Social tariffs and democratic choice – do population-based health state values reflect the will of the people?

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Abstract

In economic evaluations of health technologies, health outcomes are commonly measured in terms of QALYs. QALYs are the product of time and health-related quality of life. Health-related quality of life, in turn, is determined by a social tariff, which is supposed to reflect the public's preference over health states. This paper argues that, because of the tariff's role in the societal decision making process, it should not be understood as merely a statistical model, but as a major instrument of democratic participation. I outline what implications this might have for both the method used to aggregate individual preferences, and the set of individuals whose preferences should count. Alternative tariff specifications are explored, and future research directions are proposed.

Keywords – QALY; health state; valuation; tariff; social choice; democracy; normative theory; conceptual model; decision making.

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1 Introduction

Societal decisions, on whether or not certain health programs should be publicly provided, are often informed by economic evaluations: The (additional) costs and health benefits of, say a new drug a compared against alternatives courses of action (e.g. another drug). The results are often summarised into an incremental cost-effectiveness ratio (ICER) (Dakin et al., 2015). In England, as in many other countries, health effects are measured in Quality-Adjusted Life Years (QALY), which are the product of length and health-related quality of life. The measurement of health-related quality of life, in turn, consists of a two components: a descriptive system of health states and a social tariff which maps these states to preference values.

The currently preferred instrument for valuing health outcomes in England is the UK social EQ-5D 3L tariff (NICE, 2012; MVH Group 1995). Based on democratic principles, it is based on the preferences of (around 3,000) members of the general public. When the tariff is applied in economic evaluations, it is supposed to incorporate societal (instead of patients') preferences into health policy decisions regarding the allocation of (publicly funded) health care resources (Whitehead & Ali, 2010). Therefore, I argue that tariffs should not be understood as merely statistical models, but as a major instruments of collective choice. As such, tariffs do not only have to adhere to scientific standards, but also need to reflect the norms and democratic principles of society as a whole.

Despite the considerable impact on health policy decision-making, the implied value judgments of social tariffs have received very little attention, and research into their conceptual and normative basis has been scarce (Devlin et al., 2017; Dewitt et al., 2017). In this paper, I make a first attempt to examine the role of the tariff within the wider decision-making framework from a collective choice perspective (section 2). I go on to highlight the (im)possibility of aggregating individual health state preferences into a societal preference (section 3), and outline further implications for health state valuation studies (section 4), before I propose future research directions (section 5).

2 The health policy decision-making framework

In the following, I will provide a basic framework for economic evaluations, incorporating health state values from the general population. For clarity, some simplifications will be made (e.g. uncertainty is being ignored). Moreover, it should be noted that the QALY is built on strong assumptions, including, among others, the measurability of interpersonally comparable, cardinal preferences over hypothetical health states (Carr-Hill, 1989; Dolan, 2000; Dolan et al., 2005; Fleurbaey & Hammond 2004; Lipscomb et al., 2009). Challenging these assumptions is outside the scope of this paper, and the function of the social tariff is only investigated within this given context.

2.1 Basic notations and concepts

Suppose society consists of N individuals, whose preference functions over m (mutually exclusive) health states, given by $H = \{h_1, h_2, \cdots, h_m\}$, are denoted $p_1, p_2, \cdots, p_n$, with $p : H \rightarrow u, (u \in \mathbb{R}, u \leq 1)$. Note that preference values over health states are measured on a ratio scale, in relation to the preference for 'full health', denoted h^*, with $p'(h_j) = \frac{p(h_j)}{p(h^*)}$. The societal value of health states is captured by the social tariff $t(.)$, which is an aggregate function of individual preference functions, given by $t(h_j) = f(p'_1(h_j), p'_2(h_j), \cdots, p'_n(h_j))$. Let $S = \{s_{11}, s_{12}, \cdots, s_{21}, \cdots, s_{nm}\}$ then denote an $n \times m$ matrix containing individuals' 'health state times', i.e. the amount of time that individual i spent in state j. If we assume additive separability and zero time preference, the number of QALYs (as valued by society) accrued by all members of society $Q^t = \{q_1^t, q_2^t, \cdots, q_n^t\}$ is determined by the products of individuals' health state times and the corresponding societal valuation, given by $Q^t = t(H) * S$. The total number of QALYs in society can be evaluated by the following formula:

$$\sum_{i=1}^{n} q_i^t = \sum_{i=1}^{n} \sum_{j=1}^{m} t\left(h_j\right) * s_{ij}$$

