Time trade-off utility modified to accommodate degenerative and life-threatening conditions

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ABSTRACT

The time trade-off is often argued to be the preferred utility assessment method. When measuring current health in its classic form, it involves a comparison of two certainties: perfect health and current health, each for a fixed period of time and followed by death. This makes the time trade-off insensitive to patient fears regarding premature death or worsening health. We suggest the classic time trade-off be modified to include subjective rather than actuarial life expectancy, and relaxation of the current health option to include uncertainty in quantity and quality of life. We illustrate the mechanics of this modified time trade-off and report a preliminary application to 122 men presenting to a prostate cancer screening program. Further analysis of this modified time trade-off appears warranted.

INTRODUCTION

Among the utilities[1] available for decision analyses and cost-effectiveness analyses, the time trade-off (TTO) is often advocated. Originally developed specifically for health care by Torrance,[2, 3] the TTO is argued to be easier to use than the standard gamble utility assessment method[2, 4] and to produce more satisfactory measurement units.[5] Some argue that the TTO should replace the standard gamble as the gold standard of utilities.[5-8] Others promote its theoretical appeal due to its conceptual similarity to a quality-adjusted life year.[9] Although the TTO is not fully consistent with the von Neumann and Morgenstern axioms of choice.[4, 9] such a theoretical basis is argued by some to be flawed anyway.[5] Furthermore, when comparing various utility assessment techniques on criteria important for any utility assessment method, the TTO has fared well.[5]

The classic time trade-off is a choice between two certainties: perfect health for a fixed period of time, generally followed by death; and some health state less than perfect, for a fixed period of time, and also typically followed by death. The period of time in the perfect health state is varied to find the point where the respondent is indifferent between the two choices.

A particular problem arises when the TTO is applied to the current health of a patient with a degenerative (i.e., potentially worsening) condition. Specifically, the "certainty" of the TTO is unrealistic. The patient may currently be asymptomatic but fearful of worsening health in the future. When evaluating such a health state, the TTO artificially locks the patient into a specific health state without threat of deterioration. The asymptomatic patient may not be bothered by his current health, and thus may provide a high TTO score because he is unwilling to part with much time in his current, nonproblematic, health. The fear of deterioration, which is this patient's primary complaint, has been removed from the TTO valuation by the classic methodology. Therefore, this patient may yield a TTO comparable to the patient in perfect health, yet the degenerative-disease patient may be emotionally miserable regarding his or her health. Clearly, the utilities of the perfect health and degenerative-disease patients should not be the same.

A similar problem arises when the classic TTO is applied to a condition which is life-threatening. Here, the patient may be asymptomatic but afraid of rapid or sudden death. When the TTO is administered, his current health is again locked in for a fixed period of time, so the patient may not be willing to accept a shorter duration of perfect health because his current health is fine but of questionable duration. Obviously, the patient with a life-threatening condition should not have the same utility as the person in perfect health, but the classic TTO may not be sensitive to this distinction.

We have attempted to modify the TTO so that it will be sensitive to both degenerative and life-threatening conditions. These are important and valid considerations when rating one's health. Prognosis is an aspect of any health state, and removing it results in artificial and misleading ratings of health. In particular, we have made two major modifications to the classic TTO. First, we have relaxed the imperfect health option such that the life span and quality of health are not fixed. That is, the patient may or may not live forever, and the quality of life may change. This was necessary to reflect the reality of degenerative and life-threatening conditions.

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The open-ended life expectancy modification necessitated the second major modification, which was to use subjective rather than actuarial life expectancy for the perfect health option. The classic TTO often uses an arbitrary maximum duration of life with perfect health or uses an age, sex, and race adjusted actuarial estimate. This causes a problem if patients believe they will outlive their actuarial life expectancy.[10] For example, the patient with a terrible condition may not opt for, what he feels to be, a shortened life expectancy in perfect health. In our approach, the respondent is first shown his age, sex, and race adjusted life expectancy and then asked to adjust it if he feels it is unrealistic (see Figure 1). Then, this subjective life expectancy is used for the maximum perfect health life span, and thus the denominator of the modified TTO (see Figure 2).

