BCoDE – Burden of Communicable Diseases in Europe

A consistent and quantitative approach to risk-benefit assessment and risk ranking: the role of burden of disease estimates

Alessandro Cassini, Expert for Burden of Disease and Forecasting

EFSA Challenging boundaries in risk assessment – sharing experiences

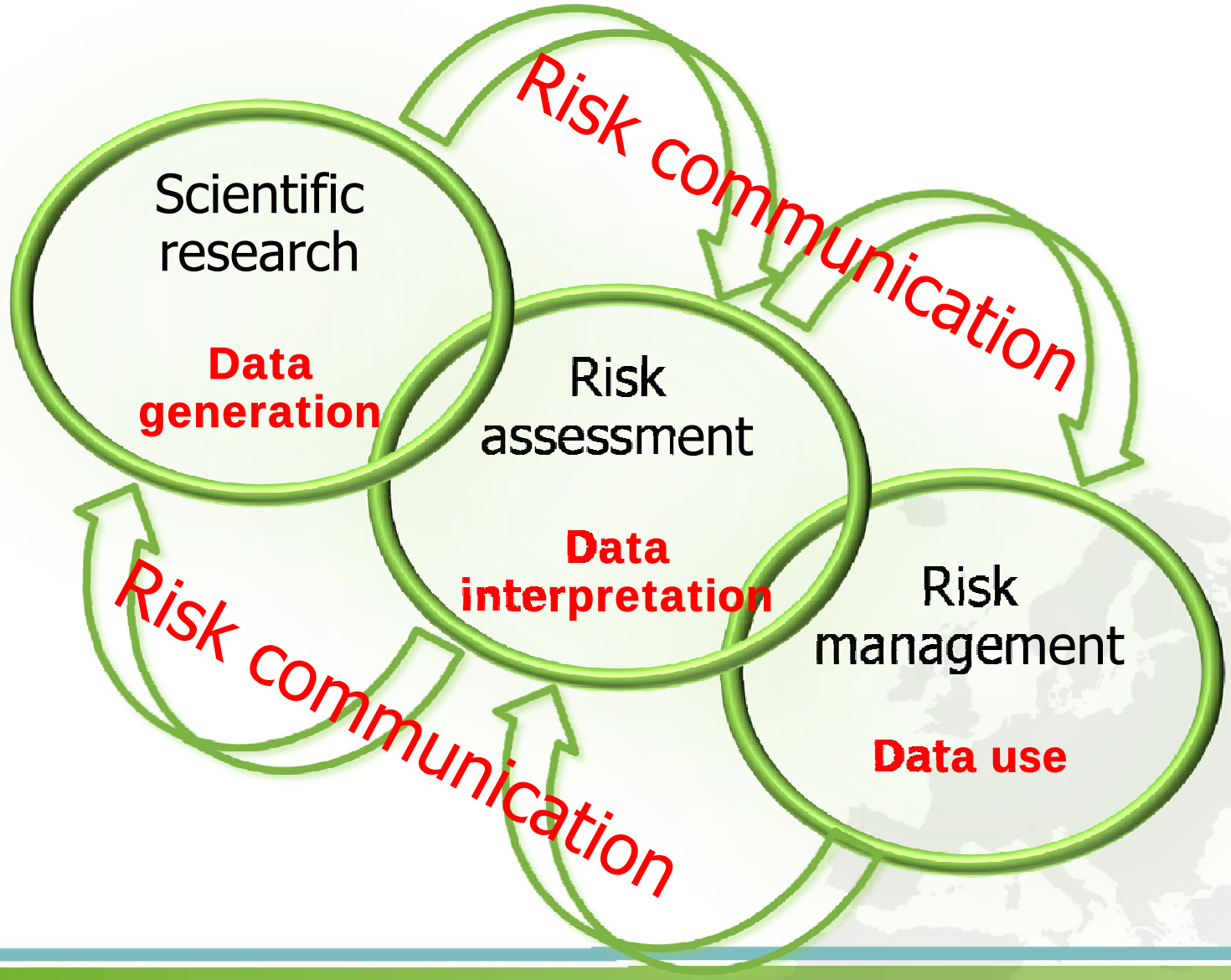
Parma, 7 November 2012

Overview

1. Risk ranking and risk-benefit assessment
2. The BCoDE project
3. Risk assessment using composite health measures: some examples
4. The BCoDE toolkit implementation within EU Member States

1. Risk ranking and risk-benefit assessment

Risk analysis

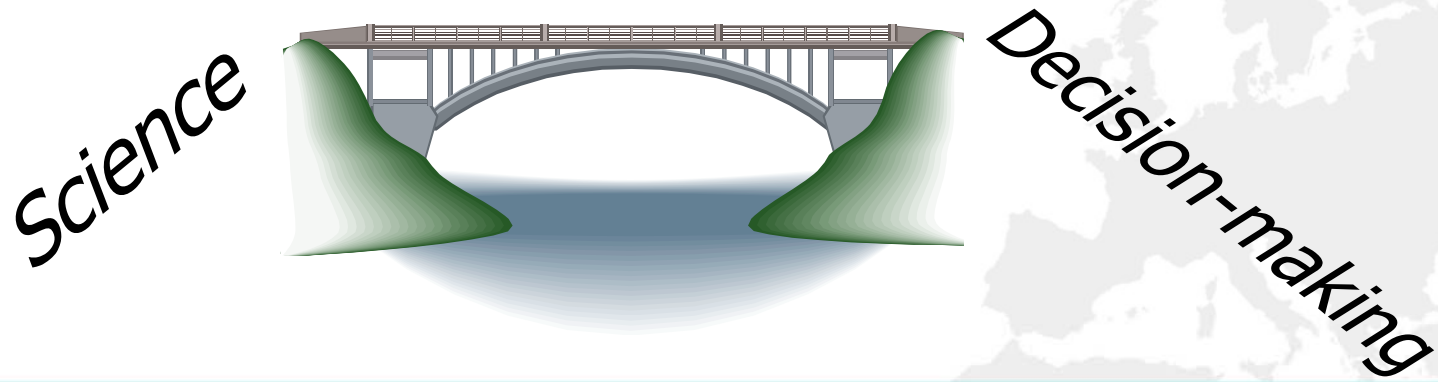


Risk assessment: using Health Technology Assessment tools

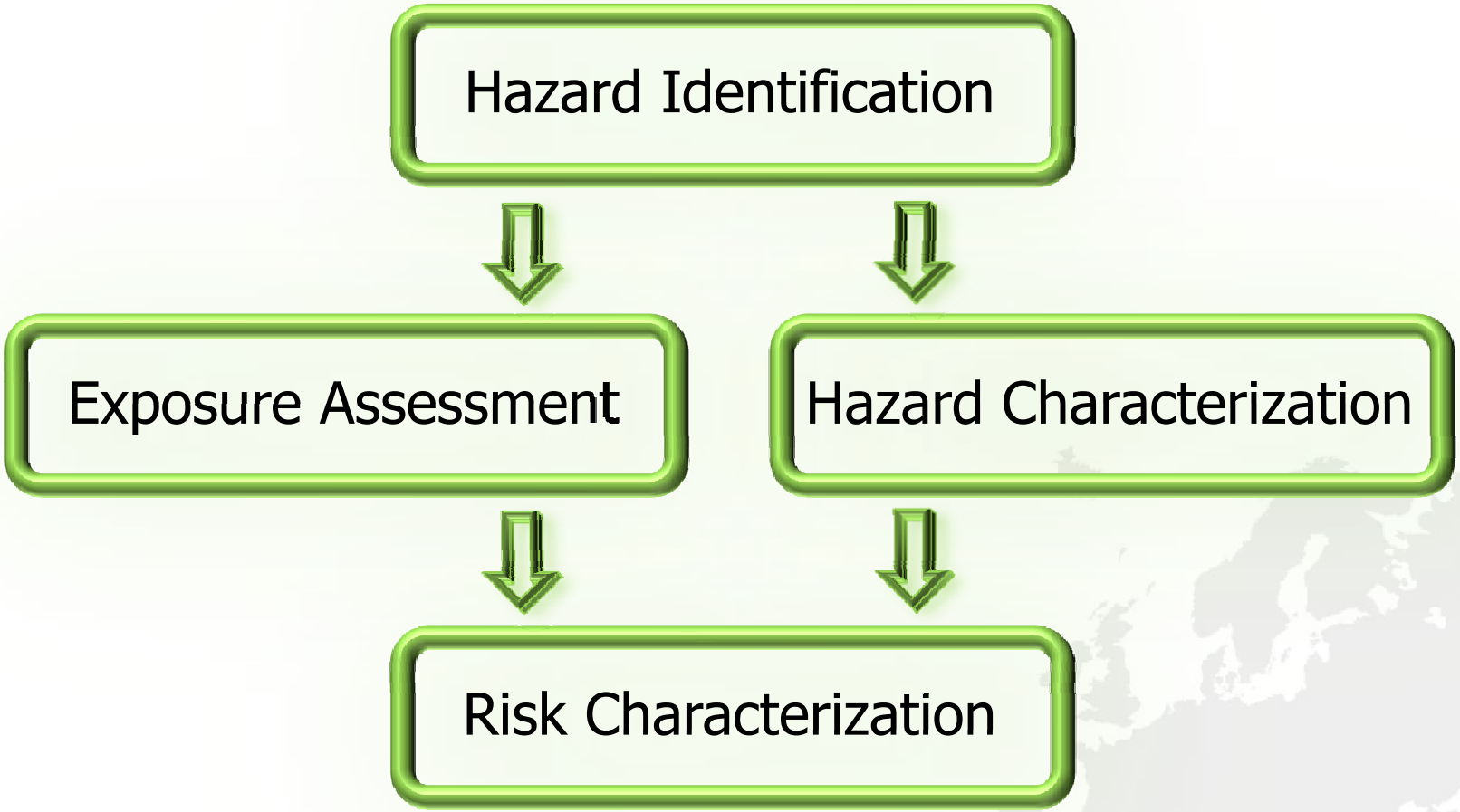
Use of information technology deriving from multidisciplinary fields with the purpose of assessing risks in a systematic and evidence-based approach

Its goal is to produce input to decision making in policy and practice

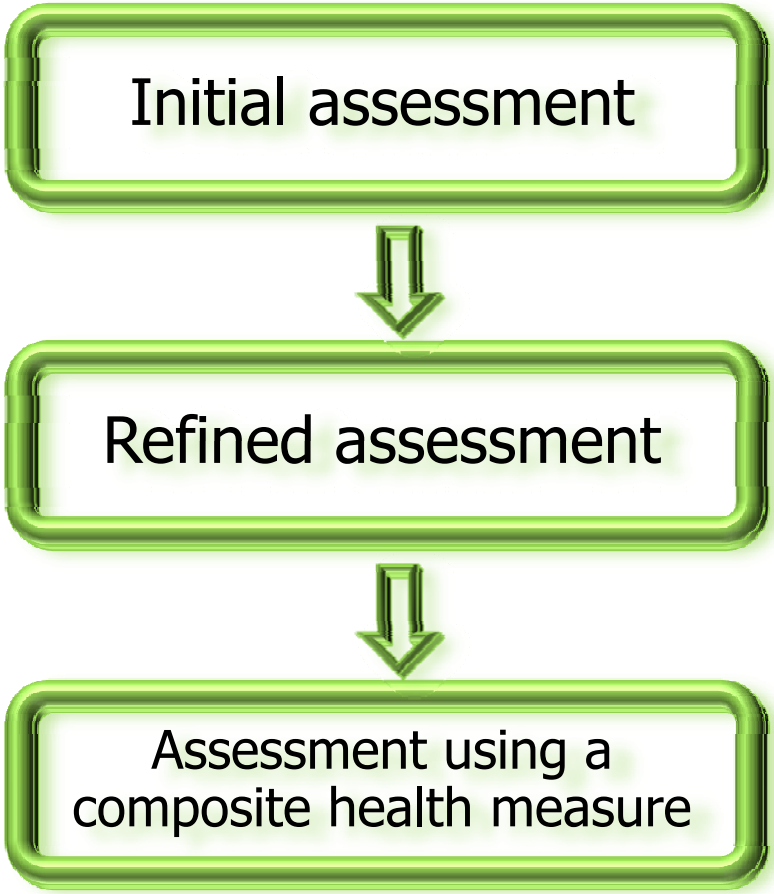
Technology Assessment



Risk-benefit assessment paradigm



Stepwise approach to risk-benefit assessment



Risk assessment modelling options

- Opinion based
- Qualitative
- Semi-quantitative
- **Quantitative**

A CHM is useful to:

1. Aggregate
2. Express
3. Compare

benefits and risks

Expression of a
Single Net Health Impact Value

Guidance on human health risk-benefit assessment of foods. EFSA Journal 2010;8(7):1673

2. The BCoDE project

Global Burden of Disease: estimating the relative impact of all diseases

Comparing incidences or mortality data of very different diseases cannot provide the full picture

There is a need to summarize epidemiological data in a single health metric in order to compare these different diseases

In 1993 WHO and WB initiated the project called Global Burden of Disease (GBD)

The purpose is to estimate the relative impact of all diseases in the world

World Health Organization

Burden of Communicable Diseases in Europe (BCoDE)

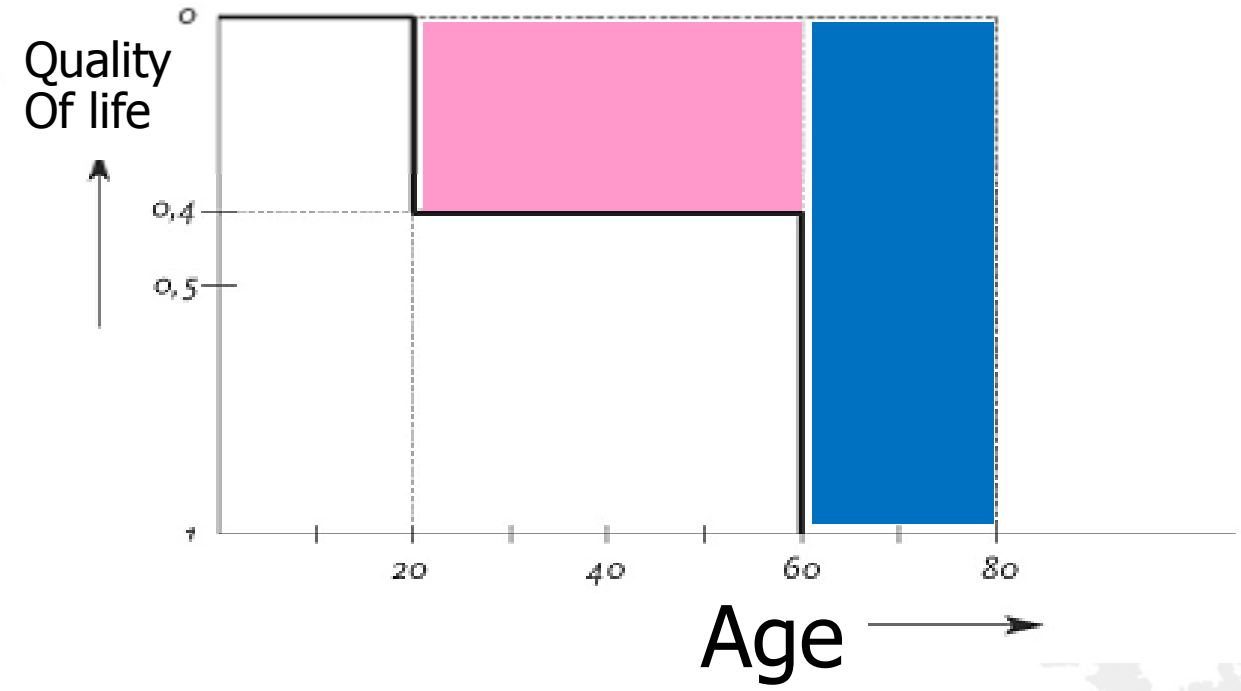
- In 2009 ECDC initiated the BCoDE study in order to assess the comparative impact of infectious diseases in Europe
- Calculations are based on natural history of disease and related disabilities: models use a pathogen-based and incidence-based approach
- Estimates will allow comparison across infectious diseases: more epidemiological information and a tool for health policy prioritization and evaluation of interventions
- Other outputs of the project concern overview of surveillance data quality and availability
- A user-friendly and ready-to-use tool for communicable disease burden estimation was created for burden estimation

Apples and pears

The primary scope of the BCoDE project is to quantify the **magnitude** of communicable diseases in Europe in a **comprehensive** manner in order to **assess** the relative burden of each communicable disease.

Choice on a **common currency** in order to compare impact of diseases, risks and benefits

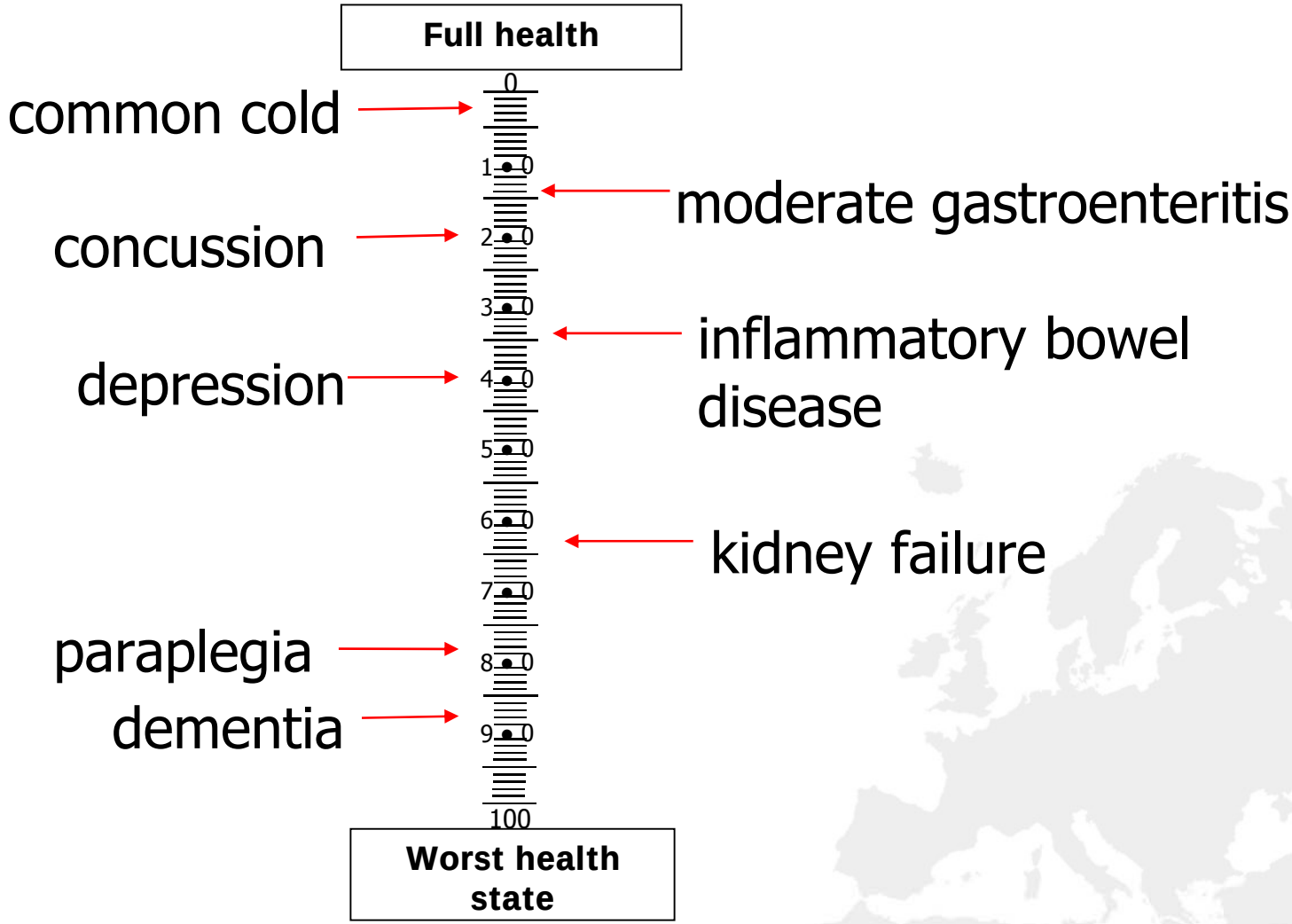
Disability Adjusted Life Year



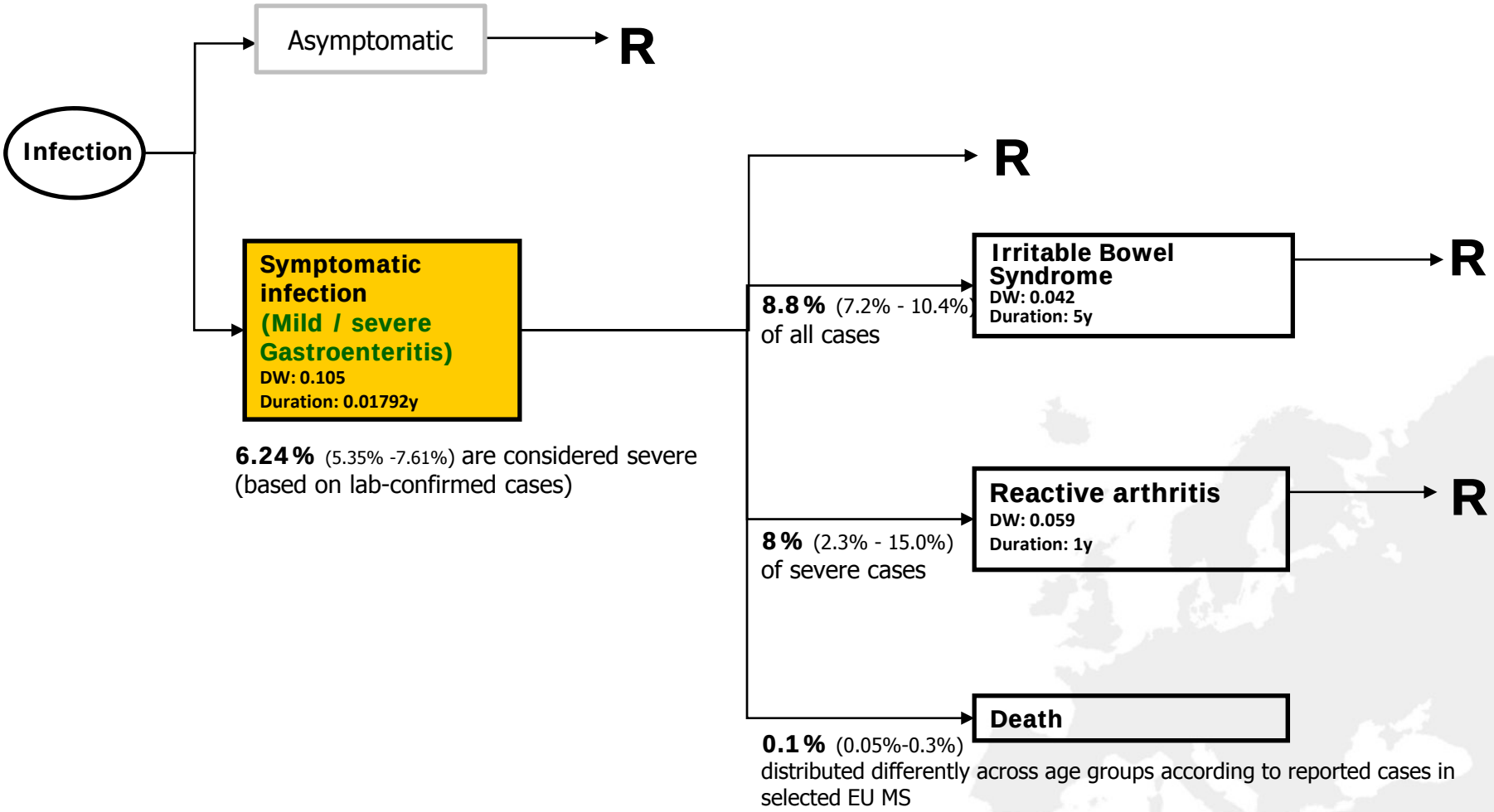
DALY = years of life lost (YLL) + years lived with disability (YLD)

= 20 years + 16 years = 36 years

What are disability weights?



