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Paper 12-02

The Interpretation of Health Care Need Among the General Public: An Empirical Investigation using a Discrete-Choice Approach

September 2012

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Abstract

Need is a central concept for health systems. Allocation according to need is the stated objective of public health systems around the world and need figures prominently in economic analysis in the health sector. Need has no universally accepted definition but, especially in the context of resource allocation, the definition of need adopted matters importantly. This study uses a stated-preference, discrete-choice experiment and develops a new latent class rank-ordered logit econometric estimator to investigate empirically the support among the general public for each of three commonly cited definitions of need: need as a person's baseline health status; need as a person's ability-to-benefit; and need as the amount of resources required to exhaust a person's ability-to-benefit. The analysis of their judgments reveals two important types of heterogeneity in interpretations of need: (1) heterogeneity across members of the public — the analysis identifies three distinct patterns in judgments of need distinguished by the emphasis placed on each of the three definitions of need investigated and by the nature of relationship between a definition and need; and (2) heterogeneity within individuals — for two of the three latent classes, judgments of need are influenced by all three definitions; only in one class did judgments depend clearly on a single definition. Among the three definitions, baseline health status emerges as the most influential determinant of need. When eliciting the views of the public to inform resource allocation or priority setting, it is important to avoid general phrases or principles, such as "allocation according to need," which the public may interpret quite differently than health analysts.

Acknowledgements

This research was funded by grant # 76670 from the Canadian Institutes of Health Research. We also acknowledge funding from the Ontario Ministry of Health and Long-Term Care to the Centre for Health Economics and Policy Analysis. We thank Neil Buckley, Tony Culyer, Kate Cuff, Stuart Mestelman, Andrew Muller, and Jingjing Zhang for helpful comments, and Dave Cameron and Aleksandra Gajic for excellent research assistance. The views expressed are ours alone, as are any errors.

Keywords: need, resource allocation. discrete-choice experiment, stated-preference, latent class model

JEL Classifications: H23, I18, C91

1 Introduction

Need is a central — indeed, some have argued indispensable (Culyer, 1995) — concept for health systems. Allocation according to need is the stated objective of public health systems around the world (van Doorslaer et al., 1993). Need figures prominently in many philosophers' and ethicists' analysis of the just basis for allocating health care (e.g., Daniels, 1985). Health economists argue that the concept of need is essential for economic analysis in the health sector (Williams, 1978; Evans, 1984; Culyer, 1995). And when members of the public are asked about the fairest way to divide the limited supply of health care among individuals who can benefit from that care, the most frequently chosen principle is allocation according to need (rather than, for instance, equal division of the resource among the individuals) (Hurley et al., 2011).

Yet, need has no universally accepted definition. Indeed, much of the practical business of health care systems proceeds leaving the notion of need largely undefined. This state of affairs is not for lack of effort by philosophers, ethicists, economists, political scientists, sociologists, public health scientists, and others, who have debated the nature of needs for decades, including questions such as whether human needs are objective or subjective, the political nature of need, the relation between needs and rights, and the role of individuals versus communities in defining needs (Robertson 1998). Despite important differences, these analyses reveal widespread (though not universal) agreement on some issues: needs differ from wants and the distinction between needs and wants can be defined only in relation to community values; the presence of a need carries with it a duty by others to respond (though this duty is not absolute); need is an instrumental concept; and the relevant notion of need can differ depending on the context and question at hand. The absence of an explicit definition in health policy may also reflect strategic and practical considerations, especially when making coverage decisions: need does not have to be defined precisely and explicitly to be useful, and ambiguity provides funders greater flexibility (Charles et al., 1997; Hurley et al., 1997).

Still, as Culyer and Wagstaff (1993) emphasized, in the context of resource allocation the definition of need one adopts does make a difference: even if we were to agree on the principle of allocation-according-to-need, different allocations follow from different definitions of need. Their analysis emphasized three commonly cited definitions of need: need as baseline health status, need as capacity-to-benefit, and need as the amount of resources required to exhaust benefit. They argued that for the purpose of guiding resource allocation, the third definition — need as the amount of resources required to exhaust benefit — is to be preferred. Even among economists, however, this argument has been challenged by those who argue that, at least in some circumstances, baseline health status should influence the allocation of resources among those in need of care (e.g, Richardson and McKie, 2005; Cuadras-Morato et al., 2001). Although the public strongly supports the principle of allocation according to need, we have little understanding of how ordinary citizens interpret "need for health care."

This study investigates how members of the general public interpret health care need. We empirically examine the support among the general public for each of three commonly cited definitions of need emphasized by Culyer and Wagstaff 1993: need as a person's baseline health status; need as a person's ability-to-benefit; and need as the amount of resources required to exhaust a person's ability-to-benefit. We do so using a stated-preference, discrete-choice experiment in which individuals are presented with a hypothetical scenario involving three individuals characterized according to their health status, ability to benefit from health care, and the amount of health care required to exhaust benefit. Respondents were then asked which person in the scenario has the greatest need and which has the least need. The design allowed for the possibility that among the general public no single definition of need holds universally. Not only may sub-groups of the population subscribe to different definitions, but a given individual may draw on all three concepts, giving different consideration to each depending on the specific case at hand.[1] Hence, judgments of need would reflect a process in which the weight given to a specific criterion could vary across cases. This design can accommodate as a special case the possibility that a person always bases

[1]Similar to the phenomenon discussed in Konow (2003) regarding judgment of justice and equity. The literature documents that few people's judgments of what is just draw on a single over-riding principle applied to every situation. Instead, people base judgments on a small number of foundational principles they weigh differently depending on the decision context.

judgments of need on a single need criteria, but it allows for more complex processes, including interactions among the relevant criteria.

The study makes two types of contributions. First, it fits within a growing empirical literature at the intersection of economics and ethics that investigates, and in some cases even tests, public support for ethical concepts and principles that heretofore had been subject solely to conceptual analysis and argument (Konow, 2003; Richardson and McKie, 2005; Frohlich et al., 1987). The fact that a majority of the public thinks a particular way does not make it right or determinative, but this approach can inject new perspectives and empirical content into what has historically been a purely conceptual inquiry. Furthermore, given the increasing emphasis on public consultation as part of health policy development (Abelson et al., 2003; National Institute for Health and Clinical Guidance, 2008; Menon and Stafinski, 2008; Bombard et al., 2011), especially regarding priority setting, understanding how the public interprets the concept of need for health care is important. Second, it extends the latent class family of econometric estimators for choice models by developing a rank-ordered conditional logit speci

cation incorporating unobserved heterogeneity and panel data structures, which accommodates scenarios where individuals are asked to rank the alternatives presented to them as opposed to indicating their preferred choice.

2 Methods/Experimental Design

We investigated people's judgments of need using a discrete-choice methodology in which the choice scenarios include individuals described by attributes associated with each of three above-noted prominent definitions of need: baseline health status, ability to benefit from health care, and the amount of health care resources required to exhaust benefit. The discrete-choice experiment randomized the combinations of these attributes assigned to individuals across the choice scenarios, thereby allowing us to estimate the emphasis subjects place on each definition when deciding who among a group of individuals has the greatest need.

2.1 Choice Scenarios and Attributes

The survey questionnaire included three parts: an introduction and scenario description; a set of choice problems; and a short demographic survey. The introduction noted that the health care systems of many countries around the world, including Canada, are designed to provide services to individuals based on their need for care, that it can be difficult for both providers and health systems managers to assess people's need for care, that there is no universal agreement on what is most important in determining an individual's need for care, and that the purpose of the survey was to gain an understanding of the respondent's views regarding people's need for care.

The choice scenario considered three individuals who suffer from chronic pain. The intensity of pain experienced by the the three individuals is identical and is sufficient to keep them from participating in many of their normal daily activities. The individuals differ, however, in the amount of time that they are in pain each day without treatment and in the hours of pain relief they can obtain from treatment using a pain medication. Even with medication, some individuals are not able to obtain complete relief from pain. The pain medication available has no negative side effects and can safely be taken in the amounts considered in the survey. The pain medication is available to the individuals at no cost, but the supply of pain medication is insufficient to provide pain relief to all individuals. The individuals were described as identical in all respects not explicitly noted, such as age, sex, income, marital status.

The basic design of the choice scenario follows closely that used in studies of equity in the allocation of resources (Yaari and Bar-Hillel, 1984; Konow, 2003). We frame the scenario in terms of chronic pain and pain-relief medication for a number of reasons. Because baseline health status is one need definition of interest, it was essential that a person's health status be easily quantifiable. Because another definition of interest is the amount of resources required to provide maximum benefit, the health care resource also had to be easily quantifiable and it had to be plausible that the amount required would vary across individuals. The choice of chronic pain as the underlying health condition allows us to quantify baseline health status as the hours of pain each day with no medication, and chronic pain is commonly treated with medication, which is both readily quantifiable as the number of pills required and plausible to vary across individuals. Finally, pain medication will be familiar to many study participants and has been used previously in studies of the role of need in health care resource allocation (Kahneman and Varey, 1991; Cuadras-Morato et al., 2001; Hurley et al., 2011).

