Joint Utility Estimators in Substance Use Disorders

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ABSTRACT

Background: Although co-occurring conditions are common with substance use disorders (SUDs), estimation methods for joint health state utility estimators in SUD to inform economic evaluation. Objectives: To compare joint health state utility estimators in SUD to inform economic evaluation. Methods: We conducted two internet-based surveys of US adults to collect community perspective standard gamble utilities for SUD and common co-occurring conditions. We evaluated six conditions as they occur individually and four combinations of these as they occur in tandem. We applied joint utility estimators using the six individual conditions’ utilities to compare their performance relative to the observed combination states’ utilities. We assessed performance with bias (estimated utility minus observed utility) and root mean square error (RMSE). Results: Using 3892 utilities from 1502 respondents, the minimum estimator was statistically unbiased (i.e., the 95% confidence interval included 0) for all combination states that we measured. The maximum estimator was unbiased for two states and the linear index and adjusted decrement estimators were unbiased for one state. The maximum estimator had the smallest RMSE for two combination states (back pain and prescription opioid misuse [0.0004] and injection crack and injection opioid use [0.0007]); the linear index and minimum estimators had the smallest RMSE for one combination state each. The additive and multiplicative estimators had the largest RMSE for all states. Conclusions: Our results demonstrate the usefulness of the minimum estimator in this context, and confirm the inadequacy of the additive and multiplicative estimators. Further research is needed to extend these results to other SUD states.

Keywords: cost-utility analysis, preferences, substance use, utility.

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Introduction

The increasing prevalence of multiple chronic conditions among individuals of all ages compels health services researchers to better understand how having two (or more) conditions at the same time affects the health-related quality of life (HRQOL) of co-occurring illness [1]. About one in four adults and two in three Medicare beneficiaries have multiple chronic conditions [2,3]. Co-occurring conditions are particularly common among individuals with substance use disorders (SUDs): approximately 39% of adults in the United States who have an SUD also have a mental health disorder [4], and 50% to 80% of injection drug users are infected with both HIV and the hepatitis C virus [5]. Because the incidence of opioid use disorder is increasing dramatically [6], understanding the HRQOL of opioid use disorder, its treatment, and co-occurring conditions is critical to decisions about optimal intervention.

Comparative effectiveness research, including cost-utility analysis (CUA) and cost-effectiveness analysis (CEA), is useful to inform decision making, CUA and CEA use quality-adjusted life-years (QALYs) as the outcome measure to quantify benefits accrued by an intervention or treatment relative to costs. QALYs are a function of the quality and longevity of a person’s life; they are the products of the HRQOL for a particular health state and the number of years lived in that state. HRQOL is measured via health state utilities, which are an economic concept that quantifies HRQOL on a uniform scale so that it is comparable across conditions [7]. Simultaneously occurring conditions present challenges for CUA and CEA because we do not fully understand how having two (or more) conditions at the same time affects HRQOL. We therefore have difficulty predicting the health state utilities and QALYs that accompany an intervention or treatment directed toward one condition in someone with multiple conditions—do we not know how the utility resulting from the second (or third) condition may change, or not, by one being resolved [8]. Because of the sheer volume of possible

**Conflicts of interest**: The authors have no competing interests to declare.

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simultaneously occurring health conditions, mechanisms for combining health state utilities for individually occurring conditions into multiple-state utilities would be highly useful for CEA and CUA [8].

Recent literature has posited methods of estimating multiple-state utility from the constituent individual (“single”) states—that is, taking known utilities for individual states and mathematically combining them to arrive at a utility for the combination state [9]. Such methods are commonly called “joint utility estimation.” Simultaneously occurring health states can take many forms in how they affect an individual. They can vary from being independent, meaning the experience of one has no effect on the experience of the other, to being interdependent, meaning the experience of one affects the experience of the other. For most co-occurring conditions, one likely ameliorates or exacerbates the experience of the other to some degree. Conditions that are physiologically unrelated, such as blindness and breast cancer, are likely experienced only minimally differently when they co-occur than when they are experienced individually. Breast cancer has little effect on the experience of blindness and vice versa. Nevertheless, conditions that are physiologically related, such as opioid use disorder and chronic pain, are likely experienced very differently when they co-occur. Pain is alleviated by opioids and so it is ameliorated in the presence of opioid use disorder and would have a better HRQOL than when experienced alone. Estimating joint utilities is therefore a complicated task that involves assumptions about individuals’ experiences.

