

# Willingness-To-Pay for a QALY: A New Approach to Estimate Cost-Effectiveness Threshold Applied to France

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## Abstract

**OBJECTIVES:** For the last 10 years health economic assessment in France focuses on a QALY-based cost-effectiveness analysis. Defining a Willingness-To-Pay (WTP) for a QALY (WTP-Q) is not an easy task and is related to the lack of consensus on the use of a reference value for economic evaluation in France. A recent study estimated the Value of Statistical QALY (VSQ) between €147,093 and €200,398. VSQ was derived from Value of Statistical Life (VSL), a standard metric associated to the WTP for saving a life or reducing a fatal risk. It is considered that VSQ reflects much more WTP for lifetime gain rather than health improvement and consequently over-estimates WTP-Q. We used a recently published theoretical framework to estimate WTP-Q for France.

**METHODS:** We estimated a WTP-Q(a) for a given age (a) that reflects both the WTP for health improvement and lifetime gain. WTP-Q(a) is modelled from VSQ(a), imminent and long-term death risk, minimum and maximum expected quality of life over an age-dependent life expectancy, and risk aversion for future scenario including both probability of good health and highly deteriorated health. We applied the recommended discount rate by the French Committee of Economic and Public Health Evaluation (CEESP). Finally, consistently with the method applied to estimate one unique VSQ, we estimated one unique WTP-Q as a weighted average of WTP-Q(a) according to the demographic structure of the French population.

**RESULTS:** According to individual risk aversion ranging from full aversion to neutral posture, we estimated a WTP-Q ranged between €27,847 and €112,586.

**CONCLUSIONS:** Assuming VSQ incompletely reflects WTP-Q, it was possible to estimate lower and upper bound of WTP-Q. If there is still to be discussed to define the acceptable level of risk aversion, we hope our contribution will help going forward to define a reference value for health economic evaluation in France.

## Methods

### Principles

Estimating a unique WTP-Q for France directly from the latest 3M€ VSL officially estimated (Quinet 2013) according to two principles

- Respecting the same ethical principle of preserving equity between citizens that prevails when proposing a VSL (Quinet 2013);
- Using no other sources than available French data (utility scores, life expectancies, demographic data).

### Theoretical Framework (Herrera-Araujo et al 2020)

- Individual future lifetime utility is a function  $u(w,q)$  where  $w$  is the individual future wealth and  $q$  the quality of life. We simplified this approach to consider only

$$u(q) = q(h,t)^\alpha \quad (1)$$

where  $\alpha$  is a measure for individual risk aversion,  $h$  the future health and  $t$  the longevity

- Let's  $q$  be an individual quality of life conditional of surviving a given period, a maximum attainable quality of life  $\bar{q}$  (i.e., full health and maximum longevity) and a minimum quality of life  $\underline{q}$  corresponding to immediate death.

$$VSQ(q) = \frac{VSL(q)}{(q-\underline{q})} \quad (2)$$

$$WTP_Q^U(q) = (1-\pi) \times VSQ(q) \quad (3)$$

$$WTP_Q^L(q) = \left[ \frac{q-\underline{q}}{\bar{q}-\underline{q}} \right] \times \left[ \frac{\mu(q)}{(1-\mu(q))} \right] \times (1-\pi) \times VSQ(q) \quad (4)$$

- Where  $WTP_Q^U(q)$  is an upper bound and  $WTP_Q^L(q)$  is a lower bound of the actual  $WTP_Q(q)$ ,  $\pi$  is the risk of death over the given period, and  $(1-\pi)$  the probability of surviving the period and  $\mu(q)$  is the probability of immediate death.

$$\mu(q) = \frac{[u(\bar{q})-u(q)]}{[u(\bar{q})-u(\underline{q})]} \quad (5)$$

### Application to the French setting

- We then considered that lifetime quality of life and utility were age dependent functions,  $q(a)$  and  $u(a)$ .

$$q(a) = \sum_{i=a}^{a+T(a)} u(i) \times (1+\delta)^{(i-a)} \quad (6)$$

- Where  $T(a)$  is the life expectancy at a given age  $a$ ,  $u(i)$  is the age-related utility and  $\delta$  a discount rate.

- we defined  $\bar{q}(a)$  as the lifetime quality of life with a perfect health and  $\underline{q}(a)$  as the quality of life in case of immediate death at a given age  $a$ , considering that immediate risk of death was the mortality rate of the French population at age  $a$ .

$$\bar{q}(a) = \sum_{i=a}^{a+T(a)} (1+\delta)^{(i-a)} \quad (7)$$

$$\underline{q}(a) = \frac{u(a)}{2} \quad (8)$$

- Where  $u(a)$  is the age-related utility at a given age  $a$

- We estimated one unique WTP-Q using a weighted average of WTP-Q(a) for ages going from 0 to 99. Weights are defined by the demographic structure of the French population in 2022.

$$WTP_Q = \sum_{a=0}^{99} WTP_Q(a) \times \frac{N(a)}{N} \quad (9)$$

- Where  $N$  is the French population and  $N(a)$  the French population of age  $a$ , in 2022 January 1<sup>st</sup>.

## Data sources and Hypotheses

### Data sources

- Demographic data** : French demographic data for 2022 published by The National Institute of Statistics and Economic Studies (INSEE)
- Utility scores** : Mean utility score per age, extracted from the EQ-5D-3L value set for France (Chevalier et al 2013)

Age	Female Mean Utility* (SD)	Male Mean Utility* (SD)
18-24 years	0.915 (0.286)	0.967 (0.079)
25-34 years	0.882 (0.131)	0.904 (0.163)
35-44 years	0.825 (0.159)	0.898 (0.122)
45-54 years	0.837 (0.225)	0.762 (0.291)
55-64 years	0.804 (0.184)	0.796 (0.219)
65-74 years	0.71 (0.224)	0.852 (0.201)
+75 years	0.665 (0.264)	0.737 (0.286)

### Hypotheses

- No risk aversion** :  $\alpha = 1$
- Discount rate** : 2,5% for the 1st 30 years and 1,5% after according to HAS recommendations

## Results

According to individual risk aversion ranging from full aversion to neutral posture, we estimated a WTP-Q ranged between €27,847 ( $\alpha = 0$ ) and €112,586 ( $\alpha = 1$ ).

WTP-Q	Base case Upper Bound* = Lower Bound	Scenario $\alpha = 0.8$ Lower Bound	Scenario $\alpha = 0.6$ Lower Bound	Scenario $\alpha = 0.4$ Lower Bound
WTP-Q	€112,586	€90,548	€70,868	€53,750

\* the Upper Bound is not sensitive to hypothesis on risk aversion

## Conclusion

This updated methodology that consists in estimating a real Willingness-To-Pay for a QALY (WTP-Q) rather than a Value of a Statistical QALY (VSQ) provides estimates that are at least 20% lower than a previous VSQ estimate for France (Tehard B et al 2020).

Considering that Public health-related decision cannot be based on a complete risk aversion statement, we consider that a 112,586€ WTP-Q could be considered as a reference value to qualify whether a health technology, for which a reimbursement is requested, may be or not efficient.

## References

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