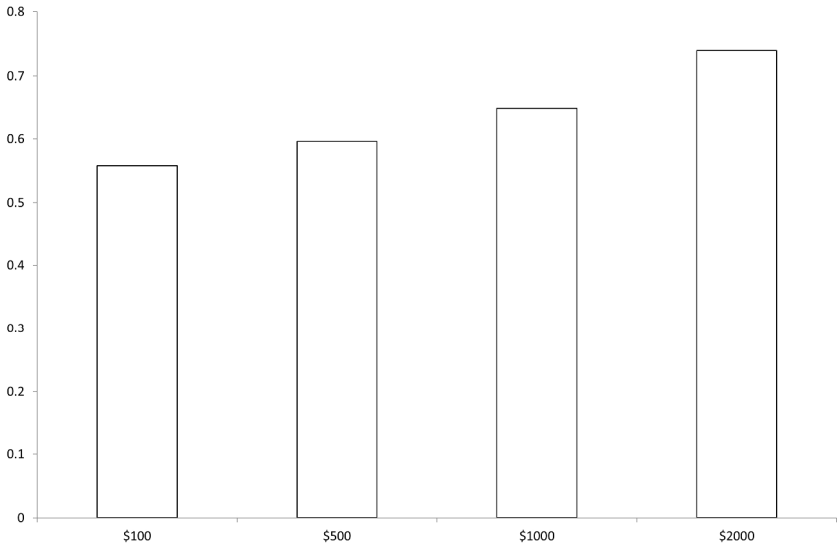
Example of choice question

254x190mm (300 x 300 DPI)



Sample flow-chart

215x279mm (300 x 300 DPI)



Predicted enrollment by incentive amount for successful discontinuation - Estimated choice probabilities obtained using Model 2 in Table 3

254x190mm (300 x 300 DPI)

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Financial incentives to discontinue long-term benzodiazepine use: a discrete choice experiment investigating patient preferences and willingness to participate

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Financial incentives to discontinue long-term benzodiazepine use: a discrete choice experiment investigating patient preferences and willingness to participate

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Abstract

Objectives: Investigate the acceptability of financial incentives for initiating a medically supervised benzodiazepine discontinuation program among people with long-term benzodiazepine use and to identify program features that influence willingness to participate.

Methods: We conducted a discrete choice experiment in which we presented a variety of incentive-based programs to a sample of older adults with long-term benzodiazepine use identified using the outpatient electronic health record of a university-owned health system. We studied four program variables: incentive amount for initiating the program, incentive amount for successful benzodiazepine discontinuation, lottery vs. certain payment, and whether partial payment was given for dose reduction. Respondents reported their willingness to participate in the programs and additional information was collected on demographics, history of use, and anxiety symptoms.

Results: The overall response rate was 28.4%. Among the 126 respondents, all four program variables influenced stated preferences. Respondents strongly preferred guaranteed cash-based incentives as opposed to a lottery, and the dollar amount of both the starting and conditional incentives had a substantial impact on choice. Willingness to participate increased with the amount of conditional incentive. Program participation also varied by gender, duration of use, and income.

Conclusions: Participation in an incentive-based benzodiazepine discontinuation program might be relatively low, but is modifiable by program variables including incentive amounts. These results will be helpful to inform the design of future trials of benzodiazepine discontinuation programs. Further research is needed to assess the financial viability and potential cost-effectiveness of such economic incentives.

Keywords: benzodiazepines, addiction, older adults, financial incentives, behavioral economics

Strengths and limitations of this study

- This study is the first to provide evidence on the acceptability of financial incentives for benzodiazepine discontinuation in older adults with a history of long-term benzodiazepine use
- It provides insights into the preferences of this group of patients and will be helpful to inform the design of future trials of benzodiazepine discontinuation programs
- Our findings are limited by the relatively small number of participants and the focus on one study site
- As we are using a stated preferences method, it is not clear whether patients would make the exact same choices when faced with the real-life decision

