MINAMATA ONLINE

SEASON 1 - 2020

Mercury science

Socioeconomic impact of mercury pollution

MINAMATA CONVENTION ON MERCURY

This is part of a series of online science sessions co-organized by the Minamata Convention Secretariat and the International Conference on Mercury as a Global Pollutant (ICMGP). The series aim to bridge the scientific community and international policy, and this session extends to social sciences. Experts will present on their work on socio-economic aspects of environmental pollution and discuss how social sciences can inform the decision making, in the context of the Minamata Convention.

SPEAKERS

Monika Stankiewicz
Executive Secretary, Minamata Convention on Mercury

Jozef Pacyna
Professor, AGH University of Science and Technology, Krakow, Poland

Leonardo Trasande
Director, NYU Center for the Investigation of Environmental Hazards

Jon Stenning
Head of Environment, Cambridge Econometrics

Milan Ščasný
Senior Lecturer, Charles University – Environment Center & Institute of Economic Studies, Czech Republic

Myriam Tobollik
Scientist, German Environment Agency

Eisaku Toda
Senior Programme Officer, Minamata Convention on Mercury

Tuesday, 01 December 2020

14:00 – 15:30 CEST

Please register for the WebEx session using the links above.

Check the Minamata Online calendar

for other upcoming events and the presentations and video recording from the previous sessions.

Mercury science

Socio-economic aspects of mercury pollution on a global scale

Minamata Online Session

Socio-economic implications of mercury pollution

1st of December, 2020

Jozef M. Pacyna

AGH University of Science and Technology, Krakow, Poland

Major questions to be addressed

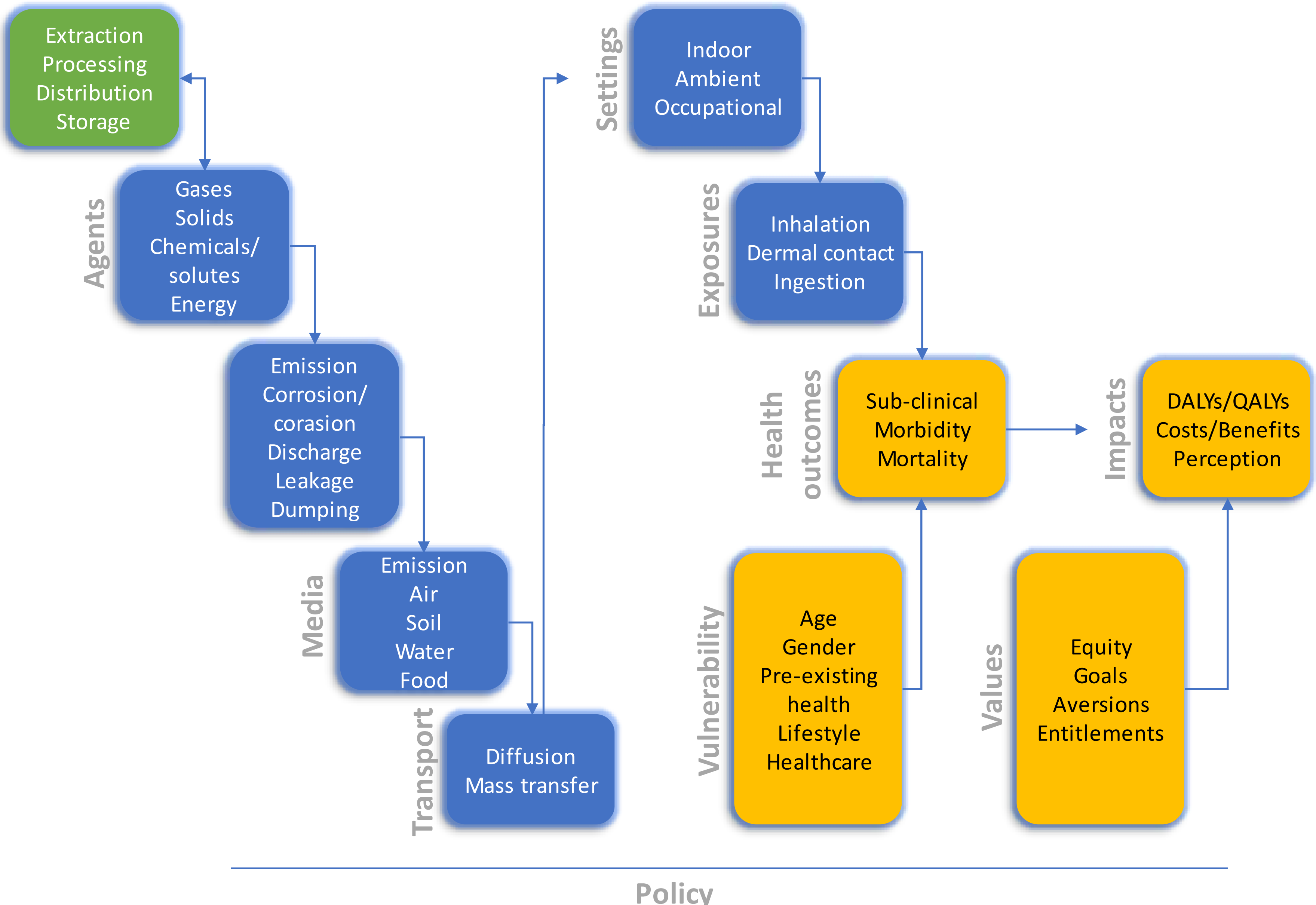
What is the recent advancement in research on assessing dose-response functions for mercury in the context of human welfare?

How high are damage costs relevant to current and future level of mercury pollution on local, regional and global scale?

What are the regions and/or populations that will bear the highest damage costs of mercury pollution in the case of continuing Hg emissions?

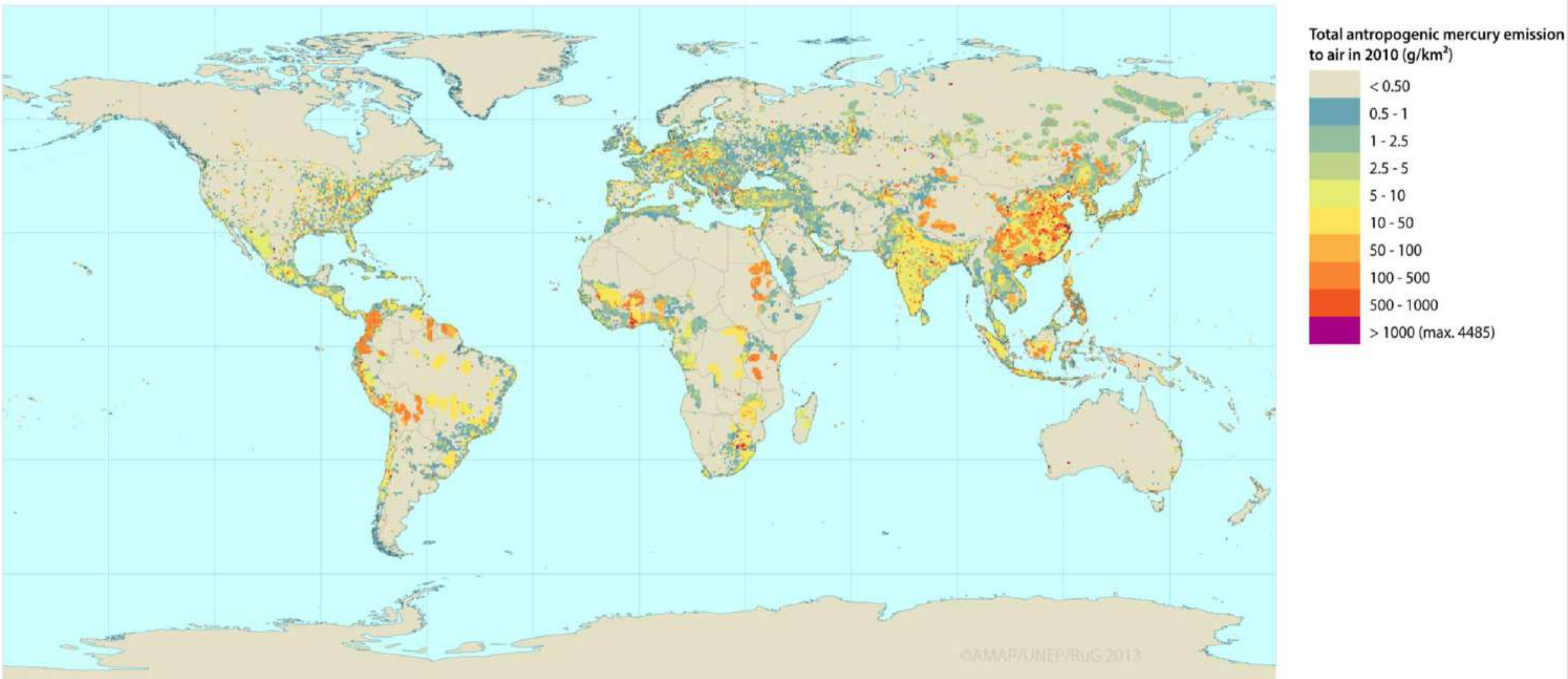
How may research on environmental and human health benefits support the implementation of the Minamata Convention?

