BCoDe study: results from the Burden of Communicable Diseases in Europe study (2009-2013)

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ecdc
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National Institute for Public Health and the Environment
Ministry of Health, Welfare and Sport

UMC Utrecht

The Burden of Communicable Diseases in Europe Project (BCoDE)

- Runtime project 2009 - 2013
- Disability-adjusted life years, based on surveillance data
- BCoDE methodology and toolkit
- Estimates of DALYs for 32 infectious diseases in Europe

PLoS Collection:
https://collections.plos.org/burden-of-infectious-diseases

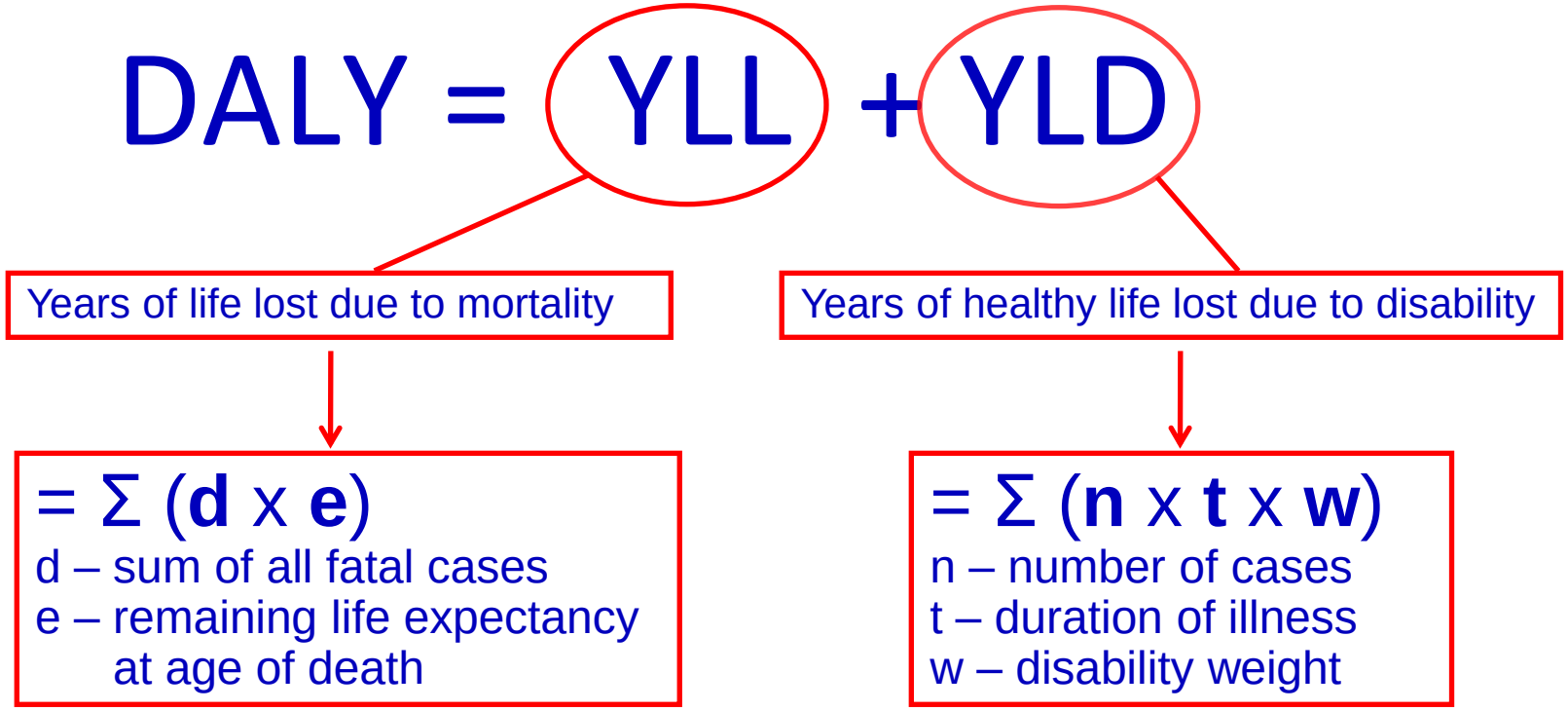
Acknowledgements

Alessandro Cassini (ECDC)
Eduardo Colzani (ECDC)

BCoDE Consortium (RIVM, UMCU, ECDC, Bielefeld University, others)
Marie-Josee Mangen, Dietrich Plass, Alies van Lier, Scott McDonald, Arie Havelaar, Cheryl Gibbons (methodology)
Juanita Haagsma (disability weights)
Daniel Lewandowski (programming)

Summary measure of population health

Disability Adjusted Life Years (DALYs) to express the burden of disease



Introduced by Murray & Lopez 1997: Global Burden of Disease Study

Incidence- and pathogen-based DALY approach

- Links sequelae to their infectious causes (pathogens) by means of outcome trees
- Based on incidence of infection per pathogen
- Burden attributed to time at infection

OPEN ACCESS Freely available online

PLoS MEDICINE

Policy Forum

New Methodology for Estimating the Burden of Infectious Diseases in Europe

Mirjam Kretzschmar[1,2*], Marie-Josée J. Mangen[2], Paulo Pinheiro[3], Beate Jahn[4,5], Eric M. Fèvre[6], Silvia Longhi[7], Taavi Lai[8,9], Arie H. Havelaar[1,10], Claudia Stein[11], Alessandro Cassini[12], Piotr Kramarz[12], for the BCoDE consortium