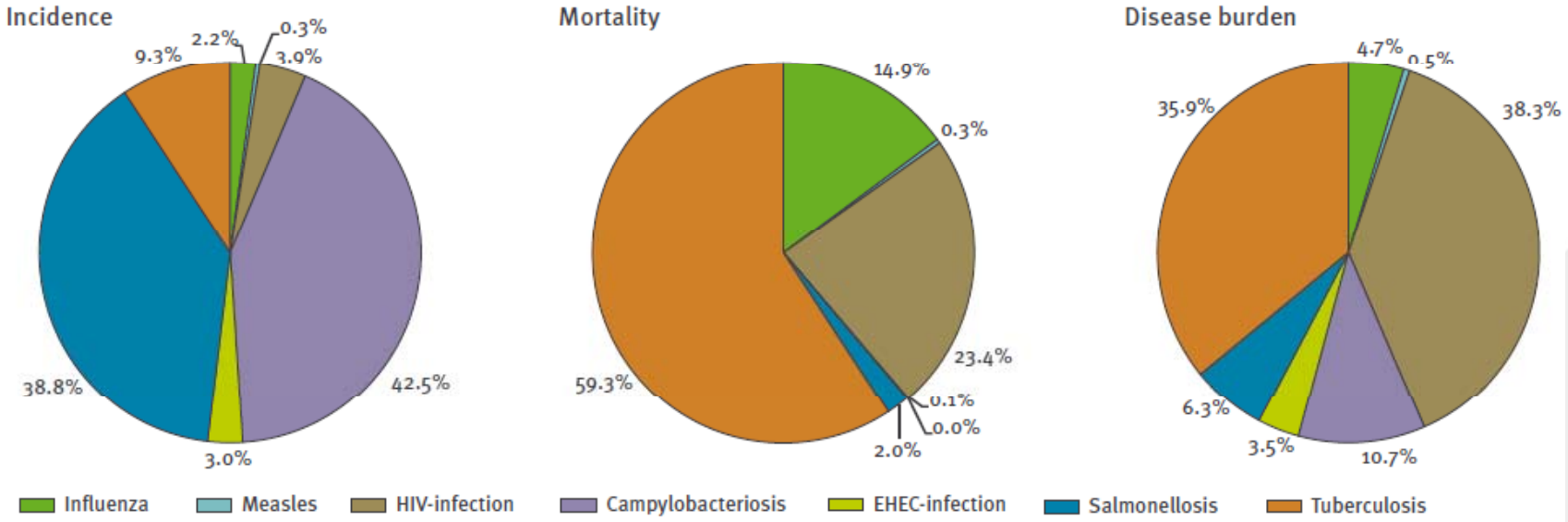
Each disease is represented by an outcome tree: salmonellosis example



3. Risk assessment using composite health measures: some examples

BCoDE pilot study: disease pie changes according to the measure

Figure: Relative burden of the seven selected diseases based on different indicators:
- incidence (mean number of reported new cases per year in the period 2003-2005)
- mortality (mean number of reported deaths per year in the period 2003-2004)
- disease burden (DALYs per year based on above-mentioned incidence and mortality), RIVM Study 2007



Based on data for twelve countries (data available for all seven diseases): Austria, Czech Republic, Germany, Ireland, Latvia,Lithuania, the Netherlands, Poland, Slovenia, Sweden, United Kingdom, Norway

van Lier EA, Havelaar AH, Nanda A. The burden of infectious diseases in Europe: a pilot study. Euro Surveill. 2007;12(12):pii=751

Changing the ranking

CHMs combine information on mortality and non-fatal health outcomes to represent the health of a particular population in a single numerical index (Field and Gold, 1998)

Mortality

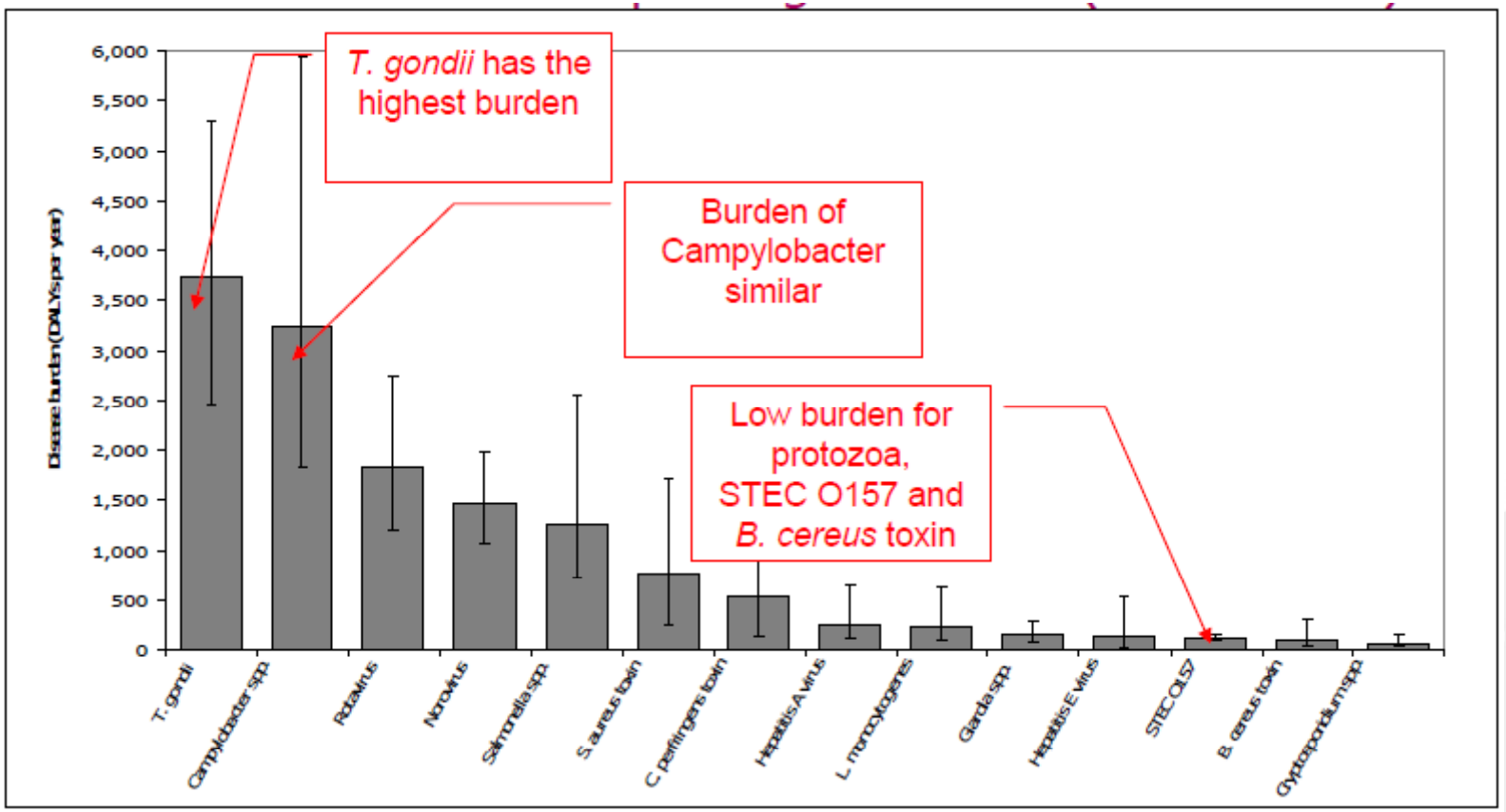
		%
1.	Ischaemic heart disease	12.2
2.	Cerebrovascular disease	9.7
3.	Lower respiratory infections	7.1
4.	COPD	5.1
5.	Diarrhoeal diseases	3.7
6.	HIV/AIDS	3.5
7.	Tuberculosis	2.5
8.	Trachea, bronchus, lung cancers	2.3
9.	Road traffic accidents	2.2
10.	Prematurity, low birth weight	2.0

DALYs

		%
1.	Lower respiratory infections	6.2
2.	Diarrhoeal diseases	4.8
3.	Depression	4.3
4.	Ischaemic heart disease	4.1
5.	HIV/AIDS	3.8
6.	Cerebrovascular disease	3.1
7.	Prematurity, low birth weight	2.9
8.	Birth asphyxia, birth trauma	2.7
9.	Road traffic accidents	2.7
10.	Neonatal infections and other	2.7

Leading Causes of Mortality and Burden of Disease, Global Burden of Disease Study 2004, Health Statistics and Informatics Department, WHO 2004

Ranking of diseases according to burden



Havelaar et al., Int J Food Microbiol 2012; 156:231 2012; 231-238

Burden attribution to transmission pathways and food groups

Attribution of the incidence, fatalities and disease burden to the major transmission pathways in the Netherlands, 2009.

Transmission pathway	Food	Environment	Human	Animal	Travel	Total[a]
Incidence (×1000)	681[b]	221	627	87	149	1770
	314–1310[c]	123–391	383–1010	44–165	81–267	945–3140
Fatal cases	78	39	73	18	25	233
	45–144	21–68	31–144	11–29	14–44	122–430
Disease burden (DALY per year, not discounted)	6020	2820	2370	1060	1270	13,500
	3360–10,700	1770–4460	1560–3620	630–1860	770–2160	8110–22,800
Disease burden (DALY per year, discounted)	4970	2200	2100	910	1090	11,300
	2630–9260	1350–3590	1370–3260	530–1670	640–1910	6500–19,700

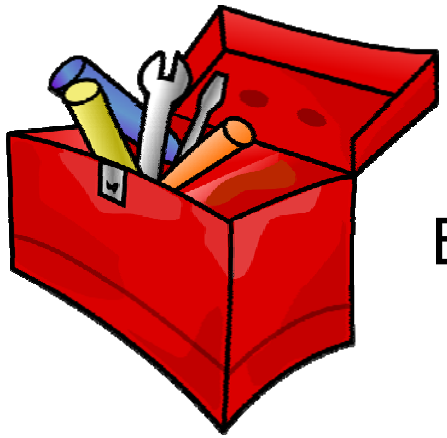
Attribution of the incidence, fatalities and disease burden of foodborne disease to food groups in the Netherlands, 2009.

Food group	Beef/ mutton	Pork	Poultry	Eggs	Dairy	Fish/ shellfish	Fruit/ vegetables	Beverages	Cereal products	Other food	Human/ animal	Total
Incidence (×1000)	107[a]	44	59	22	56	58	44	16	40	123	114	684
	42–222[b]	19–87	23–128	9–46	25–108	30–104	21–83	8–30	19–77	55–236	66–192	314–1310
Fatal cases	9.1	9.3	14	5.9	5.7	6.6	6.0	2.0	3.0	5.3	12	78
	4.8–19	6.1–15	9.3–21	4.7–8.0	3.4–11	3.4–13	3.2–11	1.1–3.5	1.6–6.0	2.2–14	5.5–23	45-144
Disease burden (DALY per year, not discounted)	951	1300	1050	243	435	384	377	96	170	450	573	6030
	501–1730	807–2020	593–1940	131–489	233–803	221–668	221–644	51–185	81–345	189–956	342–954	3370-10,740
Disease burden (DALY per year, discounted)	760	924	914	216	373	328	310	88	158	419	489	4980
	372–1460	551–1490	493–1760	108–455	189–717	182–590	174–551	45–173	72–329	167–912	281–839	2630-9270