The Full Chain Approach to IA



From: EU INTARESE project

Geospatial distribution of global antropogenic mercury emissions to air (2010)



Frits Steenhuisen, Arctic Centre RuG (f.steenhuisen@rug.nl, http://www.rug.nl/research/arctisch-centrum/)
Simon Wilson, AMAP Secretariat (www.amap.no)
February 2013

Human exposure: sources

Consumption of fish, high on the trophic chain, is the major source of MeHg exposure for humans

For some populations, marine mammals are also a source of MeHg exposure

Consumption of animals that have been nourished with fish feed may also contribute to body burden

Inhalation of Hg vapor (e.g. during small scale gold mining), followed by “internal” methylation

Recent studies suggest that in some regions, with high Hg contamination, rice may take up MeHg.

EPA's Reference Dose for Methylmercury

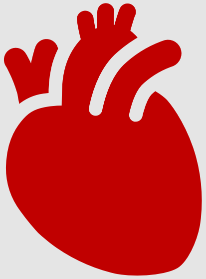
- RfD = 0.1µg/kg/day (about 1.1 ppm hair, 5.8 µg/L blood)
- Reference dose includes a uncertainty factor of 10 in converting the BMLD into the RfD
- This translates into a value of ~0.3 ppm in fish for a 60 kg person consuming 5 oz fish per week
- Similar to other regulatory or risk values
  - EU - 0.1 µg/kg/day
  - Health Canada - 0.2 µg/kg/day
  - ATSDR - 0.3 µg/kg/day
  - FDA - 0.4 µg/kg/day
  - WHO-FAO - 0.23 µg/kg/day

Annual investment and operating costs for various types of emission control equipment employed in hard and brown coal combustion

Emission control technology	Estimated Hg reduction (%)	Annual costs (US$ /MWh$_e$)		
		Investment cost	Operating cost	Total cost
Dry ESP	24	0.45	0.90	1.35
Fabric filter (FF)	90	0.46	1.47	1.93
Dry ESP – retrofitted from medium to high control efficiency	32	0.92	0.52	1.44
FF+wet or dry scrubber+sorbent injection	98	2.74	2.97	5.71
Dry ESP + wet or dry scrubber + sorbent injection	98	2.73	2.40	5.13

Human exposure: effects

- MeHg is a developmental neurotoxicant at dangerously high environmental levels in many regions of the world. It can cause neurological effects, including reductions in IQ among children.
- Elevated risk of cardiovascular diseases (especially myocardial infraction), as well as risks for reproductive outcomes, immune system effects and premature death are all health effects that are related to severe exposure of MeHg
- Dietary MeHg is almost completely absorbed into the blood and distributed to all tissues including the brain; it also readily passes through the placenta to the fetus and fetal brain. Populations who regularly and frequently consume large amounts of fish – either marine species that typically have much higher levels of MeHg than other seafood, or freshwater fish that have been affected by mercury pollution – are more highly exposed.



Annual damage costs due to ingestion of Hg for various source categories in year 2020 with and without GDP (PPP) adjustment, (in billion 2005 US$)

By-product emission		
Source category	**Not GDP (PPP) adj.**	**GDP (PPP) adj.**
Coal consumption	15	4.7
Crude petroleum consumption	0.2	0.1
Cement production	3.3	1.2
Metals production	2.3	1.0
Large-scale gold production	1.4	0.6
Mercury production	0.1	0.0
Waste incineration	0.4	0.4
Other sources	0.3	0.2
Total	**23.0**	**8.1**

Intentional use		
Source category	**Not GDP (PPP) adj.**	**GDP (PPP) adj.**
ASGM	4.0	1.4
VCM	N.A	N.A
CA	0.7	0.2
Batt	0.2	0.1
Dent	0.3	0.1
Meas	0.4	0.1
Light	0.2	0.1
Elec	0.3	0.1
Other	0.3	0.1
Total	**6.4**	**2.2**

Conclusions
from a study in connection with scientific justification for the Minamata Convention

1. A loss of IQ due to Hg pollution results in annual damage costs at a level of 10 billion US$ on a global scale
2. The total damage costs to the society due to Hg pollution are likely to be considered much higher than the damage costs related to the IQ loss only
3. On the basis of evaluation of Hg emission/ deposition patterns and global fisheries data, Australia/ Oceania, parts of South America and South East Asia were identified as regions with high potential risks of negative impacts and thus large damage costs
4. The damage costs can be reduced significantly in the future leading to large annual benefits

Contribution of future research to the Minamata Convention: Improvement of information on:

1. Further development and application of integrated assessment of environmental and socio-economic consequences of Hg biogeochemical fluxes of Hg - new dispersion, migration and exposure models, as well as improved monetary and non-monetary valuation techniques for assessment o benefits
2. More accurate assessment of dose – response functions or Hg – more advanced methods for exposure estimation
3. Environmental exposure projections for Hg in the future – methodologies for exposure scenario estimates
4. Technological measures to reduce Hg exposures – efficiency coefficients and costs of various measures
5. Non-technological measures to reduce Hg exposure on national and enterprise level – list of measures to be extended

Thank you!

