

# QUANTIFYING THE HEALTH BURDEN OF INFECTIOUS DISEASES

**Adult Immunization Board (AIB) Technical meeting**  
Assessing the health burden of vaccine-preventable  
infections in European Adults: challenges and opportunities  
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# BURDEN OF DISEASE: WHAT AND WHY?

Quantifying the health burden of infectious diseases



What are the most important (infectious) diseases?

# Burden of disease

How to define disease “impact” or “importance”?



health



psycho-social  
wellbeing



economy

Disease have an impact on multiple domains of life

- **Burden of disease** = quantification of any of these domains
- This requires specific metrics

# Burden of disease

Which disease is most important?



**Number** of cases, **number** of deaths

⇔ **Severity** of case: duration, reduction quality of life

⇔ **Severity** of death: residual life expectancy

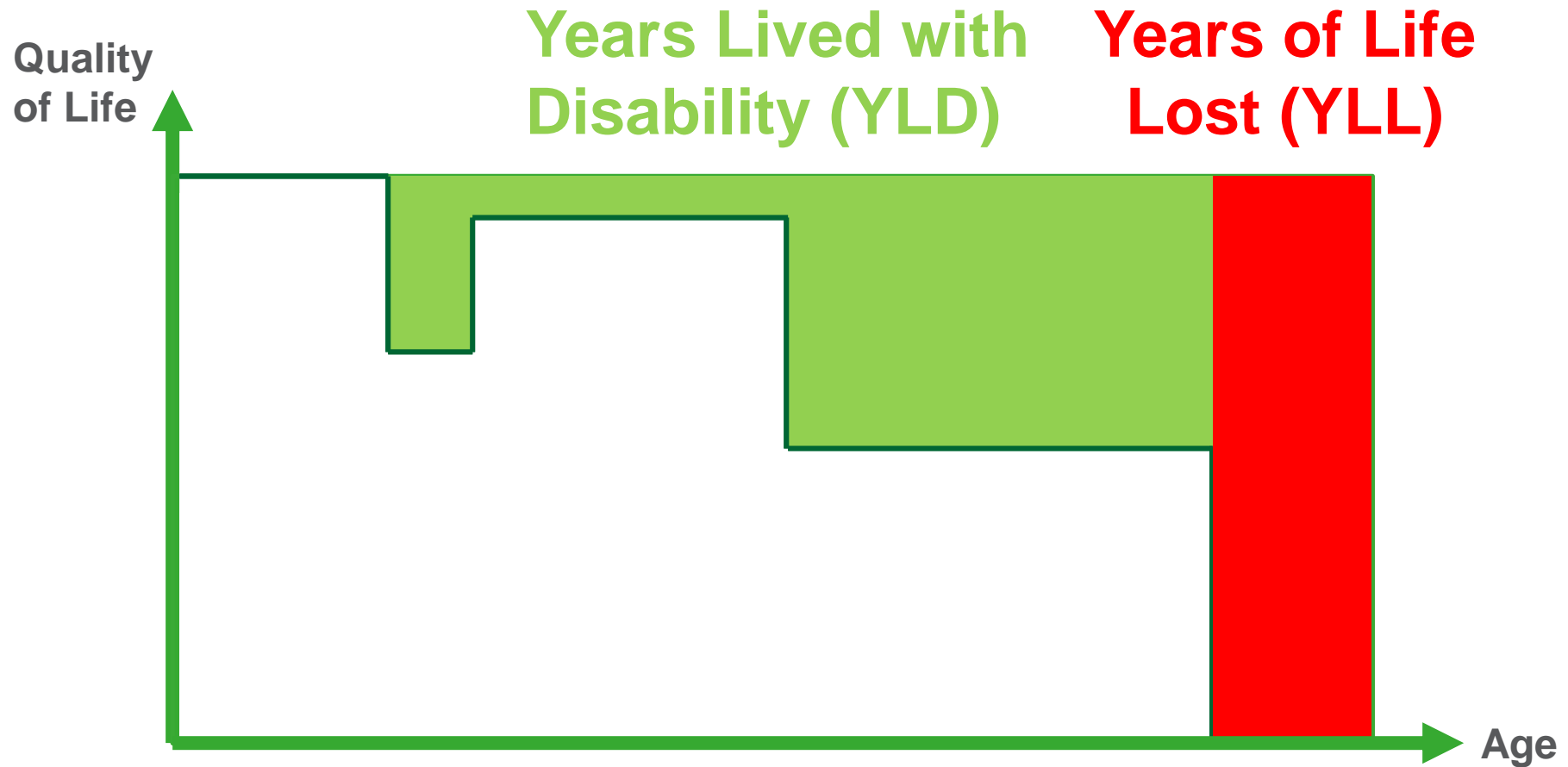
## Summary Measures of Population Health

# Summary measures of population health

	Health Experience	Health Loss
Mortality	Life Expectancy	Potential Years of Life Lost (Years of Potential Life Lost) Standard Expected Years of Life Lost
Morbidity	Quality-Adjusted Life Year	Years Lived with Disability
Morbidity + Mortality	Active Life Expectancy Disability-Free Life Expectancy Healthy Life Years Quality-Adjusted Life Expectancy Disability-Adjusted Life Expectancy	<b>Disability-Adjusted Life Year</b>