The literature has proposed five options for estimating joint health state utility from single state utility. Methods have been assessed on the basis of their mathematical accuracy in predicting observed joint state utility from observed single state utility. More recent literature has attempted to incorporate psychological mechanisms to explain the relationship between the two. The five options are as follows: 1) the minimum estimator, in which the lesser of two single states’ utilities is used as an estimate of their joint utility; 2) the additive, or constant decrement estimator, in which the sum of the two single states’ disutilities (i.e., 1 – utility) is subtracted from perfect health (1.0) to estimate their joint utility (to a minimum of 0); 3) the multiplicative estimator, in which the product of the two single states’ utilities is used as an estimate of their joint utility [10]; 4) the “linear index estimator,” a parametric model that uses the weighted sum of the minimum and the maximum of the two single states’ utilities and their interaction to estimate their joint state utility [11]; and 5) the “adjusted decrement estimator,” a nonparametric model that combines the two single states’ utilities in proportion to the difference between them [12]. There is a lack of consensus on the best estimator among this list and research has shown conflicting results [9]. We conducted this study to assess the accuracy of joint health state utility estimators in the context of SUDs, a case in which co-occurring conditions are common and none of these estimators has been tested. Our goal was to inform the estimation of utility scores for use in economic evaluation of SUD treatments and interventions.

Utilities by asking a sample of the general population to evaluate hypothetical health state descriptions, following accepted practice [7]. We asked each respondent to evaluate between three and six randomly assigned hypothetical health state descriptions describing SUD, common co-occurring conditions (depression and chronic pain), polysubstance use, and SUD and co-occurring conditions occurring simultaneously. We estimated community perspective utilities because of their usefulness for economic evaluation [7,14], and used direct elicitation methods to avoid the need for recruiting patients with these conditions as is required in indirect utility assessment [15] (direct measures ask a sample of the general population to evaluate hypothetical health state descriptions that they may or may not have personally experienced; indirect measures ask a sample of individuals with a particular condition to complete an assessment instrument to which population utilities are assigned [7]). Utility data from the two surveys were combined to create the analytic data set (Fig. 1); complete results from the first survey are reported elsewhere [16].

For both surveys, respondents evaluated their own current health as a practice exercise before evaluating the hypothetical health states, and provided basic demographic information at the end (which was supplemented with additional demographic data provided by the survey research firm). A 100-point rating scale was used as a warm-up before standard gamble (SG) evaluations [7]. The SG technique typically asks respondents to choose between living in a described (hypothetical) health state for the rest of their life and accepting a “gamble” that includes a chance of death and a chance of living in perfect health. The chance of death and perfect health in the gamble are varied until the point that the respondent is indifferent between living in the described health state and taking the gamble [7]. We used visual aids to help respondents comprehend probabilities (dot matrices). Respondents finished the gamble exercise after multiple iterations when a desired level of precision was reached for the indifference point (0.01 utility for our surveys), or if they toggled back and forth between the same two values 3 times. They could also indicate indifference by selecting a response button labeled “too hard to choose.” A respondent could choose a button “I know my answer” to avoid the iterative chance presentation process, and type in a value between 0% and 100%. Error messages were presented on the screen if a respondent selected a potentially illogical response, with an option to revise the answer (e.g., choosing to take a pill with 100% chance of death and 0% chance of perfect health, which is tantamount to selecting suicide in the face of a described health state) [17].

We followed established practice in developing the hypothetical health state descriptions [18]: for the first survey, we collected qualitative data from individuals in substance abuse treatment programs and combined them with data from the literature and expert opinion; for the second survey, we used data from the literature and expert opinion [16]. All health state descriptions were reviewed by clinical practitioners and refined by the investigators before inclusion in the survey. All included similar domains and were of similar length; none was identified by name to respondents. We included a total of 10 health states in our analysis: injection opioid use, prescription opioid misuse, cocaine use, injection crack use, chronic back pain, and moderate depression, plus the simultaneously occurring states of cocaine and prescription opioid misuse, injection crack and injection opioid use, back pain and prescription opioid misuse, and depression and injection opioid use. The simultaneously occurring states were described as one hypothetical state that an individual was experiencing, with all characteristics that would exist when the simultaneous states co-occur. Injection opioid use and prescription opioid misuse were evaluated in the first survey and the rest in the second survey (Fig. 1; all health state descriptions are included in the Appendix in Supplemental Materials found at http://dx.doi.org/10.1016/j.jval.2016.09.2404).

Methods

Study Design

We conducted a series of two cross-sectional, Internet-based utility surveys of a representative panel of the US adult, non-institutionalized population (the GfK Knowledge Panel [12]) from December 2013 to January 2014 and from March to April 2015. We administered the identical surveys to a randomly selected sample of the panel at these two time points, varying only the health states that were evaluated. We elicited community perspective

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