Minamata Online

Capturing the health effects of environmental and industrial policy in a macroeconomic model

Linking policy and their potential health and economic impacts

cambridge econometrics
clarity from complexity

Jon Stenning

1st December 2020

Approaches to policy evaluation

- Multi-criteria analysis
  - e.g. European Commission
  - separate analyses of macroeconomic and health outcomes
- Cost benefit analysis
  - e.g. UK HM Treasury
  - Economic and health impacts presented alongside each other, and both monetised

cambridge econometrics
camecon.com

Potential health impacts and links to economic assessments

- **Health care costs**
  - Avoided costs have differing macro impacts depending upon how they are funded (e.g. state vs private insurance vs individual)
- **Mortality rates**
  - Changing population impacts upon availability of labour and the consumption of goods and services
- **Labour market participation** and public benefits
  - Illness can affect participation in the labour market, and also require the payment of benefits and other government expenditure
- **Labour productivity**
  - Output per worker can be reduced as a result of ill health

cambridge econometrics
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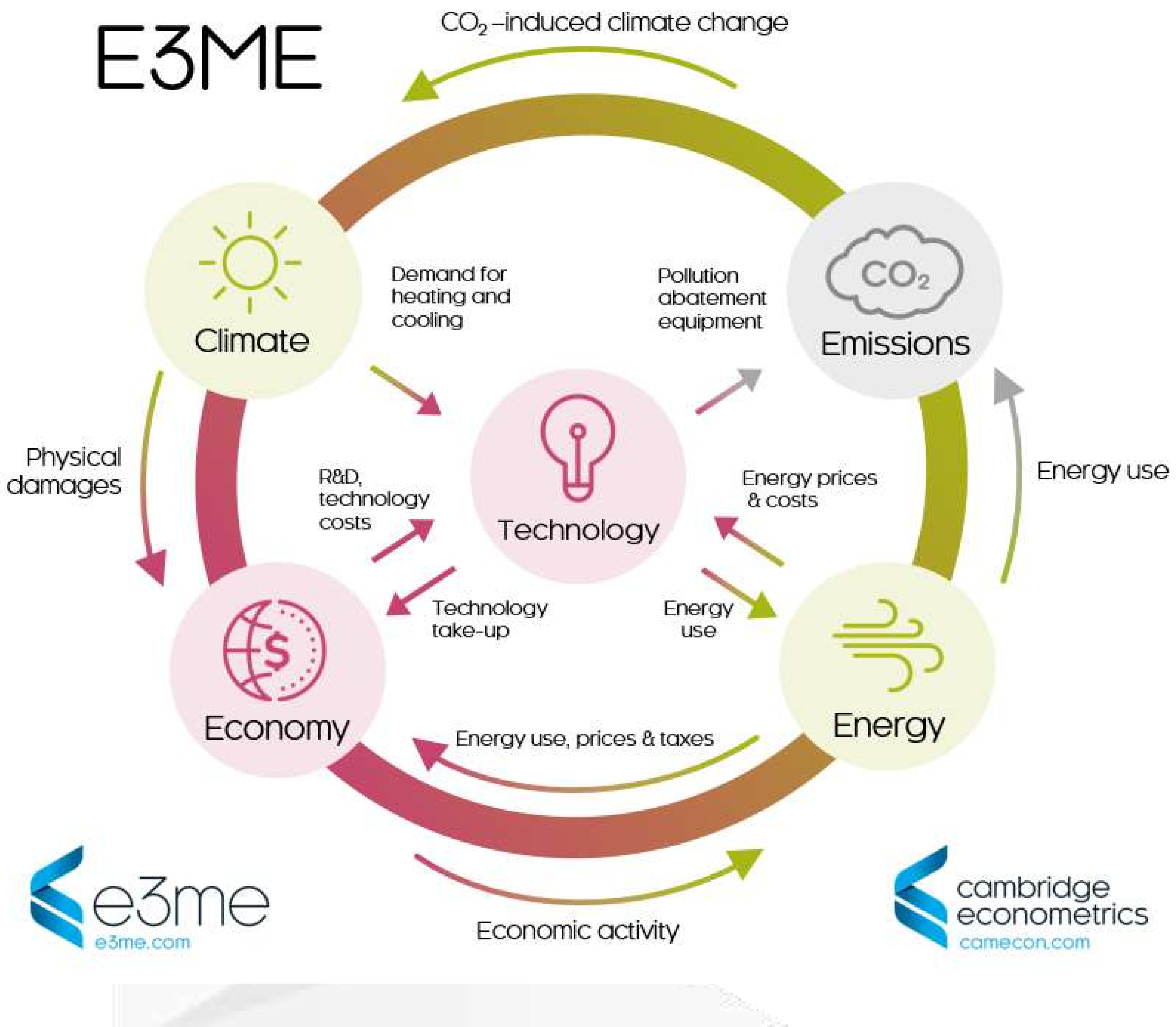
A case study – health impacts in E3ME (contd.)

- A **reduction in healthcare costs** leads to a shift in spending away from healthcare and towards other goods and services
  - Ambiguous impact on GDP, depending on the relative import content of the purchased goods/services and health services
- A **reduction in mortality rates** will mean higher levels of spending by households
  - leads to higher tax receipts and, potentially, government expenditure
  - aggregate GDP will be higher



A case study – health impacts in E3ME (contd.)

- A **reduction in mortality rates** may also mean a larger available labour force
  - this will (in the long run) lead to lower wage rates and lower business costs
  - improved competitiveness will lead to lower inflation rates, higher (real) household spending and an improvement in the trade balance, and ultimately, GDP will increase
- An **increase in labour participation rates** will lead to a further increase in labour supply
- An **improvement in labour productivity** will increase the capacity of domestic firms
  - allowing them to reduce prices and increase production levels
  - lower prices lead to competitiveness benefits, higher domestic spending and an improvement in international trade
  - firms may also benefit from lower wage rates
  - potential for lower investment (less need for new capacity)
  - overall, positive effects from lower prices are likely to outweigh investment effects and GDP increase overall

Conclusions

- Macroeconomic models are well designed for estimating the impact of policy on economic indicators (GDP, employment)…
- …but much less well suited to measuring health impacts
- There are complex interactions between health outcomes and the economy
- The models provide a way of better understanding the wider benefits from improving public health, and comparing to the costs of policy implementation…
- …and should form part of a broad evaluation of policy impacts

" In a world swamped with information and data, we provide clear insights based on rigorous and independent economic modelling and analysis. "

Jon Stenning js@camecon.com

Valuation of health benefits from exposure reduction with focus on mercury

Dr. Milan Ščasný
Charles University, Prague
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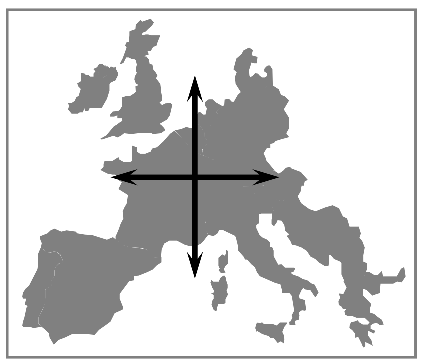
Minamata Online Session: Socio-economic implications of mercury pollution, December 1, 2020

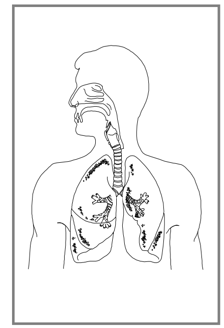
Impact Pathway Analysis

POLLUTANT & NOISE EMISSIONS

TRANSPORT & CHEMICAL TRANSFORMATION



DIFFERENCES OF PHYSICAL IMPATS



MONETARY VALUATION

Reliable DRFs and ERFs ?

- neurological and developmental effects, including the effect on IQ among children
- reproductive outcomes
- cardiovascular diseases → premature death

What is the WTP to reduce pollution?

$$WTP = \frac{dD}{dP} \times \left[w\frac{dW}{dD} + p_M \frac{dM}{dD} + p_A \frac{dA^*}{dD} - \frac{U_D}{\lambda} \right]$$

Slope of the dose response function

Loss of productivity or earnings

Medical treatment cost

Averting expenditures

Value of the disutility and discomfort of illness

Cost of Illness [COI]

WTP to pay to avoid a sick day or illness

What is the Value of a Statistical Life?