2.2 The role of the tariff in societal decision-making

The aim of the health system is assumed to be the maximisation of QALYs, subject to a fixed budget constraint. The marginal opportunity costs for £20,000 are further assumed to be 1 QALY. The resulting decision-making framework is outlined below, and figure 1 provides a schematic overview (superscripts are used to link the text with the figure).

Given the stated objective, the societal decision[12] over some health program a depends on its ICER[10], compared to its most cost-effective alternative $\overline{a}$. While the incremental costs[8], given by $\Delta c_a = [c_N|a] - [c_N|\overline{a}]$, can, in principle, be directly observed in a study[6], the incremental QALYs[9] ΔQ_a^t are not only determined by the incremental health outcomes[7] $\Delta S_a = ([S|a] - [S|\overline{a}])$, but also by the social tariff[5] $t(.)$, with $\Delta Q_a^t = t(H) * \Delta S_a$. To derive t, however, first individual health state preferences[3] have to be elicited, e.g. using the time-trade-of method[2]. Preferences are then aggregated[4], as specified by $f(.)$, before the tariff can be used to translate health outcomes into QALYs.

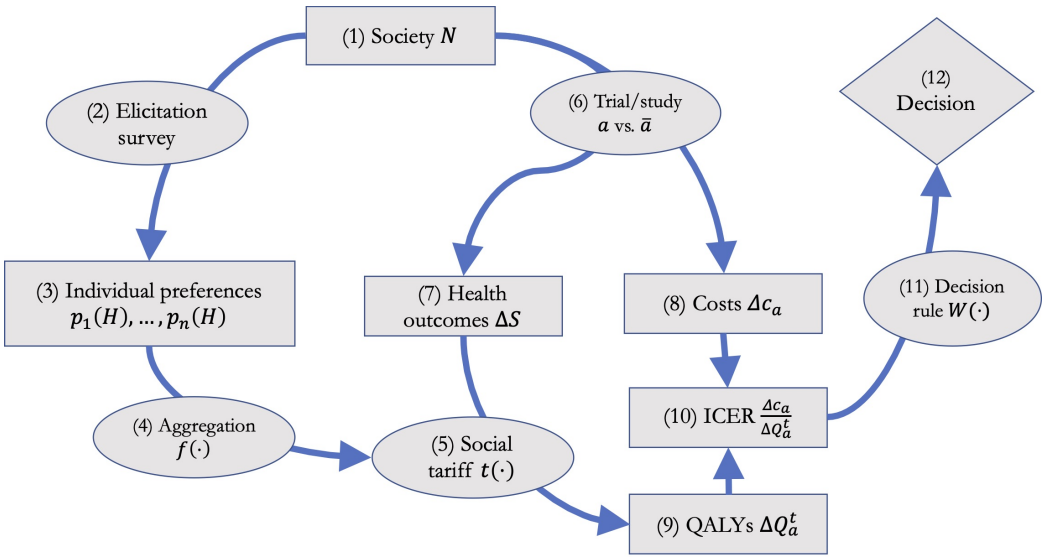

Figure 1: The role of the social tariff within the wider decision-making framework. *Ovals represent functions and rectangles the inputs/outputs.*

Finally, program a should be adopted if its ICER is smaller or equal to £20,000. The societal decision function[11] $W(.)$ can be defined as follows:

$$W(a) = \begin{cases} 0\, if\ \frac{\Delta c_a}{\Delta Q_a^t} > 20,000 \\ 1\, if\ \frac{\Delta c_a}{\Delta Q_a^t} \leq 20,000 \end{cases}$$

The overview (see figure 1) illustrates the central role of the social tariff $t(.)$ in the decision-making framework: the tariff specifies the societal value of the time individuals spend in any health state other than full health, and thereby, it determines to some, potentially great extent whether or not a health program is considered cost-effective. Depending on the distribution of preferences, the method of aggregation $f(.)$ can, thus, also have significant impact on societal decision-making.

