

Valuing mortality risk reductions in global benefit-cost analysis

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Outline

- Concept & terminology
- Review of direct estimates in LMICs
- Recommendations
 - Use direct high-quality estimates if available
 - Extrapolate from high-income country estimates, adjusting for income difference
 - As primary estimate, or sensitivity analysis
 - Extrapolation
 - 2 base values
 - 2 income elasticities
 - Sensitivity analysis for age
 - Value proportional to life expectancy

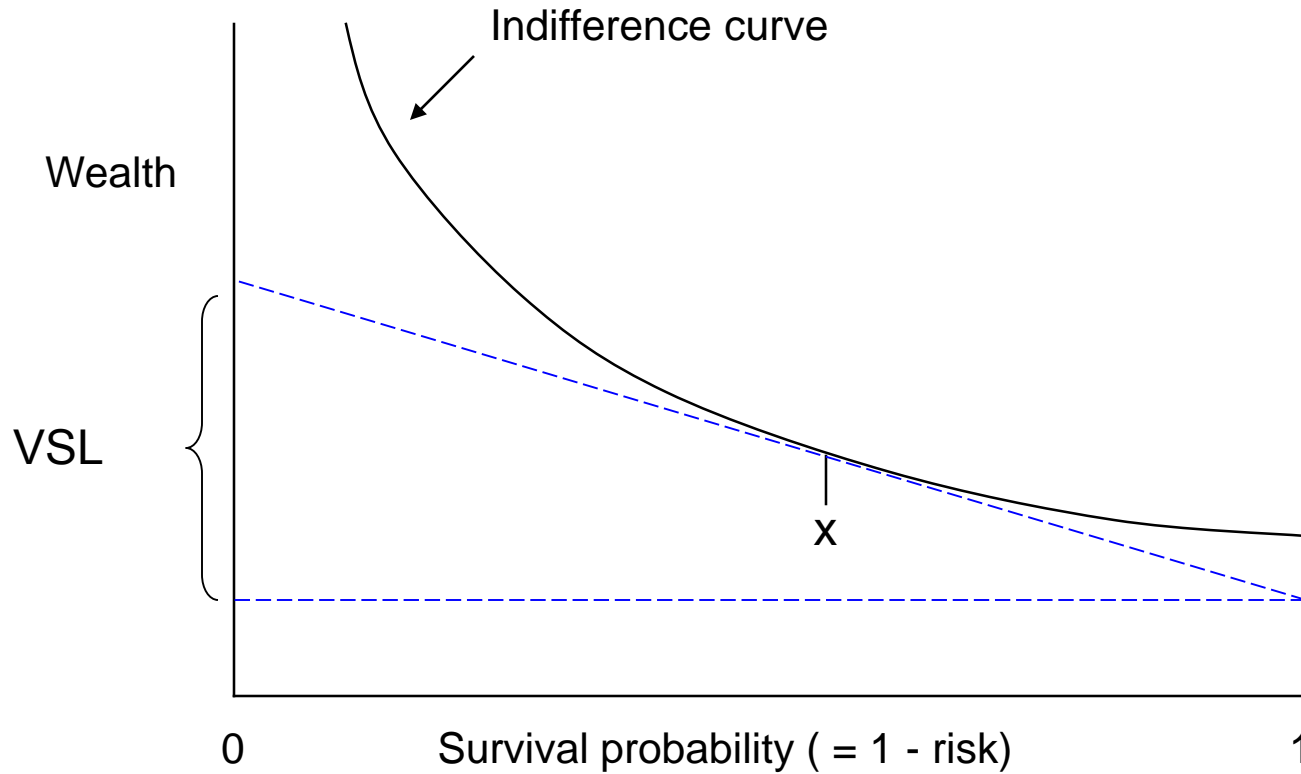
Concept

- Money value of reduction in mortality risk
 - Risk change in specified period
 - Usually short-term, e.g., current year
- Individual concept
 - Own risk
 - Own money (or household money)
- Rate of substitution (ratio of money to risk change)
 - Idealization: marginal rate (infinitesimal risk change)
 - Approximation: money value of small risk change
 - Change in wealth that has same effect on wellbeing as the risk change
 - Compensating or equivalent variation