Havelaar et al., Int J Food Microbiol 2012; 156:231 2012; 231-238

4. The BCoDE toolkit implementation within EU Member States

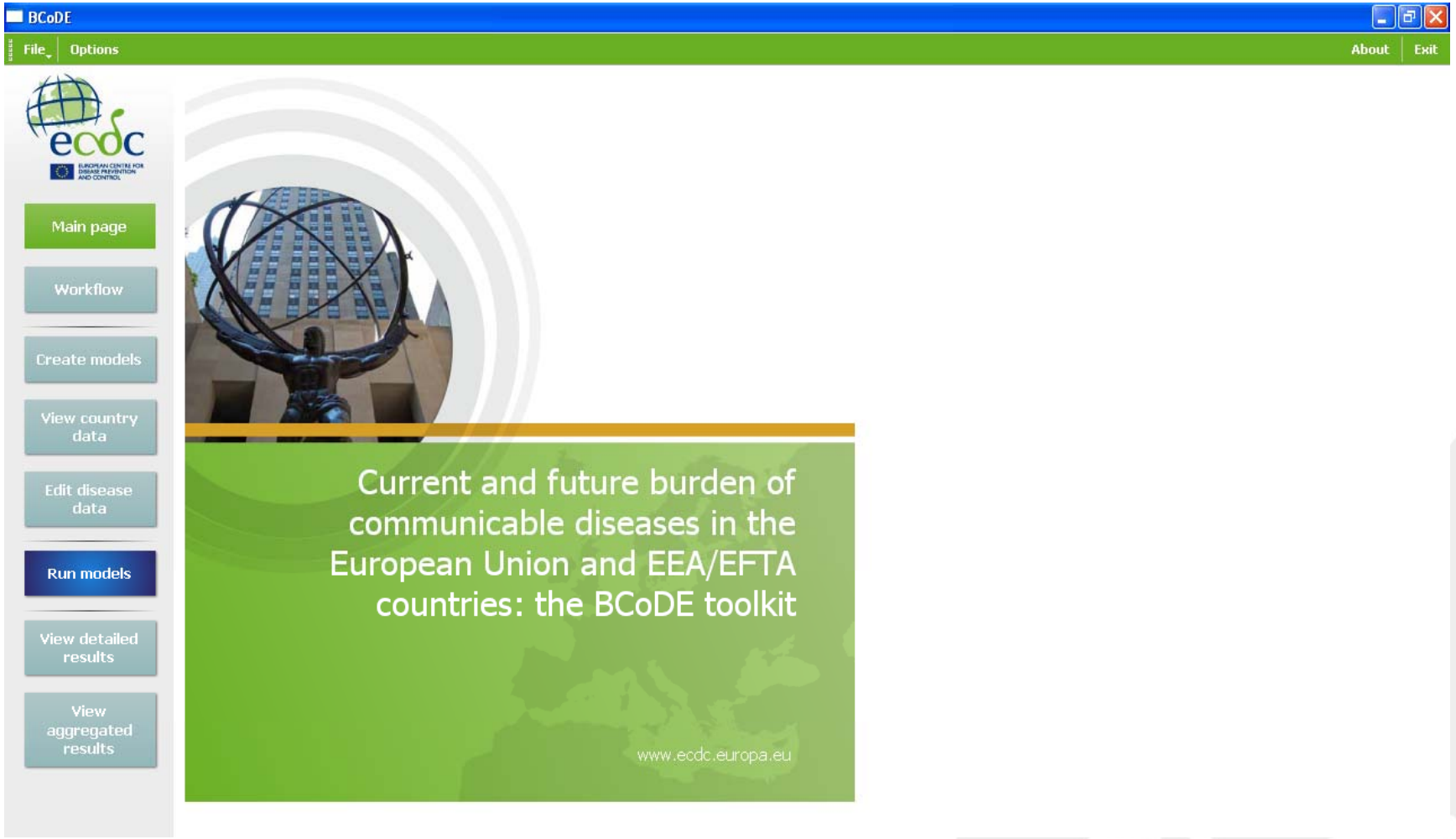
The Toolkit for burden estimation: a service for EU member states



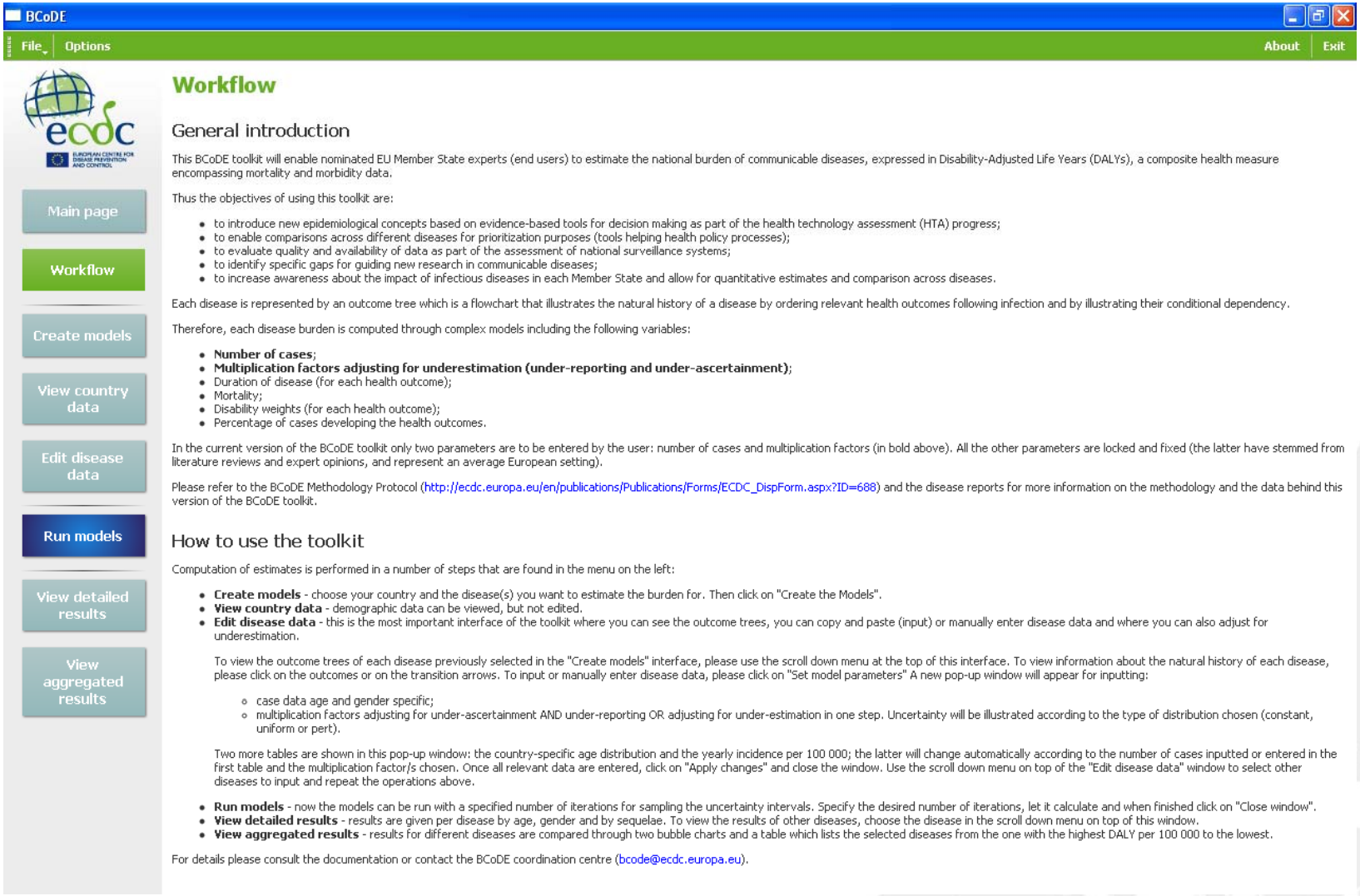
A user-friendly and ready-to-use toolkit for communicable disease burden estimation is going to be finalized by April 2012

EU member states and EEA/EFTA countries are encouraged to employ the toolkit and calculate their national burden of communicable diseases

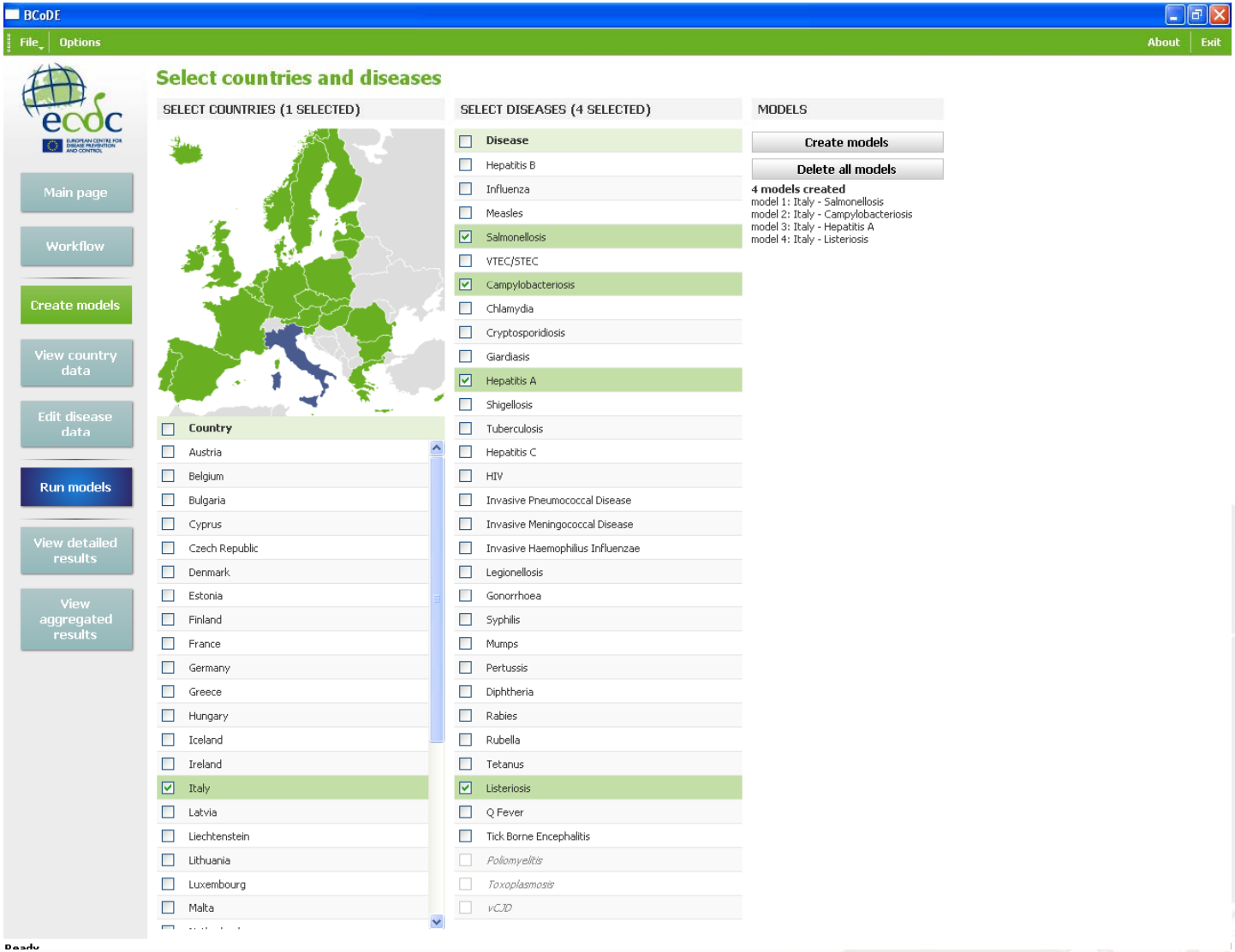
First page


BCoDE
File
Options
About
Exit
Main page
Workflow
Create models
View country data
Edit disease data
Run models
View detailed results
View aggregated results
Current and future burden of communicable diseases in the European Union and EEA/EFTA countries: the BCoDE toolkit
www.ecdc.europa.eu