Introduction

Benzodiazepines are frequently used to treat insomnia and anxiety disorders. In 2013, 8.6% of Americans age 65 or above filled one or more benzodiazepine prescription [1]. While short-term use for panic disorder and insomnia are supported by some clinical practice guidelines, [2-4] long-term use is associated with serious risks, including overdose [1], misuse and use disorder [5], falls [6], motor vehicle crashes [7], cognitive impairment [8], and dementia [9], particularly in older adults. Despite known risks associated with long-term use, discontinuing therapy with benzodiazepines can be very difficult because of physiological dependence as well as the potential for return of the symptoms that prompted benzodiazepine initiation [5]. While withdrawal symptoms can be mitigated in part by a slow taper [10], many patients are resistant to initiation of the taper [11]. Strategies such as providing patient education about the risks of benzodiazepine use have proven only modestly effective in encouraging discontinuation of therapy [12].

In this context, giving people monetary incentives conditional on achieving reduction in use and discontinuation might be a useful approach. Standard economic theory suggests that giving people monetary incentives conditional on achieving a specific health-related goal can make the net benefits of behavior change positive, immediate and more tangible for some individuals, and therefore increase the likelihood of seeing the target population adopt healthier behaviors [13]. While this type of strategy is increasingly used and has been shown effective in several contexts [14-19], no studies have explored the use of incentives in benzodiazepine use. Besides setting a monetary value that rewards a well-defined outcome, incentive design entails a careful consideration of a variety of features, especially in the case of behaviors involving repeated choices whose long term consequences are likely to be underweighted in the decision making process and can lead to persistent unhealthy habits. Characteristics of payments such as their frequency (regular vs. one-off) [20], certainty (guaranteed payments vs. lotteries) [21], or their nature (cash vs. vouchers), must be considered as they can influence take-up and success. Also, individuals often exhibit decision-making biases such as

loss aversion, present bias [22] or the overweighting of small probabilities and previous work has shown that financial incentives designed around these biases are particularly effective in influencing behaviors [23]. However, relatively little is known about the influence of incentive design on the willingness to participate in incentive-based programs and how to adapt the design to different populations/behaviors to maximize take-up, especially in the case of older adults. Previous work in this population group has shown that even small incentives are likely to increase stated uptake of a physical activity program and that cash incentives were preferred over vouchers [24]. A recent UK study on acceptability of financial incentives targeted a range of behaviors showed that lottery-based incentives were not deemed acceptable and that older people preferred programs with no incentives [25] Identifying effective incentives becomes even more challenging when considering compulsive and potentially harmful behaviors that may be perceived as acceptable and safe such as the use of physician-prescribed drugs in general and benzodiazepine use in particular. Thus, there is a clear gap in knowledge about optimal incentive structure to present to older individuals to induce program participation for healthy behavior change. This study presents a unique opportunity to narrow this gap by focusing on patients with long-term prescription benzodiazepine use.

In this study, we used a discrete choice experiment (DCE) to investigate the acceptability of financial incentives for initiating a medically supervised benzodiazepine discontinuation program among long-term benzodiazepine users and to identify program features that influence the willingness to participate. More specifically, we randomly presented a variety of incentive-based programs that differed according to a set of key features (e.g. incentive amount, lottery vs. certain payment) to a sample of older adults (age 50+) with long-term benzodiazepine use. We then asked respondents to report their willingness to participate in the programs and collected additional information on demographics, history of use, and anxiety symptoms. We used discrete choice modeling to investigate the trade-offs that individuals make between program features as well as patient factors that affect willingness to participate.

Methods

Data collection

We identified potential subjects from the patient population of the primary care and behavioral health outpatient practices of a university-owned health system. Eligible participants were aged 50 or older, with an anxiety diagnosis at any point as an outpatient or with anxiety listed on their active problem list within the electronic health record. Additionally, eligible participants must have had at least three benzodiazepine prescription orders in the previous 12 months, with the most recent prescription within 90 days of our initial screening for study participants. Those with a history of a seizure disorder were excluded. Before contacting any participants, we reached out to each provider to give them the opportunity to opt out any of their patients who they did not wish to participate in the study.