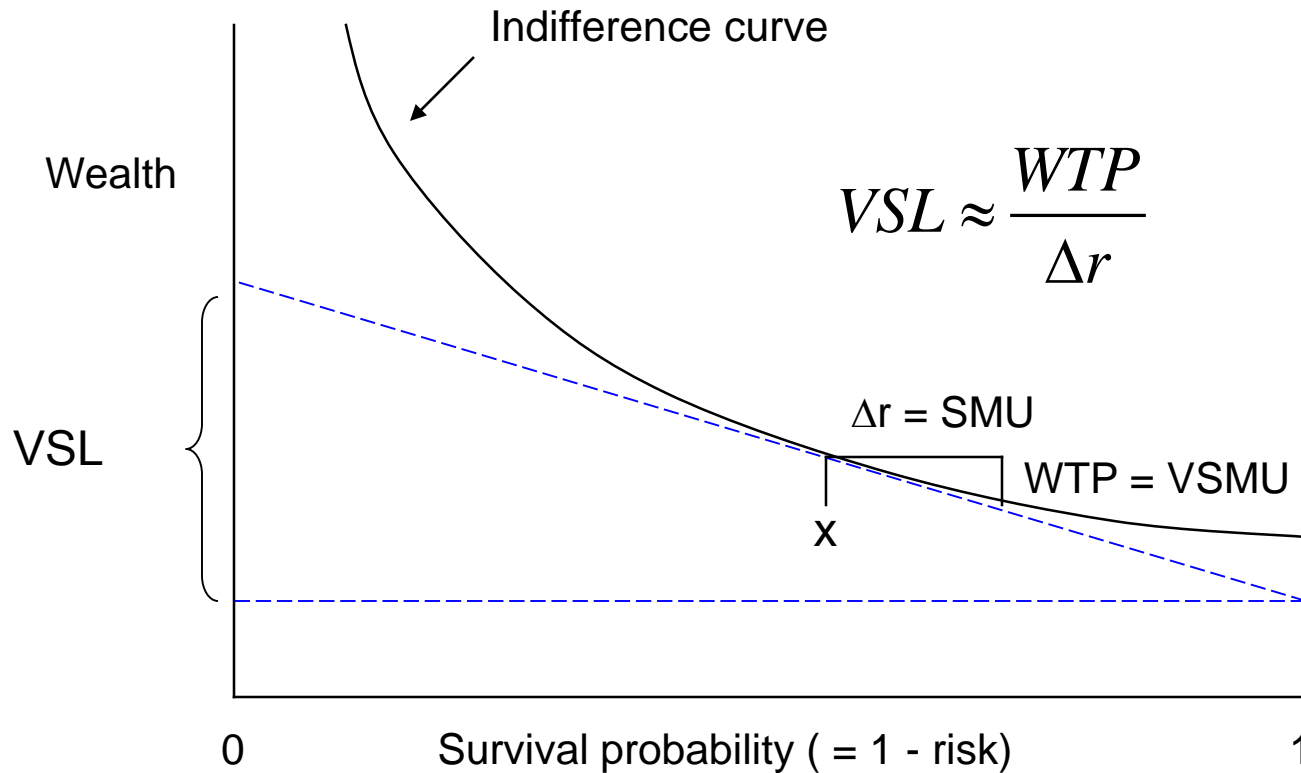
Terminology

- Rate of substitution (ratio of money to risk change)
 - Rate = ratio = change in money / change in risk
- Value per statistical life (VSL) = \$ per 1 unit change in risk (probability)
- Value per standardized mortality unit (VSMU) = \$ per 1/10,000 change in risk
 - = VSL • 1/10,000
- Value per micromort = \$ per 1/million change in risk
 - = VSL • 1/million
- EPA expected to propose a new term; we will evaluate & may recommend it (or an alternative)