Published 2012

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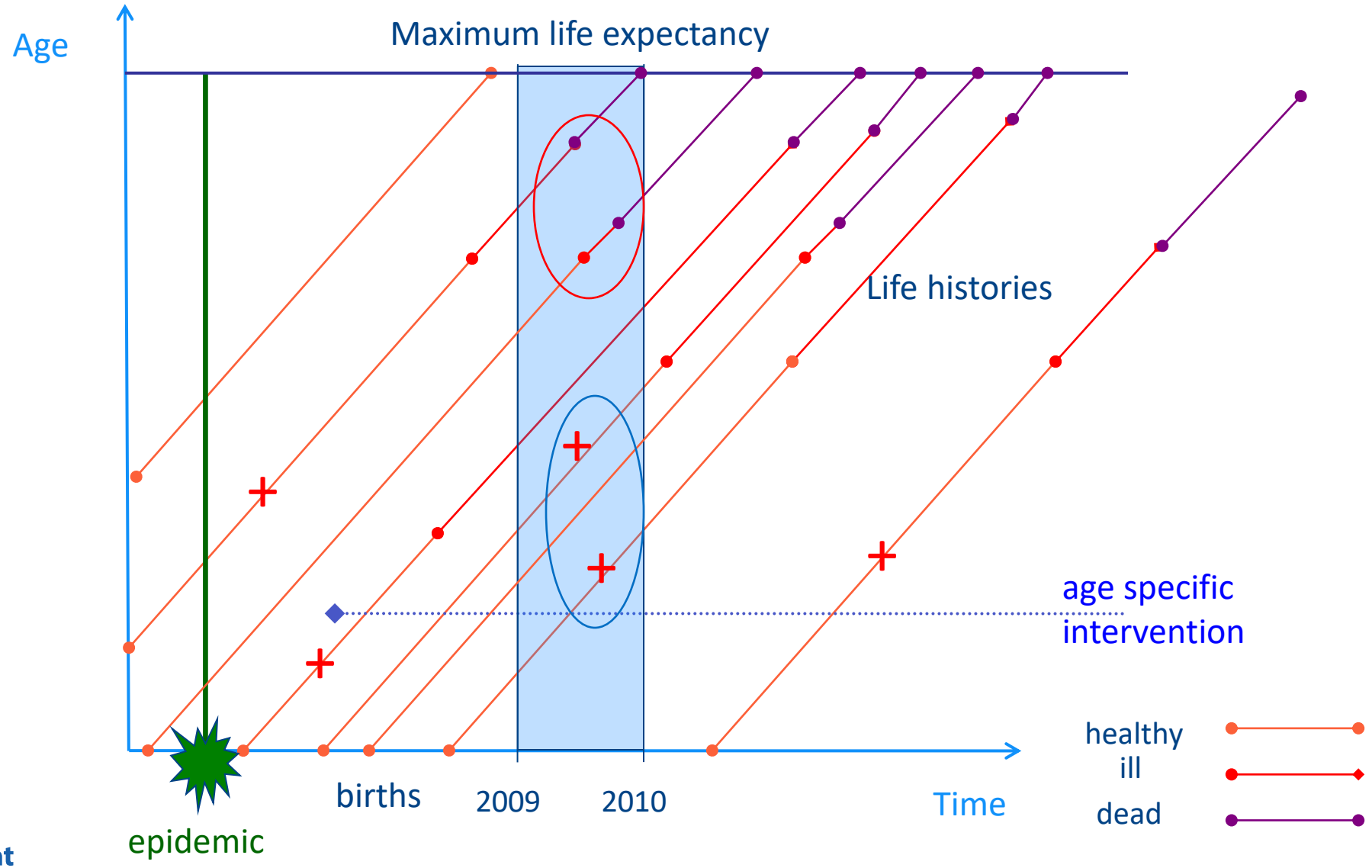
Incidence vs prevalence based approach



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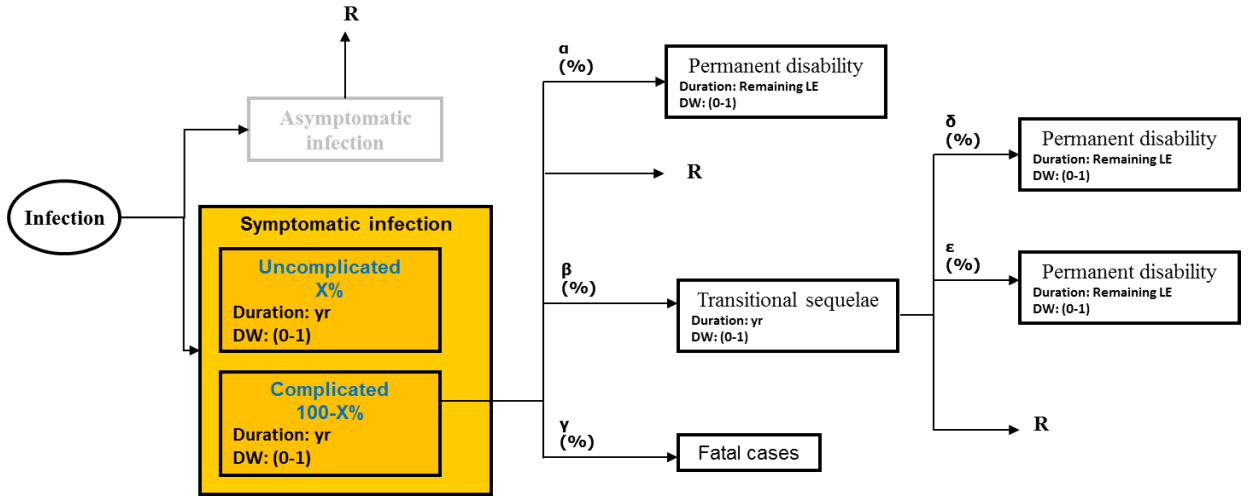
Steps in burden estimation

- Estimate population incidence of infection from notification or other surveillance data
- Use multiplication factors to account for underreporting and underascertainment
- Estimate incidence of sequelae attributed to one infection by use of an outcome tree
- Compute DALYs based on incidences, durations, and disability weights

Outcome tree

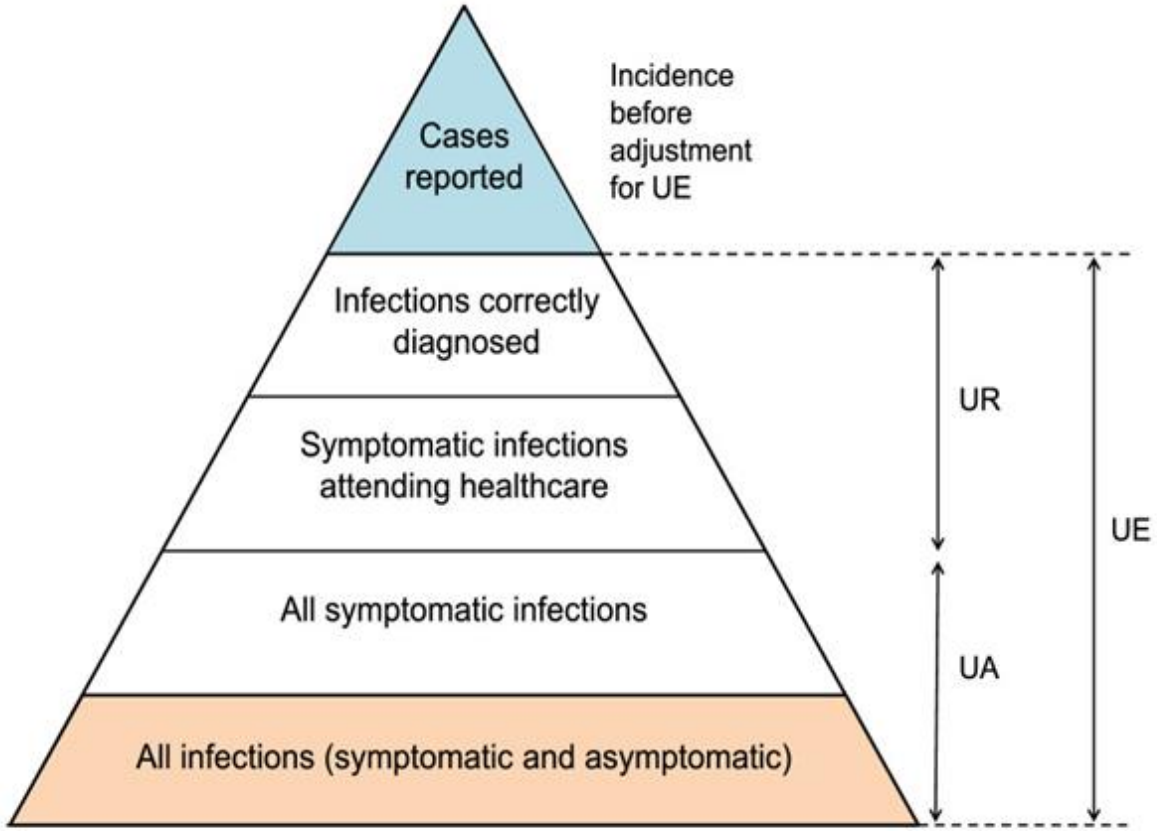
Disease model including infection, acute disease and all sequelae



