UNIVERSITÄT
HEIDELBERG

Michael Schlander, Oliver Schwarz, and Ramon Schaefer:

An Update on the Economic Value of a Statistical Life Year in Europe

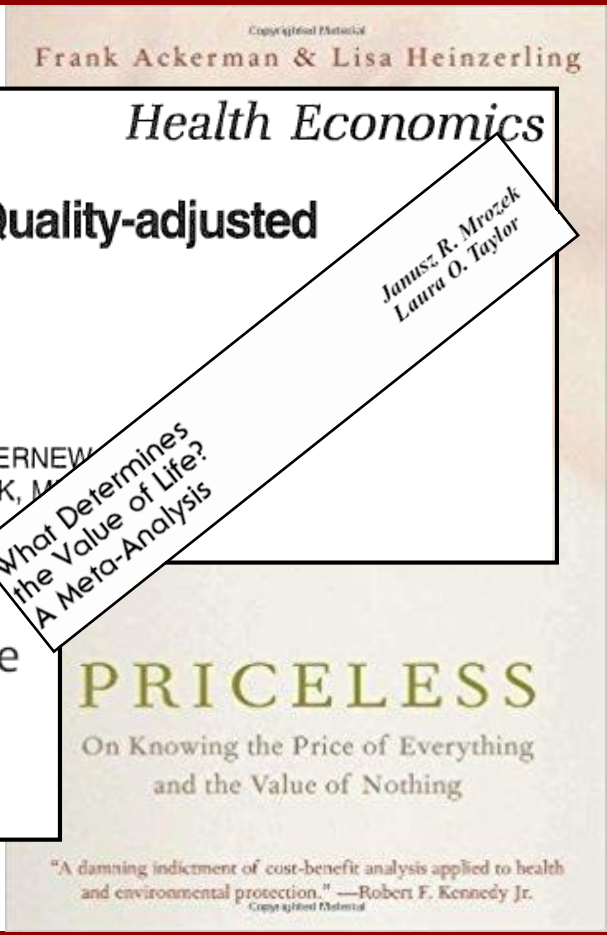
Session OS 27 Economic Evaluation and Decision Making (B) – Tuesday, June 20, 2017 – 16:30 – 18:00

dkfz.

1. Background & Research Question
2. Material & Methods
3. Results
   - ¬ European Studies
   - ¬ [Global Studies]
   - ¬ Heterogeneity, Methods and Regions
   - ¬ Summary of Results
4. Conclusions

1

Background & Research Question



Health Economics

Willingness to Pay for a Quality-adjusted Life Year:

In Search of a Standard

RICHARD A. HIRTH, PhD, MICHAEL E. CHERNEW
EDWARD MILLER, MA, A. MARK FENDRICK,
WILLIAM G. WEISSERT, PhD

Janusz R. Mrozek
Laura O. Taylor

What Determines the Value of Life? A Meta-Analysis

COLLECTION REVIEW

A Systematic Review of Studies Eliciting Willingness-to-Pay per Quality-Adjusted Life Year: Does It Justify CE Threshold?

Khachapon Nimdet[1], Nathorn Chaiyakunapruk[2,3,4,5]*, Kittaya Vichansavakul[1], Surachat Ngorsuraches[1]

dkfz.

Benchmarks for Cost Effectiveness

- **Examples of international *de facto* benchmarks**:
  - **New Zealand** (PHARMAC):
    NZ-$ 20,000 / QALY[1]
  - **Australia** (PBAC):
    AUS-$ 42,000 / LYG to AUS-$ 76,000 / LYG[2]
  - **England and Wales** (NICE):
    £ 20,000 – £ 30,000 / QALY
  - **United States** (some MCOs):
    US-$ 50,000 – US-$ 100,000 / QALY[3]
  - **Canada** (proposed "grades of recommendation"):
    CAN-$ 20,000 – CAN-$ 100,000 / QALY[4]
  - **WHO** (recommendation): 1-3 times GDP/capita / DALY[5]
- **No scientific basis**

[1]C. Pritchard (2002); QALY: "quality-adjusted life year"; [2]George et al. (2001); LYG: "life year gained"
[3]D.M. Cutler, M. McClellan (2001); [4]A. Laupacis et al. (1992); [5]DALY: "disability-adjusted life year"

In Search of a Scientific Basis

- **Demand-Side Analyses**
  - **Health Care Programs (or Interventions)**: social (or individual) WTP, holistic
  - **Attributes of Health Care Programs (or Interventions)**: social (or individual) WTP, characteristics (and their interaction)
  - **Quality-Adjusted Life Years (Individual or Social WTP-Q)**: QALY maximization hypothesis; constant proportional trade-off…
- **Supply-Side Analyses**
  - **PROs and Efficiency Frontier Approach (e.g., IQWiG)**: flexible benchmarks, contingent on therapeutic area and rationality of prior pricing and reimbursement decisions
  - **Quality-Adjusted Life Years (Shadow Prices, e.g., York):** universal benchmark, (in addition to assumptions above) also contingent on rationality of health care budget

dkfz.