A summary measure of how much someone is prepared to pay to reduce his risk of dying by a small amount

- *If I am willing to pay 500 euro to reduce risk by 1/10,000 (=0.0001), the VSL is 500 $\times$ 10,000 = 5,000,000 euro*

$$VSL = \frac{\partial WTP}{\partial R} = \frac{U(y) - V(y)}{(1-R)\cdot U'(y) + R\cdot V'(y)}$$

VSL used widely by gov agencies in policy analyses, incl. US EPA, EC's DGs, OECD, and others

Increasing number of VSL estimates

- *for various context (e.g., Alberini and Ščasný 2011, 12, 13, 18)*
- *meta-reviews (Lindhejm et al., 2001; Masserman and Viscusi 2018; Harvard group [Hammitt, Robinson], and others)*

Metric to value improvements in health

Quality of life based LYs

- QALYs, DALYs, Global Burden Diseases ≈ f(DALYs)
- Favoured by clinical medicine & health economics
- cost-effectiveness analysis (CEA)

Willingness to pay

- Health benefits expressed in money
- closely allied with environmental and regulatory economics
- Used in cost-benefit analysis (CBA)

What is common?

- Both QALYs and WTP can be justified as measures of individual preferences over health risks. QALYs however impose more restrictive conditions that are often violated by individuals (see e.g. Hammitt 2003).

What are the differences?

- the degree to which each measure captures two kinds of preferences: individuals' preferences for risks to their own health (LE+HRQL vs. Income), and
- society's preferences for the distribution of health risks across the population (max[LEs] vs. max social welfare)

QALY vs WTP perspective on reducing mortality risk to different people

Relative Value of Reducing Mortality Risk

	QALY	WTP
Life expectancy	Increase	Ambiguous
Future health	Increase	Ambiguous
Wealth	No effect	Increase
Baseline risk	No effect	Increase
Competing risk	Decrease	Decrease
Qualitative attributes	No effect	May affect

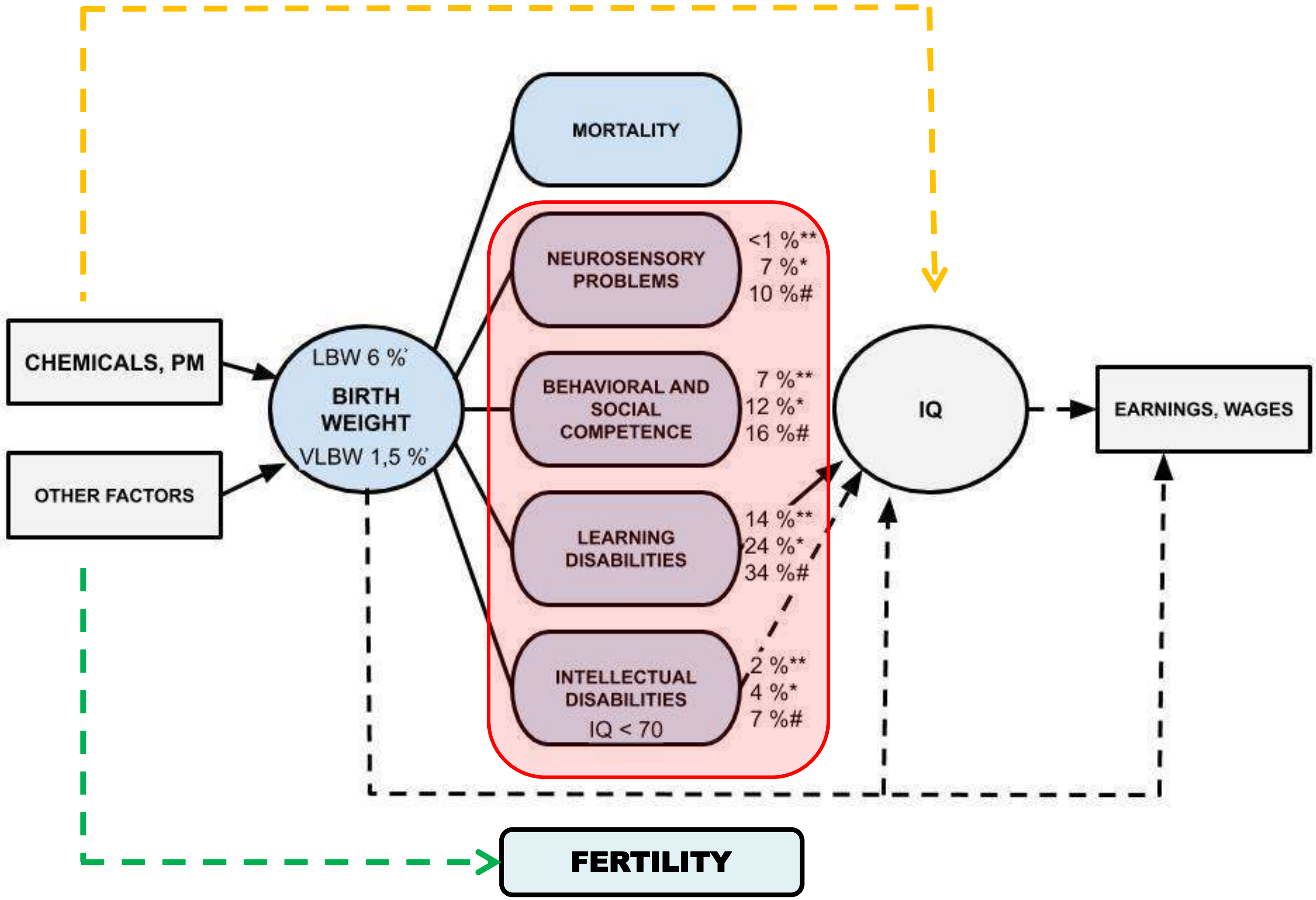
Source: Hammitt 2002

Neurological and developmental effects

IQ loss: cognitive difficulties, reduced school attendance → lower educational attendance → lower wages

- Landrigan et al. (2002), Grosse et al. (2002), FP6 DROPS (2008), Drake (2016), Trasande (2016),
- Valuation based on **loss of earnings** by Rabl and Spadaro (2006), Scasny et al (2008 DROPS) and many others
- loss of lifetime earnings indicate **a lower bound** of total damage
- **a review of WTP studies** on neurodevelopmental impairment and IQ Loss by Georgiou and Ščasný (2019; SWACHE)
- **WTP for ΔIQ of parent's child** (Mourato et al) planned for 2021 as a part of the OECD-ECHA SWACHE project

From environmental exposure to birth outcomes and to (health) impacts



Note: ' Prevalence of low birth weight (LBW) (< 2500 g) and very low birth weight VLBW (< 1500 g)
** Share of children with VLBW that have the health problems
* Share of children with LBW that have the health problems
# Share of children with normal birth weight that have the health problems

From chemicals to birth outcomes

(Ščasný and Zvěřinová 2020)

- Exposure to chemical toxicants - impacts on **fertility**, **birth-related** outcomes, and **child development** *(Kumar & Burton, 2008; Wigle et al., 2008; Prüss-Ustün, Vickers, Haefliger & Bertollini, 2011).*

- adverse effects on various **outcomes related to birth** (≈40 studies)

  - …of various **chemicals**, including heavy metals, PM fractions, co-exposure on various birth outcomes

  - …on **birth weight** (BW), **low birth weight** (LBW), **very low birth weight** (VLBW), **small for gestational age** (SGA), **length of gestation**, **preterm birth**

    - **LBW**, *or weight less than 2,500 g (or 5.5 pounds)*
      - **high prevalence** (one-in-fifteen babies born in the EU, 4–10 % across OECD c.)
      - smaller differences between LBW and normal birth weight infants in terms of health and developmental difficulties