For a specific pathogen

- Define primary health outcome(s), possibly distinguish health states
- Define associated long term sequelae
- Quantify transition probabilities and durations including possible recovery and death

Correcting for underreporting



Gibbons CL, et al. Measuring underreporting and under-ascertainment in infectious disease datasets: a comparison of methods. BMC Public Health. 2014;14:147.

Disability weights

Haagsma *et al. Population Health Metrics* (2015) 13:10
DOI 10.1186/s12963-015-0042-4

POPULATION HEALTH METRICS

RESEARCH Open Access

Assessing disability weights based on the responses of 30,660 people from four European countries

Juanita A Haagsma[1,2*], Charline Maertens de Noordhout[3], Suzanne Polinder[1], Theo Vos[2], Arie H Havelaar[4,5,6], Alessandro Cassini[7], Brecht Devleesschauwer[8], Mirjam E Kretzschmar[4,9], Niko Speybroeck[3] and Joshua A Salomon[10]

Disability weights for the Global Burden of Disease 2013 study

Joshua A Salomon, Juanita A Haagsma, Adrian Davis, Charline Maertens de Noordhout, Suzanne Polinder, Arie H Havelaar, Alessandro Cassini, Brecht Devleesschauwer, Mirjam Kretzschmar, Niko Speybroeck, Christopher J L Murray, Theo Vos

Summary

Background The Global Burden of Disease (GBD) study assesses health losses from diseases, injuries, and risk factors using disability-adjusted life-years, which need a set of disability weights to quantify health levels associated with non-

Lancet Glob Health 2015; 3: e712–23

Disability weights were assessed in 4 European countries
(project funded by ECDC and Institute for Health Metrics and Evaluation (IHME))

The BCoDE toolkit

Software package for calculation of DALYs for different countries and infectious diseases

PLOS ONE

RESEARCH ARTICLE

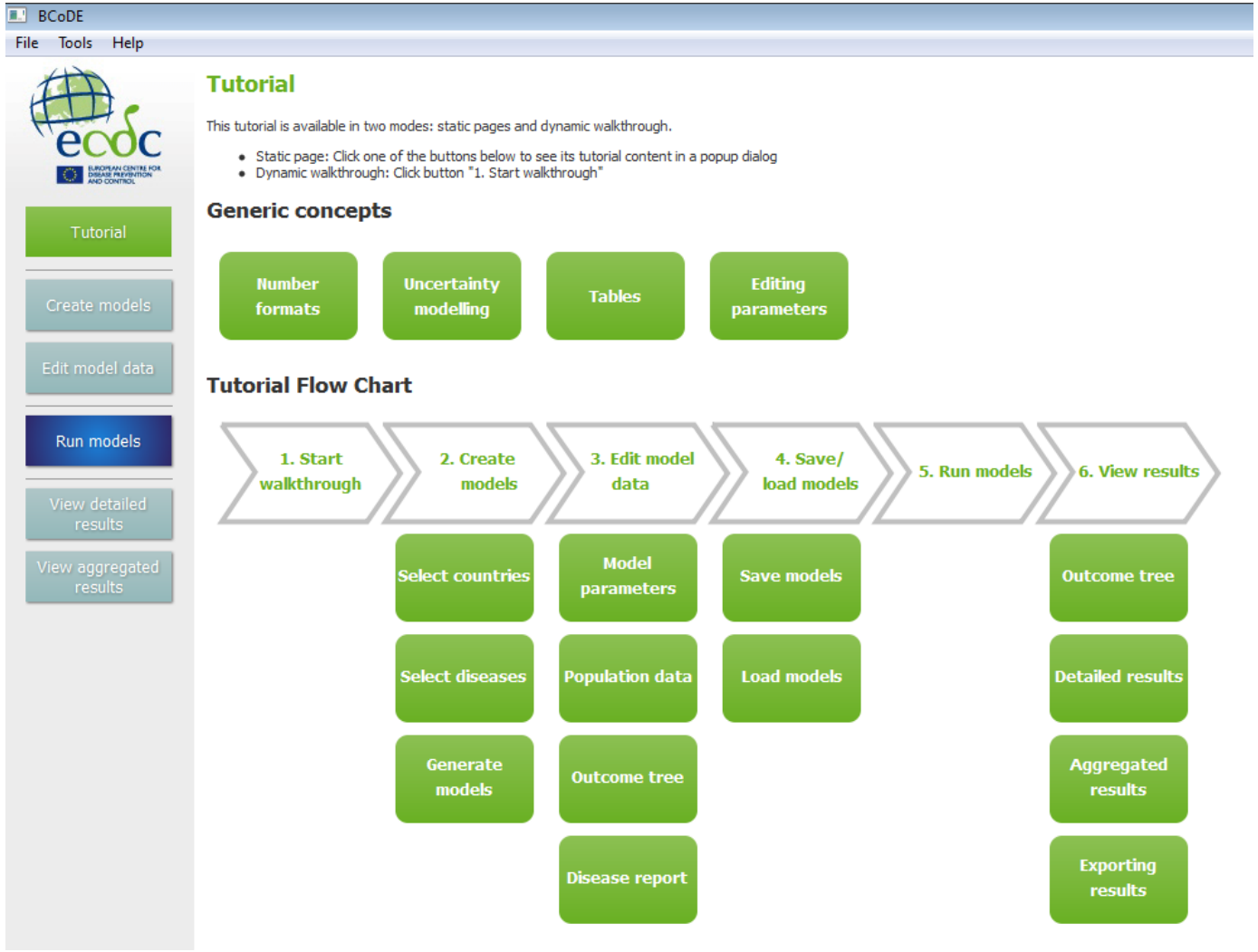
A Software Tool for Estimation of Burden of Infectious Diseases in Europe Using Incidence-Based Disability Adjusted Life Years