2.3 The social tariff as an instrument of collective choice

Before I go on to discuss the aggregation of individual preference functions, it will be useful to briefly consider what the resulting societal preference values represent. First of all, it should be noted that the current social tariff framework is fundamentally incompatible with the notion of utility maximisation. This is because, even though the tariff is based on individual (health state) preferences, it is not individual i's own valuation of their own health state(s) that informs societal decisions. Instead, a change in individual i's health from state j to state k is valued by the aggregate preference of society. This includes individuals who are neither in health state j nor k, as well as individuals who are not affected by the decision, at all. Since individual i's preference will generally not be identical to the societal preference, $p_i'(h_j) \not\equiv t(h_j)$, it follows that maximising societal QALYs is not the same as maximising health-related utilities: $\sum_{i=1}^{n}\sum_{j=1}^{m} t(h_j) * s_{ij} \not\equiv \sum_{i=1}^{n}\sum_{j=1}^{m} p_i'(h_j) * s_{ij}$.

A more convincing interpretation of the QALY can be derived from 'extra-welfarism', which offers an alternative approach for the evaluation of health policies beyond utilities (Brouwer et al., 2008; Coast et al., 2008; Cookson 2005; Culyer 1989). Here, health is not primarily recognized as a source of utility, but it has a social value in itself. In fact, this is how the QALY seems to be generally understood:

as an operational definition of *health*. Hence, the social tariff should not be regarded as a summary function of individual (health-related) utilities, but rather as a mechanism, through which society collectively derives an interpersonally comparable index of value for different sets of health functionings (Cookson 2005).

3 Aggregating individuals' health state preferences

3.1 Problem statement

With only few exceptions (e.g. Shaw et al., 2010), health state valuation studies have used the arithmetic mean to aggregate individual preferences into a societal preference (Xie et al., 2014; MVH, 1995). If the tariff would reflect (health-related) utilities, the use of the mean could potentially be justified by utilitarian welfare maximisation through potential pareto improvements. But, as argued above, the current framework is incompatible with this interpretation of the QALY (Devlin et al., 2017). Within the 'extra-welfarist' approach, however, there does not seem to be a normative basis for selecting the mean over any of the (infinitely) many other possible aggregation functions (Roberts 1980). In particular, it cannot be assumed that there is an objectively *true* value for each health state. Differences between individuals' health state valuations can, therefore, not be regarded as measurement errors, which cancel out when taking the average. Rather, differences have to be understood as genuine disagreements. If all individuals had similar preferences, however, the choice of the aggregation method would be trivial. Yet, empirical studies show that health state preferences differ considerably (Xie et al., 2014; also see figure 2), and the societal preference is thus intimately dependent on the method of aggregation – if the method is changed, the outcome might differ. This raises the question: how should preferences be aggregated?

The (im)possibility of aggregating individual preferences into a social preference has been extensively discussed in social choice and welfare economic literature. Various welfare functions and voting rules have been axiomatically examined and their attractions and drawbacks have been described (Arrow 1951; Brandt et al.,

2016; Fleurbaey & Hammond 2004; Sen 2018). Seminal findings suggest that no method can be assumed to be unequivocally superior, or unanimously accepted. The decision which method to use always requires making value judgments. This means, to be able to say one method is better than another, it first needs to be decided what values should be incorporated. However, since this question has not yet been addressed in the context of population-based health state valuations, it is unclear what properties these functions should have. Currently, it is not even obvious what types of aggregation functions are admissible at all. In a recent discussion paper, Devlin et al. (2017) suggested that a reasonable starting point for conceptualising a social tariff would be the fundamental principle of the democratic system within which the health system operates: the majority rule. As an example, they consider the most common measures of central tendency (mode, mean, median), but do not derive at a conclusive solution. In the following, I expand on their analysis and show that none of the three measures can appropriately reflect the majority view.