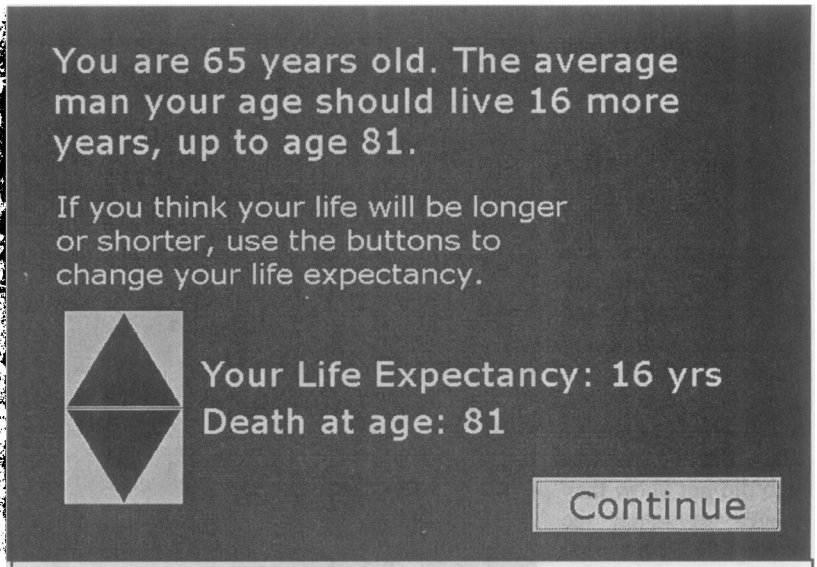

Figure 1. Subjective Life Expectancy Adjustment

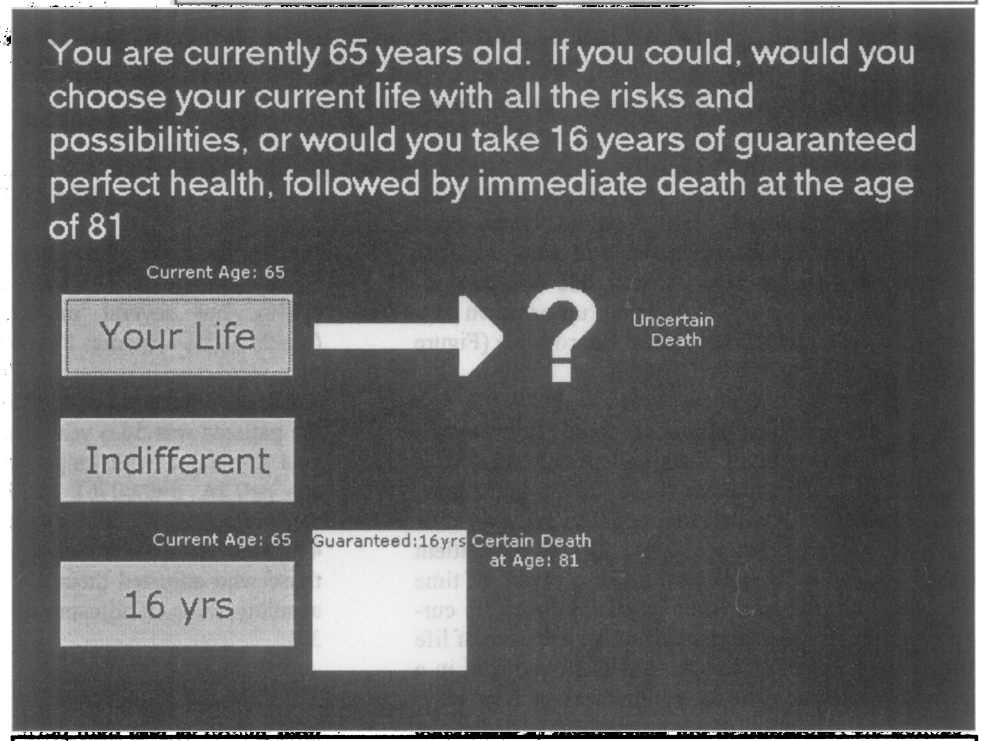

Figure 2. Time Trade-Off Interface

METHODS

We field tested this adjusted TTO on a convenience sample of men who were being screened for prostate cancer. Over a 3-month period, 333 men were screened at our institution. Most of these men lived in the neighboring community and responded to advertisements for free screening. In general, they were not referred by other physicians. In addition to having their Prostate Specific Antigen (PSA) blood test and digital rectal exam performed, patients were asked to fill out a brief health questionnaire and participate in a utility assessment exercise. Utility assessment was performed prior to meeting with the urologist. Due to time constraints or patient illiteracy, utilities were not assessed in 177 men and records were incomplete in an additional 34 men, leaving 122 valid observations. By chi-square tests, no differences were found between the 122 and those