2.2 Attributes

The choice scenarios presented three attributes regarding the individuals' pain and ability to obtain pain relief from the medication available.

1. Number of hours each day free of pain with no treatment. This attribute describes the number of pain-free hours in a 24-hour day that an individual would experience if they took no pain medication. It had four values: 0, 4, 8 or 12 hours. A value of 4 hours, for instance, means that if an individual took no pain medication they would be in pain 20 hours each day and free of pain 4 hours each day. This attribute represents a person's baseline level of health status.

2. Number of hours of pain relief possible from medication. The chronic pain is such that, no matter how many pills some individuals take, they are unable to obtain complete pain relief. This attribute describes the maximum number of hours of pain relief an individual could obtain by taking pain-relief pills. This pain relief is in addition to any pain-free hours they experience if they take no medication. The attribute had four values: 4, 12, 16 or 24 hours. A value of 12 hours, for instance, means that the maximum number of hours of additional pain relief (beyond their baseline hours free of pain) the individual can achieve by taking medication is 12 hours per day. This attribute represents a person's ability to benefit from health care.

3. Number of pain-relief pills required to obtain the maximum hours of pain relief from

medication. The scenario stated that, because of biological differences among the individuals, the effectiveness of the pills differs across the individuals. This attribute described the number of pain-relief pills an individual would need to take each day to obtain their maximum possible number of hours of pain relief per day. It had four values: 2, 6, 8 or 12 pills. A value of 6 pills, for instance, means that the individual must take 6 pills per day to obtain the maximum number of hours of pain relief possible. The attribute represents the amount of resources required to exhaust benefit.

2.3 Experimental Design

A full-factorial generic design with three four-level attributes generates 64 possible combinations. Allowing for two-way interactions between baseline hours of pain and hours of pain relief possible and between baseline hours of pain and number of pills required to exhaust benefit, a fractional-factorial design was produced with 16 choices scenarios of three alternatives (Kuhfeld, 2005; Zwerina et al., 1996). To allow for tests of response consistency, two extra choice sets were added and each was repeated within the survey: choice set number 3 was repeated as choice set 12 and choice set 13 was repeated as choice set 19. Subjects therefore responded to a total of 20 choice scenarios with three alternatives each. The design had to take account of the dependence among the attributes. For a given individual, the maximum possible value for additional hours of pain relief possible per day (attribute 2) is 24 less the number of hours free of pain each day without medication (attribute 1). Hence, some of the 64 combinations of the full factorial are not feasible (e.g., baseline of 12 pain-free hours each day and a maximum hours of pain relief equal to 16), which required that we place restrictions on the experimental design. Further, the value of attribute 3 (number of pills required to exhaust benefit) equals attribute 2 divided by the hours of pain relief obtained per pill. To allow for independent variation between attributes 2 and 3, we allowed the pain relief obtained per pill to vary implicitly across individuals. That is, pain relief per pill was not an explicit attribute, so it varied in the background. All aspects of the experimental design were performed using SAS 9.1.3 built-in capabilities (Kuhfeld, 1997). See Appendix 1 for an abbreviated version of the survey.

2.4 Survey Administration

The survey was administered to a province-wide sample drawn from the community-dwelling population of the nine English-speaking provinces of Canada (i.e., excluding the French-speaking province of Quebec). It was administered using a mixed-mode methodology in which community participants were recruited using a letter of invitation sent via regular mail, which allowed us to use postal contact information (obtained from a marketing research firm) for a representative, random sample of the provincial populations, but participants completed the survey via the Internet (Gajic et al., 2011). Participants were compensated for their participation. The study was approved by the McMaster University Research Ethics Board.

3 Econometric Analysis

For each subject for each choice scenario we have data on the individual the subject rated as having the greatest need and the individual the subject rated as having the least need. Because each choice set included three alternatives, this allows us to determine a subject's full ranking of the alternatives with respect to level of need. To exploit this information, we developed a latent-class rank-order logit model, which accounts for individual preference heterogeneity. Latent-class models are becoming more popular in the discrete-choice experimental literature (Greene and Hensher, 2003; Mentzakis et al., 2011) because, in addition to accounting for individual heterogeneity, they allow for partial relaxation of the assumption of independence of irrelevant alternatives (IIA) and accommodate the panel structure of data. In the latent-class model, individuals are implicitly sorted into a set of C classes, where each class represents a different data-generating process (i.e., pattern of weighing the three attributes). It is termed a latent-class model because the class of any specific individual is determined probabilistically and hence remains unknown to the analyst (Greene and Hensher, 2003). Assuming an additive deterministic component ($V_{iq} = \sum_{k=1}^{K} \beta_k X_{iqk}$) and a stochastic component (ϵ_{iq}) the utility of an individual becomes $U_{iq} = V_{iq} + \epsilon_{iq}$. Further, assuming that ϵ_{iq} are independent and extreme value type I distributed, the rank-order specification can be viewed as a series of sequential conditional logits (McFadden, 1974), where at each point in the series the individual chooses the most preferred alternative out of the remaining ones (Luce, 1959). Hence, the probability that individual *q* will rank alternative *i* the highest in choice scenario *t* conditional on falling within class *c* is

$$P_{iqt|c} = Pr(i > max(1, ..., J)) = \frac{e^{X_{iqt}\beta_c}}{\sum_{j=1}^{J} e^{X_{jqt}\beta_c}}$$

The remaining alternatives are also ranked following a conditional-logit probability, where the probability that alternative *m* is ranked highest of the remaining alternatives is

$$P_{mqt|c} = Pr(m > max(2, ..., J)) = \frac{e^{X_{mqt}\beta_c}}{\sum_{j=1}^{J} e^{X_{jqt}\beta_c} - e^{X_{iqt}\beta_c}}$$

As noted above, class assignment in the latent-class model is probabilistic, so following Greene and Hensher (2003) let H_{qc} be the probability that an individual *q* falls in class *c* is

$$H_{qc} = \frac{e^{Z_q \gamma_c}}{\sum_{c=1}^{C} e^{Z_q \gamma_c}}$$

where Z_q is a set of individual characteristics that influence the class membership probabilities. Following from above, the latent-class rank-order likelihood is:

$$L = \sum_{c=1}^{C} H_{qc} \prod_{i=1}^{J-1} \prod_{t=1}^{T} P_{iqt|c}$$

Our experimental design did not allow for ties or incomplete rankings, so no such considerations were incorporated into the estimation (Allison and Christakis, 1994). The number of latent classes is determined exogenously based on the model fit to the data as measured by criteria such as the Akaike Information Criterion (AIC) and the Bayesian Information Criterion (BIC) (Greene and Hensher, 2003; Swait and Adamowicz, 2001). The latent-class rank-order logit estimation routine was written using the -ml- function in Stata [2].

4 Results

4.1 Sample Descriptive Statistics

The sample includes 349 community respondents (Table 1). This reflects a response rate of 12% for completed surveys, a rate lower than that of traditional mail surveys but consistent with response rates in the range of 10-19% common for web surveys (Gajic et al., 2011; Dillman, 2009; Manfreda et al., 2008). The sample has a mean age of 53.5, 60 percent are males, 55 percent report excellent or very good health, 73 percent are married; 78 percent are post-secondary graduates (university, college, professional/trade-school), 57 percent have full-time jobs, 89 percent own their house, and income ranges from less than $20,000 to over $100,000, with the median falling between $50,000 and $100,000. A comparison with Canadian census data reveals that the sample is broadly similar to the populations from which it is drawn, though it is slightly older, more male and better educated, with associated somewhat higher rates of marriage and home-ownership. The higher proportion of male respondents and post-secondary graduates is consistent with the evidence (Dillman, 2009) that educated males tend to respond more to on-line surveys than do females or less educated individuals. The slightly older age of respondents may reflect the fact that older (retired) individuals likely have a lower average value of time and may have higher-than-average interest in health care issues.

[2] Alternatively, the EM algorithm can be used for estimation. Both ML and EM techniques where compared to ensure that both arrived at the same maxima. The EM algorithm for this routine was also written in Stata.