Information page

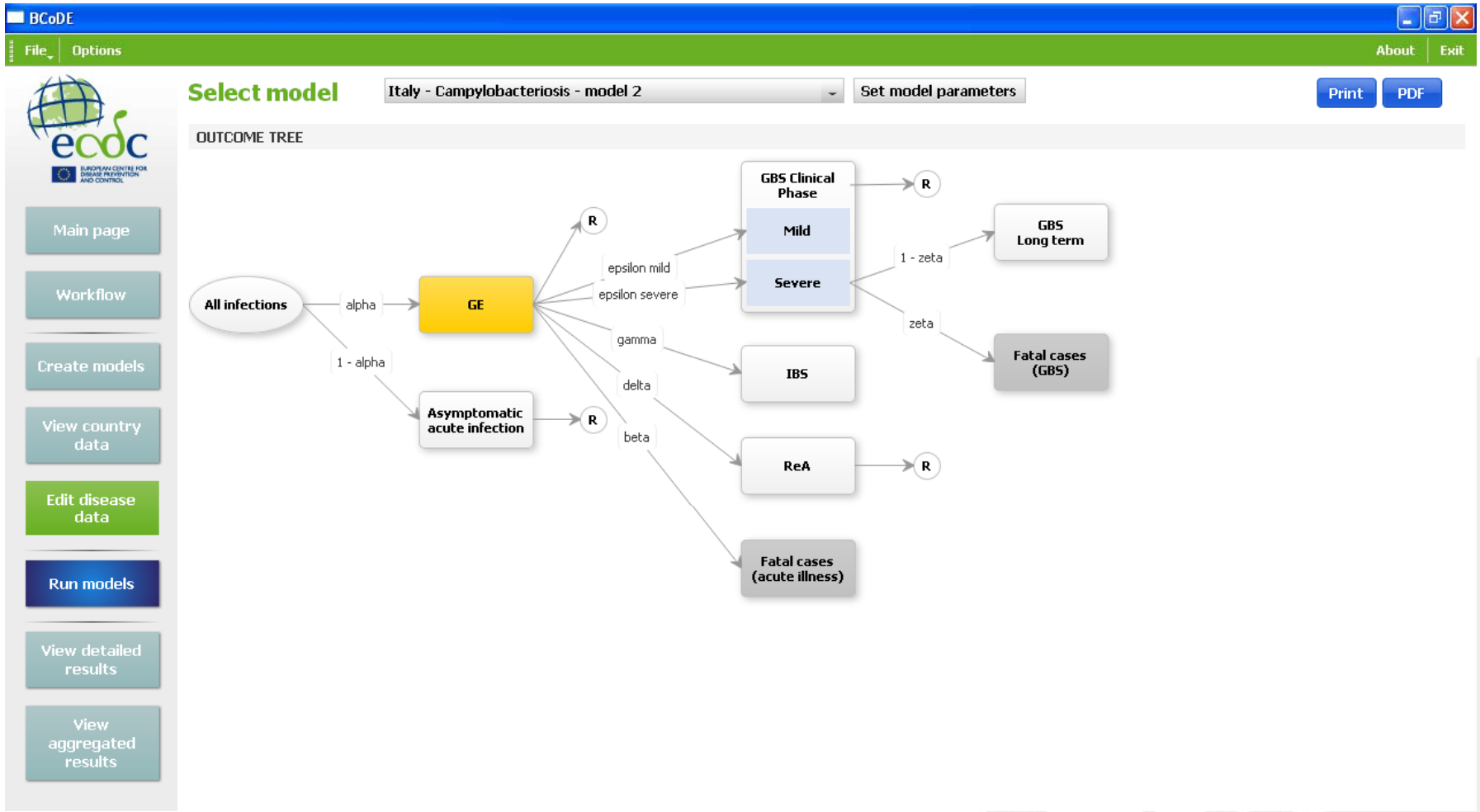


Selection of countries and diseases

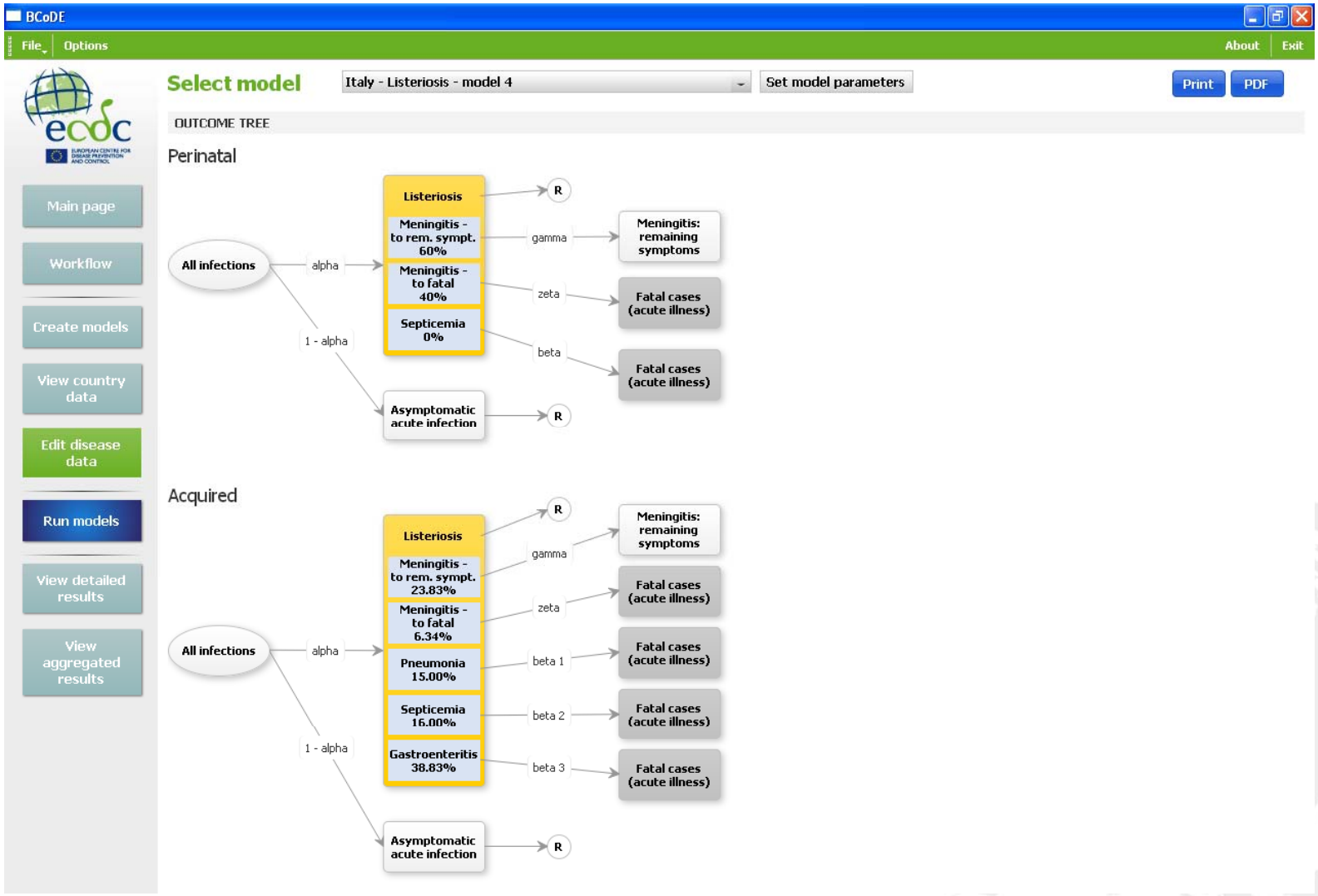


Main denominators

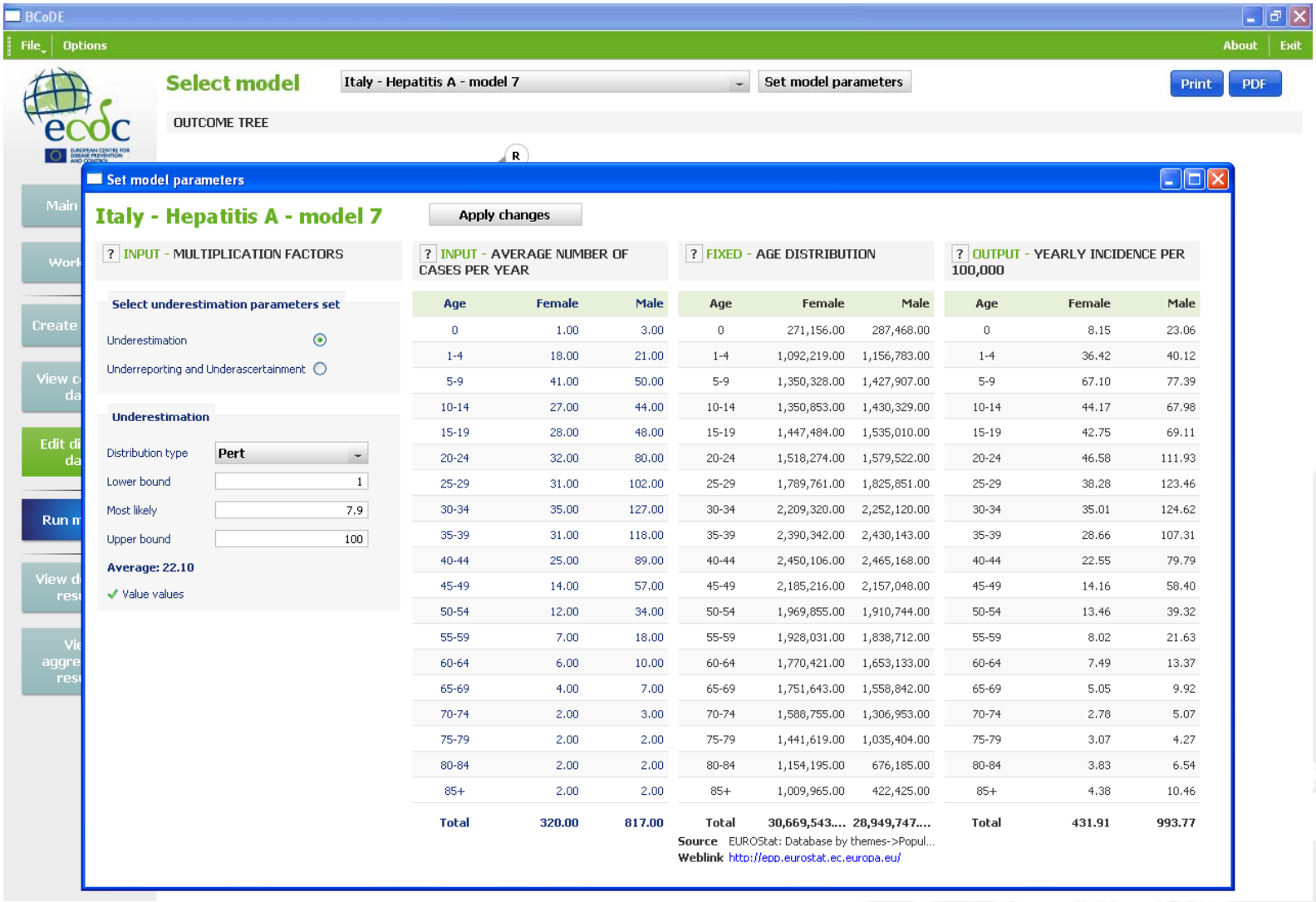
Browsing outcome trees (information by navigation)