We contacted the remaining eligible participants by phone from May 2015 through August 2015. Contacted individuals who were no longer taking their benzodiazepine medication(s) were excluded as ineligible. Research staff obtained verbal consent by phone and subsequently randomized each participant to either version A or B of the study questionnaire (see design below). Stamped and addressed envelopes were provided with the questionnaires for participants to easily return the surveys. Upon sending back the survey, all participants were mailed a retail gift card worth $20. The study was considered exempt from institutional review board oversight under exemption category 2 (i.e. research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior, and was deemed exempt by the University of Pennsylvania Institutional Review Board (protocol 820106) as (i) no information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects; and (ii) no disclosure of the human subjects' responses outside the research could reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects' financial standing, employability, or reputation). All survey responses were securely stored and all identifying information was destroyed once the surveys were returned.

Design of the choice experiment

DCEs have been used extensively to value goods and services for which there is no formal market or only incomplete markets [26]. In health and health care these techniques have been applied to address a wide variety of research questions including the elicitation of patients' preferences, the valuation of health outcomes and the trade-offs between health and non-health benefits of specific [26-28]. Importantly, recent studies have used DCEs to investigate the design of financial incentive programs [24, 29-31]. DCEs rely on random utility theory and are based on the assumption that the value of goods or services is best described by the sum of its attributes (or characteristics) and that people's choices are driven by the relative value of these characteristics. By presenting respondents with a series of choices between alternatives and by experimentally varying the characteristics of these alternatives, one is able to assess the trade-offs respondents make between product/service characteristics and to measure their influence on choices. A DCE consists of several interdependent steps: defining the attributes and their levels, experimental and survey design, data collection and statistical modeling [26].

We developed an initial list of potential attributes and levels of the tapering program via a review of the literature on the design of financial incentives for behavior change [32]. We then refined this list in a series of team meetings and through analysis of pilot data. In the final survey, we described hypothetical tapering programs using four characteristics: cash reward to start the program, the incentive amount received conditional on successful discontinuation, whether the conditional incentive was given in the form of a certain cash payment or via a lottery, and whether unsuccessful participants would still be rewarded for only cutting their use by half. These attributes and their

respective levels are presented in Table 1. The next step consisted of combining attributes to form choice sets used to reveal patients' preferences. Because it would be infeasible to show respondents all possible combinations of attributes and levels (in our case, this would mean $4^2 \times 2^2 = 64$ possible combinations), we generated a fractional factorial design using the N-gene software to obtain a reasonable number of choice sets (i.e. 12) that is sufficient to estimate the main effects of interest. We then divided the 12 choice sets into two blocks of 6 choice sets to reduce respondent fatigue, giving rise to two versions of the questionnaire (i.e. A and B). While the number of choice sets was not found to be detrimental to DCE data quality [33], we had concerns that this could be an issue in older adults. In each choice set, respondents were asked 1) to choose their preferred tapering program, and 2) to state whether or not they would enroll if such a program were available to them. As a simple validity check, we also asked respondents if they wanted to be contacted if a similar program started and gave them the opportunity to provide their contact information. An example of choice set is displayed in Figure 1. We also collected information on demographics (i.e. age, gender, education, income, and household size), history of benzodiazepine use, and current level of anxiety (measured using the GAD-7 scale) [34].

Statistical modeling

We started by describing our patient population and respondents' choice patterns. We then estimated simple conditional logit models to assess the trade-offs made by individuals between the various program characteristics, i.e. to assess the relative importance of these characteristics when making choices. We jointly modeled program choice and take-up by including an alternative-specific constant (ASC) for the opt-out option. Due to the limitation of the conditional logit model, which assumes homogeneous preferences in the population, we then estimated more flexible latent class logit models that identify a set of unobserved 'classes', or groups of individuals based on observed choice patterns. Separate parameter vectors (and variances) are estimated for each class, which allows for preference heterogeneity across the classes [35-38]. Our preferred model, based on the Akaike Information Criteria (AIC), included 2 classes. A feature of the latent class model is that, while we cannot directly observe a respondent's class membership, we can model the likelihood of class membership as a function of individual characteristics to understand the composition of population classes. We complemented our analyses by predicting program take-up among survey respondents for a range of incentive amounts for successful discontinuation. This was done by calculating the choice probabilities of each option, including the opt-out, using the latent class model. All analyses were performed using Stata 12 (StataCorp. 2011. Stata Statistical Software: Release 12. College Station, TX: StataCorp LP).