4.2 Analysis of Support for Alternative Concepts of Need

4.2.1 Model Choice

Comparison of results from standard conditional logit models and rank-ordered logit models revealed that the sign and magnitude of parameter estimates were quite similar, but the rank-ordered specification notably improved efficiency. Comparison of the standard rank-ordered logit with the latent-class rank-ordered logit model revealed important preference heterogeneity and considerable improvement in model fit using the latent-class specification. In fitting the latent-class model we tested specifications with 2-4 latent classes. The BIC goodness-of-fit statistics for the standard rank-ordered logit and the two-, three- and four-class latent-class rank-ordered logit models were 16,799.7, 15,466.7, 14,848.3 and 14,644.1 respectively, indicating that the latent-class models fit better than the standard model, and that the three- and four-class models fit better than the two-class model. The four-class model slightly out-performs the three-class model, but inspection of the estimates revealed that even in the four-class model there were only three qualitatively distinct choice patterns; the four-class model essentially split one of the classes from the three-class model into two sub-groups with slight differences that, while statistically distinct, do not provide additional insight into our understanding of interpretations of need. Below we therefore present the results based on rank-ordered latent-class logit specifications with three latent classes.[3]

4.2.2 Regression Results

We begin with a latent-class specification estimated over the full sample and that does not include any interaction terms (Table 2). This simpler specification with no interaction terms reveals in a more interpretable manner all of the central patterns of choice present in more complex specifications with two-way interaction terms.[4] Each of the three latent classes constitutes a

[3]For the review stage only, Appendix 2 presents the results of a 4-class model for comparison against the 3-class models presented in the body of the paper.

[4]Again, for review purposes, Appendix 3 presents results for models with two-way interaction terms to allow for comparison again the models presented in the body of the paper.

meaningful proportion of the sample: 0.430, 0.324, and 0.246. The assignment of individuals to the latent classes is not statistically associated with any observable individual characteristics drawn from the demographic component of the survey. This is not surprising, given that we had no *a priori* expectations that judgments of need would be systematically associated with demographic and socio-economic characteristics.

For each class and for each attribute, all the attribute levels are statistically significant from the baseline reference categories, though the patterns of signs and magnitudes of the coefficients vary across the classes. The coefficients are interpreted identically to those for a standard conditional logit model. For example, the coefficient of -2.124 on "Pain Free 4 hours" in class 1 indicates that, other things equal, a subject judges a person pain-free for 4 hours per day without medication as being in lesser need than a person in the reference category of pain-free for 0 hours per day without medication. For each of the three attributes the reference category is coded as the value of the attribute that represents the greatest need as defined for the associated definition, so negative coefficients on the listed attribute levels indicate that subjects judged a person with that level to have lesser need than the reference category; positive coefficients indicate an unexpected pattern in which a person with the level listed was judged to be in greater need than a person in the reference category.

For all three classes baseline health status, as measured by hours free of pain with no medication, is negatively associated with judgments of need: the lower is a person's baseline health status, the greater is the likelihood that the person is judged to have the greater need. The classes differ, however, with respect to the steepness of the gradient: Class 1 exhibits the strongest relationship between baseline health and judgments of need (other things equal, the probability is over 99% that a person free of pain 0 hours per day is judged to be in greater need than a person free of pain 12 hours per day) and Class 2 exhibits the weakest relationship between baseline health and need (the corresponding probability to that noted for 76%).[5]

[5]Note that these are conditional probabilities, i.e., conditional on falling into the noted class.

The relationship between ability-to-benefit, as represented by the hours of pain relief possible with medication, and judgments of need varies across classes. Class 3 exhibits the expected relationship: the greater is a person's ability-to-benefit, the greater is the probability that the individual will be judged as having the greater need. The coefficient of -1.837 on "4 hours relief," implies that the probability is only 14% that a person who can obtain only 4 hours of pain relief from medication is judged to be in greater need than a person who can obtain 24 hours of pain relief from medication. For classes 1 and 2, however, the relationship is opposite to that expected — those with greater ability-to-benefit are less likely to be judged to be in greater need. As was the case for baseline health status, the judgments of Class 1 exhibit the greatest sensitivity to ability-to-benefit and class 2 the least.

The relationship between need and the amount of resources required to exhaust benefit, as measured by the number of pills required to obtain maximum pain relief, also varies across the classes. Classes 1 and 2 exhibit the expected relationship: the greater is the number of pills required to exhaust benefit, the greater is the likelihood of being judged as having greater need. For both classes, the probability is about 80% that a person who requires 12 pills (reference category) to obtain maximum pain relief is judged to be in greater need than a person who requires only 2 pills. For class 3, however, the opposite relationship holds: those who require fewer pills are more likely to be judged in greater need. The probability is only 30% that a person who requires 12 pills to obtain maximum pain relief is judged to be in greater need than a person who requires only 2 pills.

To provide a better sense of the preferences regarding judgments of need represented by the three latent classes, Figure 1 plots the probability that a given combination of attribute levels is judged to represent greater need than the following reference combination: pain-free 0 hours per day without medication, maximum possible pain relief of 24 hours, and 12 pills required to obtain the maximum pain relief. This reference combination represents the posited greatest level of need by each of the three definitions considered. If people subscribe in the expected manner to any of the three definitions, or base judgments on some weighted combination of these three definitions, this baseline combination should be judged as representing greater need than any other combination of attribute levels. The vertical axis in the figure represents probability; the horizontal axis plots each of the 48 feasible combinations of the attribute levels.[6] Beginning at the origin, the first 16 combinations along the horizontal axis are all those in which a person is pain-free 0 hours per day; the next 12 combinations are all those in which a person is pain-free 4 hours per day; the next 12 are combinations in which a person is pain-free 8 hours per day; and the final 8 are combinations in which a person is pain-free 12 hours per day. Possible pain relief and number of pills then vary within each of these groupings. Within the 16 combinations for which a person is pain-free 0 hours per day, the first 4 represent an ability-to-benefit from medication of 4 hours; the next 4 represent an ability-to-benefit of 12 hours, and so forth. Finally, the number of pills required to exhaust benefit varies within each subset of 4 combinations that represent a given level of baseline pain and ability-to-benefit from medication. As noted, the reference combination for all probability calculations is pain-free (PF)=0, ability-to-benefit (ATB)=24, pills required to exhaust benefit (PEB) =12.

Consider first the judgments associated with class 1 (denoted by the blue diamonds). As one scans the figure from left to right, the strong negative gradient with respect to baseline hours in pain is evident: as seen on the x-axis, the first 16 points all represent combinations in which a person suffers from pain 24 hours per day without any medication; the last 8 represent combinations in which a person is in pain only 12 hours per day without medication. The probabilities among the latter are all substantially smaller than in the former. Within each latent class there is a general negative gradient as one moves left to right. Class 1 has the steepest gradient; class 2 displays the shallowest gradient; and class 3 displays a pattern that is suggestive of a threshold pattern with a break when the baseline pain-free hours increases from 0 to 4. The probability of being judged in greater need is noticeably higher when baseline pain-free hours is 0 hours than when it is 4, 8 or 12 hours.

[6] Again, only 48 of the 64 possible combinations are feasible because, for example, the maximum number of hours of pain relief possible cannot exceed the baseline number of hours of pain per day without medication.

The effect of ability-to-benefit is revealed by examining the four clusters of four observations within each level of baseline pain. Focusing first on individuals pain-free 0 hours per day (obs 1-16), class 1 exhibits a negative gradient moving from the cluster of observations with 4 hours of maximum benefit (obs 1-4)) to the cluster of observations with 24 hours of maximum benefit (obs 13-16). Both classes 1 and 2 display an unexpected negative gradient; class 3 exhibits the expected strong positive relationship: those with greater ability-to-benefit are more likely to be judged in greater need.

The effect on judgments of need of the number of pills required to exhaust benefit is revealed by the pattern for the 4 observations within each cluster of baseline health and ability-to-benefit. Focusing on the first four combinations, classes 1 and 2 exhibit the expected positive relationship between the number of pills required and need. Class 3, however, exhibits and unexpected negative relationship. The gradient is strongest for class 2, as revealed by the fact that the differences in probabilities across the 4 observations is larger for class 2 than for either class 1 or class 3.