Browsing outcome trees 2

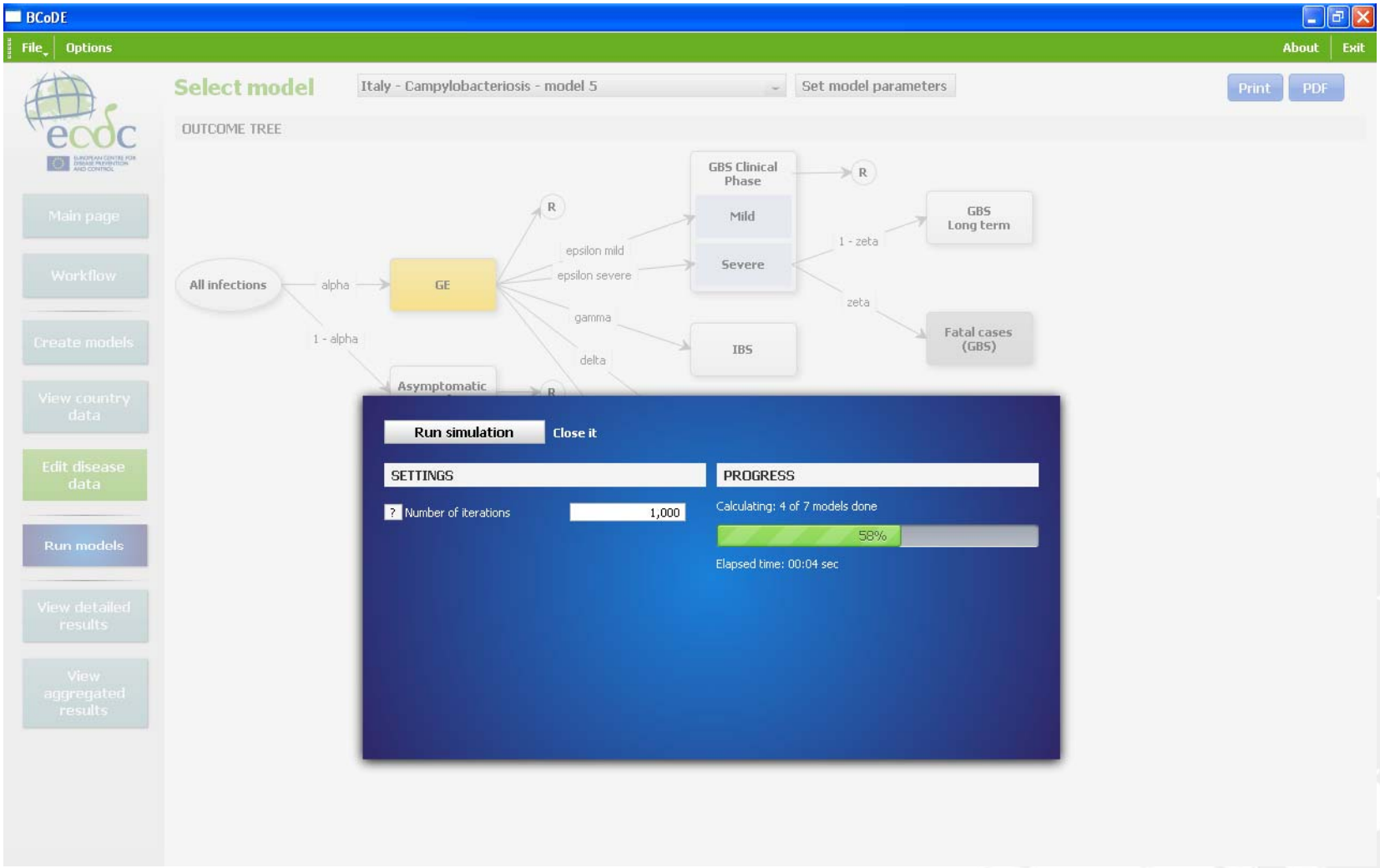


Inputting incidence data

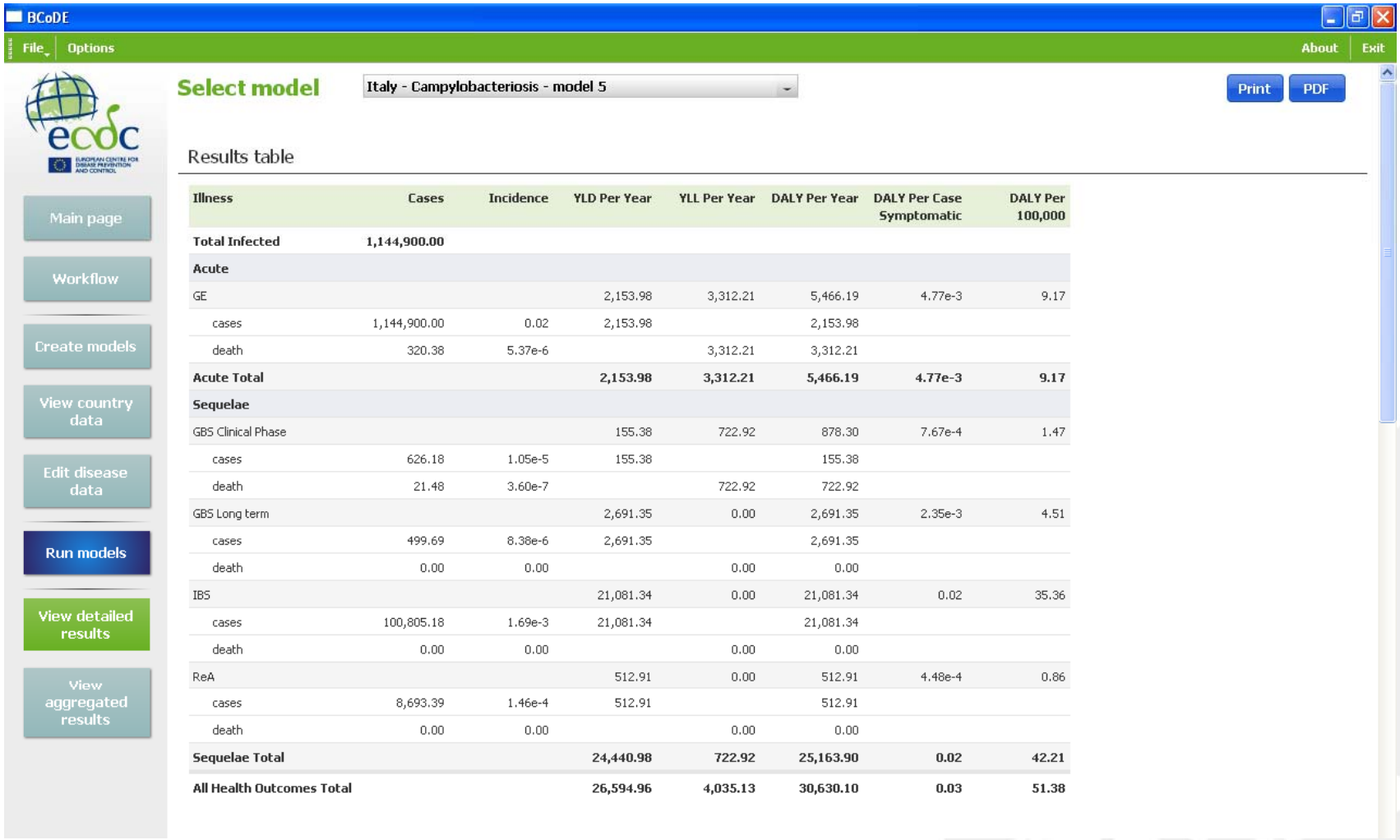


Age	Female	Male	Age	Female	Male	Age	Female	Male
0	1.00	3.00	0	271,156.00	287,468.00	0	8.15	23.06
1-4	18.00	21.00	1-4	1,092,219.00	1,156,783.00	1-4	36.42	40.12
5-9	41.00	50.00	5-9	1,350,328.00	1,427,907.00	5-9	67.10	77.39
10-14	27.00	44.00	10-14	1,350,853.00	1,430,329.00	10-14	44.17	67.98
15-19	28.00	48.00	15-19	1,447,484.00	1,535,010.00	15-19	42.75	69.11
20-24	32.00	80.00	20-24	1,518,274.00	1,579,522.00	20-24	46.58	111.93
25-29	31.00	102.00	25-29	1,789,761.00	1,825,851.00	25-29	38.28	123.46
30-34	35.00	127.00	30-34	2,209,320.00	2,252,120.00	30-34	35.01	124.62
35-39	31.00	118.00	35-39	2,390,342.00	2,430,143.00	35-39	28.66	107.31
40-44	25.00	89.00	40-44	2,450,106.00	2,465,168.00	40-44	22.55	79.79
45-49	14.00	57.00	45-49	2,185,216.00	2,157,048.00	45-49	14.16	58.40
50-54	12.00	34.00	50-54	1,969,855.00	1,910,744.00	50-54	13.46	39.32
55-59	7.00	18.00	55-59	1,928,031.00	1,838,712.00	55-59	8.02	21.63
60-64	6.00	10.00	60-64	1,770,421.00	1,653,133.00	60-64	7.49	13.37
65-69	4.00	7.00	65-69	1,751,643.00	1,558,842.00	65-69	5.05	9.92
70-74	2.00	3.00	70-74	1,588,755.00	1,306,953.00	70-74	2.78	5.07
75-79	2.00	2.00	75-79	1,441,619.00	1,035,404.00	75-79	3.07	4.27
80-84	2.00	2.00	80-84	1,154,195.00	676,185.00	80-84	3.83	6.54
85+	2.00	2.00	85+	1,009,965.00	422,425.00	85+	4.38	10.46
Total	**320.00**	**817.00**	**Total**	**30,669,543....**	**28,949,747....**	**Total**	**431.91**	**993.77**

Running the simulation



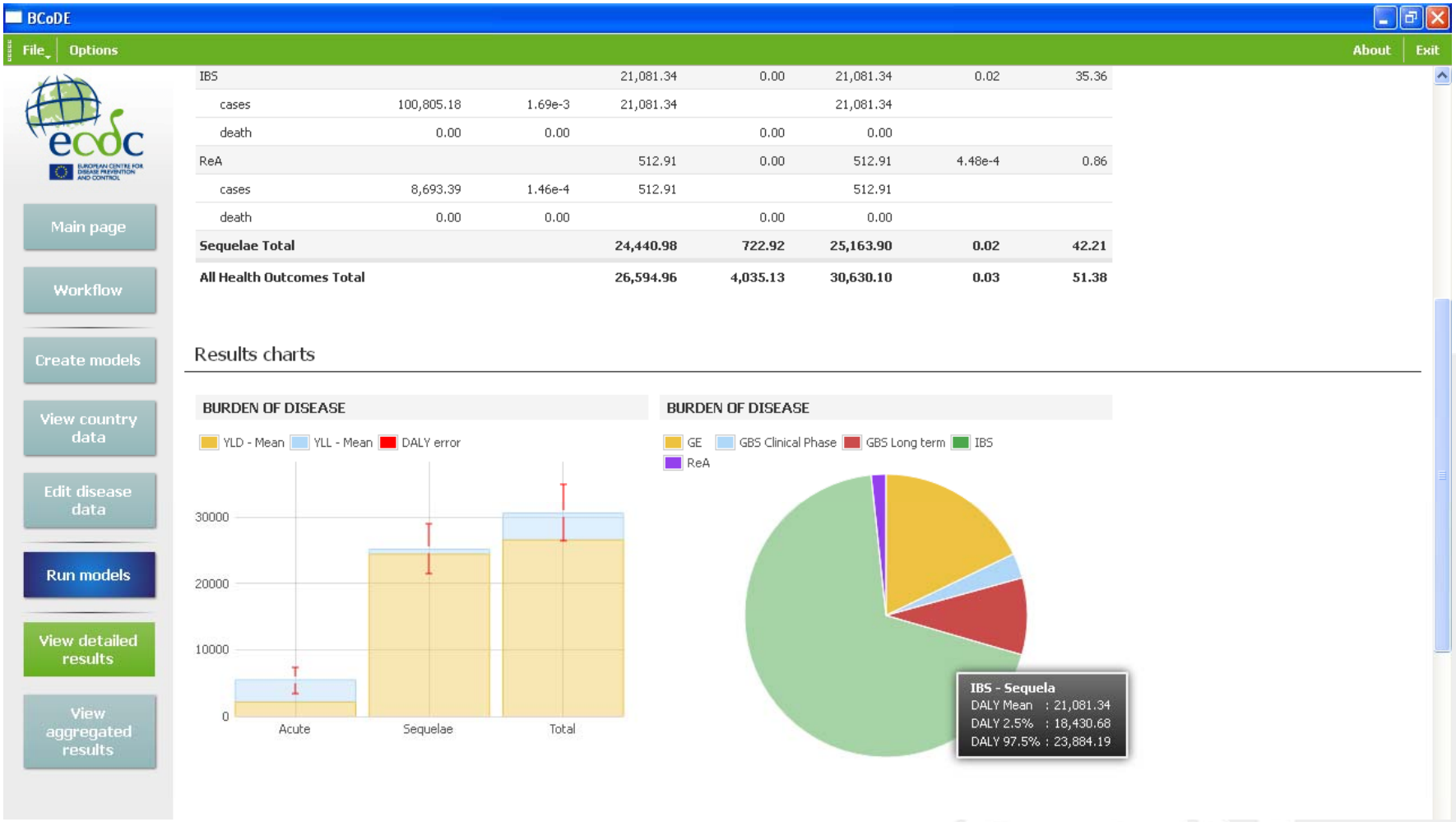
Viewing detailed results per each disease



Results table

Illness	Cases	Incidence	YLD Per Year	YLL Per Year	DALY Per Year	DALY Per Case Symptomatic	DALY Per 100,000
Total Infected	**1,144,900.00**						
Acute							
GE			2,153.98	3,312.21	5,466.19	4.77e-3	9.17
cases	1,144,900.00	0.02	2,153.98		2,153.98		
death	320.38	5.37e-6		3,312.21	3,312.21		
Acute Total			**2,153.98**	**3,312.21**	**5,466.19**	**4.77e-3**	**9.17**
Sequelae							
GBS Clinical Phase			155.38	722.92	878.30	7.67e-4	1.47
cases	626.18	1.05e-5	155.38		155.38		
death	21.48	3.60e-7		722.92	722.92		
GBS Long term			2,691.35	0.00	2,691.35	2.35e-3	4.51
cases	499.69	8.38e-6	2,691.35		2,691.35		
death	0.00	0.00		0.00	0.00		
IBS			21,081.34	0.00	21,081.34	0.02	35.36
cases	100,805.18	1.69e-3	21,081.34		21,081.34		
death	0.00	0.00		0.00	0.00		
ReA			512.91	0.00	512.91	4.48e-4	0.86
cases	8,693.39	1.46e-4	512.91		512.91		
death	0.00	0.00		0.00	0.00		
Sequelae Total			**24,440.98**	**722.92**	**25,163.90**	**0.02**	**42.21**
All Health Outcomes Total			**26,594.96**	**4,035.13**	**30,630.10**	**0.03**	**51.38**