*All use “time” as a common metric!*

# Disability-Adjusted Life Years



# Disability-Adjusted Life Years

## 1 DALY = 1 healthy life year lost

Summary measure of population health

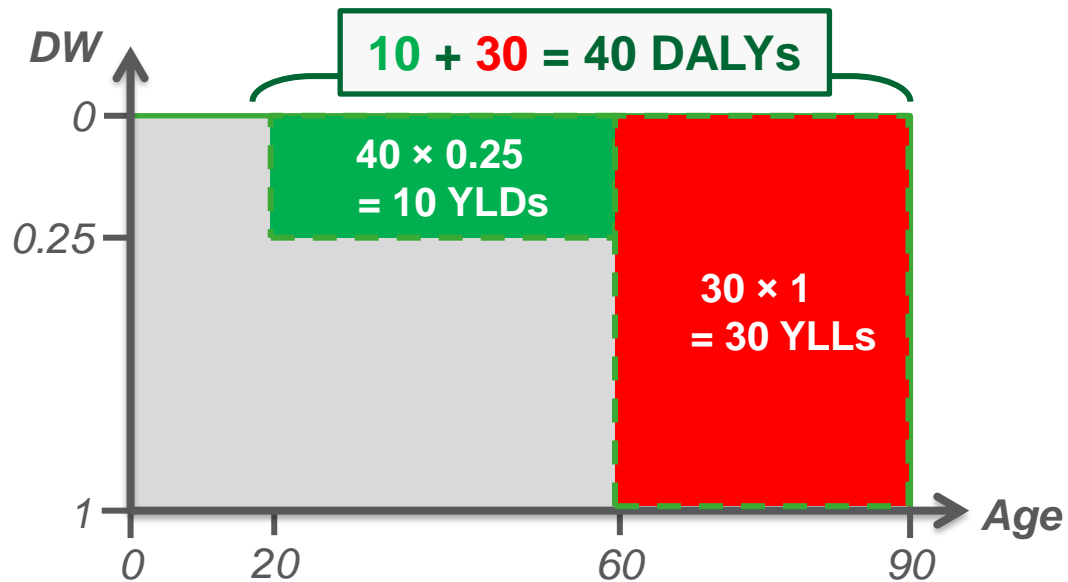
- Morbidity + mortality
- Disease occurrence + disease severity

$$\text{DALY} = \text{YLD} + \text{YLL}$$

- **YLD** = Years Lived with Disability  
= Number of incident cases  $\times$  Duration  $\times$  Disability Weight
- **YLL** = Standard Expected Years of Life Lost  
= Number of deaths  $\times$  Residual Life Expectancy



# Disability-Adjusted Life Years



$$\text{DALY} = \text{YLD} + \text{YLL}$$

- YLD = Years Lived with Disability =  $N \times D \times DW$
- YLL = Years of Life Lost =  $M \times RLE$

# METHODOLOGICAL CONSIDERATIONS

Quantifying the health burden of infectious diseases

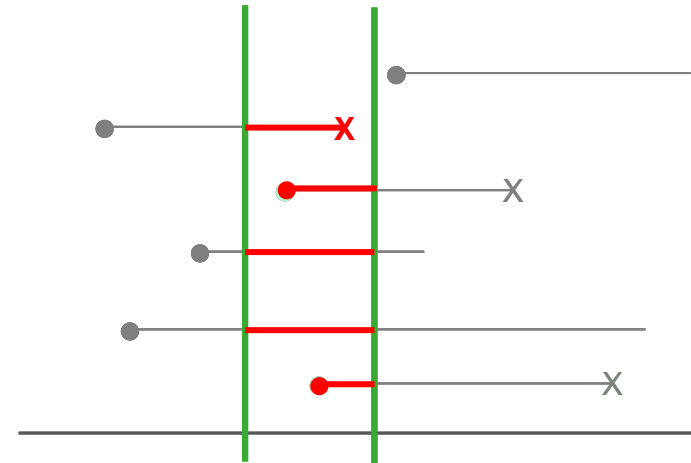
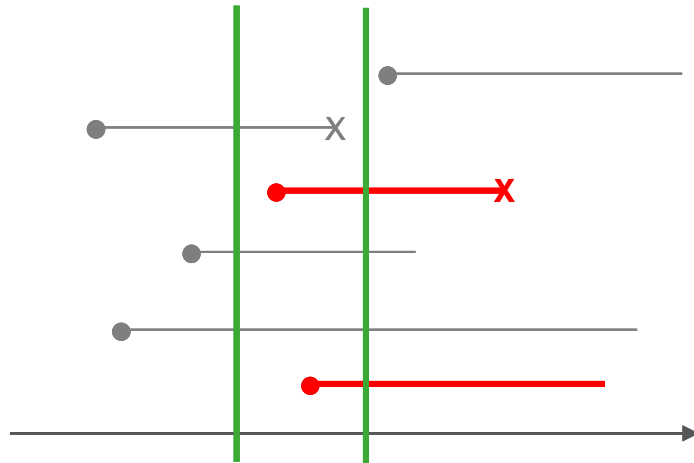
# Disability-Adjusted Life Years

