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Challenges in Valuing Temporary Health States for Economic Evaluation: A Review of Empirical Applications of the Chained Time Trade-Off Method

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ABSTRACT

Background: The time trade-off (TTO) technique is commonly used to elicit health state utilities. Nevertheless, when the health states being valued are temporary, the TTO approach may be unsuitable. A variant of TTO— chained TTO—has been suggested to be used when the health states are temporary, but little research has been done on how chained TTO should be conducted. **Objectives:** To systematically review the use of chained TTO in valuing temporary health states. **Methods:** A systematic literature search was conducted using the following major databases: Ovid MEDLINE(R), Embase, EBM Reviews, and PsycINFO. Abstracts (full articles if necessary) were screened by two independent reviewers, with a third reviewer resolving any disagreements. **Results:** The resulting number of articles for review was low (n = 9). All the reviewed studies used face-to-face interviews, most had small sample sizes (<100), and all studies valued a small number of health states (<7), with time horizons typically ranging from 4 weeks to 1 year. All studies discussed methodological issues of using chained TTO, and some compared the results with those generated using other preference elicitation methods. **Conclusions:** Chained TTO appears to be feasible, consistent, and responsive and allows the valuation of temporary health states that would improve the efficiency and accuracy of decision making in health and health care. Nevertheless, the evidence is limited due to the low number of relevant studies in the literature. Further research is needed to examine the performance and validity of chained TTO compared with conventional TTO in the valuation of temporary health states.

Keywords: health state utilities, preference elicitation, systematic review, temporary health states, time trade-off.

Introduction

One of the most common forms of economic evaluation in health and health care is cost-utility analysis (CUA), in which benefits are typically expressed using quality-adjusted life-years (QALYs) [1]. A common valuation exercise to elicit health state utilities used in deriving QALYs is the time trade-off (TTO) method, which is usually used to value chronic health states. However, there are concerns over its applicability in situations in which the health states are temporary [2]. There has not been a clear definition of a temporary health state, but the convention in the literature is that a health state lasting less than 1 year [2] or simply a short-term state followed by a return to health [3] can be considered temporary. The concern with using TTO for temporary health states is largely due to one of the restrictive assumptions of the QALY model—constant proportional TTO [4]. This assumption requires that the value of a health state is unaffected by the duration used in the valuation task; however, it has been shown that this does not always hold [5]. In the case of temporary health states, the constant proportional TTO assumption becomes more problematic because of the potential use of short time horizons, which provide respondents with a scenario that includes an imminent death. In 1986, Torrance [6] outlined a variant of TTO that could be used to value temporary health states referred to as "chained TTO." It is a two-stage preference elicitation method that avoids trading life with a short time span in the first stage, which has the benefit of making the task more realistic in the context of temporary health states.

There has been no scientific consensus on the optimal specification of the chained TTO task. This makes conducting the chained TTO difficult in practice, reduces the comparability of studies that use this method, and also discourages potential uses of this method because of the barrier of not having a well-established method guide. The first step to overcoming the aforementioned issues would be to systematically review and appraise the existing practice of chained TTO in the valuation of temporary health states. The aim of this article is, therefore, to fill this gap in the literature and provide suggestions for future research. The rest of the article is organized as follows. The second section of the article describes conventional and chained TTO, the third section outlines the literature search strategy, the fourth section reviews the retrieved articles, the fifth section

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discusses the findings, and the last section concludes and suggests areas for further research.

Conventional and Chained TTO

Conventional TTO involves a choice between two hypothetical scenarios: respondents are asked to choose between a health state i for a given duration T, and perfect health for a duration between 0 and T, both followed by death [6]. The respondent is asked which scenario he or she prefers, with the duration in perfect health being varied between 0 and T until the respondent is indifferent between the two scenarios. The duration in perfect health when the respondent expresses this indifference (X) is then used to generate the utility value for i using Equation 1:

$$U_i = \frac{X}{T}. \quad (1)$$

In contrast, chained TTO consists of two stages. In the first stage, respondents choose between two hypothetical scenarios: a (temporary) health state i for a given duration T, and an anchor health state j for a duration between 0 and T, both followed by a return to perfect health [6]. The anchor state must be worse than the temporary health state but better than death ($i > j > 0$). The length of time in the anchor state j is varied until the respondent is indifferent between the two scenarios at duration X_1. Hence, the first stage elicits the respondent's preference for health state i relative to anchor state j.