In summary, none of the latent classes apply all three criteria in the manner posited by conceptual discussions of need: classes 1 and 2 interpret the relationship between ability-to-benefit and need in the opposite direction to that posited (i.e., greater ability-to-benefit is associated with less need), and class 3 interprets the relationship between resources required to exhaust benefit and need in the opposite direction to that posited (i.e., more resources is associated with less need). In Figure 1 this is manifested by the fact that many combinations, especially for classes 1 and 2, have probabilities greater than the probability for the reference combination (PF=0, ATB=24, PEB=12), which each of the three conceptual definitions would posit as representing the greatest need. Baseline health is the only definition that is interpreted as expected across all three classes. Those in class 1 are more sensitive to variation in baseline health and ability-to-benefit than are those in class 2, whereas those in class 2 are most sensitive to variation in pill required to exhaust benefit. Class 3 differs qualitatively from classes 1 and 2 with respect to the relationships between need and ability-to-benefit and need and maximum resources required to exhaust benefit. The judgments of all three classes exhibit an inverse relationship between ability-to-benefit and resources required to exhaust benefit: classes 1 and 2 display a negative relationship between ability-to-benefit and need combined with a positive relationship between need and resources required to exhaust benefit; class 3 displays a positive relationship between need and ability-to-benefit combined with a negative relationship between need and resources required to exhaust benefit. This pattern is not the result of the mathematical dependence among these two attributes: the experimental design allowed the levels of these two attributes to vary independently.[7] Rather, this patterns reflect a certain logic in the subjects thought processes.

Table 3 and Figure 2 present the results for the same model with no interactions, but estimated over the sample comprising only those with consistent preferences. Recall that because the survey repeated two scenarios we can test for response consistency. We define consistent preferences as choosing the same alternative as representing greatest need for both of the repeated choice scenarios in the survey. By this definition, the preferences of 212 subjects are consistent.[8] The results for class 1 are virtually identical to those associated with the full sample. The results for class 3 are also very similar; the only difference is that the threshold effect associated with going from 0 pain-free hours per day to 4 pain-free hours is more evident. The results for class 2, however, change importantly: the gradients are not statistically significant and have essentially disappeared for both baseline health and resources required to exhaust benefit; the gradient with respect to ability-to-benefit has changed sign and is strongly positive. The judgments for class 2 respond only to ability-to-benefit (note that, because the gradient is as expected, essentially all of the combinations in Figure 2 have probabilities below the baseline reference case (PF= 0, ATB = 24, RREB = 12). The other important change is class shares: the share for class 1 increased from 0.430 to 0.702, decreased for class 2 from 0.324 to 0.095, and remained relatively stable for class 3 (0.246 vs. 0.201). The inconsistent responses were highly concentrated among class 2 in

[7]Tests for independence (based on Spearman's rank correlation and Kendall's Tau statistic) between the levels of these attributes specified in the survey scenarios failed to reject the null hypothesis of independence (p = 0.41 and 0.43 respectively).

[8]A logit analysis of the probability of being consistent as function of individual demographic characteristics reveals a significant association with education. Those with educational attainment "Less than secondary school" were significantly more likely to report inconsistent answers than those with higher levels of education. None of other of the other demographic characteristics was statistically significant.

the full sample. Indeed, the predicted number of people in class 1 remains unchanged (0.430*349 = 150; 0.702*212 = 149), while both the share and number of subjects fell dramatically for class 2 (from 113 to 20). Among those with consistent responses, therefore, the dominant patterns of judgments of need are those associated with class 1: highly sensitive in the expected manner to baseline health; highly sensitive, in the opposite direction to that expected to ability-to-benefit; and highly sensitive in the predicted manner to resources required to exhaust benefit.

5 Discussion

This analysis documents two important types of heterogeneity in individual's interpretations of need. One is heterogeneity across members of the public: the latent class analysis identified three distinct patterns in judgments of need distinguished by the emphasis placed on each of the three definitions of need investigated and by the nature of relationship between a definition, or determinant, and need. A second is heterogeneity within individuals: among consistent responders, for two of the three latent classes, judgments of need are influenced by all three definitions; only in one class did judgments depend primarily on a single definition.

Among the three definitions, in three senses baseline health status emerges as the most influential determinant of people's judgments of need. First, it has the broadest support. In the analysis of the full sample, baseline health was an important determinant of need judgments in all three latent classes; in the analysis of consistent responders only, it was an important determinant for two of the three classes that together accounted for over 90% of the sample. Second, baseline health status is the only definition that is consistently interpreted as expected: in all analyses and latent classes, with the exception of class 2 among consistent responders for which baseline health exerted no influence, better baseline health status is associated with less need. In contrast, for each of ability-to-benefit and resources-required-to-exhaust-benefit, in all analyses the judgments of at least one latent class reflected an interpretation of the relationship between the attribute and need in a manner opposite to that expected (i.e., greater ability-to-benefit or more resources required to exhaust benefit was associated with less need). Third, even when judgments depend on all three definitions (e.g., classes 1 and 2 in the consistent sample analysis) the influence of baseline health status was quantitatively larger than either ability-to-benefit or resources required to exhaust benefit.

Our finding that judgments of need emphasize baseline health status are consistent with findings from the broader literature that the principle of allocation according to need receives widespread support among the public and that the public views baseline health status as an important criterion for priority-setting. The emphasis on baseline health status challenges instrumental interpretations of need (e.g., Williams, 1978; Culyer and Wagstaff, 1993; Culyer, 1995), which argue that, no matter how dire a person's baseline condition, there can be no health care need if there exists no health care intervention effective in ameliorating the condition. The question of the existence of a need (a discrete, yes/no phenomenon), however, is distinct from the question of the amount of need conditional on the existence of a need. While the instrumentalist interpretation of need implies a clear necessary condition for the existence of a need — the availability of an effective intervention — its implications are less clear for assessing the amount of need condition on the availability of an effective intervention.

The general public's emphasis on baseline health status in judgments of need as in this study, and in the broader literatures on resource allocation and priority-setting, does not necessarily imply a rejection of an instrumental interpretation. To our knowledge, all such studies (including our own) focus on resources that provide some (even if minimal) benefit; none have considered conditions for which the resource provides no benefit. Hence, none have tested the most straightforward implication of the instrumentalist interpretation.

Conditional on the availability of an effective resource, a focus on baseline health status can be consistent with instrumental reasoning: such would be the case if, for instance, people judge that a given health gain produces more benefit for a person with low baseline health than for a person with moderate baseline health. That is, the benefit of a health increment achieved is determined by an interaction between baseline health and the size of the increment. In our analysis of judgments of need, although the inclusion of a set of interactions terms between baseline health and ability-to-benefit improves overall model fit (i.e., they were statistically significant as a group), very few individual interaction terms were statistically significant. A focus on baseline health is also consistent with a desire to reduce amenable inequalities in the distribution of health. Other things equal, this would call for giving priority to those furthest from the mean level of health, and again would manifest itself through interaction effects among attributes. The possible presence of such interactions between baseline health and attributes such as ability-to-benefit deserves further investigation as they can explain an emphasis on baseline health even within an instrumentalist framework.

In a related issue, richer designs in future research can also investigate the broader question of "need for what?", a question that has figured prominently in that analysis of need (Culyer, 1995). By design, the current study focused on judgments of need for health care when only a single (effective) intervention is available. Judgments of need for health care may be motivated by views regarding need for higher-level "goods" such as health. If so, it is important to understand and distinguish the relationship between judgments of need among these intermediate (i.e., health care) and ultimate (i.e., health) aims. Further, it is important to understand how people think about need (beyond the need for health care) for those suffering ill-health when there is no effective intervention or an effective intervention cannot restore full health. Investigating such broader notions of need may also provide insight into, for example, the unexpected finding in this study that some individuals judge those with less ability-to-benefit to have greater need than those with more ability-to-benefit. If individuals with less ability-to-benefit are less likely to be restored to full health, it is possible that the judgments of need we elicited were influenced by notions of need beyond the need for health care alone (non-health care support to help them cope with their condition). Investigating these types of issues are best pursued through both richer scenarios and mixed-method approaches that combine qualitative elements alongside an experimentally based stated-preference survey.

The findings of this study add further caution against the use of general phrases or principles, such as "allocation according to need," when eliciting the views of the public to inform resource allocation or priority setting. Previous research (e.g. Hurley et al., 2011) documents important framing effects when eliciting public judgments about resource allocation whereby judgments differ importantly when allocation principles are described verbally (e.g., allocate according to need, allocate to maximize health, allocate to equalize health outcomes) compared to when the quantitative allocations implied by each principle in a given situation are presented. Further, when presented with both types of information, judgments correspond more closely to those made when given the quantitative information only rather than the verbal principles only. This study documents further that the public may interpret need quite differently than many health analysts. The same may hold for other important concepts, such as "benefit". If we are genuinely interested in what the public thinks, studies need to probe beyond labels such as "need" to focus on the generic elements of an allocation problem.