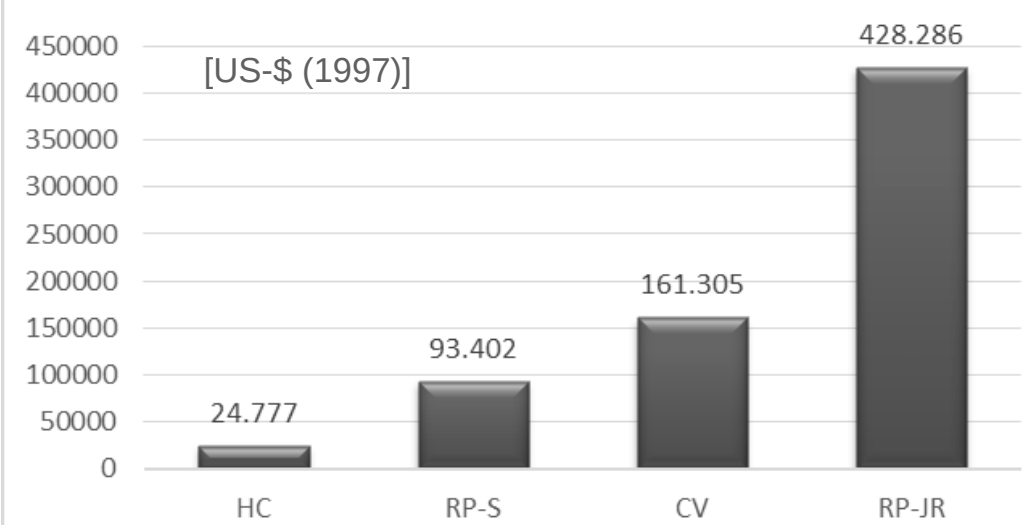
Answers Offered by [Health] Economists

- **Value of a Statistical Life Year (VSLY)**
  - **Human Capital Approach**:
    resting on productivity, *rejected by modern welfare economics*
  - **Revealed Preferences Approach**:
    observed human behavior (job risk or non-occupational safety)
  - **Stated Preferences Approach**: direct elicitation of preferences
    - **contingent valuation** (CV): direct or referendum style questions
    - **discrete choice experiments** (DCEs): choice alternatives,
      where the different goods or programs are defined by their attributes
- **Willingness-to-Pay for a QALY (WTP-Q)**
  - With adjustment for reduced average quality of life in later years, WTP-Q may be ~10% greater than VSLY (Hirth et al., 2000)
  - WTP-Q exists only if QALY maximization hypothesis is accepted and normative and empirical grounds for concern are disregarded

dkfz.

In Search of a Standard (Hirth et al., 2000[1])

WTP-Q: Willingness-to-Pay for a QALY



[1]R. Hirth et al. (2000): median based on 35 estimates based on WTP approaches, US-$ (1997) 265,345.
A total of 37 studies (28 of which came from the U.S.) yielded 42 VSL estimates suitable for inclusion in the analysis.

Research Questions

- **Demand-Side Perspective**: What Can We Learn About the Economic Value of a Statistical Life Year ("VSLY") from Empirical Studies Reporting Original Data on the Value of a Statistical Life ("VSL") over the Last Two Decades (1995-2015)?
  - Methodology of empirical studies over the last two decades
  - Heterogeneity of estimates, by method and by area of origin
  - No adjustment for health-related quality of life; no attempt to derive WTP-Q estimates from VSLY estimates
  - No specific review of the Quality-Adjusted Life Year literature
- **Two levels of analysis**
  - **European data**
  - Worldwide data

dkfz.

2

Materials & Methods

Systematic Literature Search

Databases:

EconBiz and EconLit (German and English); January 1995 – December 2015

Supplementary search in published reviews and meta-analyses

Search Terms:

Value of Life, Statistical Life, Value of a Statistical Life, Value of a Life Year, Value of a Statistical Life Year, Value of a Quality-Adjusted Life Year (QALY)

VSL Estimates:

After elimination of duplicates, extracting the reported value of (a statistical) life (VSL) for each experimental setting studied,

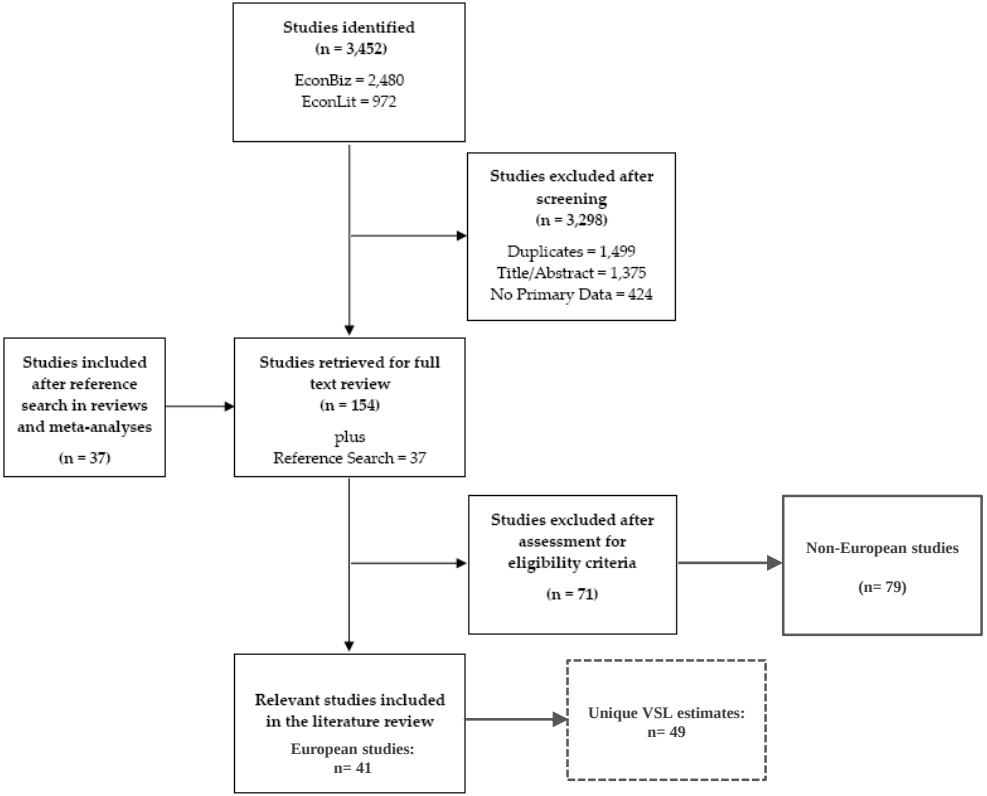
using the base case VSL if reported by the authors; otherwise calculating the mean VSL when various methods were employed on the same dataset

dkfz.