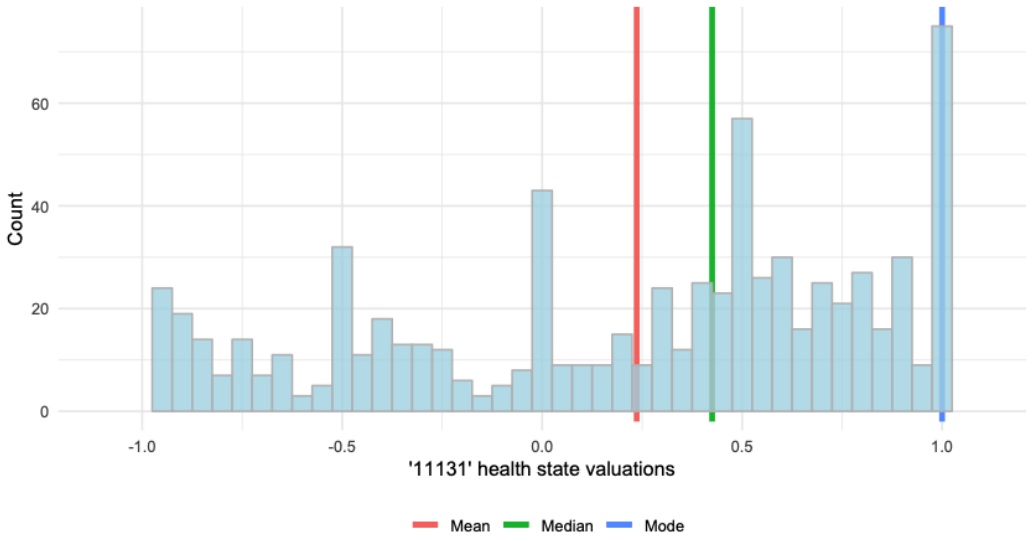

Figure 2: Distribution of individual preferences values (n=735) for EQ-5D 3L health state, '11131', and the corresponding mean, mode, and median. Source: data from MVH (1995).

3.2 Measures of central tendency and the majority rule

3.2.1. The arithmetic mean

The arithmetic mean is commonly used to aggregate preferences in health state valuation studies (Xie et al., 2014; MVH, 1995), and it has convenient properties: it is easy to compute and to predict using regression models, and, unlike the median or mode, it is consistent with $[f(p_1(h_1), p_n(h_1))] - [f(p_1(h_2), p_n(h_2))] = f([p_1(h_1) - p_1(h_2)], [p_n(h_1) - p_n(h_2)])$. However, it takes into account the preference intensity of individuals, and thus does not reflect the majority view: the mean gives more weight to individual values that are distant from the average, which makes it sensitive to outliers. This clearly conflicts with the democratic principle of 'one man (or woman), one vote'. As an example, consider figure 2. The histogram shows the distribution of 735 individual preferences values for the EQ-5D 3L health state, '11131' (no problems with mobility, self-care, usual activities and no anxiety or depression, but extreme pain or discomfort). The mean value is 0.24, but 58% prefer a higher value. Individuals with a preference value of -1 had much more weight in the estimation than individuals with preference values of 1 (1.6 times), 0.5 (4.7 times), or 0.3 (19.4 times).

3.2.2. The mode

Selecting the most frequent value from a complex distribution of cardinal preference values seems to be meaningless. The frequency of values mainly depends on the accuracy of the measurement and the extent of up- and down-rounding. In our example (figure 2), 1 is by far the most frequent value (n=72). However, 90% (n=663) prefer a lower value. Overall, in the MVH (1995) data, all health states have a mode value of either 1, 0, or -1.