Results

We identified 1,108 potentially eligible participants. Of those, we could not reach 567 (reasons included being opted out by provider, invalid phone number, and not answering the phone after 3 attempts), 245 refused to participate, and 37 were ineligible as they were no longer taking benzodiazepines (Figure 2). We mailed the survey to the 285 remaining individuals and 143 returned their survey, giving rise to a 28.4% overall response rate (143 ÷ (1,108 – 567 – 37)) and a 50.2% response rate to the mailed survey among those who provided consent, which is in line with other DCE studies in health using postal surveys [39]. We further excluded 17 respondents due to incomplete responses to the choice questions. Therefore, 126 respondents provided complete and usable survey responses.

The majority of respondents were women (62%) and the average age of respondents was 63 years old (Table 2). On average, respondents have been taking benzodiazepines for 10 years, with history of use ranging from 1 to 50 years. The majority of people took benzodiazepines daily or almost daily; only 19% took benzodiazepines once per week or less. Interestingly, 45% of respondents had previously tried to stop taking benzodiazepines. Most respondents (63%) had only minimal or mild anxiety as measured by the GAD-7 scale.

As an initial investigation of respondents' preferences, we summarized their general choice patterns. As explained above and shown in Figure 1, respondents were first asked to choose their preferred program and then asked to state their willingness to enroll if such a program were available. Responses to this second questions provided insight into the general willingness to enroll in incentive program in this population. Results showed that about 50% of respondents always (i.e. in all 6 choice sets presented) answered "yes" to the question "Would you enroll in the program you picked above if you had the opportunity?" Conversely about 30% of respondents always answered "no" to that question. On average, the proportion of "yes" responses across all respondents and choice sets was 67%, which reflects a fairly high potential enrollment rate among survey respondents. Interestingly, 57% of respondents who answered "yes" to the question "Would you enroll in the program you picked above if you had the opportunity?" at least once expressed an interest in being contacted if such program started, and shared their contact information.

The results from the conditional logit models shown in Table 3 suggest that all studied attributes had an influence on choices. More precisely, as we would expect, the higher the monetary amount for both incentives (start and completion), the higher the probability the respondent would choose that program. We also observed that respondents tended to favor programs that offer a reward even if complete discontinuation was not achieved. Finally, respondents in our sample were more likely to choose a program that offers a cash reward rather than a lottery with equal expected value. While we did not include any choice set aimed at testing respondents' rationality, we formally investigated attribute dominance (i.e. whether for some respondents, choices were driven by a single attribute) [40]. We identified 3 respondents who systematically chose the program with the highest incentive, but have decided not to exclude these as this does not necessarily reflect irrational behavior.

When heterogeneity in preferences is investigated using the latent class model (Model 2), we identify two distinct classes (or types) of respondents. Class 1 respondents have a high ASC, i.e. a strong preference for opting-out – these individuals can be considered as "non-traders" as it is highly unlikely that they will enroll. We don't observe any significant impact of program attributes in this group. These respondents represent 35.5% of the sample, which is in line with the observed rate of 30% in the choice patterns described above. Conversely, Class 2 respondents are responsive to all program characteristics and are highly likely to choose to enroll. The attributes coefficients are of similar magnitude than in the conditional logit model. The latent class logit framework allows to model the likelihood of class membership as a function of individual characteristics. In other words, we model the probability for respondents to belong to the group of "non-traders" (i.e. Class 1). We find that male and lower income respondents were less likely to be non-traders (they are less likely to opt-out) and, perhaps not surprisingly, that respondents with a longer history of benzodiazepine use were more likely to opt-out. Figure 3 shows the predicted choices when the incentive amount for successful discontinuation is varied. The predicted enrollment rate among respondents was around 55.8% with an incentive of $200 and reached 74.0% when the incentive is set at $2,000.