who did not participate with respect to race (p=0.082), marital status (p=0.990), education (p=0.192), or employment status (p=0.400).

Utility assessment was performed with an unattended touchscreen system and without a human facilitator in attempt to avoid bias. A clinic representative was nearby for patients who did not know they needed to touch the screen to start the exercise, but the representative did not help the patient answer the questions. The utility assessment software was designed and written by our group.

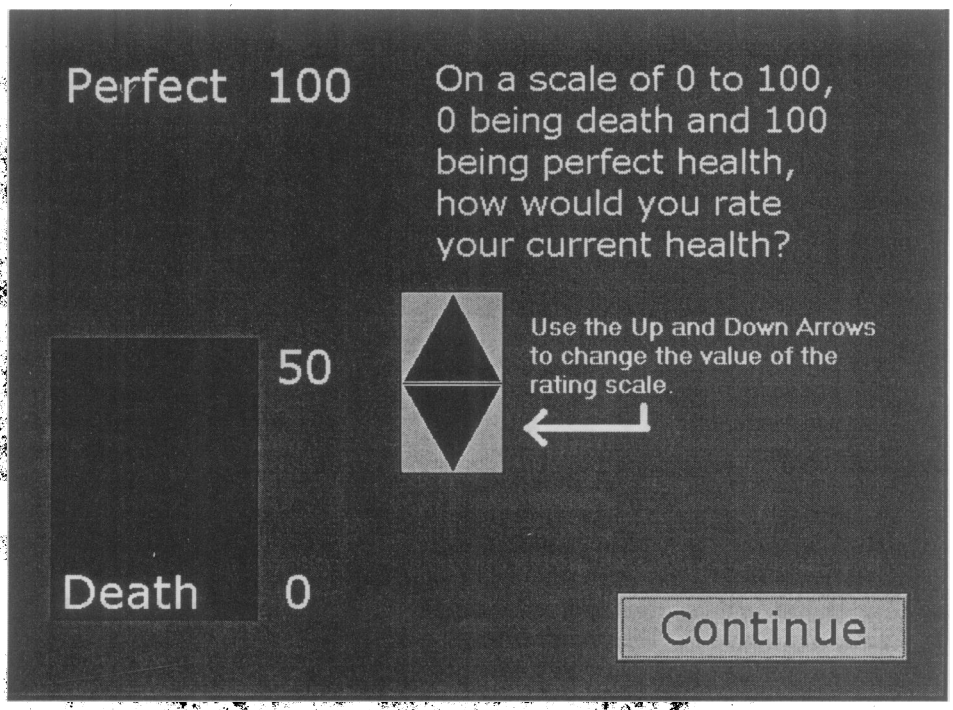

Figure 3. Rating Scale Interface

The patient first entered demographic information: name, social security number, and date of birth. Next, he was provided with his actuarial life expectancy and asked whether he felt this estimate was realistic. He was then allowed to adjust his life expectancy up or down to a value (in years) which he felt was appropriate (Figure 1).

The patient was then offered a choice between his current health, with its risks and possibilities, or a guarantee of perfect health (followed by immediate, painless death) for a duration equal to his own estimate of life expectancy (Figure 2). If the patient chose guaranteed perfect health (for a period of time equal to his perceived life expectancy) over his current health, he was offered half of his estimate of life expectancy in perfect health, and this continued in a bisecting manner until the patient was indifferent or reached the resolution of our assessment (a difference between options of 0.9 years). If the patient did not accept a perfect health guarantee equal to his estimate of life expectancy, and thus was unwilling to give up any time, his TTO value was 1.0. For comparison, the rating scale was also assessed (Figure 3). Starting and ending times were logged in the database.