## Methodological considerations

### Incidence

vs

### Prevalence



$$YLD = I \times D \times DW$$

~ future health losses due to current exposures

~ attributed to age at onset

~ disease prevention and control

$$YLD = P \times DW$$

~ current health losses due to past exposures

~ attributed to age in reference year

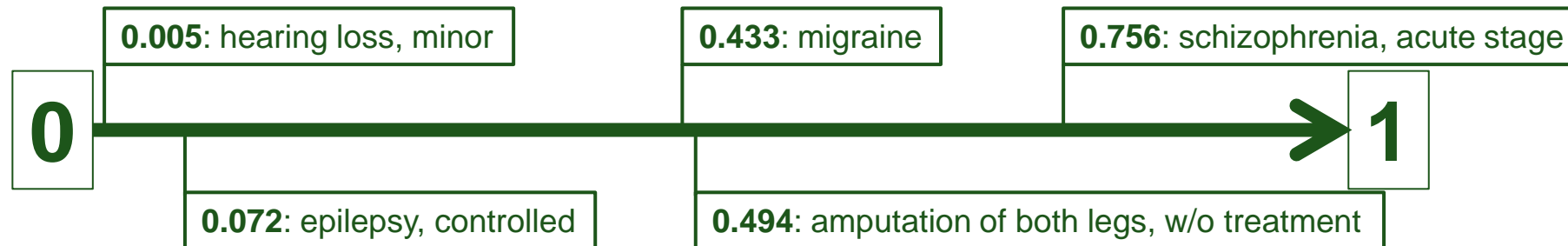
~ healthcare burden

# Disability-Adjusted Life Years

## Methodological considerations

### Disability weights

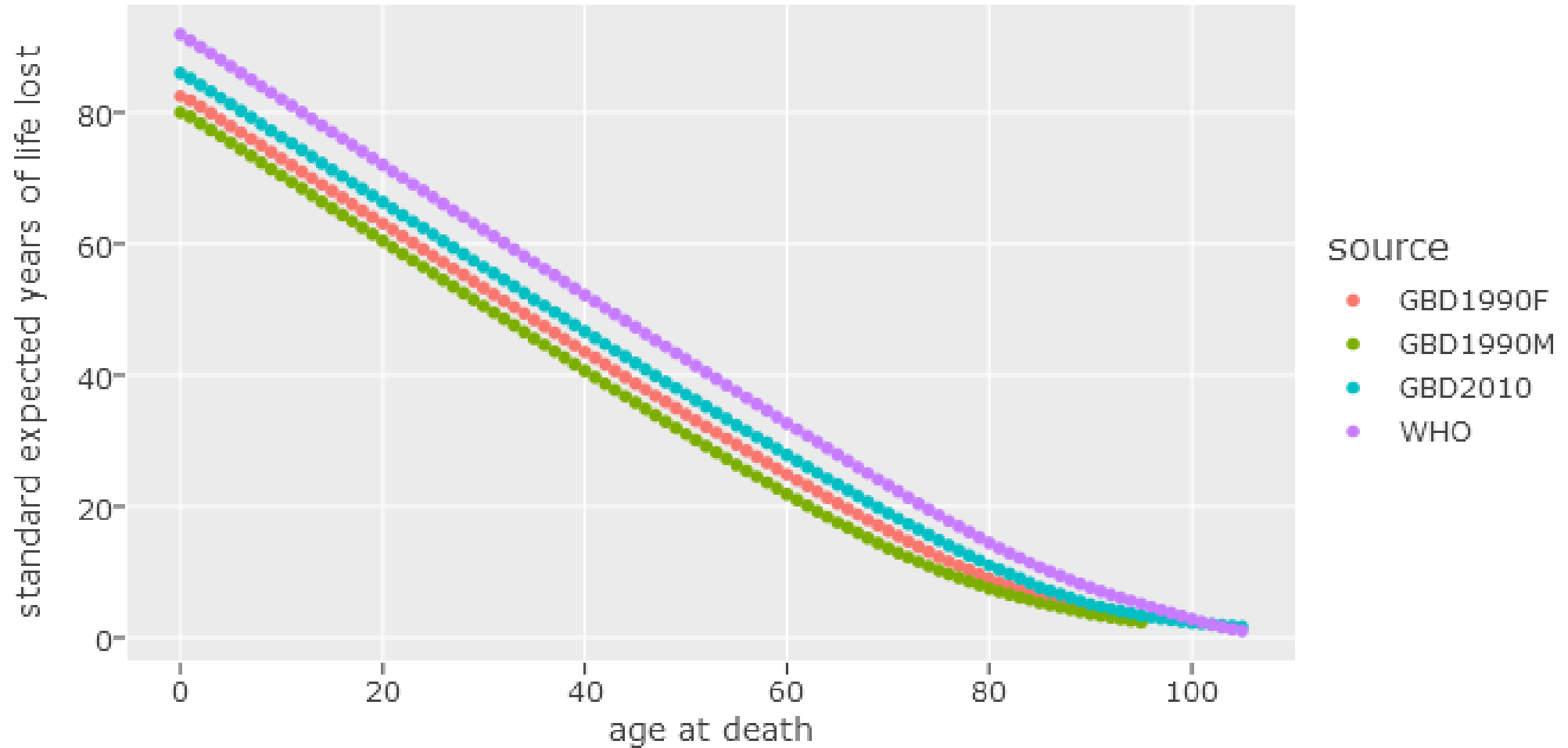
- Relative reduction in quality of life associated with a “health state”
  - 0 = 0% = perfect health
  - 1 = 100% = death



GBD Disability Weights: [http://www.thelancet.com/journals/langlo/article/PIIS2214-109X\(15\)00069-8](http://www.thelancet.com/journals/langlo/article/PIIS2214-109X(15)00069-8)