Discussion

These results suggest that the enrollment rate among survey respondents for a behavioral economics trial encouraging benzodiazepine taper and discontinuation might range from 56% if the incentive for successful discontinuation was $200 and up to 74% if the incentive were $2,000. However, as only 28.4% of eligible patients agreed to participate and returned the survey, the real-world enrollment rate among eligible patients might be lower. The choice models indicate that all four studied program characteristics (amount of cash incentive to start the program, amount of incentive provided conditional on successful discontinuation, half of the incentive received if the dose is cut in half, and incentive format) influenced the probability of choosing a given program. The expectations regarding the design features of the incentive scheme were largely supported by the results. While higher incentives led to higher predicted uptake, the relationship was not linear, as found previously [24]. We also found that respondents strongly favored cash incentives rather than lotteries of equal expected value, and that offering an incentive for reducing the dose by half is likely to increase enrollment. Further, willingness to participate was higher among men and low-income respondents and lower for respondents with a longer history of benzodiazepine use.

We conducted this choice experiment following best practice guidelines [41] and within the population of interest, i.e. older adults taking benzodiazepines. While our study offers valuable insight into the acceptability and potential take-up of incentive programs for benzodiazepine discontinuation, it has several limitations. First, while stated preferences surveys have been widely used in health services research, it is important to keep in mind that we are analyzing hypothetical choices and therefore our results should be interpreted with caution, as real-world decisions may differ, especially

if the setting – in particular features of the health system – differs widely from the U.S. context. Nevertheless, DCEs have been shown to provide relatively accurate predictions of behavior, with 80% agreement found between stated and revealed preferences [42, 43]. Also, beyond predicting choices, DCEs are helpful in understanding the relative importance of the various characteristics of the product or service under study. Second, we had an overall response rate of only 28.4%, which may reflect reluctance of people with long-term benzodiazepine use to discontinue [11]. Third, as we opted for a paper-based survey, we cannot be certain that respondents did not receive support from friends or relatives to complete it. Finally, to keep the survey at a reasonable level of complexity and to reduce respondent burden, we did not state other potentially relevant features of an incentive program, such as program length, contacts with providers or formal record of behavior change.

This study is the first to provide insight into the acceptability of financial incentives for benzodiazepine discontinuation. Knowing that potential participants are sensitive to the incentive amount for initiating the program and for successful completion, prefer certain vs. lottery payment, and prefer partial payment for dose reduction will be helpful in informing the design of future trials. Naturally, even if the intervention were effective in bringing about benzodiazepine discontinuation or dose reduction in a substantial number of participants, the long-term effects on health outcomes such as falls, automobile crashes, cognitive decline, and quality of life would need to be demonstrated. Further, an economic evaluation of such a program would be helpful to assess its financial viability and the potential return on investment/cost-effectiveness. In other words, from a health system perspective, are the benefits to patients in terms of avoided health care costs and improved health outcomes from discontinuing benzodiazepines large enough to justify a monetary investment? Recent research has shown that the health benefits (quality of life gained) of some types of drugs are likely to be offset by an increase in future costs, even when limiting the analysis to one category of long-term costs (fall-related costs in this case) [44]. A comprehensive cost-effectiveness modeling study might help to better understand the potential returns of such investments, both in terms of avoided future costs and increase long-term quality of life.

Acknowledgments

Conflict of interest

The authors have no conflicts in the cover letter as well as in the manuscript, as noted above

Author contributions

JM and DM led the design of the choice experiment. MB JF MR and SH contributed to the design of the choice experiment. JM performed the statistical analyses and drafted the methods and results sections. MB drafted the introduction. All authors contributed to the interpretation of results and manuscript write-up, and read and approved the final version of the manuscript.

Sponsor's role

The Sponsor had no role in the design, analysis, and interpretation phases of the project.