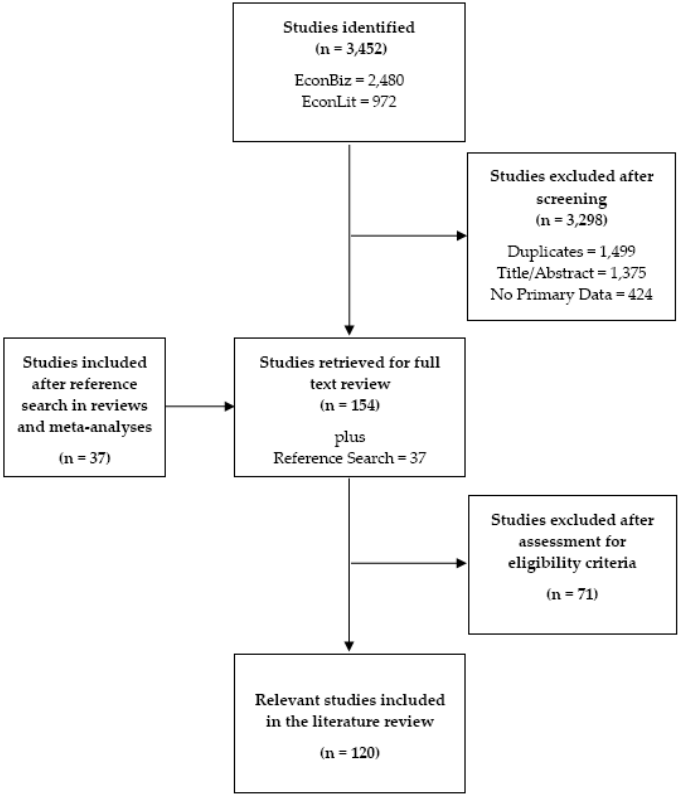
Study Eligibility Criteria

- **Report VSL(Y) based on an original data analysis**
  - Reports clearly state currency and year of VSL(Y) estimates
  - No reviews or meta-analyses
  - No specific review of WTP-Q ("value of a QALY") literature
- **Data sources and methods used specified**
  - HC; SP/CV; SP/DCE; RP and type of risk (WR, non-occupational)
  - Characteristics of study population (time of survey; respondent selection criteria, age, male/female; white/blue collar, …)
  - Identification of national origin of data
- **European subset**
  - Data originating from a European setting

Literature Search: European Studies



Literature Search: Global Results



Extracting Data from Study Reports

Data extracted for analysis included the following:

- VSL (base case or mean, and range, for each experimental setting)
- Country and Year (for origin of data and for publication)
- Method: HC; WTP: SP (CV / DCE), RP (WR / non-occupational safety); cross-sectional / longitudinal / panel data analysis
- Population studied (size; blue-collar / white-collar; male/female ratio)
- Mean age of study population
- Type of risk / risk reduction / fatality risk (mean, min/max)
- Currency (and year); average annual income

Additional data sources used for analysis:

- Life expectancy (by year, sex, and age): WHO Life Tables
- GDP / capita (by year): World Bank
- CPI, PPPs, exchange rates: World Bank

Computing the VSLY from Reported VSL Data

Abbreviated calculation procedures:

- VSL (base case or mean for each experimental setting) from study
- Currency reconversion from US-$ (or else) to LCU (exchange rates)
- VSL inflated to year 2014 using country-specific CPIs
- GDP / capita from year of data generation, inflated as VSL
- Conversion of LCU values for 2014 to Euro (PPPs)

VSLY computation:

- Calculation separately for men and women,
  Residual Life Expectancy data from WHO Life Tables by Country
- Base case discount rate 3% (for sensitivity analyses, 0% - 10%)
- Formulas: $VSLY = \frac{VSL \cdot (1+r)^{t-1} \cdot r}{(1+r)^t - 1}$ or (for r = 0%): $VSLY = \frac{VSL}{t}$
- Calculating VSLY average (and range, if data were available), weighted by study population sex ratio

dkfz.

Database for Analysis

- **European data**:
  - **41 studies**,
    yielding a total of 49 unique VSL estimates
  - **Regional origin of studies yielding VSL estimates**:
    Sweden (13),
    United Kingdom (4);
    France, Germany, Norway, Switzerland (3 each);
    Italy, Netherlands (2 each);
    Austria, Czech Republic, Denmark, Netherlands, Poland (1 each);
    plus three comparative international studies
    (reporting VSL for more than one country each)
  - **Methodological basis of estimates**:
    HC, 0; RP/WR, 11; SP/DCE, 11; SP/CV, 27

3

Results

- European Studies
- [Global Studies]
- Heterogeneity, Methods and Regions
- Summary of Results

dkfz.

Overall European Results:

Mean and Median VSL and VSLY

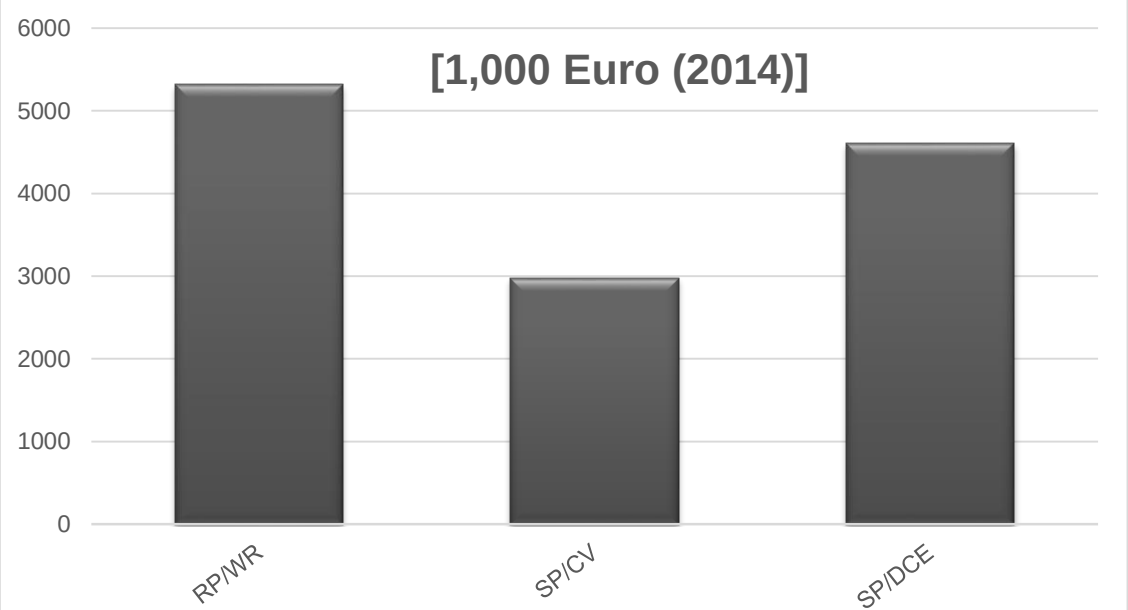
	Mean	**95% Confidence Intervals** (nonparametric bootstraps)	
		Lower Bound	Upper bound
VSL	€ 4,721,286	€ 2,940,381	€ 6,502,190
VSLY	€ 209,424	€ 127,307	€ 291,540

	Median	**95% Confidence Intervals** (nonparametric bootstraps)	
		Lower Bound	Upper bound
VSL	€ 3,428,516	€ 2,727,662	€ 4,129,370
VSLY	€ 158,448	€ 136,147	€ 180,750

dkfz.