# Disability-Adjusted Life Years

## Methodological considerations



# Disability-Adjusted Life Years

## Methodological considerations

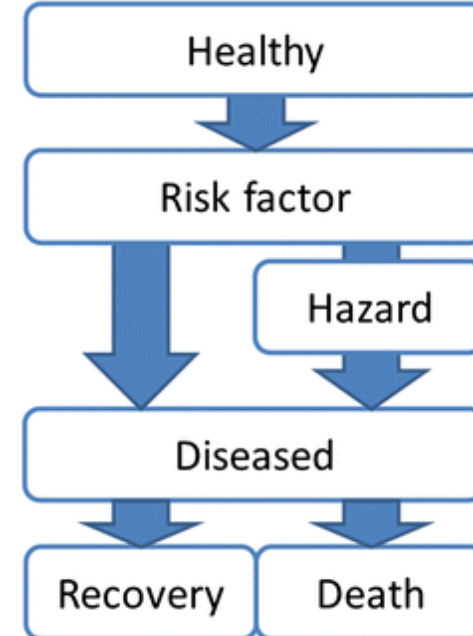
### Disease model, outcome tree

Schematic representation of “health states”

- acute, chronic stages; complications; death
- multiple severity levels

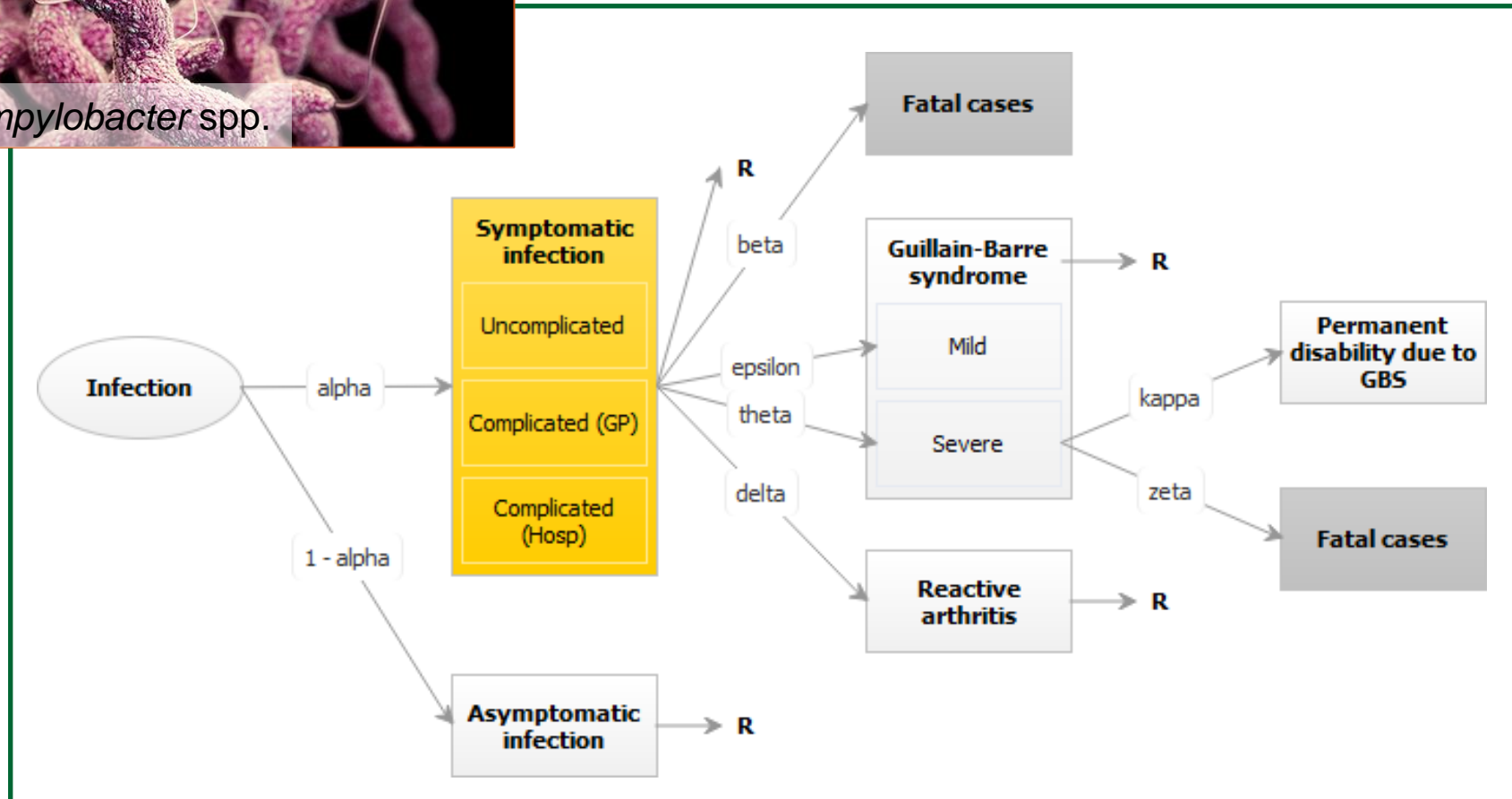
Point of interest

- Outcome-based