    - **VLBW**, *or weight less than 1,500 g (or 3.25 pounds)*
      - **lower prevalence** (7 per 1000 children born in Europe, 0.6–1.4 % across c.)
      - **better evidence** about health and developmental difficulties

Valuation of reproductive outcomes and developmental effects

Child birth or infertility

- WTP for increasing a probability to conceive (Ščasný and Zvěřinová 2014 in ECHA WTP study)
- WTP for IVF (Š&Z 2014)
- WTP for reducing infertility (Rheinberger/ECHA planned in 2021 within SWACHE)

Birth defects

- WTP for 3 types of birth defects (affecting **internal organs** or neuro-logical system, of **the external body parts, minor defects) by** Š&Z (2014)

Low birth weight

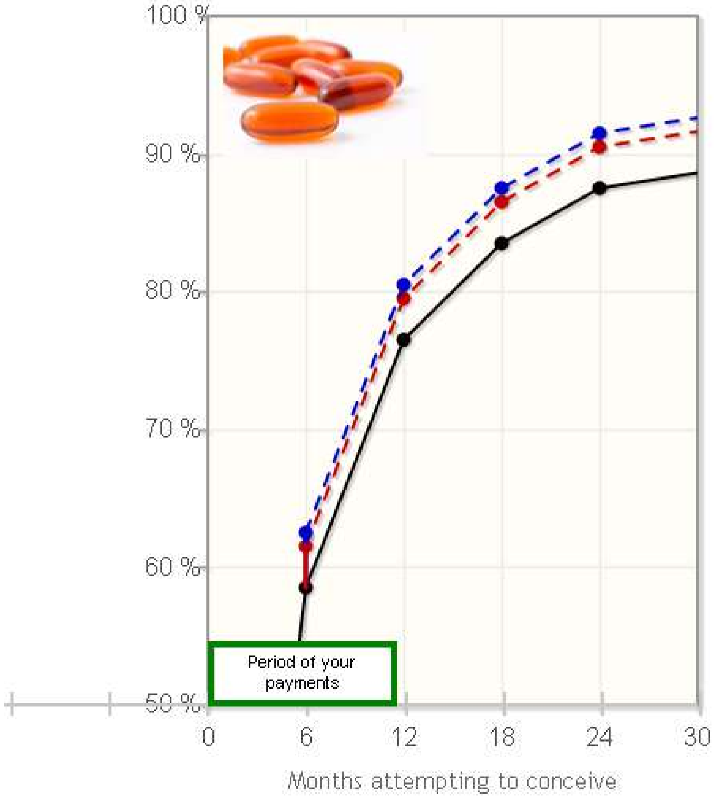
- WTP for VLBW in ECHA study (Š&Z 2014)
- WTP for VLBW and LBW in Health Canada study (Š&Z 2016) and OECD-ECHA SWACHE (Š&Z planned for 2012)

Fertility: Probability of conceiving

Ščasný and Zvěřinová (2014)

First choice

Would you choose Vitamins A, Vitamins B, or neither?



0 = time you start trying for a baby

Attribute	Complex of vitamins A	Complex of vitamins B	Current state
Beneficiary	You and your partner	You and your partner	You and your partner
Percentage of increase of the probability of conceiving as shown in the graph	+ 3%	+ 4%	0% no increase
Number of months of trying to conceive after which the probability will increase	after 6 months	after 6 months	0
Costs	£ 360	£ 3000	£ 0
(Monthly payment over 1 year period)	(£ 30 per month for 1 year)	(£ 250 per month for 1 year)	
Which option would you prefer?	Vitamins A	Vitamins B	Current state

Valuation of (V)LBW in ECHA & HCAN studies and planned within SWACHE OECD-ECHA study

Ščasný & Zvěřinová (2014; 2016)

- ECHA study & Health Canada study
- **problems and difficulties** related to VLBW described in detail (neurosensory, behavioral and social competence, intellectual and learning disabilities). We did not value specific problem (such as IQ), but (V)LBW as an **'umbrella' outcome**, i.e. WTP for reducing **the probability of your child to be born with (very) low birth weight**
- both contexts and the type of a contingent good (the same as used to value *fertility* and *birth defects*):
  - **private good** (a novel complex of vitamins and minerals) as well as
  - **public good** scenario ("chemical-free products" introduced thanks to a more strict policy at the EU / "new regulation" in Canada)
- two different **target populations**: **adults who plan to have a baby** *(private good)*, and **general population** *(both contexts)*
- **double-bounded dichotomous choice** questions

Valuation of (V)LBW: literature review /1.c

Ščasný & Zvěřinová (2014; 2016)

- double-bounded dichotomous choice
- **WTP** for reducing **the probability** of your child *(x in 1,000)* to be born with (very) low birth weight → **Value of a Statistical Case of (V)LBW**

Table: VSC (V)LBW, in EUR PPS

Health outcome	Very low birth weight			Low birth weight		
Target population	Who plan to have a baby		General population	Who plan to have a baby		General population
Type of the good / Context	private good (vitamins)	public good (regulation)		private good (vitamins)	public good (regulation)	
CANADA, no Zika*	201 858	875 380	423 547	136 032	702 401	220 834
CZECH REPUBLIC	120 558	405 517	546 737	NA	NA	NA
ITALY	245 157	532 549	669 255	NA	NA	NA
NETHERLANDS	NA	620 842	NA	NA	NA	NA
UNITED KINGDOM	80 090	420 130	316 092	NA	NA	NA
ECHA pooled data**	120 165	386 114	477 838	NA	NA	NA
EU28, based on benefit transfer	126 200	NA	548 300	NA	NA	NA

EU28 WTP Values

People who want a child – private good, in EUR

Health outcome	Conservative approach	Sensitivity analysis
Value of a statistical pregnancy	26,000	38,000
Value of a statistical infertility (in vitro fertilisation treatment)	31,000	
Value of a statistical case of Healthy Child: MINOR birth defects	13,000	20,000
Value of a statistical case of Healthy Child: defects in INTERNAL organs	216,000	246,000
Value of a statistical case of Healthy Child: defects on EXTERNAL body parts	151,000	204,000
Value of a statistical case of VLBW	132,000	

Ščasný and Zvěřinová 2014

From one pollutant to multi-pollutants: Ancillary effects of CC mitigation

Table 2 Cumulative difference in emission volumes and percentage change in Europe for each climate mitigation scenario compared to the corresponding Reference scenario (SSP2) for the period 2015–2100

Scenario	NMVOC (kt)	NOx (Mt)	PM2.5 (kt)	SOx (Mt)	Cd (t)	As (t)	Ni (t)	Pb (t)	Hg (t)	Cr (t)	CO_2 (Gt)
Reference (SSP2)	3088	195	25,150	563	938	6413	20,397	8321	1214	4523	96
RCP2.6	−509	−153	12,013	−551	−434	−3705	−13,318	−2552	−769	−1983	−99
RCP4.5	−702	−93	−2240	−329	−374	−2908	−3483	−3037	−576	−1852	−60
Percentage change with respect to SSP2											
RCP2.6	−16 %	−78 %	48 %	−98 %	−46 %	−58 %	−65 %	−31 %	−63 %	−44 %	−103 %
RCP4.5	−23 %	−48 %	−9 %	−59 %	−40 %	−45 %	−17 %	−37 %	−47 %	−41 %	−62 %

Ščasný, Massetti, Melichar, Carrara ERE 2015

Ancillary benefits by pollutant

Table 6 Present value in billion Euros of pollution cost (SSP2) and ancillary benefits (RCP) per pollutant and region