European Results

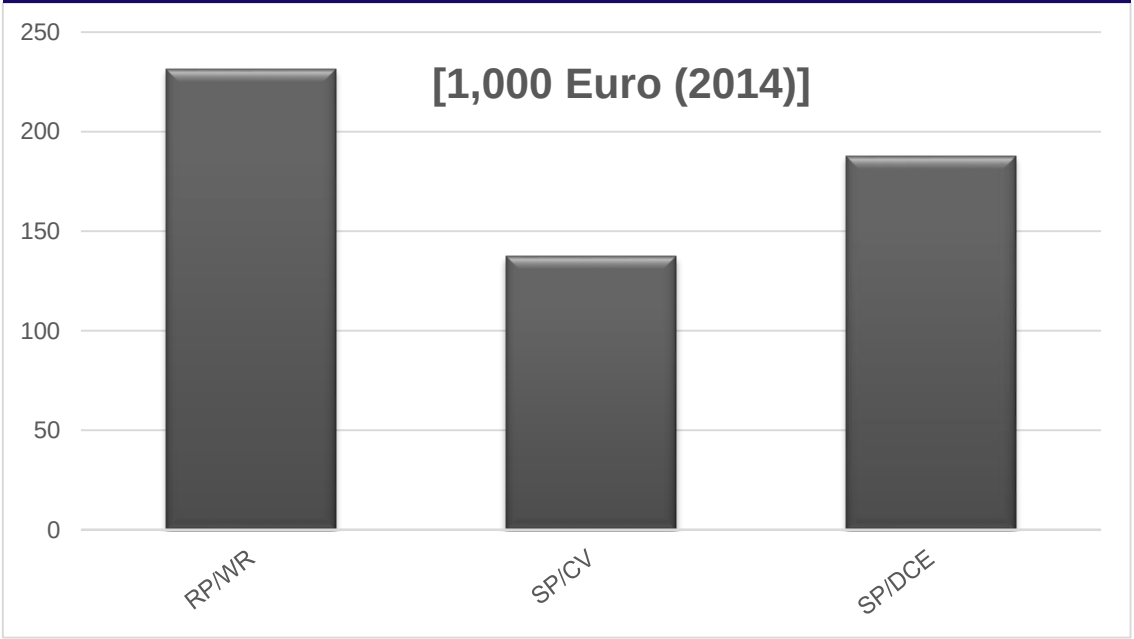
Median VSL Estimates by Method



dkfz.

European Results

Median VSLY Estimates by Method



European Results

Revealed Preference Studies (Wage Risk)

	Mean	Median	25% Percentile	75% Percentile
All RP/WR Studies				
VSL	€ 8,436,298	€ 5,319,627	€ 2,192,626	€ 7,340,022
VSLY	€ 376,493	€ **231,422**	€ 100,058	€ 334,954

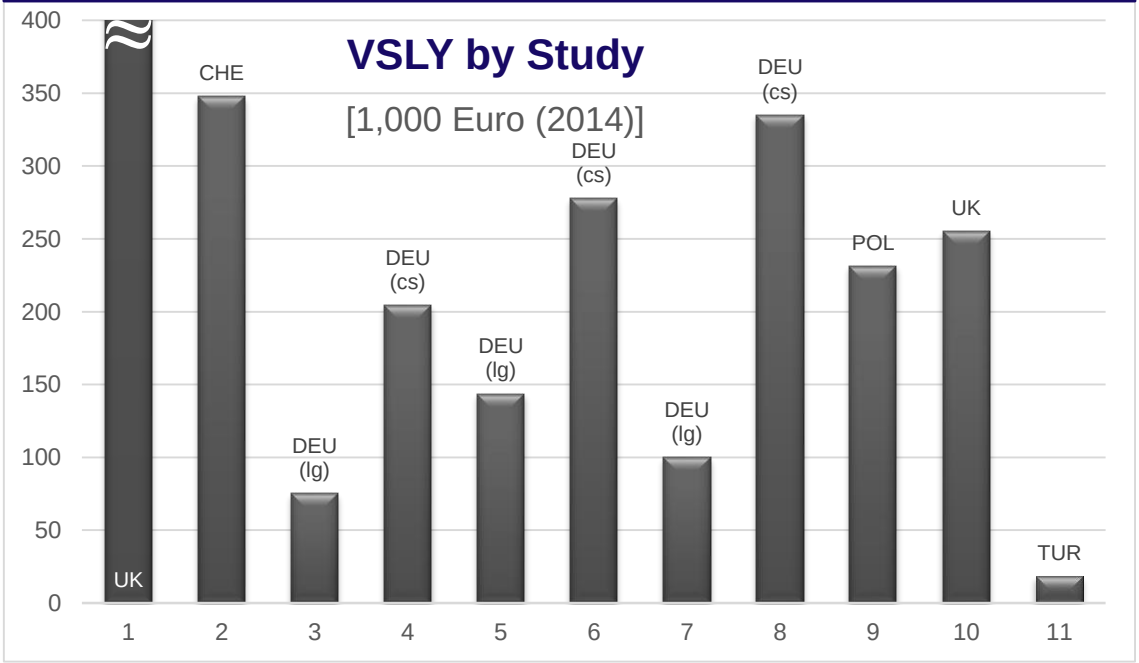
European Results

Revealed Preference Studies (Wage Risk)

	Mean	Median	25% Percentile	75% Percentile
All RP/WR Studies				
VSLY	€ 376,493	**€ 231,422**	€ 100,058	€ 334,954
Scenario Analysis (1): RP/WR-Studies, *excluding Spengler (2004) and Schaffner and Spengler (2005)*				
VSLY	€ 491,550	**€ 255,023**	€ 100,058	€ 347,818
Scenario Analysis (2): like Scenario (1), *excluding Sandy and Elliott (1996)*				
VSLY	€ 214,642	**€ 243,222**	€ 100,058	€ 334,954

European Results

Revealed Preference Studies (Wage Risk)



dkfz.