- Hazard-based, pathogen-based
- Risk factor-based



# Disability-Adjusted Life Years

## Methodological considerations

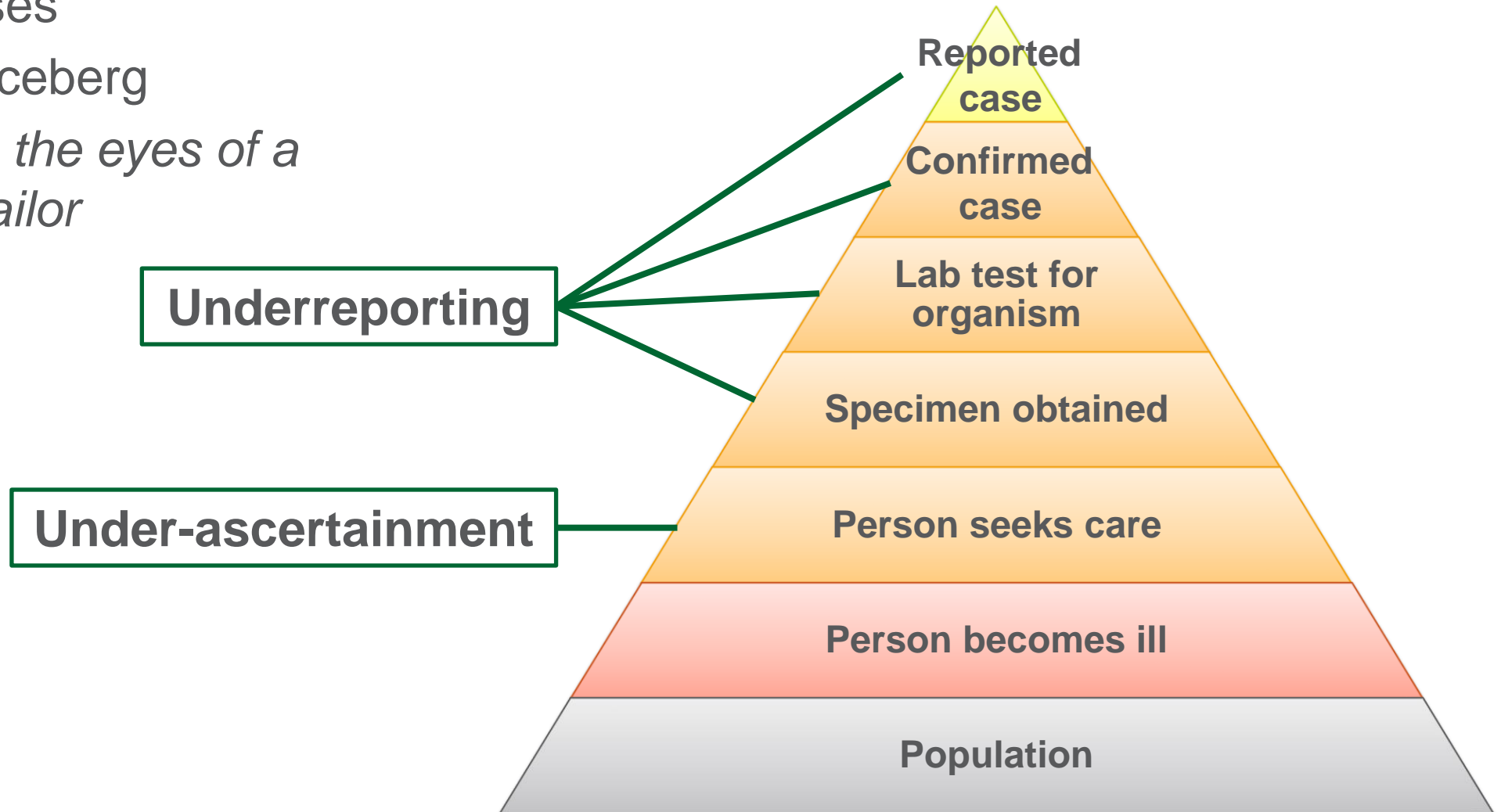


# Disability-Adjusted Life Years

## Methodological considerations

### Reported cases

- Tip of the iceberg
- *... through the eyes of a drunken sailor*



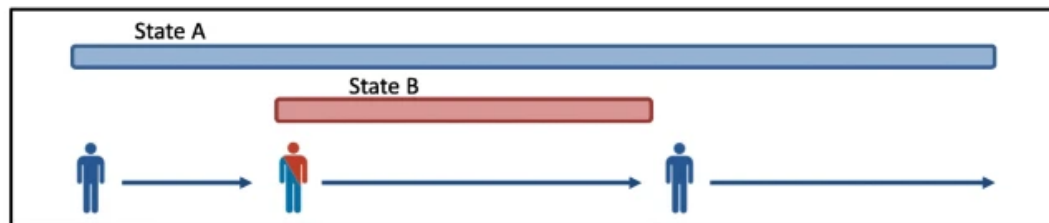
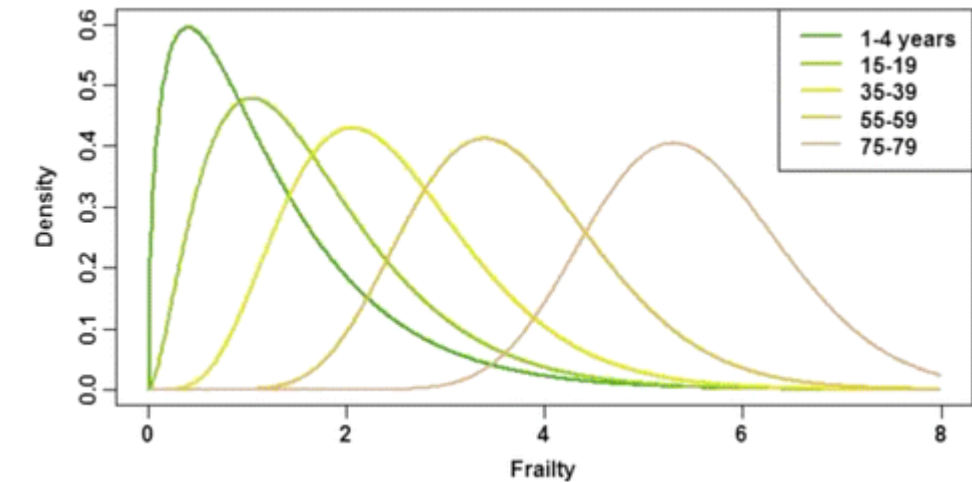