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Table 1: Descriptive Statistics

Variable	Mean	Std Dev
Age (Min = 18; Max = 88)	53.5	13.91
Male (1 = male; 0 = female)	0.60	0.49
Married (1 = married; 0 = non-married)	0.73	0.45
SAHS (1 = E,VG; 0 = G,F,P)	0.55	0.50
Education (1 = post-secondary grad; 0 = other)	0.78	0.41
Employed (1 = employed FT; 0 = other)	0.57	0.50
Own House (1 = own home; 0 = rent)	0.89	0.31
Household Income		
< $20,000	0.023	−−
$20,000 to $49,999	0.180	−−
$50,000 to $99,999	0.335	−−
>$100,000	0.255	−−
Did not report	0.206	−−
Ever employed in health care sector	0.21	0.41

Table 2: Latent-Class, Rank-Ordered Logit, Full Sample, No Interaction Terms

	Class 1	Class 2	Class 3
Mean Probability Class Assignment	0.430	0.324	0.246
Baseline Health			
Pain Free 4 hours	−2.124**	−0.377**	−1.056**
	(0.112)	(0.078)	(0.097)
Pain Free 8 hours	−3.545**	−0.729**	−1.841**
	(0.136)	(0.089)	(0.121)
Pain Free 12 hours	−5.805**	−1.176**	−2.509**
	(0.199)	(0.101)	(0.133)
Ability to Benefit			
4 hours relief	3.121**	1.132**	−1.837**
	(0.152)	(0.119)	(0.157)
12 hours relief	1.508**	0.505**	−1.125**
	(0.115)	(0.107)	(0.138)
16 hours relief	0.855**	0.227**	−0.636**
	(0.112)	(0.105)	(0.137)
Pills Required to Exhaust Benefit			
2 pills	−1.298**	−1.451**	0.898**
	(0.093)	(0.087)	(0.098)
6 pills	−0.494**	−0.767**	0.497**
	(0.081)	(0.073)	(0.090)
8 pills	−0.526**	−0.407**	0.341**
	(0.084)	(0.071)	(0.091)
Constant	0.283**	−−	−0.274
	(0.144)	−−	(0.156)
Observations	16,743		
Individuals	349		
Log-L	−7283.13		

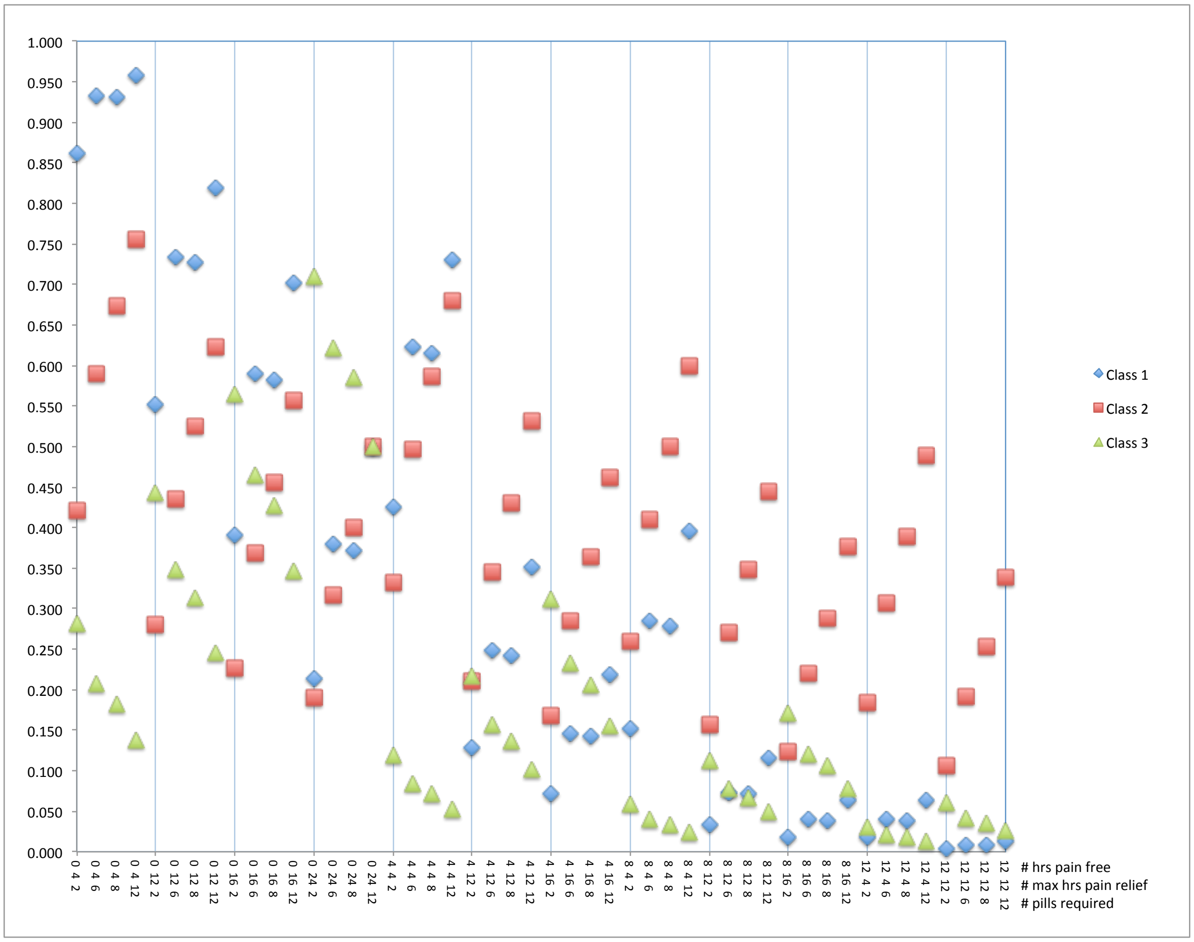
Reference categories are: 0 hours pain-free per day; 24 hours of pain relief possible; and 12 pills
** $p < 0.05$; * = $0.05 \leq p < 0.10$

Table 3: Latent-Class, Rank-Ordered Logit, Consistent Sample, No Interaction Terms

	Class 1	Class 2	Class 3
Mean Probability Class Assignment	0.702	0.095	0.203
Baseline Health			
Pain Free 4 hours	−1.694**	0.150	−2.159**
	(0.093)	(0.169)	(0.195)
Pain Free 8 hours	−2.938**	−0.023	−3.907**
	(0.112)	(0.189)	(0.277)
Pain Free 12 hours	−4.863**	−0.035	−5.562**
	(0.148)	(0.192)	(0.343)
Ability to Benefit			
4 hours relief	3.091**	−1.670**	−1.184**
	(0.129)	(0.314)	(0.207)
12 hours relief	1.391**	−1.208**	−0.583**
	(0.105)	(0.264)	(0.189)
16 hours relief	0.779**	−0.808**	−0.261
	(0.101)	(0.247)	(0.191)
Pills Required to Exhaust Benefit			
2 pills	−1.518**	0.097	0.934**
	(0.083)	(0.167)	(0.155)
6 pills	−0.646**	0.044	0.603**
	(0.074)	(0.155)	(0.151)
8 pills	−0.556**	0.048	0.402**
	(0.075)	(0.155)	(0.153)
Constant	2.002**	−−	0.760**
	(0.250)	−−	(0.281)
Observations	10,173		
Individuals	212		
Log-L	−3926.60		