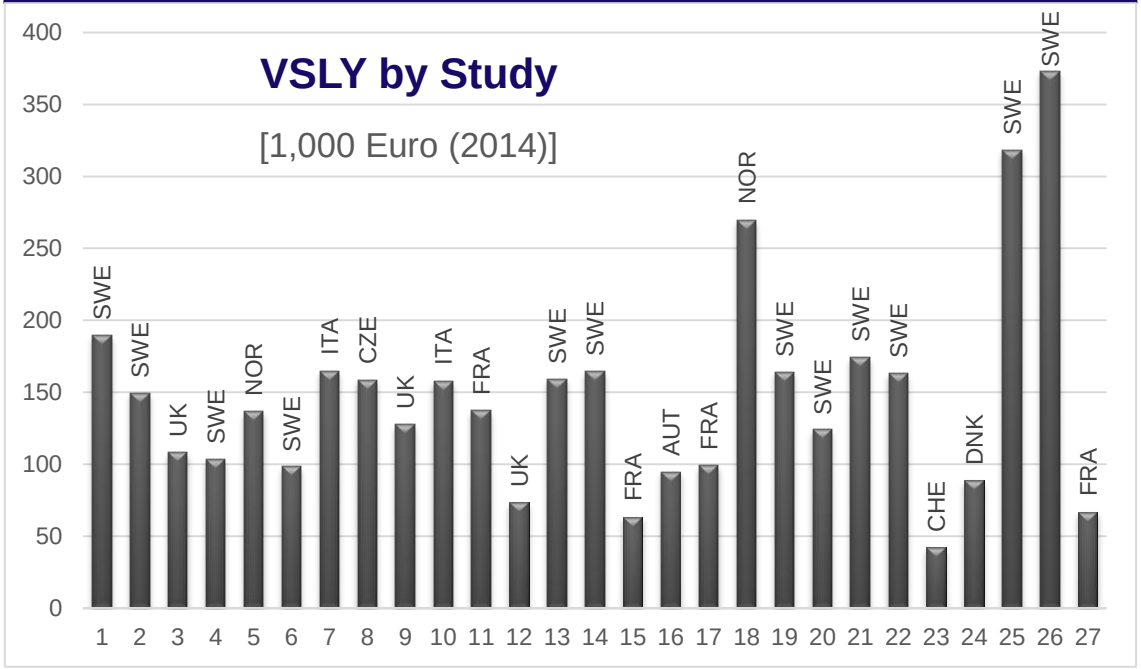
European Results

Stated Preference Studies (CV, DCE)

	Mean	Median	25% Percentile	75% Percentile
VSL (CV)	€ 3,311,944	€ 2,978,677	€ 2,319,086	€ 3,942,348
VSLY (CV)	€ 147,053	**€ 137,413**	€ 98,268	€ 164,409
VSL (DCE)	€ 4,465,568	€ 4,603,748	€ 2,169,577	€ 6,782,770
VSLY (DCE)	€ 195,448	**€ 187,857**	€ 102,472	€ 296,563

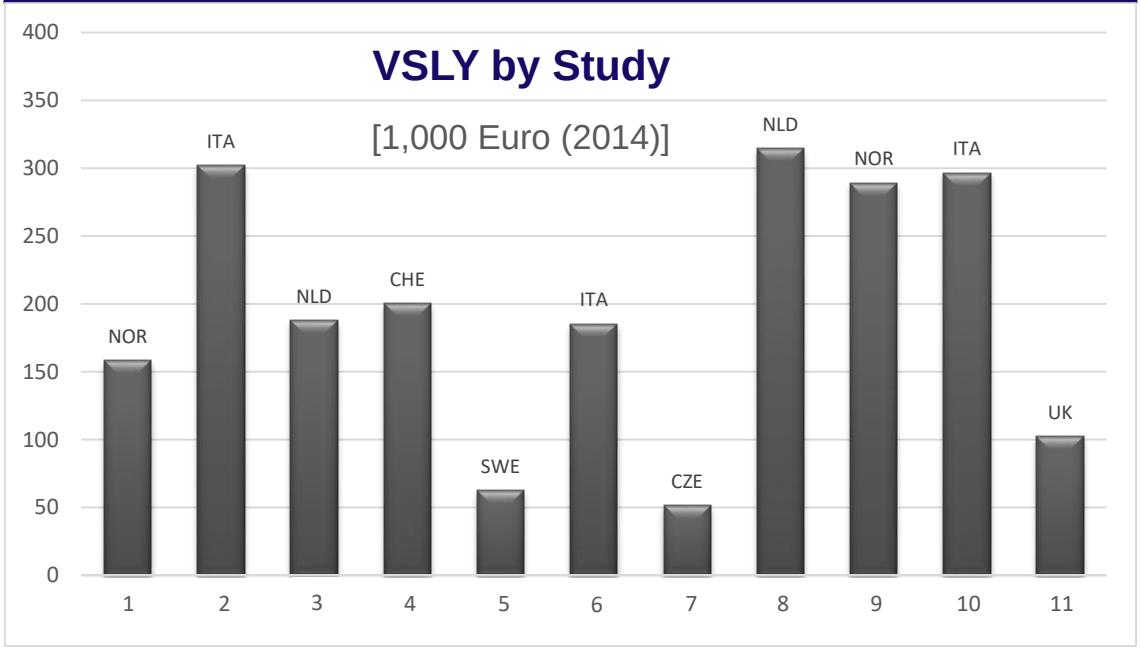
European Results

Stated Preference Studies (CV)



European Results

Stated Preference Studies (DCE)