# Disability-Adjusted Life Years

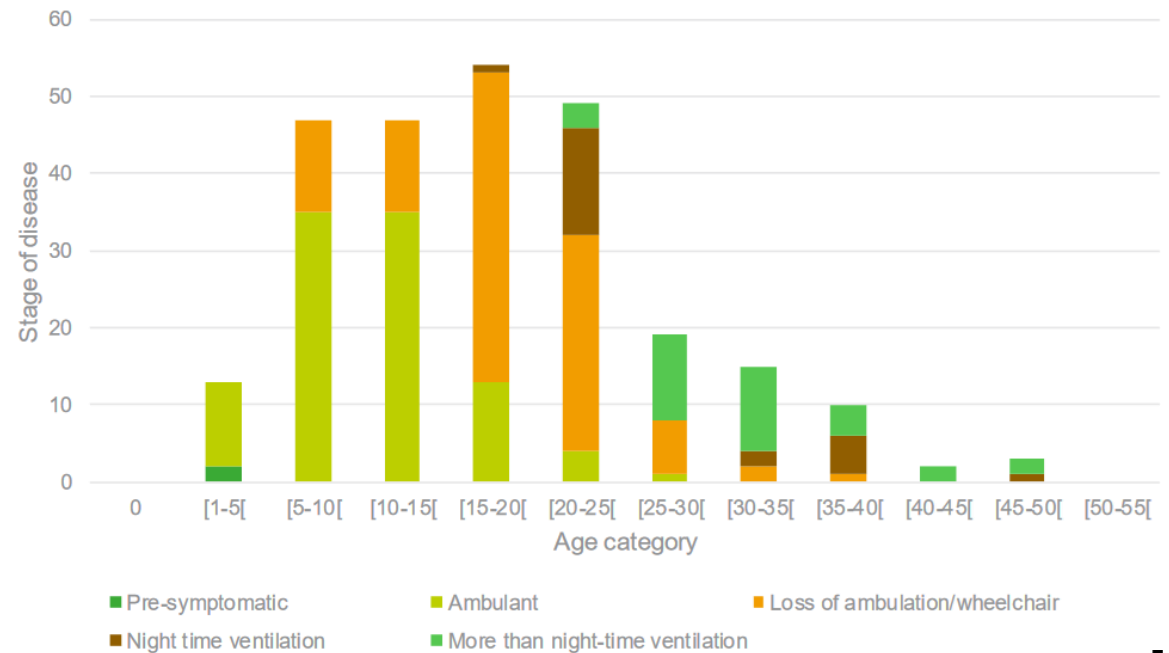
## Methodological considerations

DALYs are typically calculated at population level

.. but can also be calculated at individual level — if you have the data !



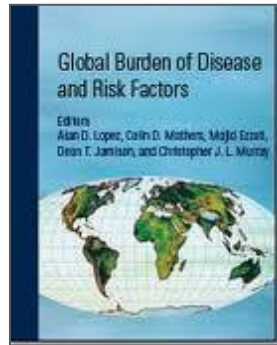
DMD registry: symptoms (health states) can be identified at patient level → DALYs at patient level!