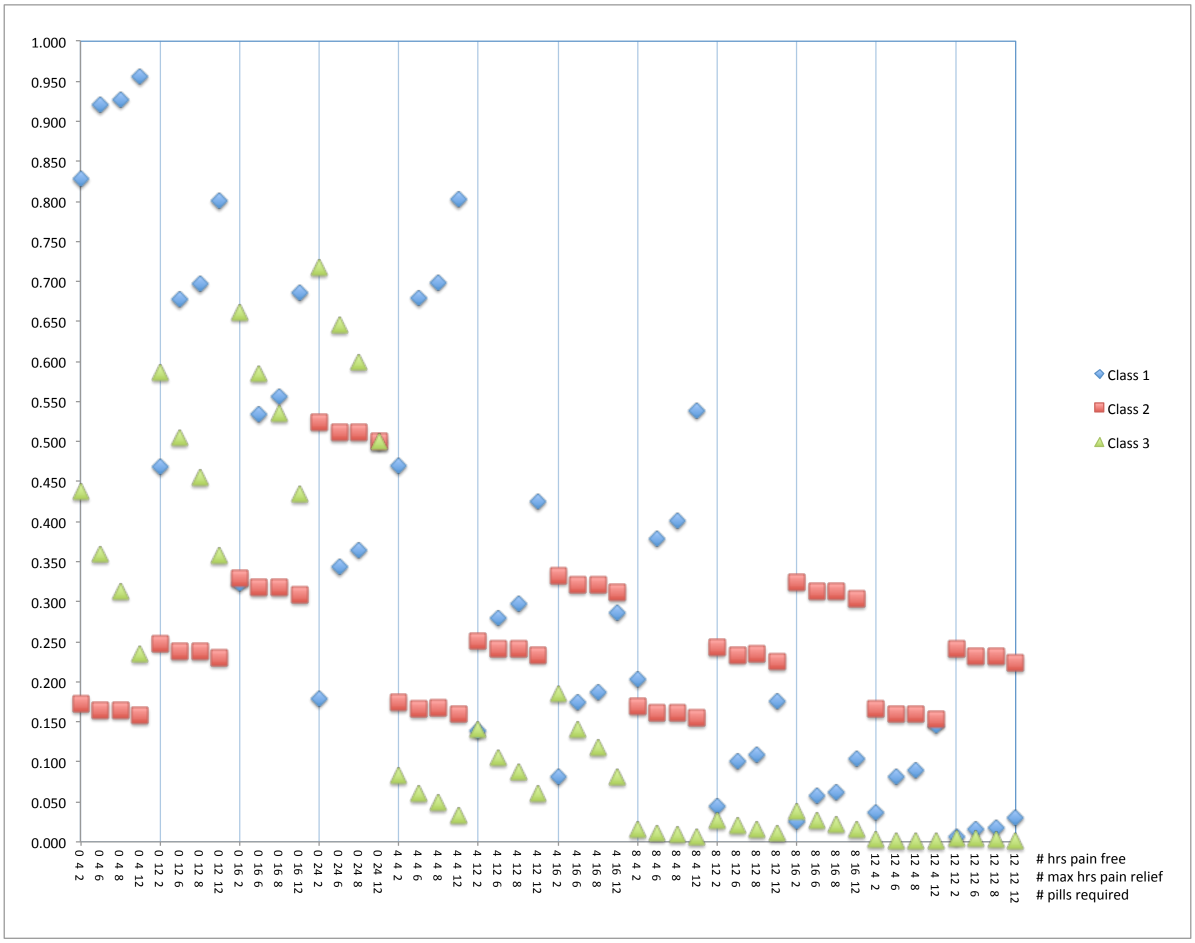
Reference categories are: 0 hours pain-free per day; 24 hours of pain relief possible; and 12 pills
** $p < 0.05$; * $= 0.05 \leq p < 0.10$

Figure 1: Probability of Being Ranked as Greater Need than Pain Free = 0, Pain Relief = 24 and Pills = 12, No Interaction Terms, Full Sample



Note: The reference combination for probability calculations is: 0 hours pain-free, 24 hours max pain relief, and 12 pills required to exhaust benefit. The vertical axis depicts the probability that a given combination is judged to represent greater need than the reference combination. All probabilities are conditional on class.

Figure 2: Probability of Being Ranked as Greater Need than Pain Free = 0, Pain Relief = 24 and Pills = 12, No Interaction Terms, Consistent Sample



Note: The reference combination for probability calculations is: 0 hours pain-free, 24 hours max pain relief, and 12 pills required to exhaust benefit. The vertical axis depicts the probability that a given combination is judged to represent greater need than the reference combination. All probabilities are conditional on class.

Appendix 1: The Discrete-Choice Survey Instrument

HEALTH CARE NEEDS SURVEY [1]

Introduction

Allocating Health Care Resources According to Need

Canada, like many other countries around the world, has designed its health care system to provide health care services to individuals based on their need for care. However, it can be difficult for both health care providers and health system managers to assess people's need for care. Evaluating who has the greater need among those seeking care can be especially difficult. There is currently no universal agreement on what is most important in determining an individual's need for care.

The purpose of this short survey is to gain an understanding of your views regarding people's need for health care. In the survey we present you with a series of scenarios that describe three individuals who suffer from chronic pain. The level of pain experienced by the three individuals is identical, and is sufficient to keep them from participating in many of their normal daily activities. The individuals differ, however, in the amount of time that they are in pain each day when they receive no treatment, and in the hours of pain relief they can obtain from pain medication. Even with medication, some individuals are not able to obtain complete relief from pain. For each scenario, we are interested in your views on which of the three individuals has the greatest need for pain-relief pills, and which individual has the least need. There are no right or wrong answers.

The pain-relief pills that are available have no negative side effects for any of the individuals and can safely be taken in the amounts considered in the survey. The pain-relief pills are available to the individuals at no cost.

Each scenario describes three characteristics of the individuals related to the pain they experience and the relief that they can get from medication. All other characteristics of the individuals that are not described (such as an individual's age, sex, income, marital status, and so forth) are identical across the three individuals. The individuals differ only with respect to the three characteristics listed. The three characteristics are described on the next screen.

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[1] The survey was designed and administered online using Limesurvey. This Appendix version is identical in content to the online versions but omits various "next buttons" used to progress to the next screen and "submit button" used to submit responses. Additionally, a progress bar was also provided on screen. All questions were mandatory and Limesurvey issued a warning if a response was not submitted.

Characteristics

Characteristic 1: Number of hours each day free of pain with no treatment

This characteristic describes the number of pain-free hours in a 24-hour day that an individual experiences if they take no pain medication. This characteristic can take on four different values: 0, 4, 8 or 12 hours. For example, if the value for an individual is 4 hours and that individual takes no pain medication, they will be in pain 20 hours each day and free of pain 4 hours each day.

Characteristic 2: Number of hours of pain relief possible from medication

Some individuals are not able to obtain complete pain relief, no matter how many pills they take. This characteristic describes the maximum number of hours of pain relief an individual can obtain by taking pain-relief pills. This pain relief is in addition to any pain-free hours they experience if they take no medication. This characteristic can take on four different values: 4, 12, 16 or 24 hours. For example, if the value of this characteristic is 12 hours, then the maximum number of hours of additional pain relief the individual can achieve by taking medication 12 hours per day.

Characteristic 3: Number of pain-relief pills required to obtain the maximum possible hours of pain relief from medication

Because of biological differences among the individuals, the effectiveness of the pills differs across individuals. This characteristic describes the number of pain-relief pills an individual needs each day to obtain their maximum possible number of hours of pain relief per day. This characteristic can take on four different values: 2, 6, 8 or 12 pills. For example, if the value for an individual is 6 pills, then the individual must take 6 pills per day to obtain the greatest number of hours of pain relief possible.

Example of a Description

To give a concrete example, consider the following individual whose values for the three characteristics are as follows:

Number of hours free of pain with no treatment: 8 hours
Number of hours of additional pain relief possible: 12 hours
Number of pills required for maximum benefit: 6 pills

These three pieces of information tell you that this individual has 8 hours free of pain each day even if they take no pills, that by taking pain-relief pills they can obtain an additional 12 hours of pain relief (for a total of 20 hours per day free from pain), and that they must take 6 pills per day to achieve the maximum possible relief from pain.

Example of a Scenario

Individuals A, B and C all suffer to varying degrees from chronic pain. A limited supply of pain-relief medication is available that relieves this chronic pain, but its effectiveness differs across individuals. The limited supply of pain-relief pills is not sufficient to provide complete pain relief to all three individuals. Based on the information provided in the table below, please indicate which individual you judge to have the *greatest* need, and which other individual you judge to have the *least* need.

Example	Individual A	Individual B	Individual C
Hours each day free of pain with no treatment	0 hours	4 hours	8 hours
Additional hours of pain relief possible from medication	4 hours	12 hours	12 hours
Pain-relief pills required to obtain the maximum possible hours of pain relief from medication	6 pills	2 pills	8 pills

Please select the individual who you believe has the GREATEST need among individuals A, B and C:

O Individual A O Individual B O Individual C

Please select the individual who you believe has the LEAST need among individuals A, B and C:

O Individual A O Individual B O Individual C

(This is an example, please do not answer)

Note that we have created reminder pop-up windows to help remind you of the characteristics. Simply click on any of the characteristic labels for helpful information.

On the following 20 screens, we present 20 different scenarios that are similar to this example. For each of the scenarios, please choose the most preferred option. Remember, there are no right or wrong answers.

Question 1	Individual A	Individual B	Individual C
Hours each day free of pain with no treatment	0 hours	0 hours	0 hours
Additional hours of pain relief possible from medication	4 hours	12 hours	24 hours
Pain-relief pills required to obtain the maximum possible hours of pain relief from medication	6 pills	2 pills	8 pills

Please select the individual who you believe has the GREATEST need among individuals A, B and C:

O Individual A O Individual B O Individual C

Please select the individual who you believe has the LEAST need among individuals A, B and C:

O Individual A O Individual B O Individual C

This section of the survey was then followed by 19 scenarios formatted identically to this. Only one scenario appeared on screen at a time, automatically followed by the next scenario upon response submission. Subjects were unable to go back to revise previous scenario responses after submitting. Note that if subjects submitted the same individual as having both the greatest and least need, a warning would appear: “You have chosen the same individual for both questions. Please make another selection” and subjects were then free to re-select either or both responses.