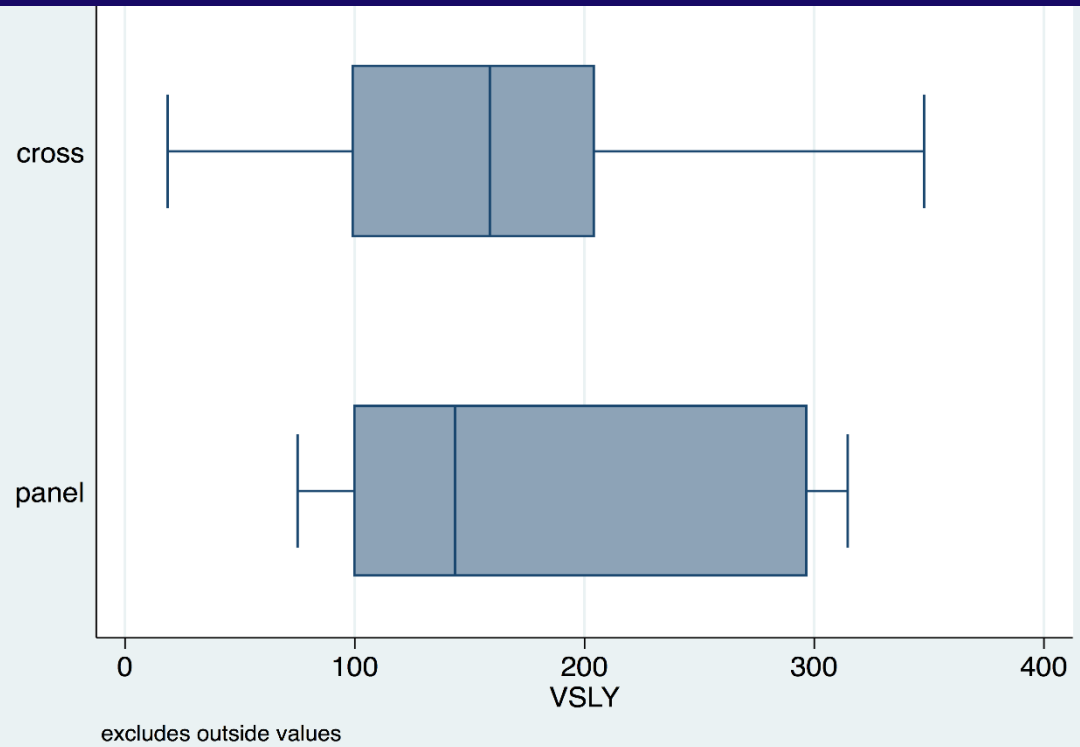
dkfz.

European Results

Panel vs. Cross-Sectional Analysis

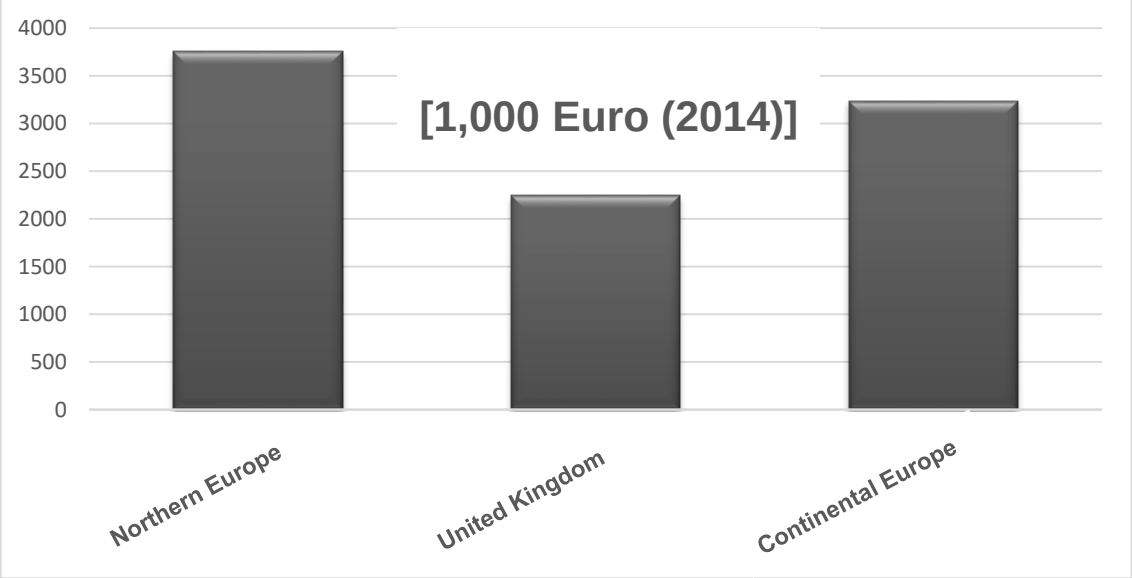
	Mean	Median	25% Percentile	75% Percentile
cross-sectional analysis	€ 213,676	**€ 158,753**	€ 99,125	€ 204,121
panel data analysis	€ 183,913	**€ 143,614**	€ 100,058	€ 296,563

Panel vs. Cross-Sectional Analysis



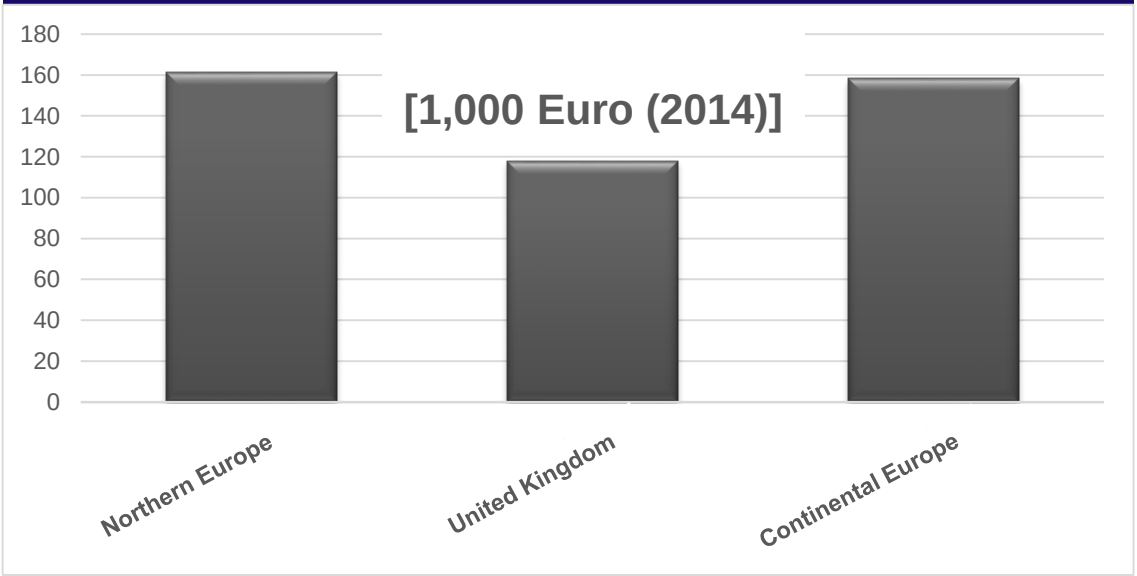
European Results

Median VSL Estimates by Region



European Results

Median VSLY Estimates by Region



dkfz.

