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

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

<table>
<thead>
<tr>
<th>Health Experience</th>
<th>Health Loss</th>
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</thead>
<tbody>
<tr>
<td><strong>Mortality</strong></td>
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<tr>
<td>Life Expectancy</td>
<td>Potential Years of Life Lost (Years of Potential Life Lost) Standard Expected Years of Life Lost</td>
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<tr>
<td><strong>Morbidity</strong></td>
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<tr>
<td>Quality-Adjusted Life Year</td>
<td>Years Lived with Disability</td>
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<td><strong>Morbidity + Mortality</strong></td>
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<tr>
<td>Active Life Expectancy Disability-Free Life Expectancy Healthy Life Years Quality-Adjusted Life Expectancy Disability-Adjusted Life Expectancy</td>
<td>Disability-Adjusted Life Year</td>
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</tbody>
</table>

All use “time” as a common metric!
We all want to live a long life in good health.

**Disability-Adjusted Life Years**

- **Years Lived with Disability (YLD)**
- **Years of Life Lost (YLL)**

Diagram showing the relationship between age, quality of life, and 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

DALY = YLD + YLL

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

\[
DALY = YLD + YLL
\]

- \( YLD = \text{Years Lived with Disability} = N \times D \times DW \)
- \( YLL = \text{Years of Life Lost} = M \times RLE \)

\[ 10 + 30 = 40 \text{ DALYs} \]

- \( 40 \times 0.25 = 10 \text{ YLDs} \)
- \( 30 \times 1 = 30 \text{ YLLs} \)
METHODOLOGICAL CONSIDERATIONS

Quantifying the health burden of infectious diseases
Disability-Adjusted Life Years
Methodological considerations

Incidence vs Prevalence

YLD = I x D x DW
- future health losses due to current exposures
- attributed to age at onset
- disease prevention and control

YLD = P x DW
- current health losses due to past exposures
- attributed to age in reference year
- healthcare burden
Disability weights

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

Disability-Adjusted Life Years
Methodological considerations

![Diagram showing Disability-Adjusted Life Years over age at death with different sources: GBD1990F, GBD1990M, GBD2010, WHO.](image-url)
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

Campylobacter spp.
Disability-Adjusted Life Years
Methodological considerations

Reported cases
• Tip of the iceberg
• ... through the eyes of a drunken sailor
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
Global Burden of Disease study

https://vizhub.healthdata.org/gbd-compare/
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/
Burden of Infectious Diseases
National studies
TAKE HOME MESSAGES

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