

APPENDIX 1. QALY Model Assumptions

UTILITY INDEPENDENCE. Attribute H (e.g., HRQL) is *utility independent* of attribute Y (e.g., years of life) if an individual's conditional preferences for lotteries over H given $Y = y_i$ do not depend on the particular value y_i . Mathematically stated, for lotteries over H given fixed values for Y .

$$\begin{aligned} [p, (h_i, y_r); (1-p), (h_j, y_r)] \succ [p', (h_k, y_r); (1-p'), (h_l, y_r)] &\Rightarrow \\ [p, (h_i, y_s); (1-p), (h_j, y_s)] \succ [p', (h_k, y_s); (1-p'), (h_l, y_s)] &\forall h \text{ of } H, \forall y \text{ of } Y. \end{aligned} \quad (\text{A.1})$$

MUTUAL UTILITY INDEPENDENCE. Attributes H and Y are *mutually utility independent* if they are *utility independent* of each other. *Utility independence* is a cardinal condition while *preference independence* is an ordinal condition. It is thus a more demanding condition.

CONSTANT PROPORTIONAL TRADE-OFF. The *constant proportional trade-off* assumption of years of life for HRQL holds if an individual is indifferent to a choice between y years in health state h and αy years, $0 < \alpha < 1$, in a more attractive health state h' , then the individual should also be indifferent between βy years, $\beta > 0$, in health state h and $\alpha\beta y$ years in health state h' .

Mathematically,

$$h' \succ h \quad \alpha \in (0,1), (h, y) \sim (h', \alpha y) \Rightarrow (h, \beta y) \sim (h', \alpha\beta y) \quad \forall \beta \geq 0, \quad (\text{A.2a})$$

or equivalently,

$$h' \succ h \quad \alpha \in (0,1), U(h, y) = U(h', \alpha y) \Rightarrow U(h, \beta y) = U(h', \alpha\beta y) \quad \forall \beta \geq 0. \quad (\text{A.2b})$$

RISK NEUTRALITY WITH RESPECT TO LIFE YEARS. *Risk neutrality with respect to life years* holds if a rational individual is indifferent between a lottery over life-years given a fixed HRQL level and the deterministic alternative of expected years of life and the lottery fixed HRQL level.

Mathematically,

$$\forall h, y, p \quad p \in (0,1) \quad \left(p, (h_i, y_j); (1-p), (h_i, y_k) \right) \sim (h_i, py_j + (1-p)y_k). \quad (\text{A.3})$$

ZERO-CONDITION. For a duration of zero life-years, all HRQL levels are equivalent.

Mathematically,

$$U(h, 0) = U(h', 0) \quad \forall h, h'. \quad (\text{A.4})$$

Bleichrodt et al. state⁴¹: “The zero-condition is entirely self-evident in the medical context.”

ADDITIVE UTILITY INDEPENDENCE.⁴⁸ The utility of a health status in one period is independent of the health status in all other periods.