3.2.3. The median

At first glance, the median provides a promising alternative: according to the Median Voter Theorem (Black 1948), a majority will select the outcome most preferred by the median voter (given single peaked preferences). Correspondingly, in our example, there is no majority for a value that is higher (preferred by 49.5%)

or lower (preferred by 48.3%) than the median (=0.43). From this one might conclude that this is the value that the majority supports. However, the Median Voter Theorem only applies to voting on one dimension. For multiple dimensions, there is not necessarily a stable majority, and societal preferences might be intransitive (McKelvey 1976). For the valuation of multiple health states, this means that although median values would reflect the majority view for each state individually, combining the median values of multiple health states into a social tariff might not represent the majority view globally. Moreover, the interpretation of median preferences is further complicated by the fact that the difference between the medians for two health states is not equal to the median difference. This can lead to paradoxical results, as the following example may illustrate.

Suppose individuals $x1$, $x2$ and $x3$ have preferences over health states h_1 and h_2: $x1$ prefers h_1 ($p_{x1}(h_1) = 0.65$) over h_2 (0.44); $x2$ also prefers h_1 (0.94) over h_2 (0.83); and only $x3$ prefers h_2 (0.98) over h_1 (0.34). One could thus conclude that a majority of individuals prefers h_1. However, the median values for the two health states are 0.65 and 0.83 (the geometric medians are 0.68 and 0.72), which would indicate that the group prefers h_2. See figure 3 for a visual illustration.

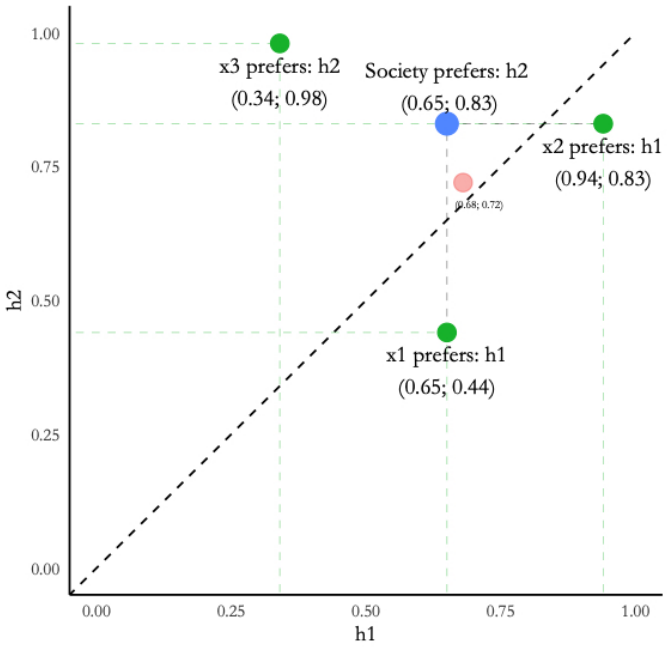

Figure 3: The 'median health state paradox'. Even though a majority of individuals (green dots) prefers health state $h1$ over state $h2$, based on median (blue) or geometric median (red) health state values, the group prefers $h2$.

3.3 Constructing a democratic social tariff

None of the three measures of central tendency discussed above are able to incorporate the majority rule into the social tariff, let alone into decision-making. As the 'median health state' example has shown, it even seems questionable whether the majority rule can be meaningfully applied at the health state level at all. In the following, I will thus outline an alternative approach: a re-formulation of the social tariff as a majority voting system over health programs (see figure 4). Even if the proposed method is unlikely to be considered a viable alternative to the current system in the near future, it might serve to illustrate the conception of the social tariff as an instrument of democratic participation.