# BURDEN INITIATIVES

Quantifying the health burden of infectious diseases

# Global Burden of Disease study



GBD2001



World Health Organization



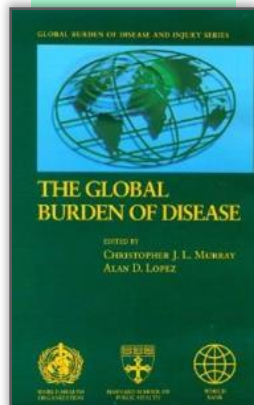
GBD2004



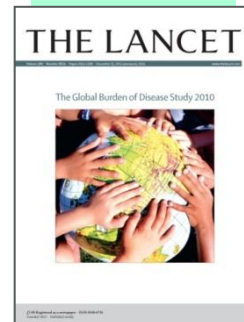
WHO Global Health Estimates



GBD1990



GBD2010

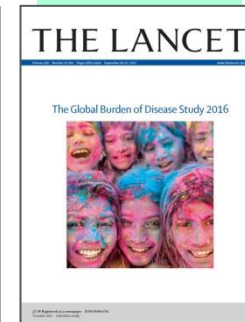


GBD2013

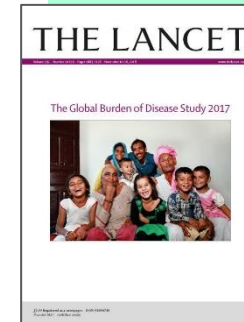


GBD2015

GBD2016



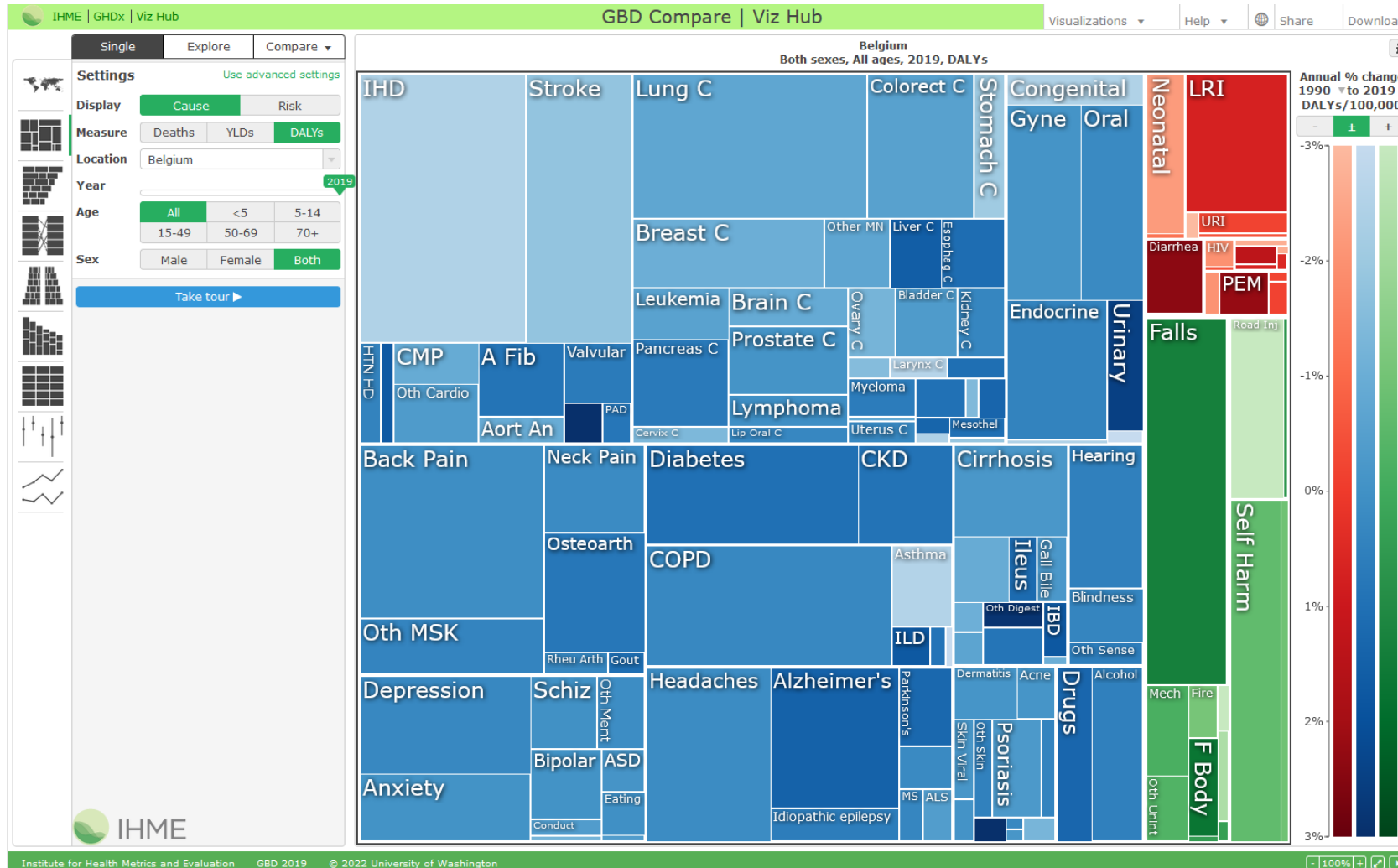
GBD2017



GBD2019



# Global Burden of Disease study



# Burden of Infectious Diseases

## Global and regional studies

### ECDC: Burden of Communicable Diseases in Europe (BCoDE)

- 32 communicable diseases
- 6 healthcare associated infections
- Burden of disease “toolkit”



### WHO: Foodborne Disease Burden Epidemiology Reference Group (FERG)

- 31 foodborne microbiological and chemical hazards
- <http://collections.plos.org/ferg2015>