VSL = slope



VSL = slope



Total value of a change in population risk = sum of individual values

- Total value = sum of (individual VSL x individual risk reduction)

$$= \sum_{i=1}^n (VSL_i \cdot \Delta r_i)$$

- \approx average VSL x sum of (individual risk reduction)

$$\approx \overline{VSL} \sum_{i=1}^n \Delta r_i$$

Approximation is exact if individual VSLs and risk reductions are uncorrelated

- = average VSL x expected number of lives saved

Lives saved = deaths avoided during period

$$= \overline{VSL} \cdot E(\text{lives saved})$$

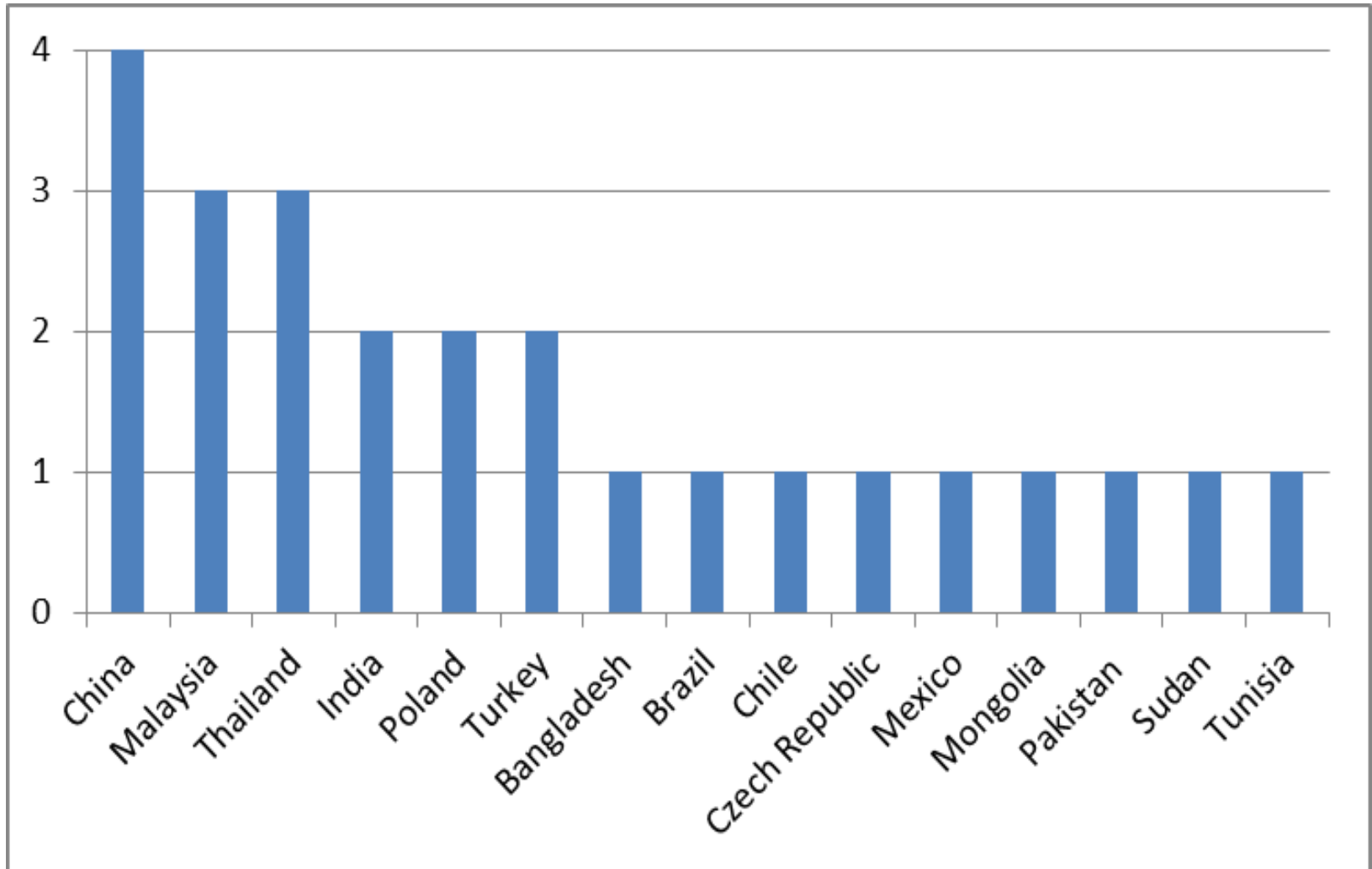
VSL depends on

- Individual characteristics
 - Wealth & income
 - We know something about how to adjust for this
 - Age & life expectancy
 - Conflicting evidence, we suggest crude adjustments
 - Health
 - Household size & composition
- Social or cultural characteristics
 - Preferences for allocating resources to self v. family or community
- Risk characteristics
 - Traumatic injury v. chronic disease
- Other factors?