Edoardo Colzani[1☯*], Alessandro Cassini[1,2☯*], Daniel Lewandowski[3], Marie-Josee J. Mangen[2,4], Dietrich Plass[5], Scott A. McDonald[4], Alies van Lier[4], Juanita A. Haagsma[6,7], Guido Maringhini[1], Alessandro Pini[1], Piotr Kramarz[1], Mirjam E. Kretzschmar[2,4]

Published 2017

ECDC BCoDE toolkit [software application]. Version 1.1
Stockholm: European Centre for Disease Prevention and Control; 2015.
Available from: http://ecdc.europa.eu/en/healthtopics/burden_of_communicable_diseases/Pages/Tool.aspx

Stepwise approach for burden calculation



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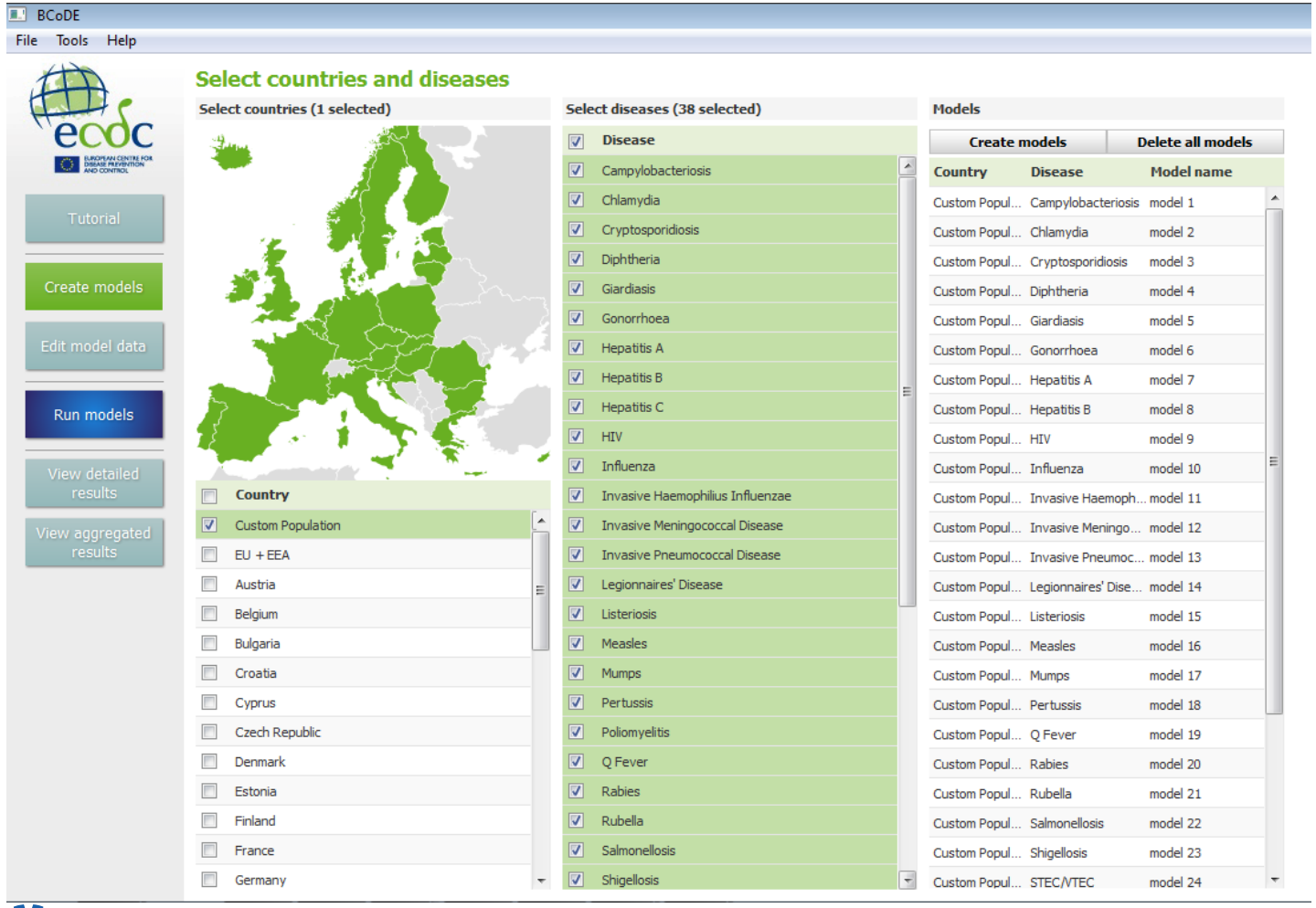
Selecting the countries and the diseases



31 countries
EU+EEA
Custom population

32 infectious diseases
6 healthcare associated syndromes

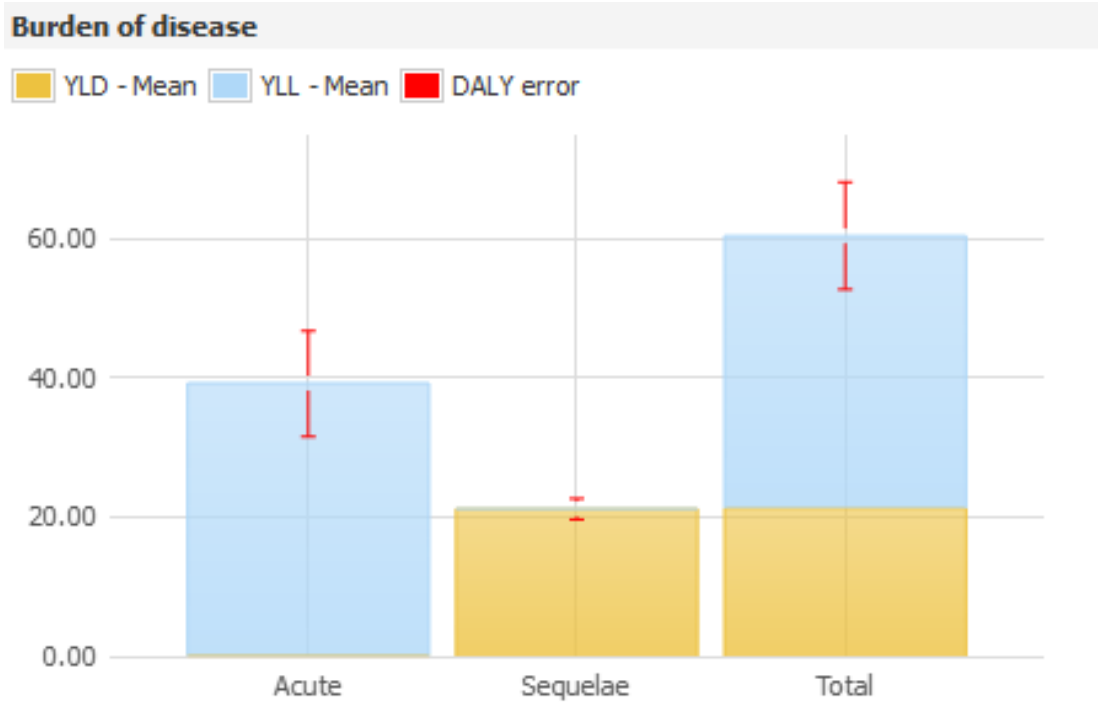
Data input

- Incident cases by sex and age from surveillance system
- Multiplication factor to correct for underreporting
- Inclusion of asymptomatic cases if they contribute to burden
- Definition of time discount factor