European Results

Median VSL / VSLY by Region

	Mean	Median	25% Percentile	75% Percentile
Continental Europe				
VSL	€ 3,831,291	€ 3,235,183	€ 2,192,626	€ 5,319,627
VSLY	€ 170,241	**€ 158,448**	€ 94,601	€ 231,422
United Kingdom				
VSL	€ 10,273,115	€ 2,244,332	€ 1,964,914	€ 5,848,654
VSLY	€ 469,957	**€ 117,956**	€ 102,472	€ 255,023
Northern Europe (including Denmark)				
VSL	€ 4,106,781	€ 3,754,427	€ 2,978,677	€ 4,197,741
VSLY	€ 177,000	**€ 161,052**	€ 124,020	€ 189,478

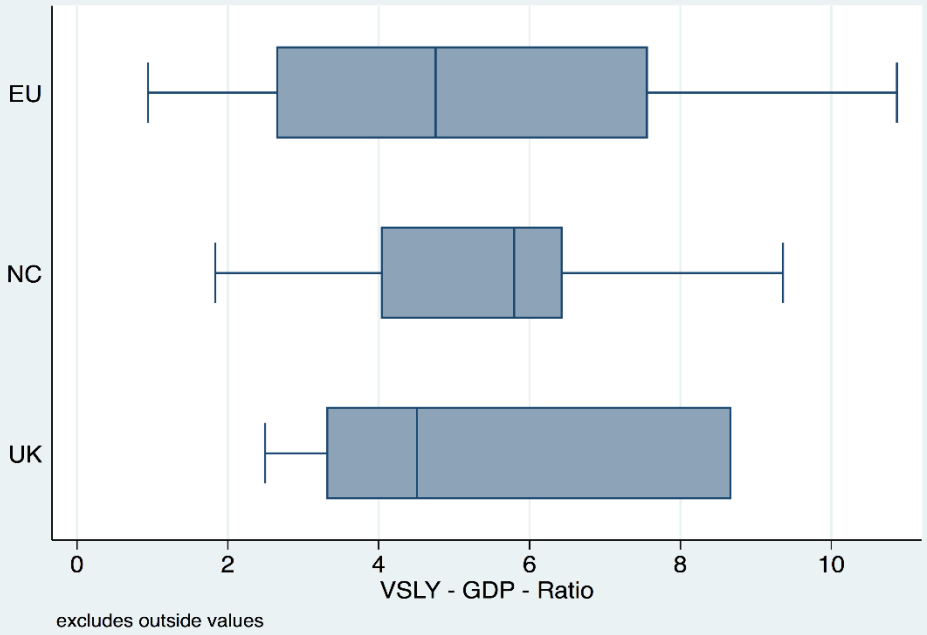
European Results

VSLY / GDP/capita (by region)

Continental Europe

Northern Europe

United Kingdom



dkfz.

European Results

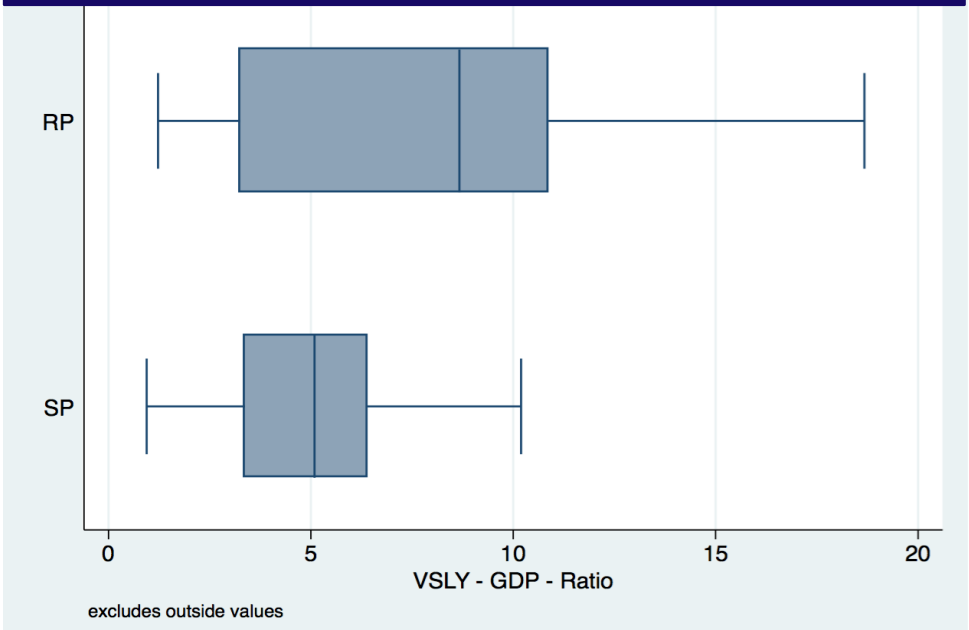
VSLY / GDP/capita (by region)

	Mean	Median	25% Percentile	75% Percentile
Continental Europe	5.74	**4.75**	2.66	7.56
Northern Europe	5.92	**5.79**	4.04	6.43
United Kingdom	26.00	**4.51**	3.32	8.67
Europe (overall)	8.29	**5.10**	3.37	7.01

dkfz.

European Results

VSLY / GDP/capita (by method: RP vs. SP)