The second stage values the anchor state j using the conventional TTO method, in which respondents are asked to choose between the anchor health state j for the given duration T, and perfect health for a duration between 0 and T, both followed by death. The length of time in perfect health is varied until the respondent is indifferent between the two scenarios at duration X_2.

Utility U_i for the temporary health state i is calculated using Equation 2:

$$U_i = 1 - (1 - U_j)\frac{X_1}{T}, \quad (2)$$

where utility U_j for the anchor state j is calculated using Equation 3, as in conventional TTO:

$$U_j = \frac{X_2}{T}. \quad (3)$$

It should be noted that chained TTO has also been used to value chronic health states [7], because it is thought that using an anchor health state may improve the sensitivity of TTO when trying to detect differences in utility between health states that are similar. In this review, we focus only on those studies that use the chained TTO method to value temporary health states.

Search Strategy

Established methodological approaches for undertaking systematic reviews in health care were followed throughout the review process [8,9]. A literature search was conducted of published studies from the earliest possible date up to July 2016 in the major databases: Ovid MEDLINE(R), Embase, PsycINFO, and EBM Reviews. Initially, titles, abstracts, and keywords were searched using only the terms listed in column A of Table 1 to identify all TTO studies, the purpose of which was to create a database of TTO studies for future work, with the added benefit that additional search terms could be added with ease at a later date if required for different study purposes. The results were then imported into reference management software EndNote version X7 [10] and duplicates were subsequently removed. After this step, titles, abstracts, and keywords were searched again in the EndNote database of TTO studies using the terms listed in column B of Table 1 to identify *chained* TTO studies. The eligibility of the identified records for inclusion in the review was then determined according to the following inclusion and exclusion criteria.

Table 1 – Search terms.

Column A	Column B
time-trade-off	Chained
time-trade-off	Temporary
time-trade off	Short-term/short term
time trade off	Two-stage/two stage
time tradeoff	Process
timetrade off	Acute
TTO	Transient

Inclusion criteria:

1. Studies published in English;
2. Chained TTO used to value temporary states only;
3. Primary data collected.

Exclusion criteria:

1. Review articles;
2. Non–health-related studies.

Abstracts were screened on the basis of the aforementioned criteria, and full-text screening was conducted if it was not possible to assess eligibility from the abstract alone. The screening was conducted independently by two reviewers and compared for consistency, with a third reviewer resolving any disagreements.

Results

Literature Search Results

After the initial search using terms from column A of Table 1, 3715 studies were identified, and 2025 studies remained after removing duplicates. The subsequent search using terms from column B of Table 1 then resulted in the identification of 285 potential studies. After screening the abstracts, 169 studies were excluded, leaving 116 studies for full-text examination, which resulted in 8 studies being identified for the review. Subsequent reference and citation searches of the eight studies resulted in an additional relevant study being identified—this particular article [11] did not come up in our search because it does not mention "time trade-off" in the title, abstract, or keywords. Another five studies that used chained TTO to value chronic health states rather than temporary health states were identified but not included in the review. Figure 1 illustrates this search process using a Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow diagram [9].

The following characteristics were extracted from each study: lead author, title, publishing journal, clinical area, study location, methods used, sample characteristics, information about the health states, methodological issues raised, comparisons with other methods (if applicable), and the key conclusions. In addition, the chained TTO values were typically analyzed by calculating mean [11–15] or median [16–18] or both [19] the values generated. We were unable to prospectively assess the study quality because of the lack of established criteria for assessing such studies. Nevertheless, given the few studies identified, we