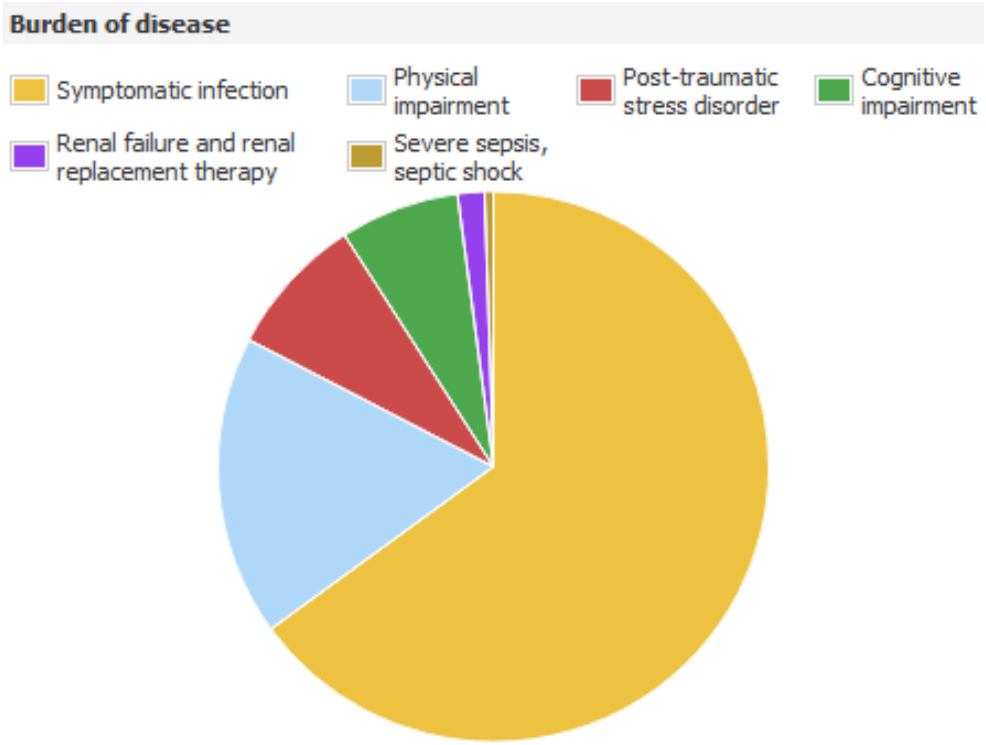
Result output

- Estimated „true“ incidence of acute infections
- DALYs
  - Pathogen, age-group and sex specific
  - Per year, per 100,000 and per infected case
  - By YLL and YLD
  - By acute illness and sequelae
- Ranking of diseases according to DALYs
- Uncertainty bounds

Stratification of burden by sequelae



Distribution by YLL and YLD



Distribution by sequelae

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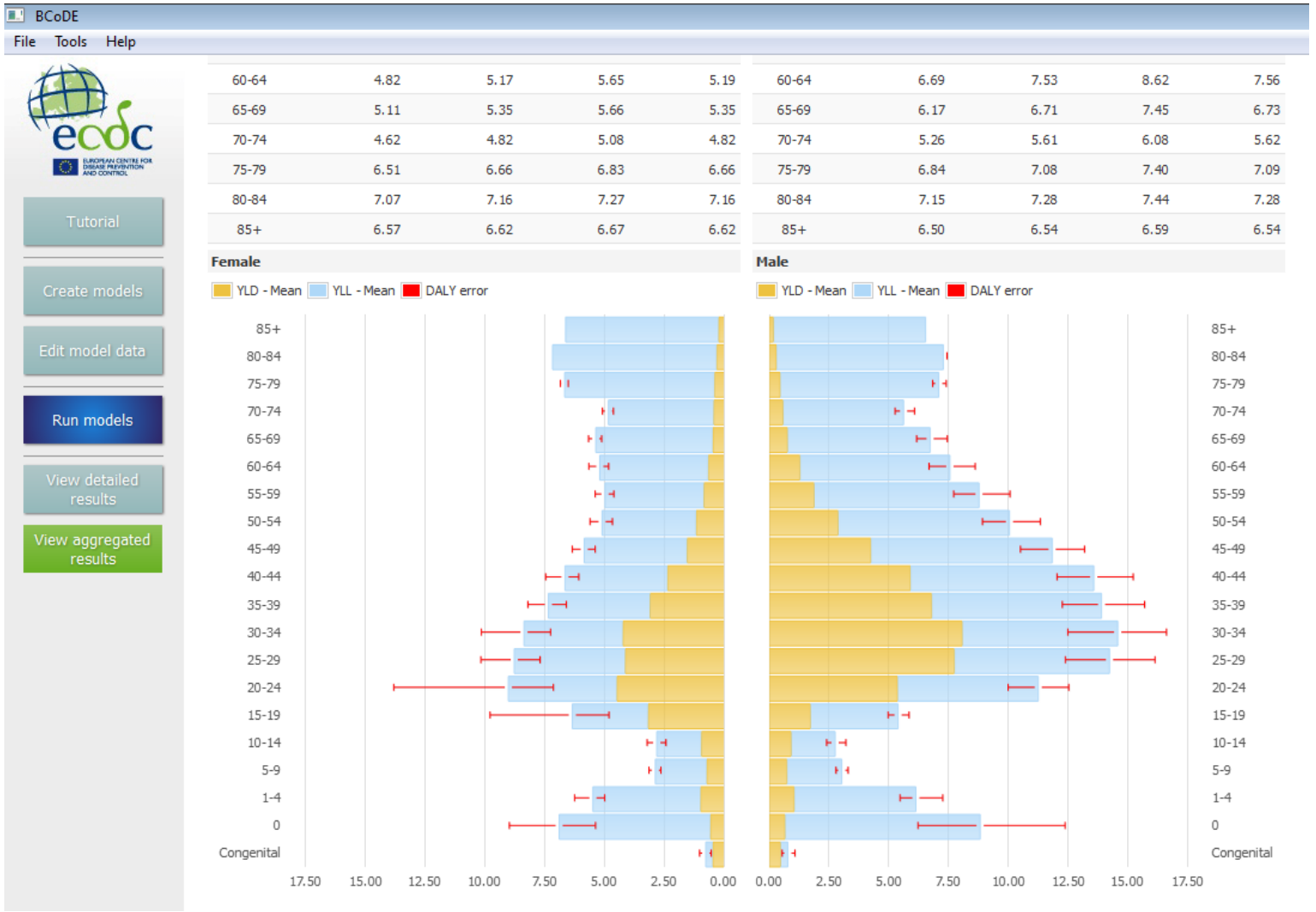
Example: hospital acquired pneumonia