	NMVOC	NOx	PM2.5	SOx	Cd	As	Ni	Pb	Hg	Cr	Total
Reference scenario											
EU15+EFTA	0.65	402	128	1242	0.02	1.01	0.02	0.72	2.76	0.02	1779
EASTEU	0.03	47	5	169	0.00	0.10	0.00	0.06	0.31	0.00	222
RCP4.5											
EU15+EFTA	0.12	175	7	663	0.01	0.38	0.00	0.20	1.10	0.01	847
EASTEU	0.01	15	0.76	59	0.00	0.03	0.00	0.02	0.11	0.00	76
RCP2.6											
EU15+EFTA	0.11	310	−41	1208	0.01	0.53	0.01	0.19	1.58	0.01	1479
EASTEU	0.02	42	1	162	0.00	0.09	0.00	0.05	0.27	0.00	205

Values 0.00 indicates smaller value than 0.01 and is not shown due to rounding. The negative number −41 for PM2.5 in RCP2.6 in EU15+EFTA indicates the increase in emissions and hence ancillary damage

Ščasný, Massetti, Melichar, Carrara ERE 2015

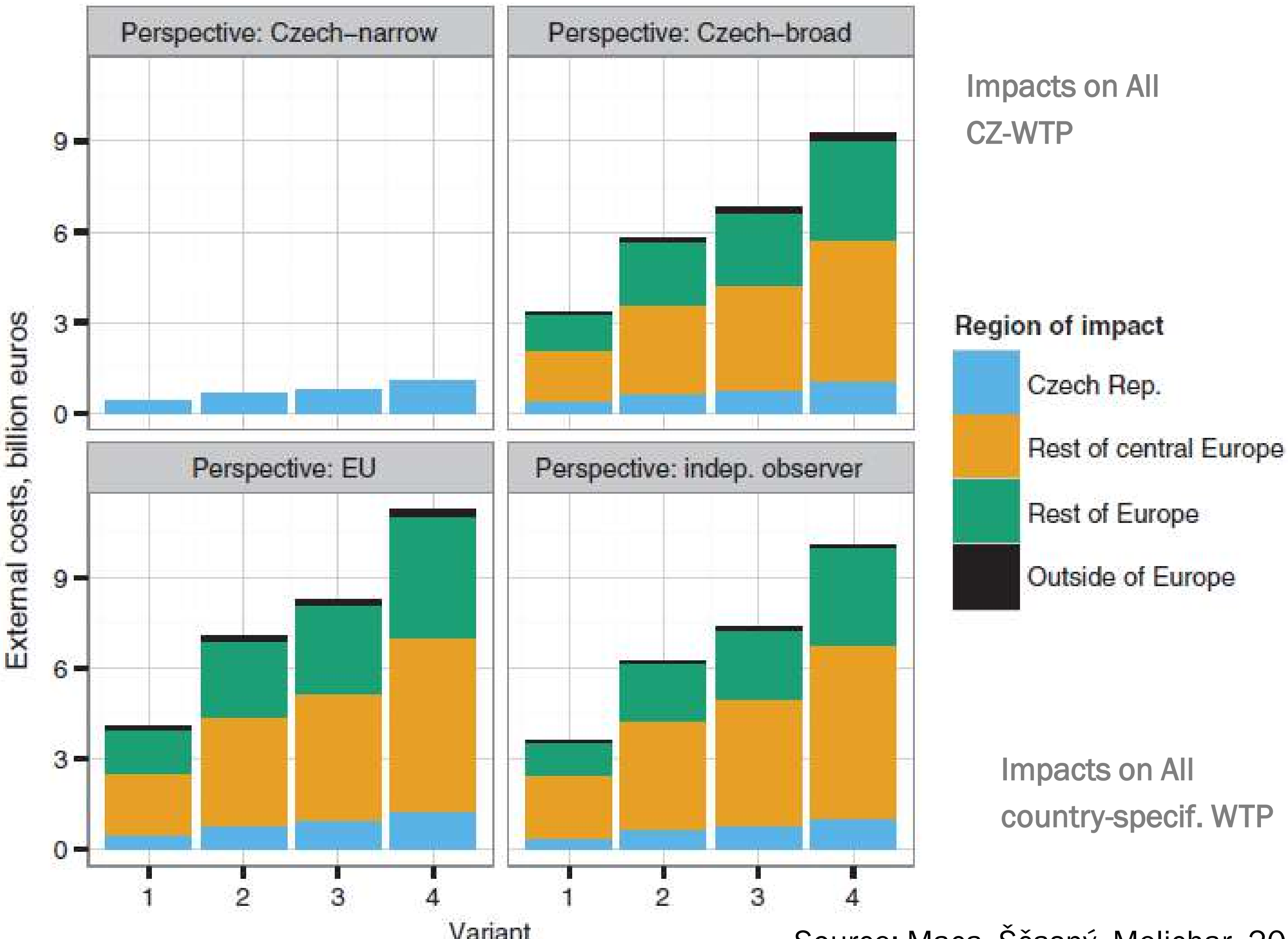
Economic standing:
Which benefits and how to value them?
[Four variants of lifting coal limits in the Czech Republic]

Impacts on domestic voters
CZ-WTP

Impacts on All
CZ-WTP

Impacts on All
EU-WTP

Impacts on All
country-specif. WTP



Source: Maca, Ščasný, Melichar, 2017

Questions ?

What are the means of improving the methods of quantification of economic benefits of human health impacts due to the implementation of policies?

- More studies to get total economic value for the impact categories with reliable DRF/CRF/ERF
  - ❑ In particular, WTP estimates are needed.
  - ❑ VSL for various contexts, from different risks, with morbidity before dying
- Benefit transfer and economic standing
- Weighting (equity issues, risk aversion, discounting)

How to improve the quality of damage function approaches?

- I can only say something about economics (valuation).

For our Environment

Umwelt Bundesamt

Minamata Online – socioeconomic implication of mercury pollution, 1/12/2020

Global Burden of Disease of Mercury Used in Artisanal Small-Scale Gold Mining

Myriam Tobollik & Dietrich Plass - German Environment Agency

Claudia Hornberg - Bielefeld University

Bret Ericson & Richard Fuller - Pure Earth, formerly Blacksmith Institute

Nadine Steckling-Muschack & Stephan Bose-O‘Reilly - University Hospital Munich

Objective

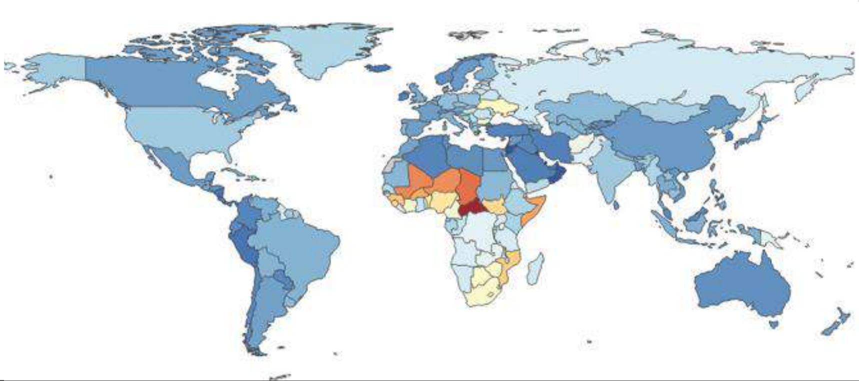
- To quantify the number of disability-adjusted life years globally attributable to chronic mercury vapor intoxication due to the use of mercury in artisanal small-scale mining

- Funding: Pure Earth (USD 7,500)

- Results published in Annals of Global Health (Steckling et al. 2017)

Burden of disease concept

- Quantifying the burden using disability-adjusted life years (DALY):
  - Years of life lost due to premature mortality (YLL)
  - Years lived with a disability (YLD)
- Summary measure of population health developed by World Health Organization, World Bank and Harvard School of Public Health in the 90s
- Best known example is the global burden of disease study by the Institute for Health Metrics and Evaluation (IHME)
  - Mercury intoxication due to artisanal small-scale mining is not included as a risk factor



Methods

- Population and geographic area: global artisanal small-scale gold miners (male, female, all ages)

- Health outcome: Moderate cases of a chronic metallic mercury vapor intoxication (CMMVI)

- DALY quantification:
  - YLLs: No mortality effects were expected
  - YLDs: Prevalence-based approach

Person with a high level of mercury in his or her body causing slight tremor of fingers, hands, and limb and erethism (psychological disturbances like memory impairment, sleep disorders, shyness, irritability, fatigue). Decreased nerve conduction velocities can be measured. The increased excretion of proteins in urine indicates renal effects.