### Global Burden of Animal Diseases (GBADs)

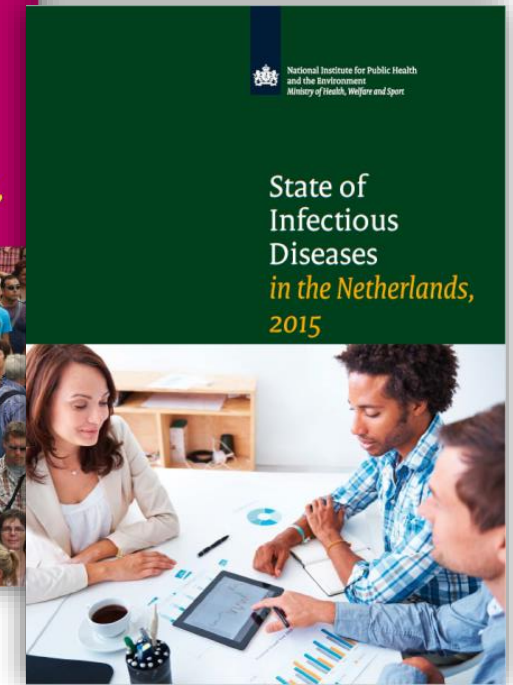
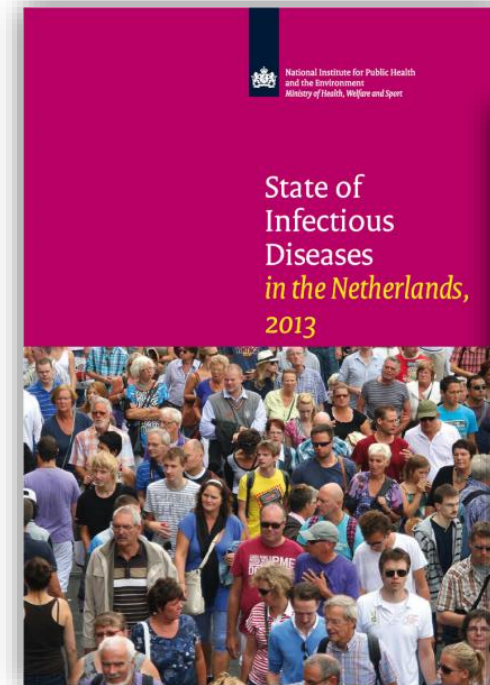
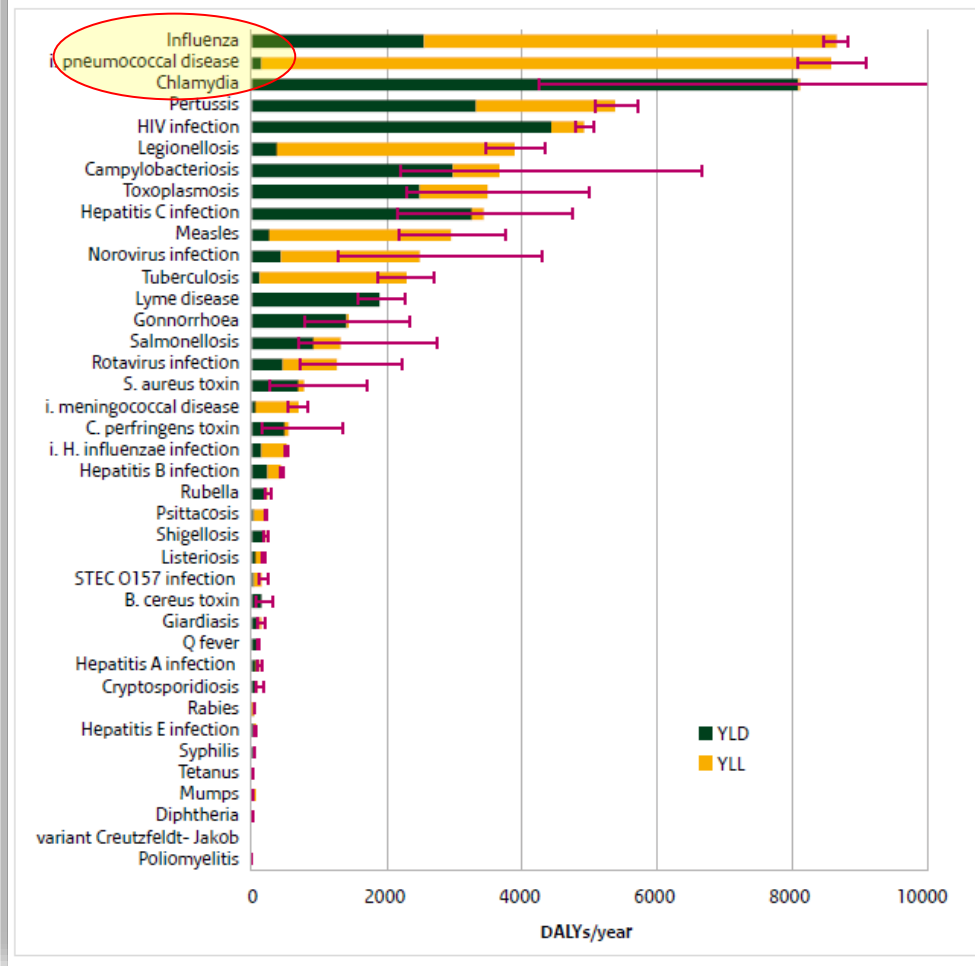
- Human health impact of livestock-related pathogens
- <https://animalhealthmetrics.org/>

# GBADs

# Burden of Infectious Diseases

## National studies

Figure 5.1 Average estimated annual disease burden in DALY, split by YLL and YLD, caused by infectious diseases in the Netherlands, 2012-2014. Red error bars indicate 95% uncertainty intervals.



# TAKE HOME MESSAGES

Quantifying the health burden of infectious diseases



# Quantifying the health burden of infectious diseases

- “Burden of Disease” is the comparative quantification of disease impact on one or more domains of life
  - BoD estimates are used by decision makers to identify unmet needs, inform new prevention/control/research actions, evaluate past actions...
- DALYs (healthy life years lost) are the key indicator for quantifying BOD
  - Important data needs
  - Methodological choices → a DALY is not a DALY !
  - Measure problems, not solutions
  - Health impact is just one of many aspects
- Different initiatives exist at global, regional and national level to quantify infectious disease DALYs