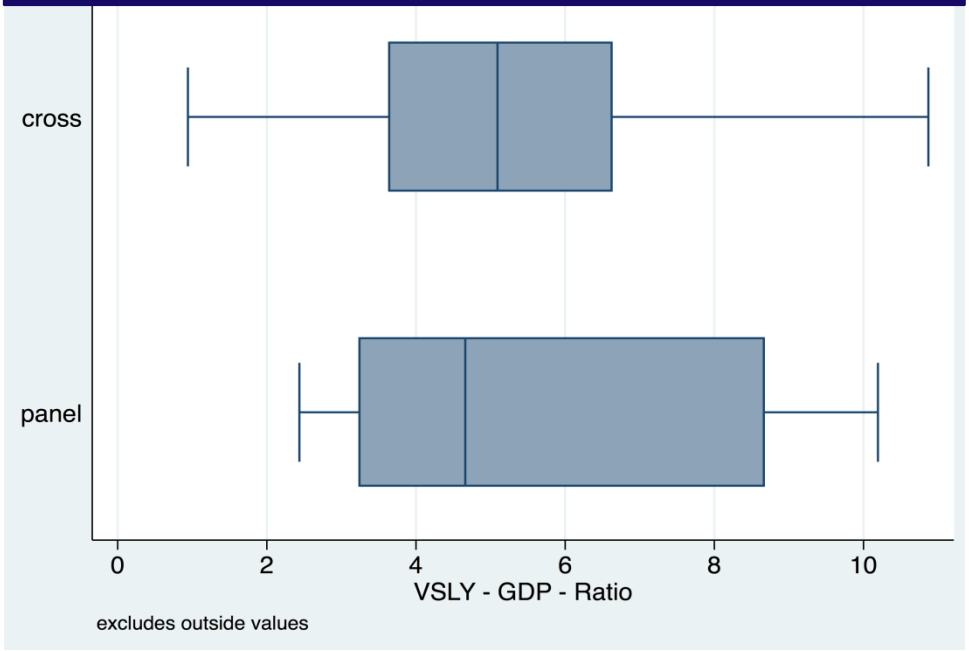


European Results

VSLY / GDP/capita (by method: c-s vs. panel)

cross-sectional analysis

panel data analysis



dkfz.

European Results

VSLY / GDP/capita (by method)

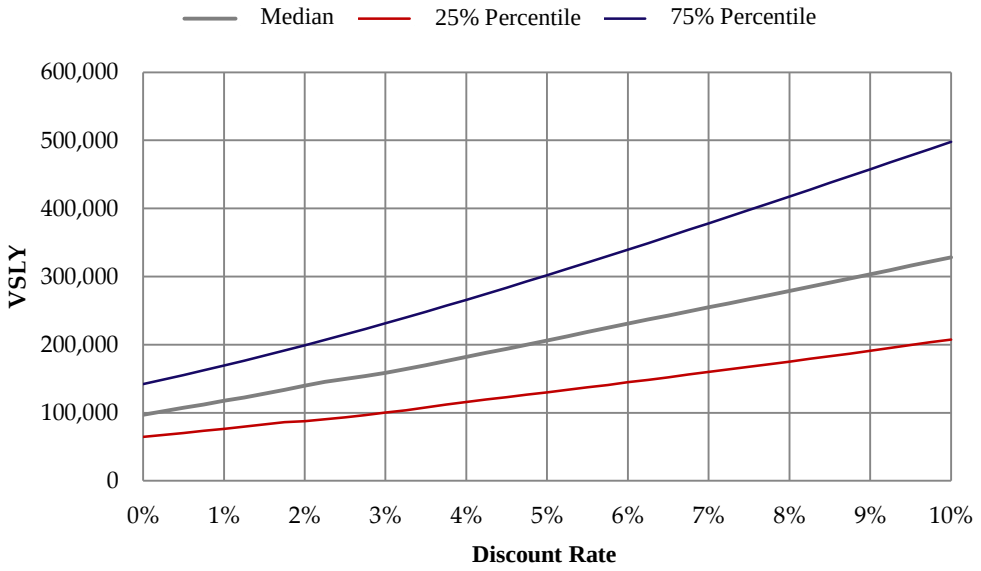
	Mean	Median	25% Percentile	75% Percentile
Revealed Preferences	18.82	8.67	3.25	10.87
Stated Preferences	5.24	5.09	3.37	6.39

	Mean	Median	25% Percentile	75% Percentile
cross-sectional	8.71	**5.15**	3.65	6.62
panel data	5.73	**4.66**	3.25	8.67

European Results

Sensitivity Analysis (VSLY)

Combined Impact of Discount Rate and Uncertainty



dkfz.

European Results

Sensitivity Analysis (VSLY)

Combined Impact of Discount Rate and Uncertainty

	Discount Rate				
	1%	2%	**3%**	4%	5%
25% Percentile	76,340	87,808	**100,058**	115,935	130,039
Median	**117,431**	**139,552**	158,448	**182,008**	**206,114**
75% Percentile	169,235	199,136	**231,422**	265,792	301,918

4

Summary and Conclusions

Current European Analysis (1995-2015)

compared with

US-Driven International Analysis (<1997)

VSLY		Indirect Measurement		Direct Measurement	
Method Study	HC	RP-WR	RP-S	SP-CV	SP-DCE
Schlander et al. (2017): 1995-2015	n.a.	€ 231,422	n.a.	€ 137,413	€ 187,857
Hirth et al. (2000): 1969-1997	€ 25,950	€ 448,500	€ 97,800	€ 168,900	n.a.

All VSLY expressed in Euro (2014); Hirth et al. /2000) data were transformed from US-$ (1997) using CPI, PPP, and a WTP-Q transformation factor of 1.1

Summary – Europe

- Database: 41 studies, yielding 49 unique European estimates
- Median VSLY = 158,448 € [2014]
- 95% confidence interval, 136,147 € - 180,750 € (nonparametric bootstrapping)
- Median VSLY = 5.10 times GDP / capita
- WTP-Q > VSLY (transformation factor reportedly around ~1.1)
- Large heterogeneity between studies, which in part may be explained by different methodological approaches and by different regional sources of data (significant in the worldwide dataset only)
- Neverthelss, VSLY >> currently accepted benchmarks for cost effectiveness (among health economists and the HTA community)

dkfz.

Implications

Currently used benchmarks for cost effectiveness (WTP-Q) appear to be much lower than empirical willingness-to-pay for a life year (or "VSLY") in other sectors of life.

However:

- Policy implications will be influenced by the type of health care system in question; an NHS with a politically determined health budget may respond differently than a bottom-up financed system.
- We have no intention to suggest a new benchmark for WTP-Q.
- Among other concerns, there are data which suggest that the conversion of length and quality of life, as it is inherent in the conventional QALY model, may be flawed.
- We believe there are compelling reasons to reject a universal WTP-Q benchmark on both normative and empirical grounds.

dkfz.

Thank You for Your Attention!

Professor Michael Schlander, M.D., Ph.D., M.B.A.

Contact

www.innoval-hc.com
www.michaelschlander.com

michael.schlander@dkfz.de
michael.schlander@innoval-hc.com

INNOVAL HC
Institute for Innovation & Valuation in Health Care

Deutsches Krebsforschungszentrum (DKFZ)
Im Neuenheimer Feld 581 (TP4)
D-69120 Heidelberg

Phone: +49 (0) 6221 42 1910

dkfz.

InnoVal HC
An der Ringkirche 4
D-65197 Wiesbaden

+49 (0) 611 4080 7890