Data sharing statement

Our informed consent document does not permit sharing of patient-level data.

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Table 1 – Attributes and levels

Attributes	Levels	Levels used for the "opt-out" option
Cash reward to start the program (take up)	$0, $10, $20, $50	$0
Incentive received conditional on successful discontinuation	$200, $400, $600, $1500	$0
Half of the incentive received if use is cut in half	Yes, No	No
Incentive format	Certain cash amount, lottery with a 1 in 10 chance of winning	Certain cash amount

Table 2 – Respondent characteristics (N=126)

Variables	Mean (IQR)
Demographic characteristics	
Age	63.4 (57-69)
Male	38%
Education: high school or less	27%
Income: less than $25,000/year	14%
Use of BZD	
Number of years of use	9.8 (4-15)
Frequency of use	
Once per week or less	19%
1-3 times per week	18%
Almost every day	13%
Every day	33%
Multiple times per day	16%
Ever tried to stop using BZD	45%
Anxiety (GAD-7)	
Minimal (>4)	30%
Mild (4-9)	33%
Moderate (10-14)	21%
Severe (>=15)	16%
Choice patterns	
Would you enroll?	
Always "yes"	49%
Always "no"	29%
Average number of "yes" (out of 6)	3.67
Proportion of "yes" (in all choice situations)	67%
Validity check	
Would you like to be contacted if such program started?	
"Yes" in the full sample	45%
"Yes" among those who answered always "no" to the question "Would you enroll?"	15%
"Yes" among those who answered "yes" at least once to the question "Would you enroll?"	57%

Table 3 – Choice models

	Model 1: Conditional logit		Model 2: Latent class logit			
Utility function			**Class 1 ("non-traders")**		**Class 2**	
	Coefficient	95% Confidence Interval	Coefficient	95% Confidence Interval	Coefficient	95% Confidence Interval
Opt-out ASC[a)]	0.6064	0.3274-0.8855	5.4439	3.2462-7.6417	-1.8744	-2.4692- -1.2797
Incentive for enrolling	0.0044	0.0016-0.0072	0.0126	-0.0103-0.0356	0.0049	0.0018-0.0081
Incentive for successful benzodiazepine cessation	0.0004	0.0002-0.0006	0.0007	-0.0008-0.0022	0.0005	0.0003-0.0007
Half incentive for reducing dose by half	0.3576	0.1623-0.5529	0.8525	-1.2748-2.9798	0.3947	0.1825-0.6070
Cash rather than lottery	0.7207	0.5213-0.9200	1.0786	-0.9806-3.1378	0.7362	0.5208-0.9517
Probability of Class 1 membership						
Age in years (continuous)			-0.0098	-0.0485-0.0288		
Years of use (continuous)			0.0418	0.0002-0.0739		
Gender (male)			-0.7132	-1.6357- -0.0093		
Education: high school or less			0.2782	-0.5978-1.1541		
Income: less than $25,000/year			-0.6573	-1.8428- -0.0528		
Anxiety: severe			-0.0789	-0.0848-0.6900		
			Class share:	**0.355**		**0.645**
N	**126**					

a) Alternative-specific constant

Figures and legends

Figure 1: Example of choice question

Figure 2: Sample flow-chart

Figure 3: Predicted enrollment by incentive amount for successful discontinuation - Estimated choice probabilities obtained using Model 2 in Table 3

Which program do you prefer?

Program features	Program A	Program B
Reward for starting the program	$100 in cash	$50 in cash
Reward if you are able to completely stop using antianxiety medications by the end of the program	You enter a lottery and have a 1 in 10 chance of winning $4000 in cash	$600 in cash
Reward if you are unable to completely stop using antianxiety medications but still achieve to cut your use in half by the end of the program.	You enter a lottery and have a 1 in 10 chance of winning $2000 in cash	You don't receive any reward
Please mark which program you prefer (MARK ONLY ONE):	X	

Would you enroll in the program you picked above if you had the opportunity?