Demographic Questions

In this last part of the survey we gather some basic information about you. The information from the following questions will not be used to identify you; it will assist in the analysis. Please select one answer for each of the questions.

What is your sex?

O Female
O Male
O Prefer not to respond

What is your year of birth? _________

In general, compared to individuals of your own age, would you say your health is (excellent, very good, good, fair, poor)?

O Excellent
O Very Good
O Good
O Fair
O Poor
O Prefer not to respond

What is your marital status?

O Single (never legally married)
O Married or Common-Law
O Divorced
O Widowed
O Prefer not to respond

Are you currently employed?

O Part-time employment
O Full-time employment
O Not Employed
O Retired
O Prefer not to respond

Do you own or rent your house / apartment?

O Own
O Rent
O Other
O Prefer not to respond

What is the highest level of education you have attained?

O Less than secondary school
O Secondary school graduate
O Post-secondary graduate (i.e., college, apprentice, trade diploma or certificate)
O University graduate
O Prefer not to respond

What is your best estimate of your <u>total household</u> income over the past 12 months?

O No income
O Less than $20,000
O $20,000 to $49,999
O $50,000 to $99,999
O $100,000 or more
O Prefer not to say

Have you ever worked in the health care sector?

O Yes
O No
O Prefer not to respond

Click Here to Submit Your Survey.

Thank you for completing this survey.

Appendix 2: Results of Latent-Class, Rank-Order Logit Model, Consistent Sample, No Interactions, 4 Latent Classes

	Class 1	Class 2	Class 3	Class 4
Mean Probability Class Assignment	0.378	0.096	0.189	0.337
Baseline Health				
Pain Free 4 hours	−2.968**	−0.012	−2.093**	−1.155**
	(0.251)	(0.173)	(0.200)	(0.127)
Pain Free 8 hours	−4.764**	−0.066	−3.827**	−2.174**
	(0.359)	(0.196)	(0.282)	(0.152)
Pain Free 12 hours	−7.315**	−0.061	−5.335**	−3.947**
	(0.472)	(0.198)	(0.360)	(0.199)
Ability to Benefit				
4 hours relief	2.376**	−1.633**	−1.274**	4.022**
	(0.203)	(0.289)	(0.229)	(0.257)
12 hours relief	0.976**	−1.183**	−0.605**	1.958**
	(0.168)	(0.260)	(0.202)	(0.172)
16 hours relief	0.353**	−0.791**	−0.247**	1.231**
	(0.166)	(0.247)	(0.199)	(0.166)
Pills Required to Exhaust Benefit				
2 pills	−1.372**	0.125	1.053**	−1.825**
	(0.140)	(0.152)	(0.161)	(0.160)
6 pills	−0.474**	0.052	0.637**	−0.725**
	(0.132)	(0.148)	(0.159)	(0.110)
8 pills	−0.475**	0.036	0.401**	−0.618**
	(0.139)	(0.155)	(0.158)	(0.107)
Constant	0.116	−1.258**	−0.575**	−−
	(0.226)	(0.274)	(0.218)	−−
Observations	10,173			
Individuals	212			
Log-L	−3770.3			

Reference categories are: 0 hours pain-free per day; 24 hours of pain relief possible; and 12 pills
** $p < 0.05$; * $= 0.05 \leq p < 0.10$

A comparison of the above estimates with those in with Table 3 for the 3-class model estimated over the consistent sample reveals that: (a) the estimates for class 2 above (including class share) correspond to those for class 2 in the 3-class model; (b) estimates for class 3 above correspond closely with those for class 3 in the 3-class model (again, including class share); and (c) estimates for both class 1 and class 4 above correspond to those for class 1 in the 3-class model (even the sum of the class 1 and class 4 shares above – 0.715 – corresponds closely with that for class 1 in the 3-class model).

Appendix 3: Latent-Class Rank-Order Logit Models with Two-way Interaction Terms

Table A3.1: Latent-Class, Rank-Ordered Logit, Full Sample with Interaction Terms

	Class 1	Class 2	Class 3
Mean Probability Class Assignment	0.429	0.322	0.249
Baseline Health			
Pain Free 4 hours	−1.079**	−0.588**	−1.265**
	(0.241)	(0.215)	(0.235)
Pain Free 8 hours	−3.797**	−0.641**	−2.157**
	(0.340)	(0.284)	(0.507)
Pain Free 12 hours	−5.687**	−1.427**	−2.696**
	(0.326)	(0.225)	(0.268)
Ability to Benefit			
4 hours relief	3.120**	1.043**	−1.968**
	(0.233)	(0.146)	(0.203)
12 hours relief	1.711**	0.532**	−1.044**
	(0.156)	(0.133)	(0.162)
16 hours relief	1.075**	0.364**	−0.650**
	(0.144)	(0.133)	(0.171)
Pills Required to Exhaust Benefit			
2 pills	−1.455**	−1.559**	0.843**
	(0.192)	(0.171)	(0.201)
6 pills	−0.739**	−1.019**	0.482**
	(0.185)	(0.176)	(0.222)
8 pills	−0.195	−0.438	0.050
	(0.205)	(0.176)	(0.190)
Interaction: Painfree*Painrelief			
pf4pr4	0.540	0.375**	0.192
	(0.257)	(0.186)	(0.208)
pf4pr12	0.022	0.143	−0.100
	(0.227)	(0.180)	(0.206)
pf8pr4	0.173	0.171	0.223
	(0.280)	(0.202)	(0.239)
pf8pr12	−0.050	−0.059	−0.098
	(0.234)	(0.190)	(0.223)
pf12pr4	−0.099	−0.061	0.263
	(0.266)	(0.203)	(0.260)
Interaction: Painfree*Pill			
pf4pill2	0.691**	0.269	0.097
	(0.271)	(0.244)	(0.296)
pf4pill6	−0.305	0.111	0.043
	(0.260)	(0.238)	(0.276)
pf4pill8	−1.306**	−0.152	0.574*
	(0.324)	(0.287)	(0.299)
pf8pill2	0.124	−0.454	0.108
	(0.396)	(0.308)	(0.534)
pf8pill6	0.791**	−0.006	0.214
	(0.332)	(0.286)	(0.528)
pf8pill8	0.553	−0.235	0.418
	(0.462)	(0.335)	(0.548)
pf12pill2	0.889**	0.600**	0.324
	(0.280)	(0.240)	(0.307)
pf12pill6	0.768*	0.381	−0.259
	(0.400)	(0.310)	(0.365)
pf12pill8	0.209	0.376	0.424
	(0.405)	(0.344)	(0.408)
Constant	0.287*	−−	−0.257
	(0.152)	−−	(0.163)
Observations	16,743		
Individuals	349		
Log-L	−7183.92		

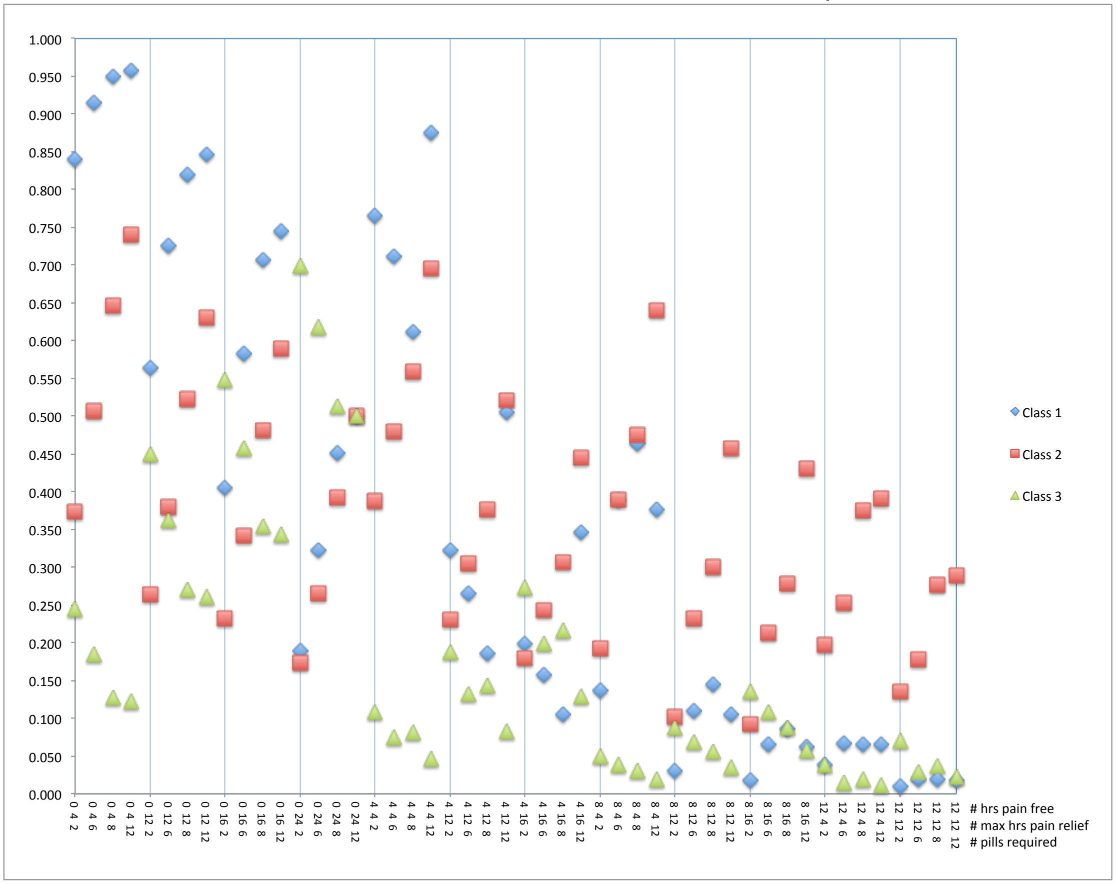
Reference categories are: 0 pain-free hours per day; 24 hours of pain relief possible; and 12 pills
** $p < 0.05$; * $= 0.05 \leq p < 0.10$