Stratification by age and gender



Burden is attributed to age at infection

Burden of infectious diseases in Europe

RESEARCH ARTICLE

Impact of infectious diseases on population health using incidence-based disability-adjusted life years (DALYs): results from the Burden of Communicable Diseases in Europe study, European Union and European Economic Area countries, 2009 to 2013

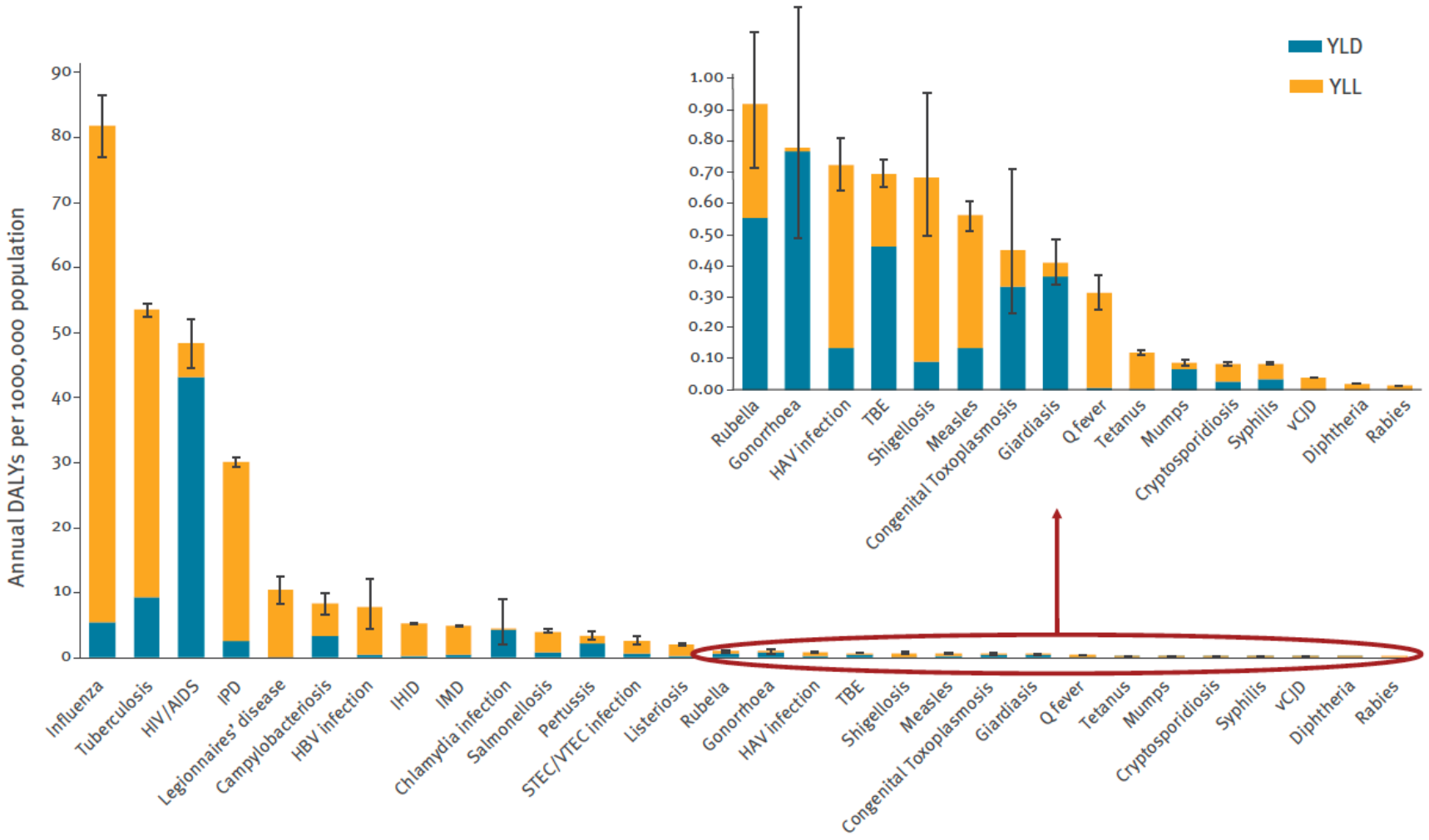
Alessandro Cassini[1,2], Edoardo Colzani[1], Alessandro Pini[1], Marie-Josee J Mangen[2,3], Dietrich Plass[4], Scott A McDonald[3], Guido Maringhini[1], Alies van Lier[3], Juanita A Haagsma[5], Arie H Havelaar[3,6], Piotr Kramarz[1], Mirjam E Kretzschmar[2,3], on behalf of the BCoDE consortium[7]