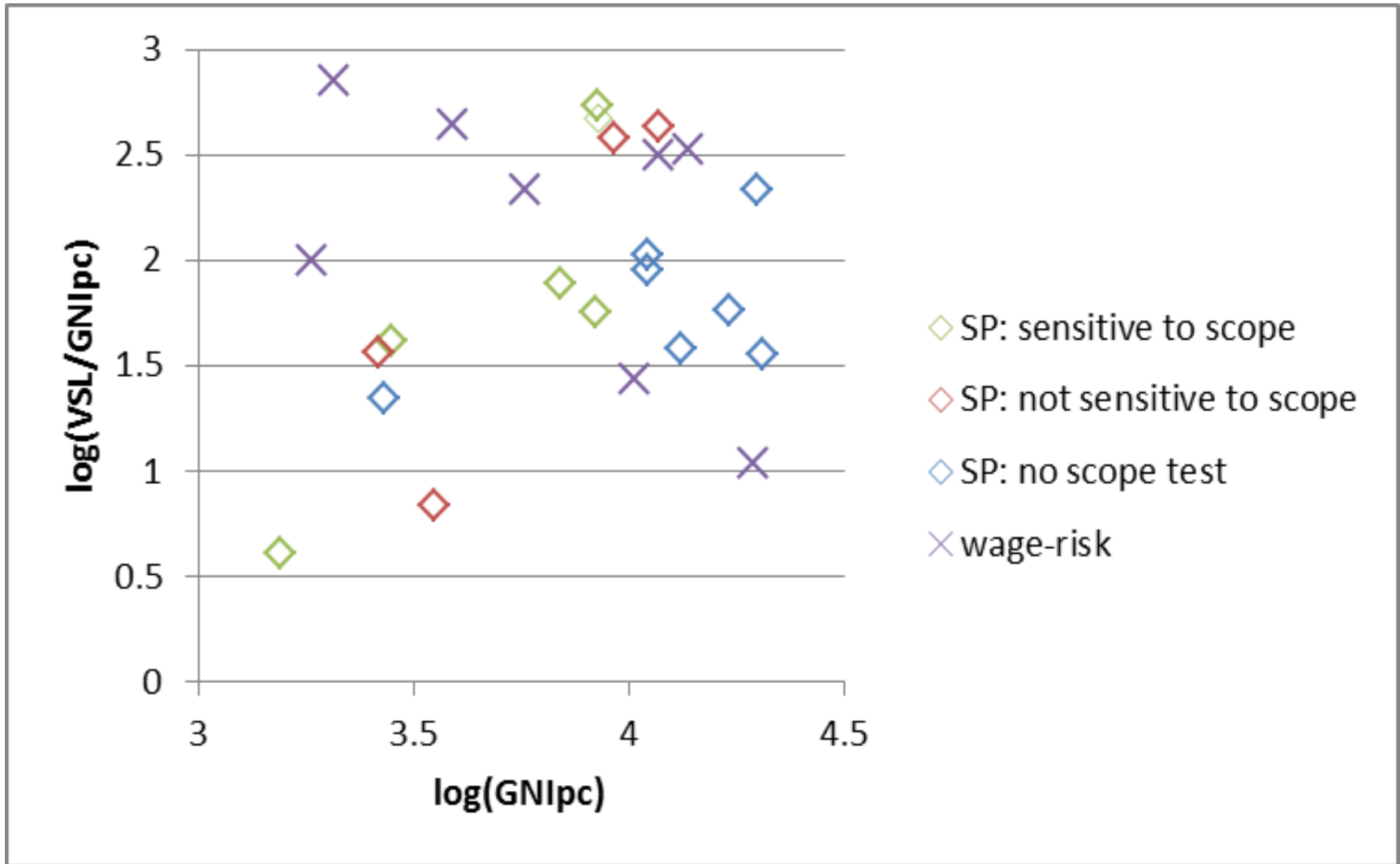
Direct estimates in LMICs

- Searched for studies conducted in LMICs
 - General adult population
 - Probabilistic (not convenience) sample
 - WTP to reduce own risk
 - Data collected in past 20 years (1997 – present)
 - Written in English
- 25 studies
 - 8 revealed preference (wage differential)
 - 17 stated preference studies (18 estimates)
 - 9 of 18 tested whether willingness to pay increases with risk reduction
 - 5 of 9 found a statistically significant increase

25 studies, 15 countries



VSL / GNIpc vs. GNIpc (not adjusted to common year)



Recommendations

- If high-quality direct estimates exist, use them
 - Requires multiple high-quality studies
 - Government guidance exists for many high-income countries
- Otherwise (or as sensitivity analysis) extrapolate from high-quality estimates (in high-income country)
 - Adjust for income, using GNI per capita as measure
 - GNI per capita is broad measure, available for all countries
 - Base value (2)
 - $VSL / \text{GNI per capita} = 170 \text{ \& } 80$
 - Income elasticity (2)
 - Income elasticity = 1.0 & 1.4
 - Bound result to $VSL / \text{GNI per capita} \geq 20$

Rationale: base value

(expressed as VSL / GNI per capita; 2013 dollars)

- US government guidance (HHS)
 - Central value: \$9 million → VSL/GNIpc = 170
 - Based on wage-differential estimates (with good risk data) & stated-preference estimates (that satisfy validity test)
 - DOT (wage differential): \$9.2 million
 - EPA (old wage-differential and stated-preference): \$9.7 million
 - Low value: \$4.2 million → VSL/GNIpc = 80
- Why US values?
 - Based on many high-quality studies, numerous reviews