Table A3.2: Latent-Class, Rank-Ordered Logit, Consistent Sample with Interaction Terms

	Class 1	Class 2	Class 3
Mean Probability Class Assignment	0.693	0.096	0.211
Baseline Health			
Pain Free4 hours	−1.279**	0.304	−2.817**
	(0.227)	(0.442)	(0.435)
Pain Free 8 hours	−3.318**	−0.657	−2.660**
	(0.302)	(0.659)	(0.743)
Pain Free 12 hours	−4.834**	−0.441	−6.318**
	(0.236)	(0.502)	(0.538)
Ability to Benefit			
4 hours relief	3.312**	−0.171**	−1.187**
	(0.202)	(0.369)	(0.307)
12 hours relief	1.581**	−1.130**	−0.611**
	(0.133)	(0.312)	(0.235)
16 hours relief	1.025**	−1.035**	−0.221
	(0.127)	(0.290)	(0.266)
Pills Required to Exhaust Benefit			
2 pills	−1.577**	−0.139	0.704**
	(0.173)	(0.328)	(0.309)
6 pills	−0.862**	−0.266	0.400
	(0.165)	(0.351)	(0.504)
8 pills	−0.245	−0.152	−0.122
	(0.184)	(0.357)	(0.361)
Interaction: PainFree*Painrelief			
pf4pr4	0.489*	−0.433	−0.020
	(0.256)	(0.394)	(0.309)
pf4pr12	0.194	−0.617*	−0.026
	(0.208)	(0.368)	(0.365)
pf8pr4	−0.279	−0.338	0.361
	(0.267)	(0.438)	(0.337)
pf8pr12	0.021	−0.282	0.124
	(0.206)	(0.388)	(0.370)
pf12pr4	−0.178	−0.130	0.436
	(0.262)	(0.453)	(0.498)
Interaction: PainFree*Pill			
pf4pill2	0.389	−0.157	0.307
	(0.245)	(0.531)	(0.456)
pf4pill6	−0.514**	0.712	0.504
	(0.250)	(0.485)	(0.576)
pf4pill8	−1.438**	0.346	1.068**
	(0.312)	(0.611)	(0.513)
pf8pill2	0.254	1.056	−1.938**
	(0.348)	(0.701)	(0.856)
pf8pill6	0.827**	1.235*	−1.881*
	(0.292)	(0.669)	(0.969)
pf8pill8	0.819**	0.747	−1.619*
	(0.399)	(0.771)	(0.894)
pf12pill2	0.986**	0.423	0.548
	(0.252)	(0.517)	(0.529)
pf12pill6	0.820**	0.549	0.073
	(0.347)	(0.644)	(0.765)
pf12pill8	0.539	−0.295	1.543*
	(0.349)	(0.750)	0.805)
Constant	1.198**	0.784**	
	(0.248)	(0.283)	
Observations	10173		
Individuals	212		
Log-L	−3842.75		

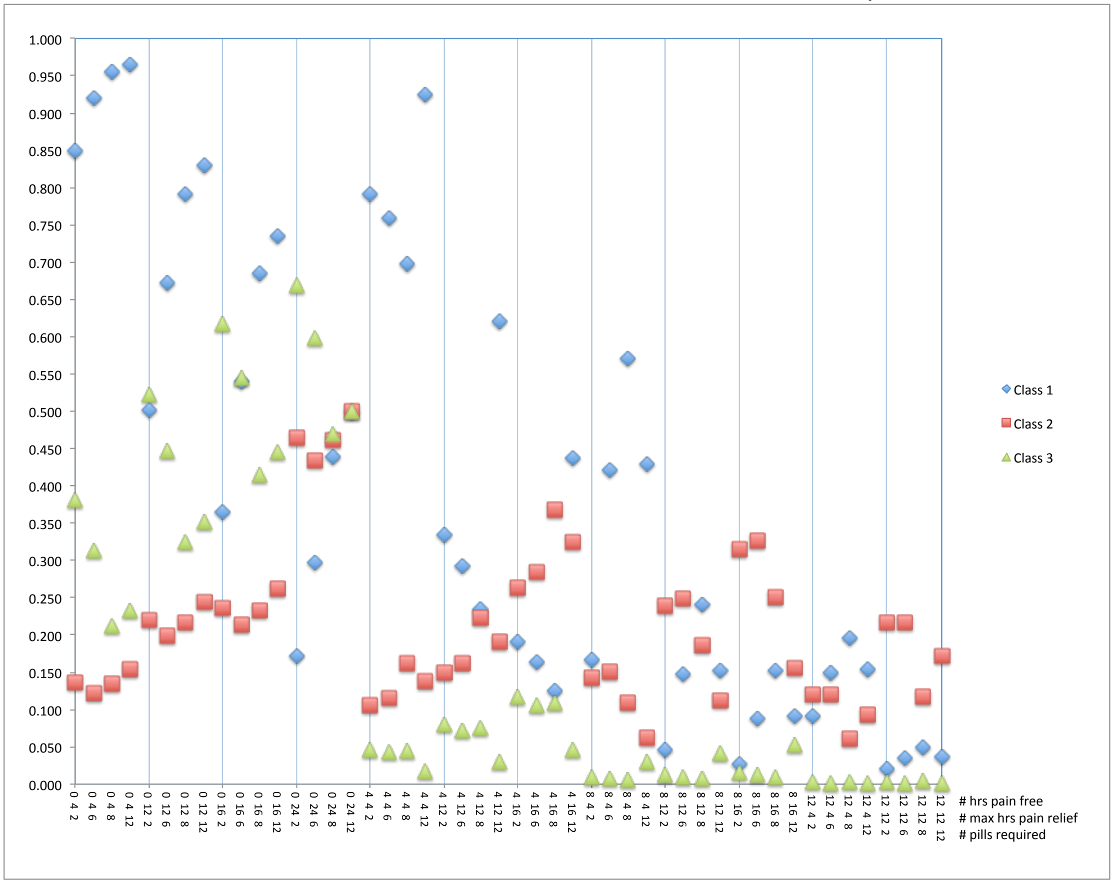
Notes: Reference categories are: 0 pain-free hours per day; 24 hours of pain relief possible; and 12 pills
Consistent respondents those who chose the same alternative for the repetitions of the scenarios in the consistency test.
** $p < 0.05$; * $= 0.05 \leq p < 0.10$

Figure A3.1: Probability of Being Ranked as Greater Need than Pain Free = 0, Pain Relief = 24 and Pills = 12, Interaction Terms, Full Sample



The reference combination for probability calculations is: 0 hours pain-free, 24 hours max pain relief, and 12 pills required to exhaust benefit. The vertical axis depicts the probability that a given combination is judged to represent greater need than the reference combination. All probabilities are conditional on class.

Figure A3.2: Probability of Being Ranked as Greater Need than Pain Free = 0, Pain Relief = 24 and Pills = 12, Interaction Terms, Consistent Sample



The reference combination for probability calculations is: 0 hours pain-free, 24 hours max pain relief, and 12 pills required to exhaust benefit. The vertical axis depicts the probability that a given combination is judged to represent greater need than the reference combination. All probabilities are conditional on class.