□ YES □ NO

Example of choice question

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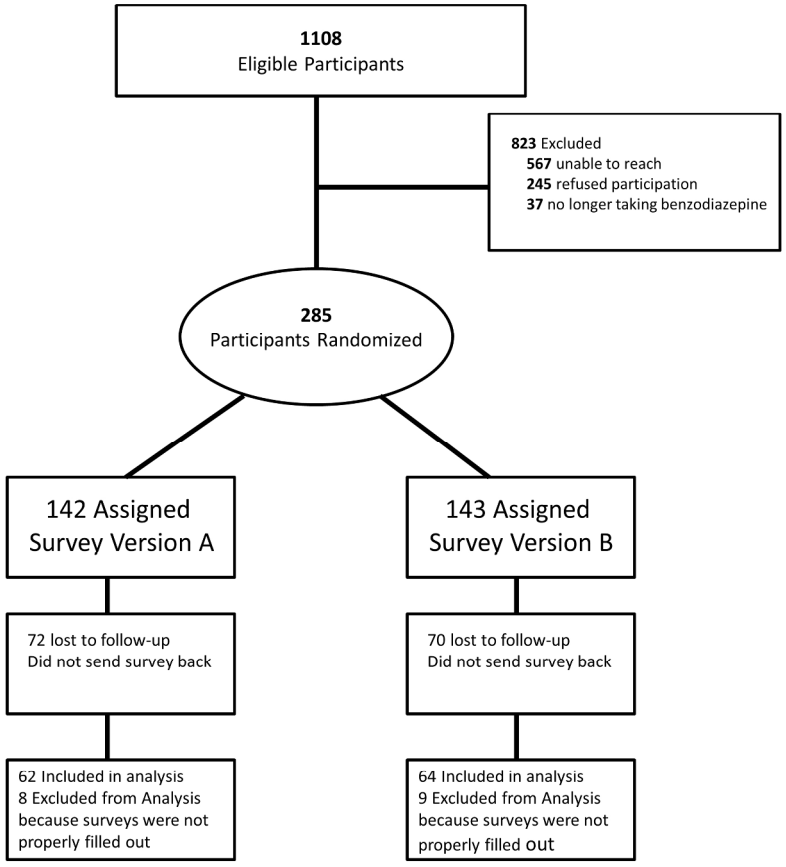
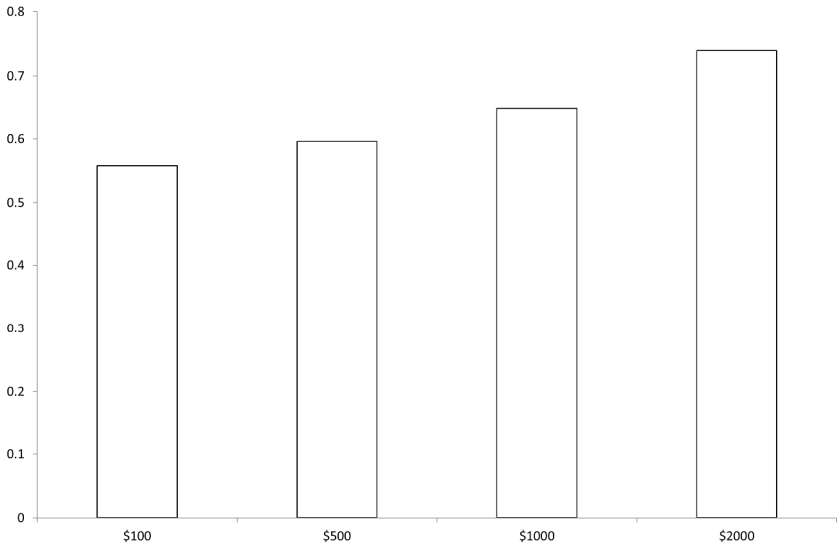


Sample flow-chart

215x279mm (300 x 300 DPI)



Predicted enrollment by incentive amount for successful discontinuation - Estimated choice probabilities obtained using Model 2 in Table 3

254x190mm (300 x 300 DPI)