As noted above, the incremental societal QALYs of program a are given by ΔQ_a^t whereby the superscript indicates that incremental health state times ΔS are valued using the societal tariff $t(.)$. Alternatively, QALY estimates could be derived from individuals' health state preference functions directly, with $\Delta Q_a^{p_i} = p_i'(H) * \Delta S$. The societal health effects of program a would then be evaluated by all individuals $i \in N$ separately (i.e. how many QALYs does program a generate in society from the perspective of individual i?). Imposing the societal efficiency decision rule $W(.)$ on everyone, individual i's decision function is given by

$$d_i(a) = \begin{cases} 0 \; if \; \frac{\Delta c_c}{\Delta Q_a^{p_i}} \leq 20,000 \\ 1 \; if \; \frac{\Delta c_a}{\Delta Q_a^{p_i}} > 20,000 \end{cases}$$

Subsequently, the societal decision rule could be re-formulated as a majority voting system: individual decisions $d_1(a), d_2(a), ..., d_n(a)$ could be summed up, and a should be adopted by society, if a majority of individuals 'voted' for it. The modified societal decision function W' is given below.

$$W'(a) = \begin{cases} 0 \; if \; \frac{n}{2} \leq \sum_{i=1}^{n} d_i(a) \\ 1 \; if \; \frac{n}{2} > \sum_{i=1}^{n} d_i(a) \end{cases}$$

If more than two health programs are evaluated at the same time, majority voting has important limitations, and alternative voting rules should be considered (e.g. Brandt et al., 2016 provide a contemporary overview).

It should be stressed that the proposed change would only affect the level and the method of aggregation, while the source (the general population) and the objects (hypothetical health states) of preferences remain the same. Conceptually, however, this method offers a clear advantage over the current system: it would give all individuals equal weight in the decision. Furthermore, it would also be more transparent, in terms of how many individuals do and do not support a given policy decision. Thereby, the voting system might not only be more democratic, but also easier to understand than an average societal health state tariff. Nevertheless, one might rightly object that the informational demands of this system would be significant. Detailed primary data on the health outcomes, as well as individuals' health state preference functions would be required. Moreover, if the threshold of 20,000 GBP is assumed to be based on the societal opportunity costs, each individual could, in principle, have a different threshold, depending on how many QALYs are currently being generated in the health care system from their perspective (i.e. according to their individual preference function).

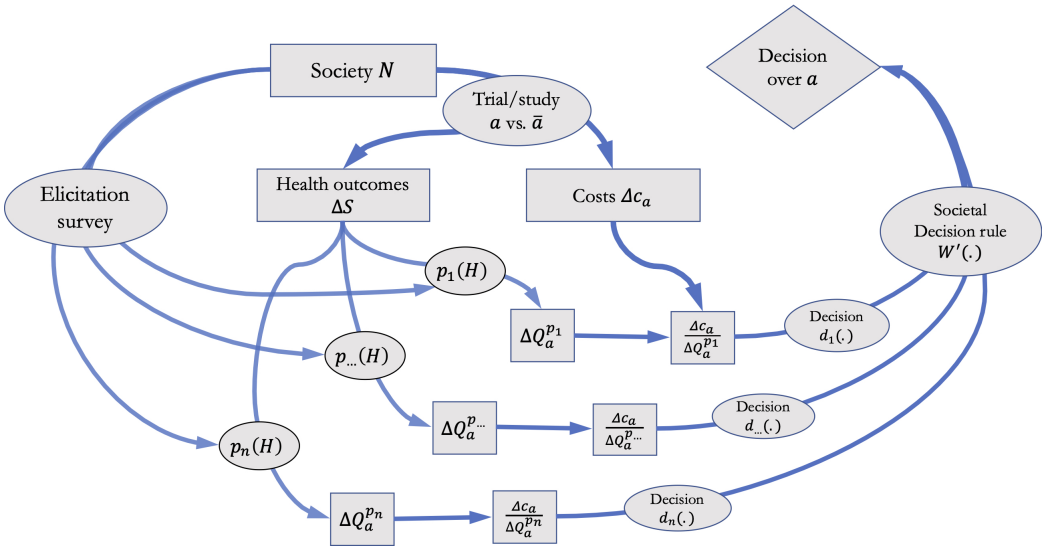

Figure 4: A democratic reformulating of the social tariff as a majority voting system.