 - Larger than most other high-income countries
 - Treat central US value as high estimate for high-income countries
 - Proposed range covers central value from OECD meta-analysis: \$3.0 million → VSL/GNIpc = 100

Rationale: income elasticity

- Ratio of VSL to income probably increasing with income
 - Share of income required for basic necessities lower at higher income
 - → income elasticity ≥ 1
- Well being from year of living probably greater than value of consumption of goods & services
 - $VSLY \geq \text{consumption} \approx \text{GNlpc}$
 - $VSL \geq \text{present value of future consumption} \approx 20 \times \text{GNlpc}$
- Direct estimates (median GNlpc \sim \$9,400)
 - Exclude ratios > 170 and < 20
 - Of remaining 14, half are between 98 & 37 (median = 57)

Extrapolate to GNlpc =	Base = 170 Elasticity = 1	Base = 80 Elasticity = 1	Base = 170 Elasticity = 1.4	Base = 80 Elasticity = 1.4
\$10,000	170	80	87	41
\$1,000	170	80	34	16 → 20

Adjustment for age

- Estimates suggest
 - VSL increases then decreases with age
 - May be ~ 2x higher for children than adults
- Recommendation: if policy disproportionately affects young or old, add sensitivity analysis using constant VSLY
- $VSLY = VSL / \text{life expectancy at mean adult age}$
 - Consistent with using VSL for mean-age adult
- → Value of reducing mortality risk inversely proportional to life expectancy
 - Alternative (divide VSL by present value of discounted future life years) yields results between recommendation and using same VSL for all ages
- For children, newborns, fetal mortality
 - No special recommendation, conduct sensitivity analysis