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Preference-Based Assessments

The Utility Assessment Method Order Influences Measurement of Parents' Risk Attitude

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ABSTRACT

Background: Standard gamble (SG) and time trade-off (TTO) are two methods used for obtaining health utility values (utilities). Whether the order in which the methods are applied alters the relative utilities obtained by each method is unknown. **Objective:** We sought to determine whether the order in which SG and TTO utilities were obtained affects the relative values of the utilities obtained by each technique. **Methods:** Utilities were assessed for 29 health states from 4016 parents by using SG and TTO. The assessment order was randomized by respondent. For analysis by health state, we calculated (SG –TTO) for each assessment and tested whether the SG – TTO difference was significantly different between the two groups (SG first and TTO first). For analysis by individual, we calculated a risk-posture coefficient, γ, defined by the utility curve, $SG = TTO^{\gamma}$. We predicted γ through regression analysis with the covariates: child age, child sex, birth order, respondent age, respondent education level, and assessment method order. **Results:** In 19 of 29 health states, the SG − TTO difference was significantly greater (more risk averse) when TTO was assessed first. In the regression analysis, "child age" and "assessment method order" were significant predictors of risk attitude. The risk posture coefficient γ was higher (more risk-seeking) with increasing child age and in the SG-first respondents. **Conclusion:** The order in which the SG versus TTO method is used strongly influences the relative values of the utilities obtained.

Keywords: standard gamble, time trade-off, utility, utility assessment.

Introduction

With the rapidly increasing cost of health care, demand is growing for cost-utility analyses that can inform decision makers about the cost and benefit from existing or proposed health care interventions. A cost-utility analysis often includes many health states, each with its own health utility value (utility). Standard gamble (SG) and time-trade off (TTO) are the two most widely accepted methods used for the direct assessment of utilities. With both methods, participants are presented with health state scenarios and asked about their health state preference [1,2].

Both methods have their roots in the expected utility theory formalized by Von Neumann and Morgenstern [3]. In the SG method, the subjects are asked what *risk* they would be willing to take to achieve a better health state. SG, therefore, measures not only preference but also risk attitude. In other words, SG is risk sensitive. By contrast, in the TTO method, the participants are asked the amount of time they would be willing to give up to achieve a better health state. Thus, TTO is risk insensitive and measures only preference [4].

The two methods have been shown to result in theoretically equivalent utility values for a risk-neutral decision maker [2], but it remains unclear whether one method is better than the other. Both have advantages: SG is sensitive to a respondent's attitude toward risk and conforms to the axioms of expected utility theory [4,5], but TTO may be easier for respondents to understand [6,7]. Sometimes, both methods are used [8–14]. Because the SG method is risk sensitive and the TTO method is not, however, utilities obtained by SG are typically higher than those obtained by TTO. We hypothesized that when SG is presented before the TTO, respondents would tend to give higher values for TTO, matching the higher values they had just given for the SG.

To test this hypothesis, we assessed utilities for child health outcomes on a large sample of parents as proxy responders for their children, using both utility assessment techniques but randomizing the order in which they were given.

Methods

Population

Pediatric utilities for 29 different conditions were assessed from 4016 parent interviews over a 2-year period. The details of the recruitment and utility assessment are detailed elsewhere [9] and reviewed more briefly here. Recruitment and interviews were done at a variety of locations in and around the city of Indianapolis between 2006 and

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2008. English-speaking men and women older than 18 years with at least one child younger than 18 years were eligible to participate. Participants provided informed consent, and each was given a $5 gift card.

Health states

The pediatric health states for which utilities were assessed were chosen by the investigators to be of interest to researchers conducting cost-utility analyses of pediatric interventions and to cover a range of severities. The choice of health states was based on clinical experience, research experience, and the goal of spanning conditions ranging from worst to best. Brief narrative scenarios describing the physical, social, and emotional characteristics as well as the duration of each health state were developed and pretested on convenience samples of the general public before proceeding with the main study. These scenarios were written in the second person and referred to the participant's child. An example of such a health state scenario, Severe Seizure Disorder, follows:

> Three to four times a day, <child's name> would have a seizure. During the seizure, he/she would become unconscious and have violent shaking of his/her arms and legs. His/her back would arch and his/her eyes would roll back. This would last 3-8 minutes each time. He/she would take medications to reduce the number of seizures, but would still have them 3-4 times every day. After each seizure, he/she would feel tired and "out of it,'" and sometimes forget what was happening right before the seizure started. The seizures would disrupt school and make it difficult to learn. He/she would not be able to drive when he/she is older because of the seizures.