4 Democratic representativeness of the social tariff

From a democratic perspective, it is not sufficient to address the question *how* preferences should be aggregated. It also needs to be determined *whose* preferences should count. Even if *the public* is to be accepted as the source of preferences, it has not been established what practical implications this may have for health state valuation studies. In the following, I make some recommendations for aspects that should be considered.

Firstly, the surveyed group of individuals should be representative of the society for which a decision is to be made. This means, participants should be selected randomly. After the data are collected, all reasonable efforts should be made to retain representativeness throughout subsequent analyses. This implies that incomplete cases should not be excluded, nor should missing values be ignored. The exclusion of 399 (12%) participants from the in the MVH study (1994) because of missing values appears disconcerting in this regard. Missingness is unlikely to be (completely) random, and appropriate imputation methods should be considered (Rubin 1976). Moreover, seemingly irrational preferences – e.g. assigning the same value to all health states (Lamers et al., 2006) – should also not automatically be removed. Preferences might be consistent with some underlying beliefs, and researchers should not presume to make judgements about them (Devlin et al., 2017).

Secondly, democratic representativeness also commands that only those individuals are considered in the tariff, who are members of the very society, for which decisions are to be made. Health preferences vary across different regions and cultures (Gerlinger et al., 2019). NICE's decision to use a UK-wide, instead of an English tariff, to value health outcomes seems problematic in this regard, as it might well be the case that the four UK countries also have distinct preference profiles. One could take this a step further and argue that local authorities should also consider the use of local tariffs to evaluate local health programs, if the preferences of the local community are assumed to differ from the rest of the country. Whether the benefits of more accurate QALY estimates actually outweigh the costs of constructing local

tariffs, will depend on the regional heterogeneity of preferences and the uncertainty around the policy decision. However, due to the scale of health care budgets, wrong decisions, based on biased estimates, could have significant opportunity costs.

Finally, it seems self-evident that an individual's participation in collective, democratic decisions needs to be intentional and deliberate. First and foremost, this means that participants in health state valuation studies need to be informed about the (potential) purpose of the survey (Israel 2015). Using participants' stated preferences to inform policy decisions without obtaining informed consent for doing so does not only violate the autonomy of the participants, but it also seems utterly undemocratic. Given the potential impact their responses may have on health policy decisions, some individuals may want to give their answers more thought, and some may also prefer to abstain from participating. Hausman (2010) further proposed that societal decisions should not be based on individuals' 'private' health state values at all. Instead, public deliberations would be required to derive an adequate information basis for economic evaluations. I would argue that, at the very least, participants in health state valuation studies should be given the opportunity to reflect on their responses and to seek additional information about the health states they are not familiar with (Devlin et al., 2019; Gansen et al., 2019).

5 How to move forward

I have outlined several research gaps related to the use of social tariffs in economic evaluations.

Considering the significance of the tariff for health policy decision-making, further research is urgently needed. It seems particularly important to establish a better theoretical basis for the use of social tariffs in health economic evaluations. Before more appropriate theories and methods can be developed, however, it will be the responsibility of the decision makers to better define what the objective(s) of the health system, and what the function of the social tariff ought to be (Devlin et

al., 2017). It should be stressed that the group of decision makers that should be considered relevant does not only include elected politicians and civil servants, but also members of the general public, on which ultimately all the power in a democratic society rests. Health economists can support the search for more appropriate preference aggregation methods by translating normative value judgments into corresponding decision rules. To this end, Dewitt et al. (2019) proposed a deliberative approach for eliciting the meta-preferences over aggregation procedures. In a first step, relevant ethical norms and societal values are identified from decision makers. Potential social tariffs are then constructed and subsequently presented to the participants. The preferences over the aggregation procedures (i.e. their meta-preferences) are then elicited in an iterative process.

6 Conclusion

Under the assumption that the social tariff represents a major instrument of democratic participation, this paper raises several critical questions and challenges the conceptual foundation of the current framework. Although the practical implications are still to be determined, a democratic (re)interpretation of the social tariff would undoubtedly have important consequences for population-based health state valuations. A new line of research is proposed to establish a conceptual basis for social tariffs from a democratic perspective.

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