RESULTS

Patients completed the utility session in a mean of 5.6 minutes (range 3-12). Most of the men were white (70%), but several minorities were represented (black: 19%, hispanic: 8%, other: 3%). Most of the men were currently married (78%), employed (63%), and had completed college (59%). The mean age of the patients was 56.6 years (range 35-79). Older age was associated with longer total session time (Pearson r=0.24, p=0.0076). Life expectancy estimates were increased by 55% of the patients, decreased by 4%, and left alone for the remaining 41%. Among those who adjusted their life expectancies, the mean absolute value of adjustment was 7.7 years (range 2-33).

Based on the rating scale, all but 5 patients reported their health as less than perfect (i.e., <100). Of these 117 patients with RS<1, 19 were willing to accept perfect health for a duration which was shorter than their subjective life expectancy yet longer than their actuarial life expectancy.

DISCUSSION

An insightful study by Tsevat et al[11] underscores the need for an improvement in the TTO technique. In

this study, the authors elicited the TTO for elderly patients who were hospitalized. In their version of the TTO, patients were asked to choose between life in their current health state for 1 year and life in a perfect health state for a period of time less than 1 year. Two problems occur with the first option. First, the threat of eventual poor health in the future may negatively impact how the patient feels about his current health, and that impact may not be getting measured. As an example, a patient with asymptomatic prostate cancer may not be worried about the year ahead but he may well be troubled about the possibility of eventual death from prostate cancer. Limiting his consideration to a time period which effectively assumed no progression of disease would seem to be incongruous with his current perceived health state.

Second, a guaranteed year of life in current health may be unrealistic for the very sick. Thus, patients would not really be evaluating their current state of health but rather a hypothetical health state with longer life expectancy. Moreover, these patients may have difficulty comprehending an option which they believe is overly optimistic, and assessing it will not truly estimate their feelings about their current state of health. For these reasons, we and others[3] have begun to advocate using subjective life expectancy estimates as the default option of the TTO.

Siggelbout[12] has proposed what could be considered an alternative solution to the problem we raise. In their study, they elicited certainty equivalents, the number of years considered by the patient to be equivalent to a gamble involving even odds for a long or short life. While this method also makes the classic TTO more realistic for life-threatening conditions, it does not directly address the degenerative issue. Furthermore, our approach, although not free of problems, would appear to be simpler for the patient to answer as well as avoid the issue of risk (i.e., the gamble in the certainty equivalent).

One concern of our pilot study is the high degree of incomplete assessments. While we did not pursue the assessment of men who did not have slack time in their screening visit or who did not read the English language, utilities were not completed in 34 of the potential 156 patients (22%). None of the authors participated in the decision of whom to exclude from assessment, eliminating the threat of a conscious bias on our part. Nonetheless, the potential for selection bias clearly exists, and future studies should focus on determinants of failure to to complete this modified time trade-off. We saw no association with marital status, race, education level, or engagement status, but a more detailed analysis is necessary. In particular, our use of an unattended touchscreen may have led to an increase in either noncompliance and/or incomprehension, another fruitful avenue for further research in this modified TTO.

Our motivation to use an unattended touchscreen was based on the growing need for mass elicitation of utilities to support the increasing interest in cost-effectiveness analyses.[13] Another factor which drives the need for efficient utility assessment is the fact that treatment preferences for particular diseases such as prostate cancer are especially sensitive to individual utilities, and group means are insufficient.[14] Finally, we wanted to avoid the possible bias that a human facilitator might impose. Although a facilitator might help the patient understand what is being asked, he or she might also bias the respondent into providing estimates that the facilitator feels are reasonable. While informal testing of our software suggests that patients do find it friendly and comprehendible, rigorous testing might not. Due to the high percentage (22%) of incomplete records, it is possible that many patients still do not fully understand the questions as we presented them. A facilitator may improve upon this rate of missing values. Furthermore, the large proportion of patients who did not complete the assessment leaves open the question of a possible response bias. Nonetheless, it appears that using the patients' subjective life expectancy as the denominator of the time trade-off may be the preferred approach when assessing utilities for chronic health states. Further research involving the modified time trade-off appears warranted.

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