Each participant was asked to provide utility values for three randomly chosen health states as they applied to one of the participant's children (the index child). If the index child had experienced one of the randomly selected health states, a new set of health states was randomly selected for the participant. We did not determine whether children other than the index child had the condition.

Utility assessment methods

Both SG and TTO were used to obtain utilities from all participants. By using a computer script, a trained research assistant first asked the participant to rank the three health states from "best" to "worst" on the basis of his or her preference over outcomes for the index child. We asked them to rate the outcomes on the basis of global preference, consistent with the classic expected utility theory. The computer then selected at random which utility assessment method would be used first, and the same order was then maintained for the assessment of the remaining two health states.

TTO assessment

For the TTO method, the participant was asked to choose between two alternatives for his or her child: to live in the selected health state for a defined duration of time and then die a quiet, painless death or to live for half as long in perfect health and then die a quiet, painless death. If the participant chose the selected health state, the period of time in perfect health was increased. If perfect health was chosen, the period of time was decreased until the participant felt that the two alternatives were equally desirable.

SG assessment

For the SG method, the participant was asked to choose between the least preferred of the three health states and a gamble between perfect health (utility = 1) and death (utility = 0). The probability of the gamble was varied until the participant was indifferent between the sure outcome and the gamble between perfect health and death. The probability of perfect health at this indifference point was the utility for the intermediate health state.

Because many respondents have difficulty comparing outcomes with utilities close to 1 to a gamble involving death, the SG was set up as a "chain of gambles" on the basis of how the participants ranked the health states. Each successive outcome was evaluated against a gamble between perfect health and the next lower ranked outcome. Only the worst outcome was evaluated against a gamble between perfect health and death. Because the probabilities of perfect health and death were defined as 0 and 1, respectively, the other outcomes' utilities were calculated as the expected value (EV) of the gamble at the indifference point, $u(\text{State}_2) = p(\text{PerfectHealth}) + [1 - p(\text{PerfectHealth})] \times u(\text{State}_3)$.

This allowed respondents to assess outcomes in the central 80% of the probability scale in which responses are considered most accurate [15].

To minimize any "anchoring effect," [16,17], the full range of probabilities was presented, and gambles were initially presented as a 50-50 chance. Then, the difference was split 25-75, 37-63, 18-82, and so on depending on the participant's choice. The process was repeated until the indifference point was reached. To avoid "framing" effects [17,18], the interviewer always emphasized the probability of both the better outcome and the worse outcome when the gamble was described.

SG, TTO, and risk attitude

We wanted to examine whether the order of assessment technique would affect the overall response of subjects across the range of outcomes for which utilities were assessed. We chose to do this by modeling risk attitude. By risk attitude, we are referring to the difference between the EV of a standard lottery and the value of the respondent's certain equivalent (CE) for that lottery. Torrance and Feeney [4] have shown that the TTO utility is the CE of a SG between the life expectancy, L, in good health and immediate death, where L is the duration of life in the impaired health state to be assessed, but only under the assumption of risk neutrality over remaining years of life. Thus, the TTO utility for a given outcome maps to the EV of a lottery between L and immediate death. Similarly, the chained utilities assessed by our SG approach determine the subject's CE for a similar gamble. The difference between the EV from the TTO and the CE from the SG is what we refer to here as the risk attitude (over remaining years of life) [8]. The utilities obtained from SG typically exceed those from the TTO, and this is widely interpreted as indicating risk aversion [19,20].

Analysis by health state

First, we analyzed our data by health state. We divided all measurements for each health state into two groups, those obtained with the SG method first and those obtained with the TTO method first. For each health state we then generated a scatter plot with each data point representing one participant's response. The SG value from each assessment was plotted on the y-axis and the TTO value on the x-axis. These scatter plots thus represented a risk-attitude curve for a given condition across all respondents similar to the one shown in Figure 1. We define points above and to the left of the diagonal as "risk aversion" and those below and to the right as "risk seeking." We then calculated the difference, SG – TTO, for each of the 12,048 health state assessments among 4016 respondents. Positive values represented risk aversion, and negative values represented risk seeking. We tested whether the SG – TTO difference was significantly different between the two groups (SG first and TTO first) by using the Wilcoxon rank sum test. This analysis was done by using SAS version 9.2 (SAS Institute, Inc., Cary, NC).

Analysis by individual response

We used the three health state utilities obtained from each respondent to model each individual's risk attitude, assuming constant proportional risk posture (CPRP), consistent with the constant proportional trade-off assumption that underlies the