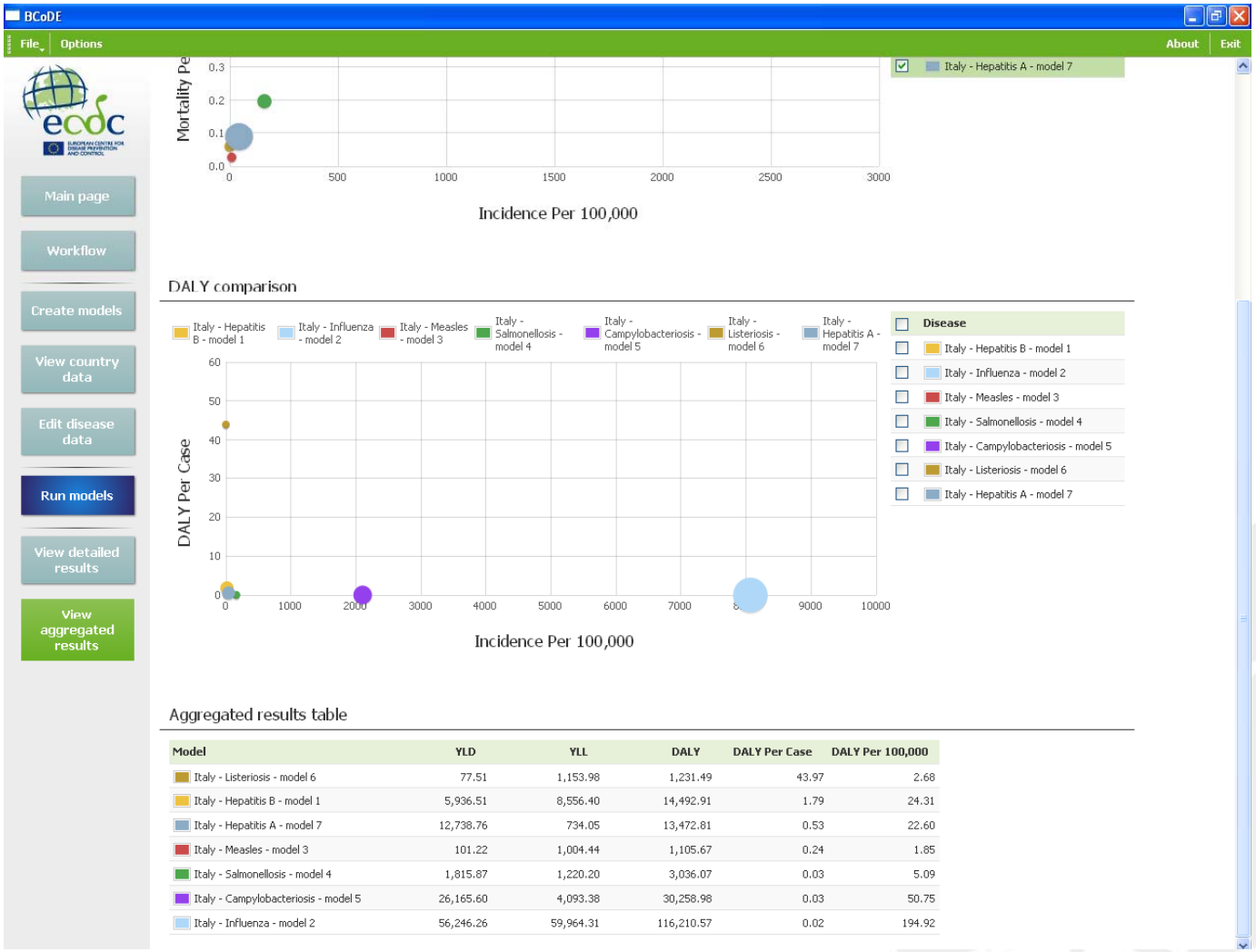
Viewing detailed results per each disease 2



Viewing detailed results per each disease 3

Viewing aggregate results

Viewing aggregate results 2 (risk ranking)



Model	YLD	YLL	DALY	DALY Per Case	DALY Per 100,000
Italy - Listeriosis - model 6	77.51	1,153.98	1,231.49	43.97	2.68
Italy - Hepatitis B - model 1	5,936.51	8,556.40	14,492.91	1.79	24.31
Italy - Hepatitis A - model 7	12,738.76	734.05	13,472.81	0.53	22.60
Italy - Measles - model 3	101.22	1,004.44	1,105.67	0.24	1.85
Italy - Salmonellosis - model 4	1,815.87	1,220.20	3,036.07	0.03	5.09
Italy - Campylobacteriosis - model 5	26,165.60	4,093.38	30,258.98	0.03	50.75
Italy - Influenza - model 2	56,246.26	59,964.31	116,210.57	0.02	194.92

Key messages from today

BCoDE project`s objective is to improve evidence-based decision making in prioritisation of CDs in Europe

ECDC and the BCoDE European consortium have:

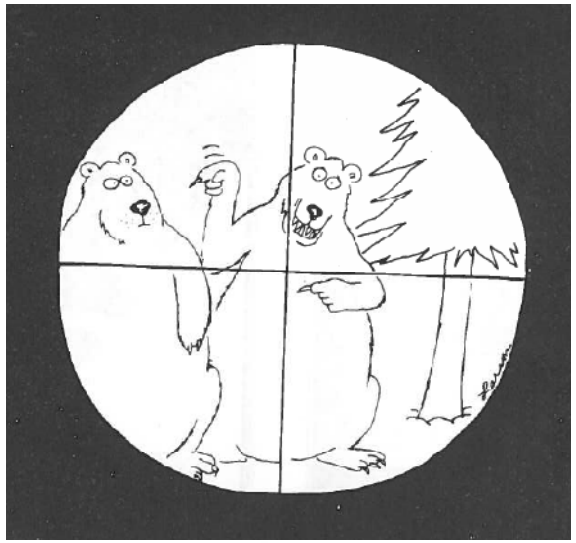
- Undergone extensive literature reviews;
- Outlined the methodology
- Tested the methodology in four European countries
- Created a software, user-friendly toolkit for burden estimation

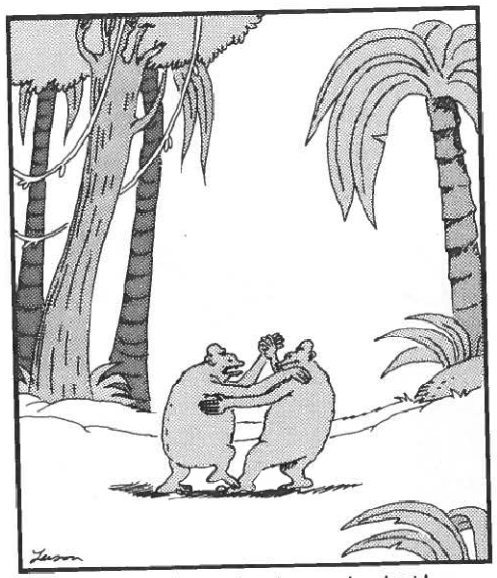
The national expert is now invited to estimate its national burden of communicable diseases

Key messages from today 2

Incidence data (cases and multiplication factor) is the most sensitive input

It`s very important to target the correct users, i.e. country and disease experts





"I'm afraid you misunderstood. ... I said I'd like a mango."

Uncertainty and limitations must also be expressed

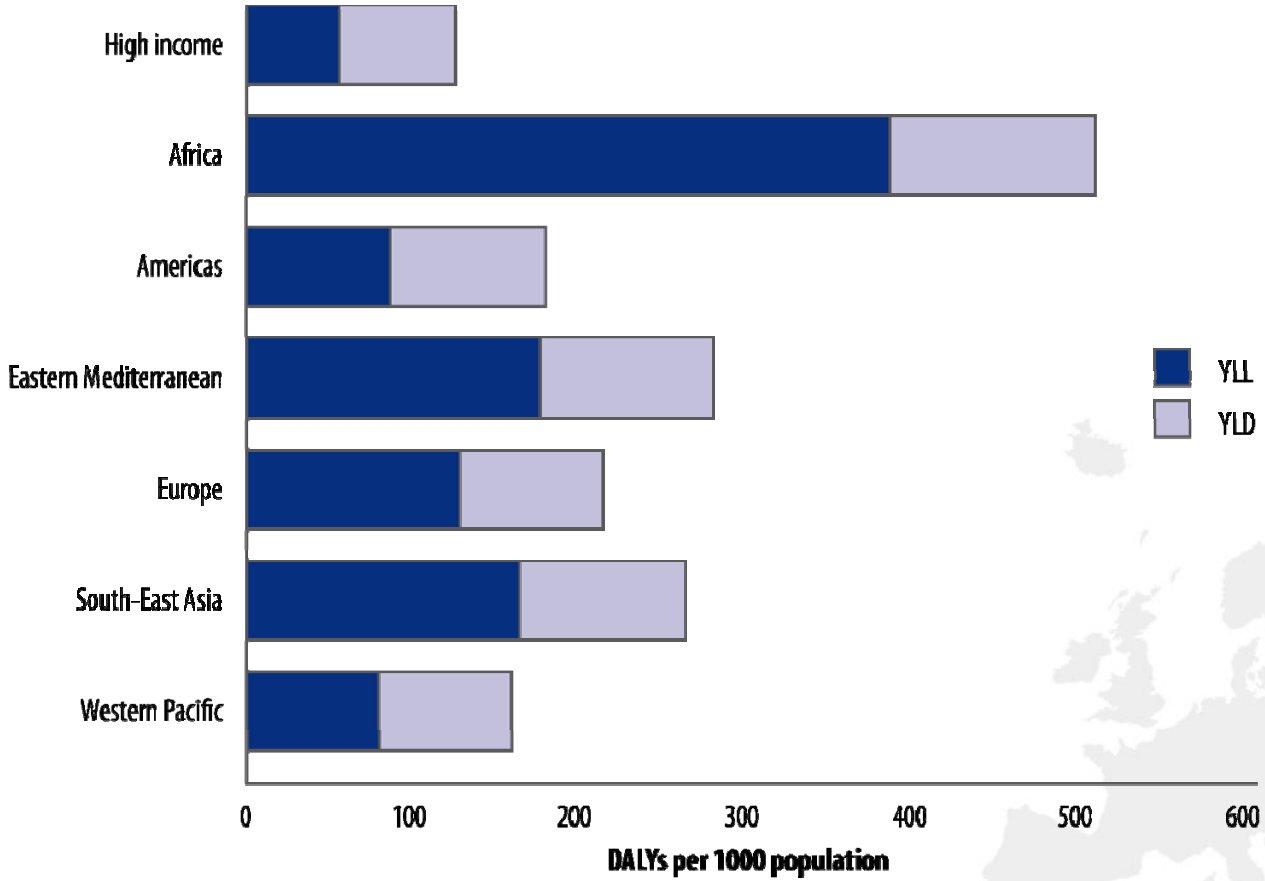
Never under-estimate the weight of communication

Questions and thank you

For suggestions, comments and questions please email:
BCoDE@ecdc.europa.eu
Alessandro.Cassini@ecdc.europa.eu