Eurosurveillance 2018

DALYs per 100,000 population per year

FIGURE 1

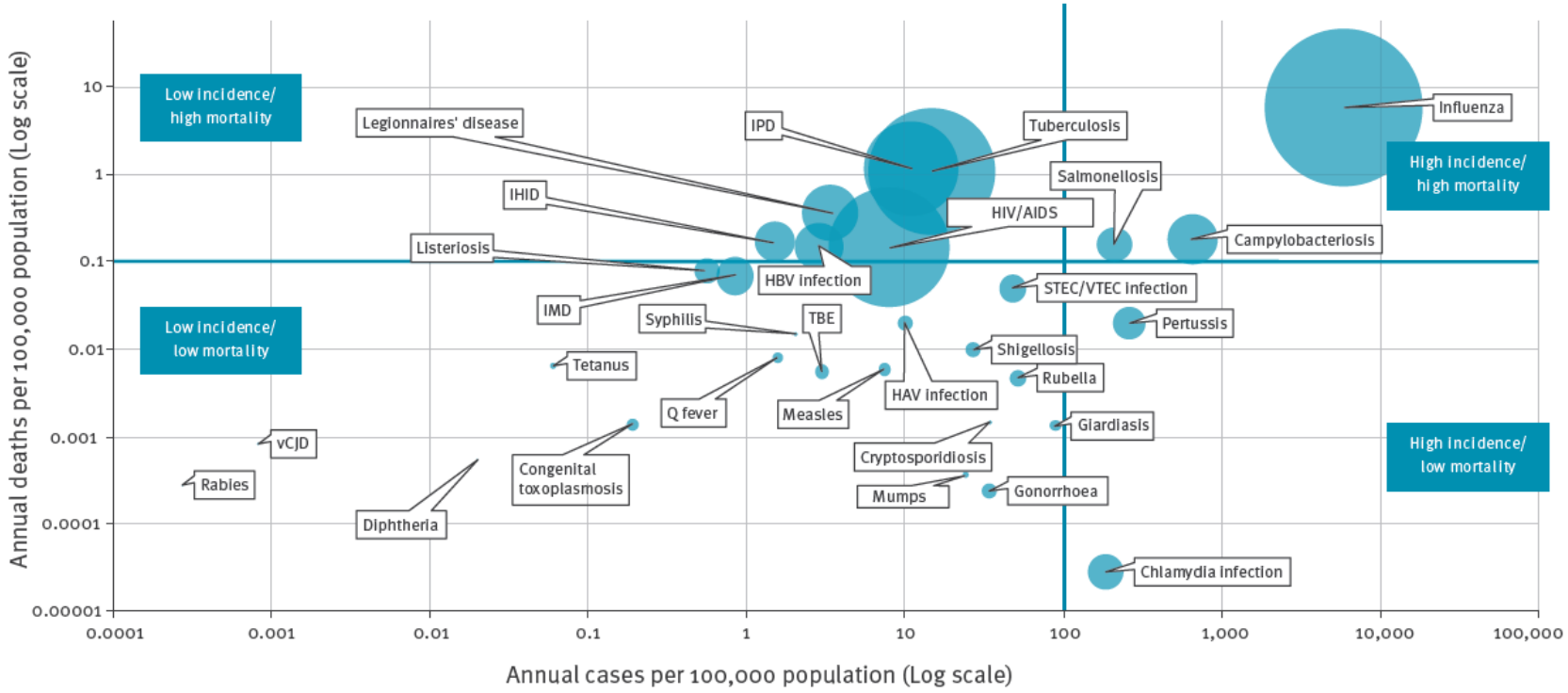
Median annual DALYs per 100,000 population for selected infectious diseases, EU/EEA countries, 2009–2013



Incidence, mortality, and disease burden

FIGURE 3

Bubble chart of the burden of selected infectious diseases in terms of mortality and incidence, EU/EEA countries, 2009–2013



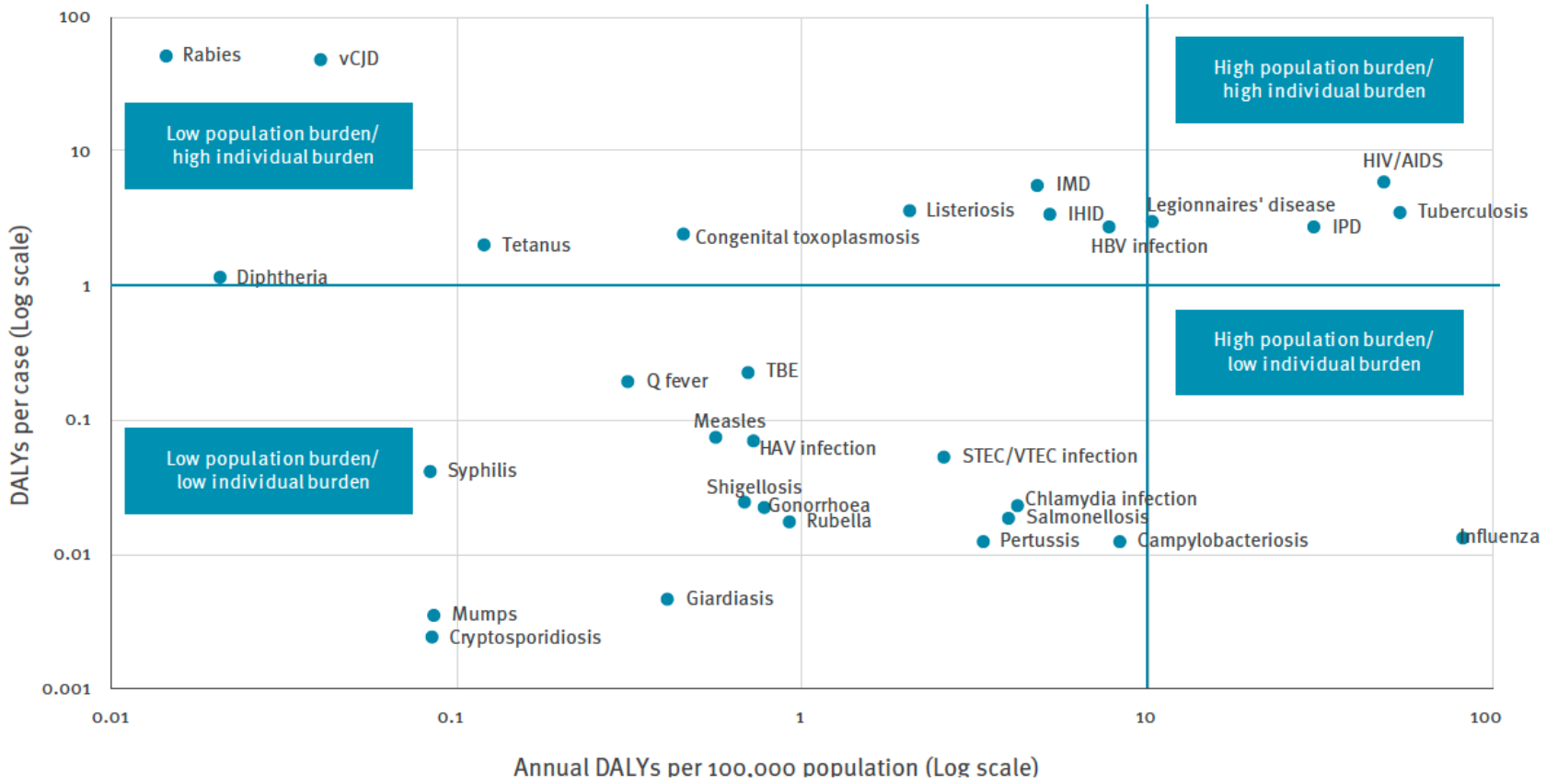
EU/EEA: European Union/European Economic Area; HAV: Hepatitis A virus; HBV: Hepatitis B virus; HIV/AIDS: Human immunodeficiency virus infection; IHID: Invasive *Haemophilus influenzae* disease; IMD: Invasive meningococcal disease; IPD: Invasive pneumococcal disease; STEC/VTEC: Shiga toxin/verocytotoxin-producing *Escherichia coli*; TBE: Tick-borne encephalitis; vCJD: variant Creutzfeldt–Jakob disease

The diameter of the bubble reflects the number of DALYs per 100,000 population per year.