(condensed version Steckling et al. 2017; based on Steckling et al. 2015)

Number of miners x prevalence rate x disability weight

Methods: Number of miners

- No official registers
- Studies:
  - Telmer &Veiga (2009): ASGM is observed in more than 70 countries
  - Seccatore et al. (2014): presents numbers of miners for 56 countries
  - Project addition: number of miners for further 6 countries were found in the literature
  - Minimum and maximum estimates were used when available

  → To show the uncertainties

Methods: Disability weight

- Weighting factor for severity of diseases on a scale from 0 to 1
  - 0.368 with an uncertainty interval of 0.261-0.484 (Steckling et al. 2017)

EQ-5D+C-3L: 121222
(generic tool from the EuroQol group to survey health related quality of life)

The person
- has no problems in walking about
- has some problems with self-care
- has no problems with performing usual activities
- is moderately anxious or depressed
- has moderate pain or discomfort
- has some problems in cognitive functions

Methods: Prevalence rate I

Mercury concentration in urine	**Medical Score Sum**		
	0-2 points	3-4 points	5-10 points
below 7 µg/l or 5 µg/g cr.	not intoxicated	not intoxicated	not intoxicated
between 7 and <25 µg/l or 5 and <20 µg/g cr.	not intoxicated	not intoxicated	**intoxicated**
above 25 µg/l or 20 µg/g cr.	not intoxicated	**intoxicated**	**Intoxicated**
Based on Drasch et al. (2001) and Doering et al. (2016). In Drasch et al. (2001), the medical score sum was more extensive and mercury concentraion in blood and hair was additionally included. In Doering et al. (2016), mercury concentraion in blood and hair was additionally included			

Data from Ecuador, Indonesia, Philippines, Tanzania, Zimbabwe

Methods: Prevalence rate I

Methods: Prevalence rate II

n	Subgroup	Concentration classes used for data analysis	Proportion of sample per concentration classes	Prevalence of moderate CMMVI in concentration classes
663	Gold miners from Ecuador (n= 36), Indonesia (n= 235), Philippines (n= 87), Tanzania (n= 128), Zimbabwe (n= 177)	0.1-6.9 µg/l	34,7%	0,0%
		7-24.9 µg/l	31,2%	19,8%
		25.0-99.9 µg/l	22,0%	68,5%
		100-199.9 µg/l	6,0%	67,5%
		200-299.9 µg/l	2,3%	80,0%
		300.0-399.9 µg/l	1,5%	70,0%
		400.0-5249 µg/l	2,3%	60,0%
603	Gold miners from Indonesia (n= 221), Philippines (n= 87), Tanzania (n= 129), Zimbabwe (n= 166)	0.08-4.9 µg/g cr.	40,0%	0,0%
		5.0-19.9 µg/g cr.	29,9%	17,8%
		20.0-99.9 µg/g cr.	21,1%	63,0%
		100.0-199.9 µg/g cr.	6,0%	58,3%
		200.0-299.9 µg/g cr.	1,5%	77,8%
		300.0-1697.39 µg/g cr.	1,5%	66,7%
Parts of the data were analyzed previously by applying different analyses methods.				

Scenario 1, overall prevalence: 23,7

Scenario 2, specific prevalence: 34,3

Results I

- Number of miners: range from 14 to 19 million in 62 countries
- Prevalence estimates were based on Human-biomonitoring data from 3.194 individuals (Scenario 2: 1.590)
- Assumed overall prevalence: 23.7% (Scenario 2: 34.3%)
- Disability weight: 0.368 (UI: 0.261-0.484) (Steckling et al. 2017)
- 1.22 (UI: 0.87 to 1.61)* million DALYs (minimum number of miners, lower prevalence)
- 2.39 (UI: 1.69 to 3.14)* million DALYs (maximum number of miners, higher prevalence)