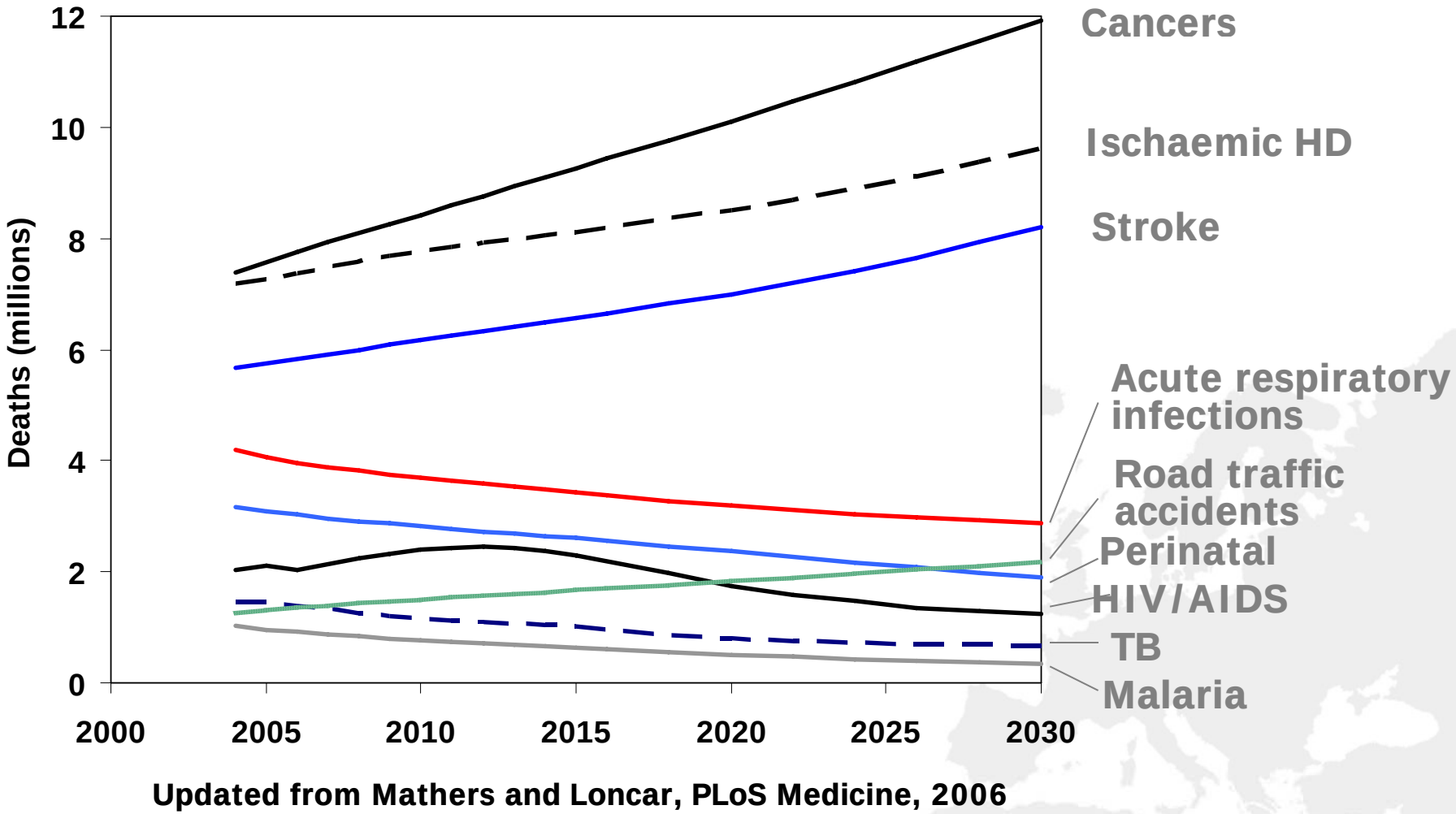
5. Backup slides: using burden of disease estimates

YLL, YLD and DALYs by region, 2004



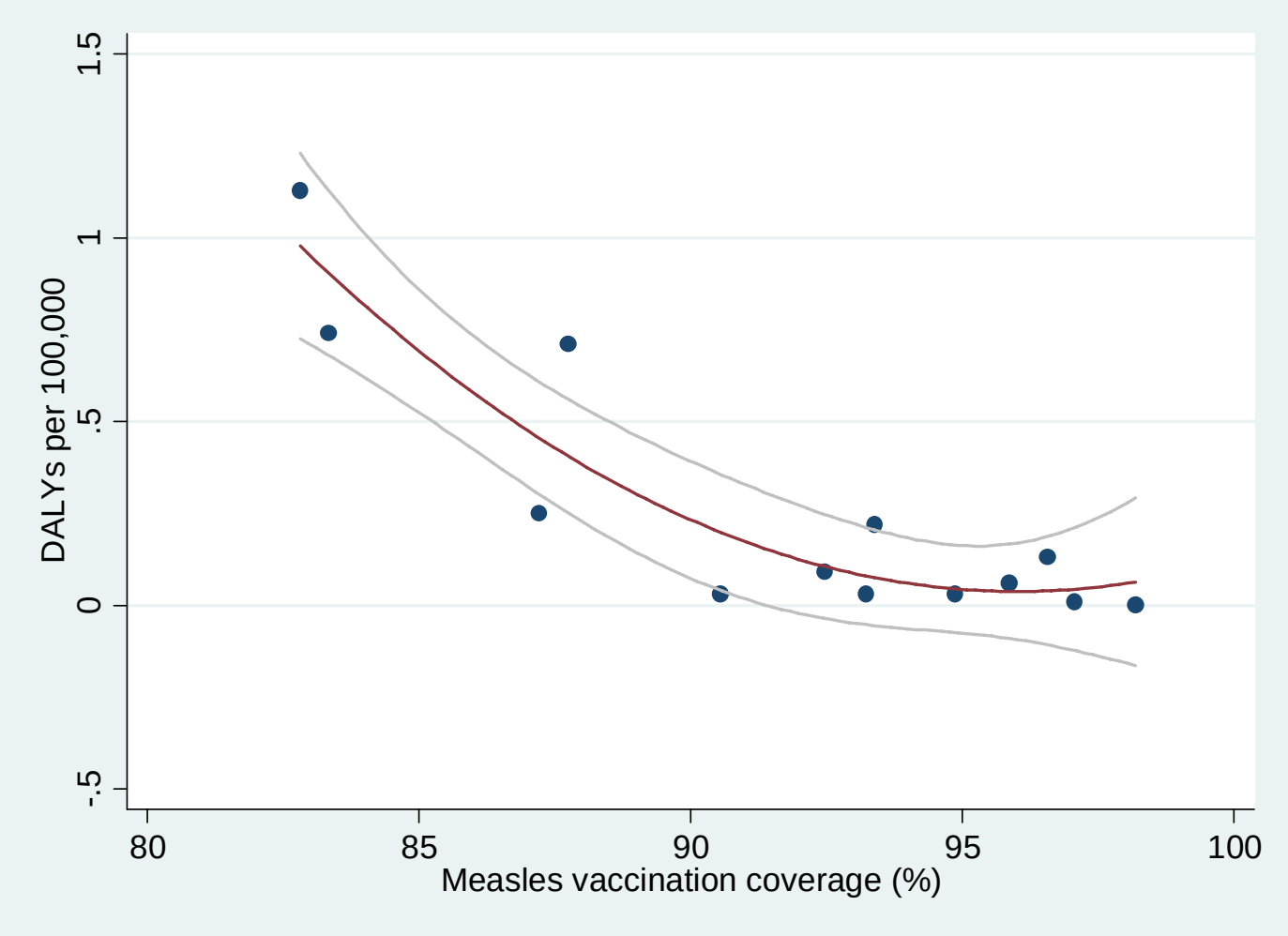
Health Statistics and Informatics Department, WHO 2004

Global projections for selected causes, 2004 to 2030



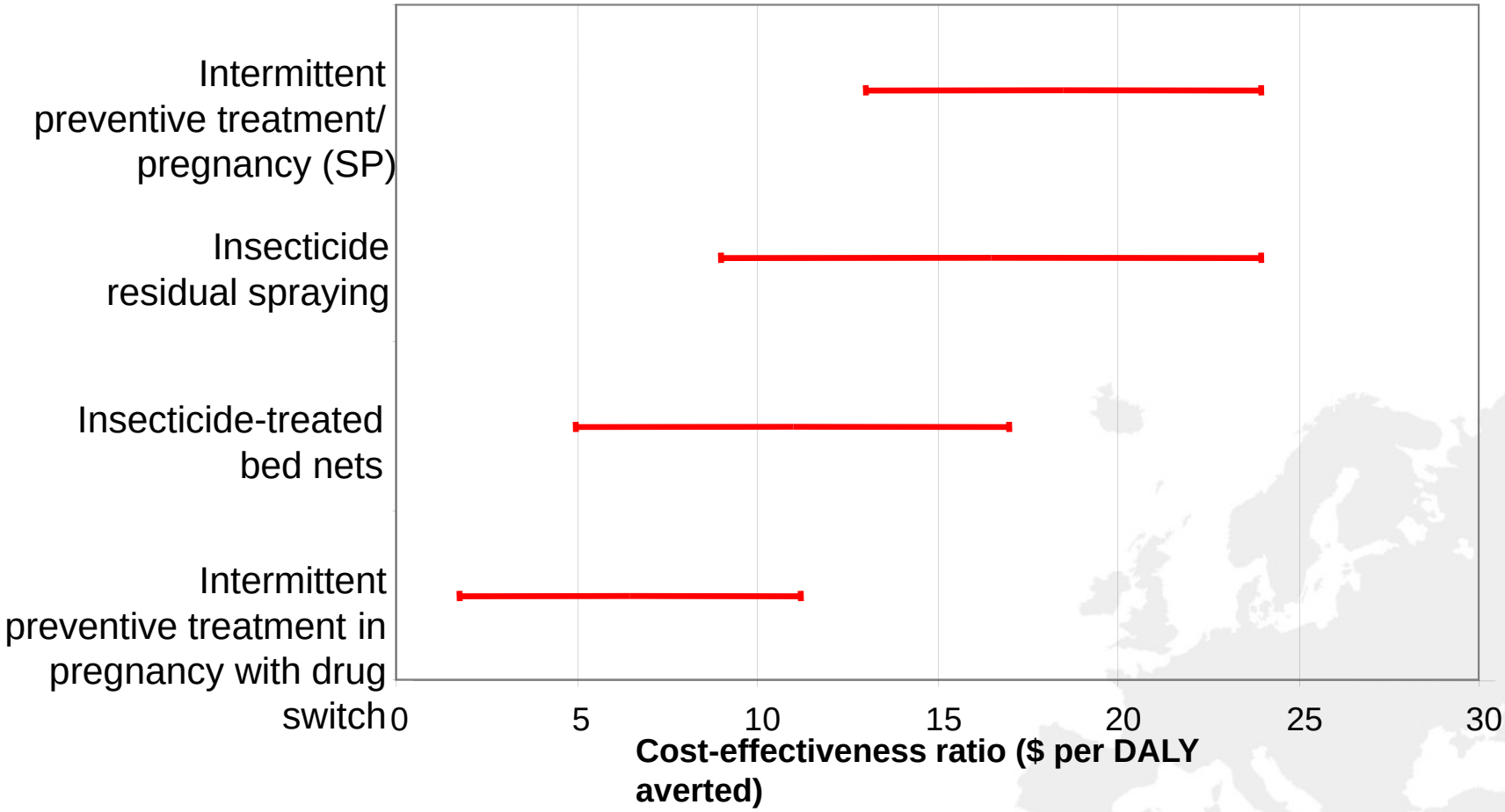
Updated from Mathers and Loncar, PLoS Medicine, 2006

Quadratic correlation between vaccination coverage and burden of measles in different MS



R-squared=0.76; p<0.05

Cost-Effectiveness of Interventions Against Malaria in Sub-Saharan Africa



R. Laxminarayan et al (DCPP authors), 2006 in *Disease Control Priorities in Developing Countries*

Ranking of communicable diseases by DALYs

Disease Condition	Disease Burden
HIV-AIDS	84.5 million
Neglected Tropical Diseases	56.6 million
Malaria	46.5 million
Tuberculosis	34.7 million

Hotez PJ, Molyneux DH, Fenwick A, Ottesen E, Ehrlich Sachs S, Sachs JD
***PLoS Medicine* 2006; 3: e102**

Disease Burden and Research and Development Funding

Condition	Global Disease Burden (million) DALYs*	R&D Funding ($Millions)	R&D Funding per DALY*
Cardiovascular	148.190	9402	$63.45
HIV/AIDS	**84.458**	**2049**	**$24.26**
Malaria	**46.486**	**288**	**$6.20**
Tuberculosis	**34.736**	**378**	**$10.88**
Diabetes	16.194	1653	$102.07
Dengue	**0.616**	**58**	**$94.16**

Malaria and R&D Alliance: *Science*, 13 January 2006: *Disability-Adjusted Life Year.
DCPP estimates in millions are: cardiovascular = 208.8; HIV = 71.5; malaria = 40.0; tuberculosis = 36.1; Diabetes = 20.0; dengue = 0.5

Each disease is represented by an outcome tree: campylobacteriosis example