*UIs are based on uncertainty intervals of disability weights

Results II

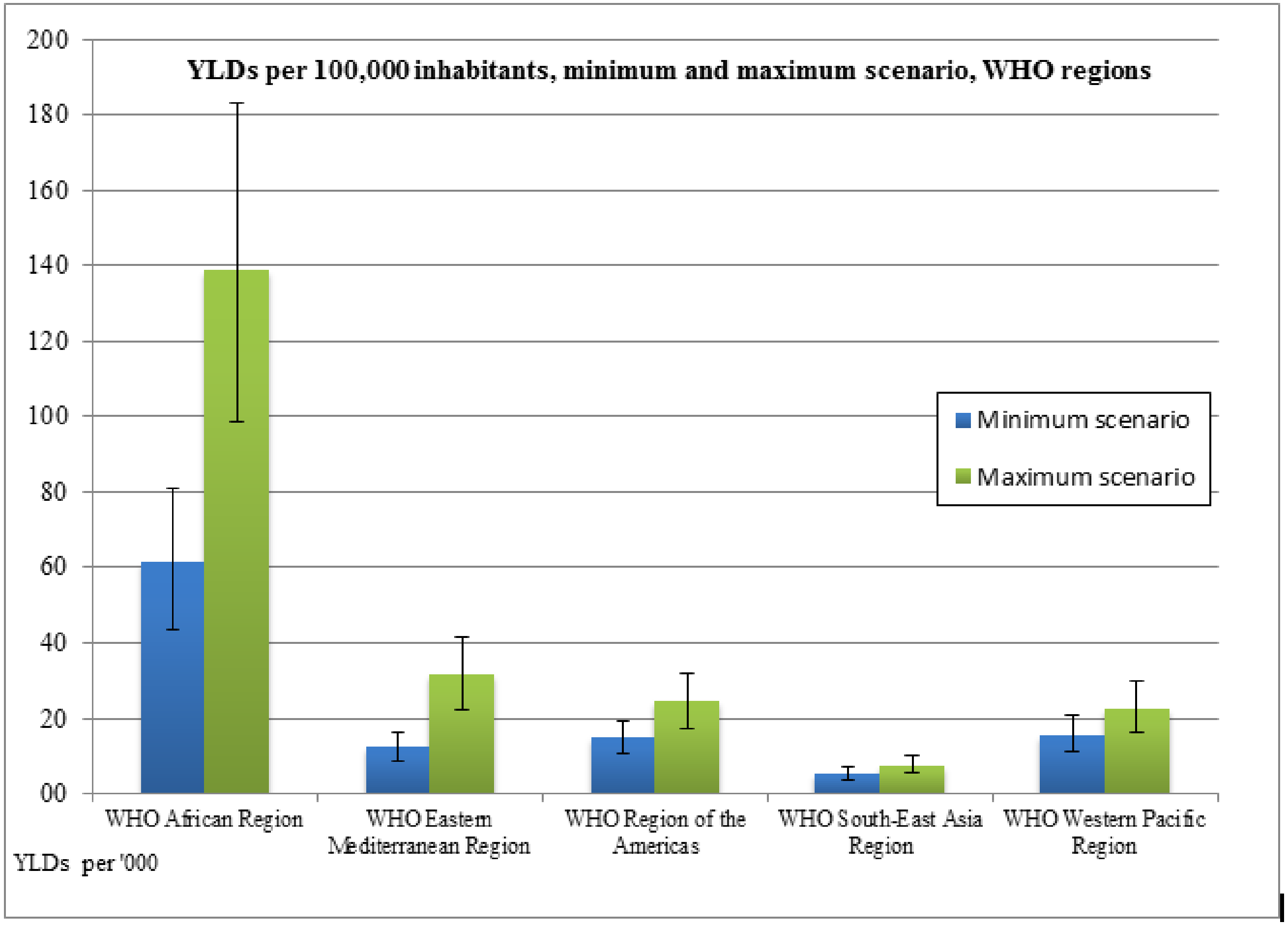


Figure 1: Minimum scenario: lowest number of miners, lower prevalence rate of 23.7% intoxication and maximum scenario: highest number of miners, higher prevalence rate of 34.3% intoxication of years of life lost (YLDs; corresponding to DALYs, disability-adjusted life years) per 100,000 inhabitants by WHO regions. Numbers of inhabitants were taken from WHO[40]; the vertical lines show the uncertainty intervals (UI) based on the UIs of the disability weights (DWs)

Results III

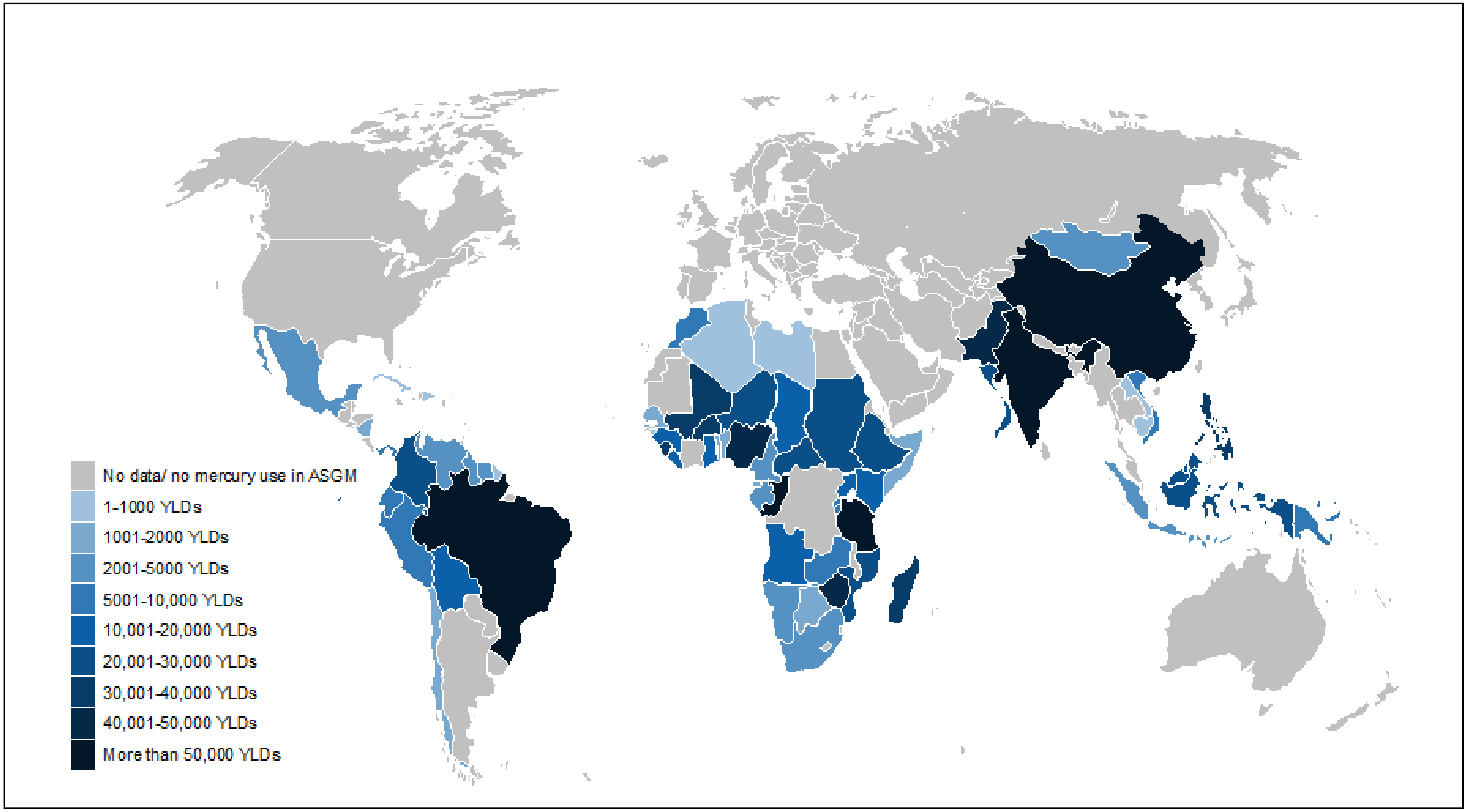


Figure 2: Number of total YLDs (corresponding to total DALYs) per country, estimated in the minimum scenario (lower number of miners and lower prevalence rate)

Discussion

First country-based estimate of the burden of disease due to mercury used in artisanal small-scale mining

→ More attention to gold miners‘ disease burden is needed

Analysis was restricted to miners

→ DALY estimates of further subgroups (family members, former miners, etc.) are needed, missing data hampers analysis

Overall prevalence estimate was based on human-biomonitoring data from more than 3000 individuals

→ Country-specific prevalence estimates are desirable

→ Available human-biomonitoring raw data should be merged in one database

Analysis was restricted to mercury-related effects

→ Collections of more and standardized (not only mercury-related) health data are needed

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Thank you

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MINAMATA ONLINE

SEASON 1 - 2020

Mercury science

Socioeconomic impact of mercury pollution

MINAMATA CONVENTION ON MERCURY

This is part of a series of online science sessions co-organized by the Minamata Convention Secretariat and the International Conference on Mercury as a Global Pollutant (ICMGP). The series aim to bridge the scientific community and international policy, and this session extends to social sciences. Experts will present on their work on socio-economic aspects of environmental pollution and discuss how social sciences can inform the decision making, in the context of the Minamata Convention.

SPEAKERS

Monika Stankiewicz
Executive Secretary, Minamata Convention on Mercury

Jozef Pacyna
Professor, AGH University of Science and Technology, Krakow, Poland

Leonardo Trasande
Director, NYU Center for the Investigation of Environmental Hazards

Jon Stenning
Head of Environment, Cambridge Econometrics

Milan Ščasný
Senior Lecturer, Charles University – Environment Center & Institute of Economic Studies, Czech Republic

Myriam Tobollik
Scientist, German Environment Agency

Eisaku Toda
Senior Programme Officer, Minamata Convention on Mercury

Tuesday, 01 December 2020

14:00 – 15:30 CEST

Please register for the WebEx session using the links above.

Check the Minamata Online calendar

for other upcoming events and the presentations and video recording from the previous sessions.

Mercury science