Population burden versus individual burden

FIGURE 4

Scatterplot of the burden of selected infectious diseases in DALYs per case and DALYs per 100,000 population per year, EU/EEA countries, 2009–2013



EU/EEA: European Union/European Economic Area; HAV: Hepatitis A virus; HBV: Hepatitis B virus; HIV/AIDS: Human immunodeficiency virus infection; IHID: Invasive *Haemophilus influenzae* disease; IMD: Invasive meningococcal disease; IPD: Invasive pneumococcal disease; STEC/VTEC: Shiga toxin/verocytotoxin-producing *Escherichia coli*; TBE: Tick-borne encephalitis; vCJD: variant Creutzfeldt–Jakob disease

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National Infectious Disease Burden Study Netherlands

PLOS ONE

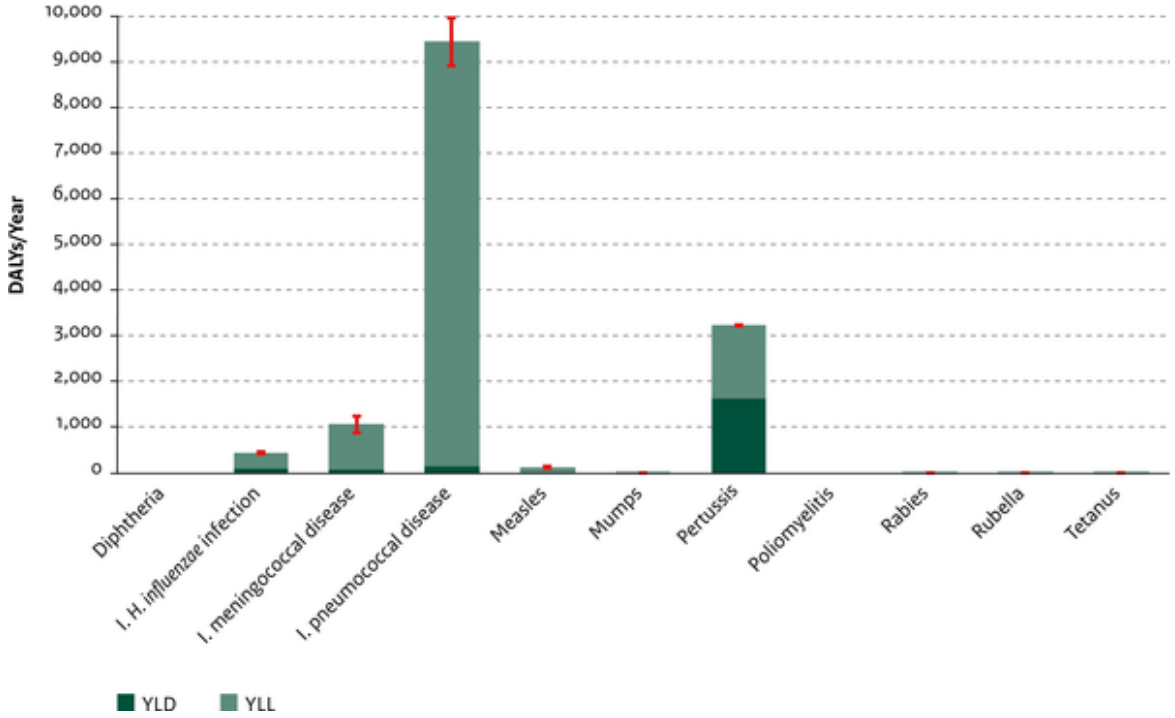
RESEARCH ARTICLE

Disease Burden of 32 Infectious Diseases in the Netherlands, 2007-2011

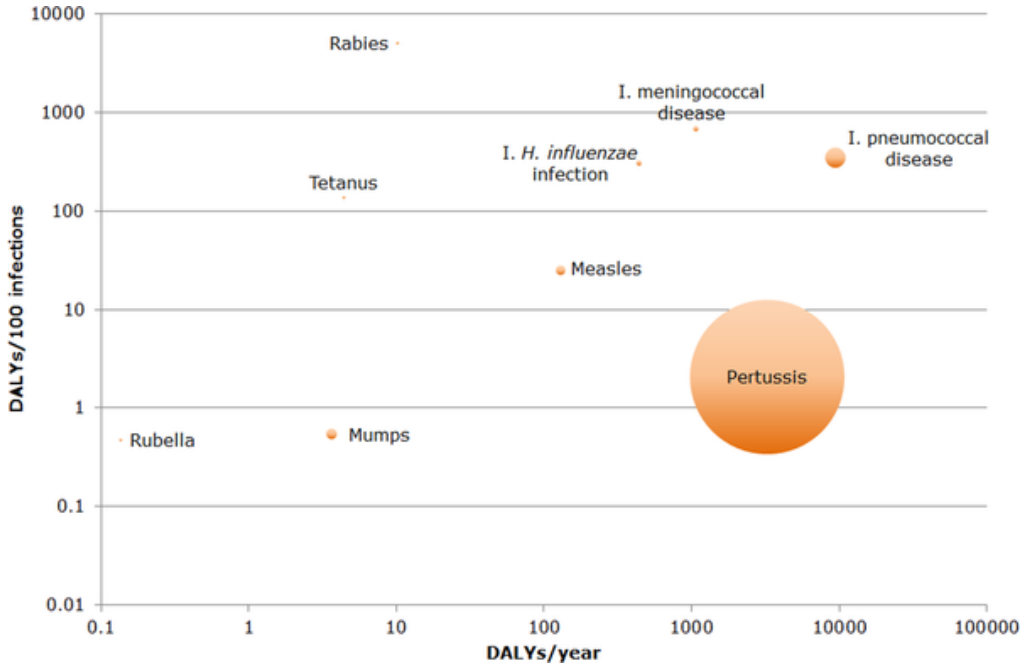
Alies van Lier[1☯], Scott A. McDonald[1☯*], Martijn Bouwknegt[1], EPI group[1¶], Mirjam E. Kretzschmar[1,2], Arie H. Havelaar[3], Marie-Josée J. Mangen[1,2], Jacco Wallinga[1], Hester E. de Melker[1]

Published April 2016

Results vaccine preventable diseases



Daly per year (average 2007-2011)



Population versus individual burden

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van Lier A, McDonald SA, Bouwknegt M, EPI group, Kretzschmar ME, et al. (2016) Disease Burden of 32 Infectious Diseases in the Netherlands, 2007-2011. PLOS ONE 11(4): e0153106. https://doi.org/10.1371/journal.pone.0153106
https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0153106

Burden of infectious disease in the Netherlands

Since 2014 Annual report
"State of infectious diseases in the Netherlands"
→ Estimation disease burden >32 diseases

6 sexually transmitted infections
11 vaccine-preventable infections
11 foodborne diseases
4 respiratory diseases

Calculation disease burden: BCoDE-toolkit
Except for 9 foodborne diseases

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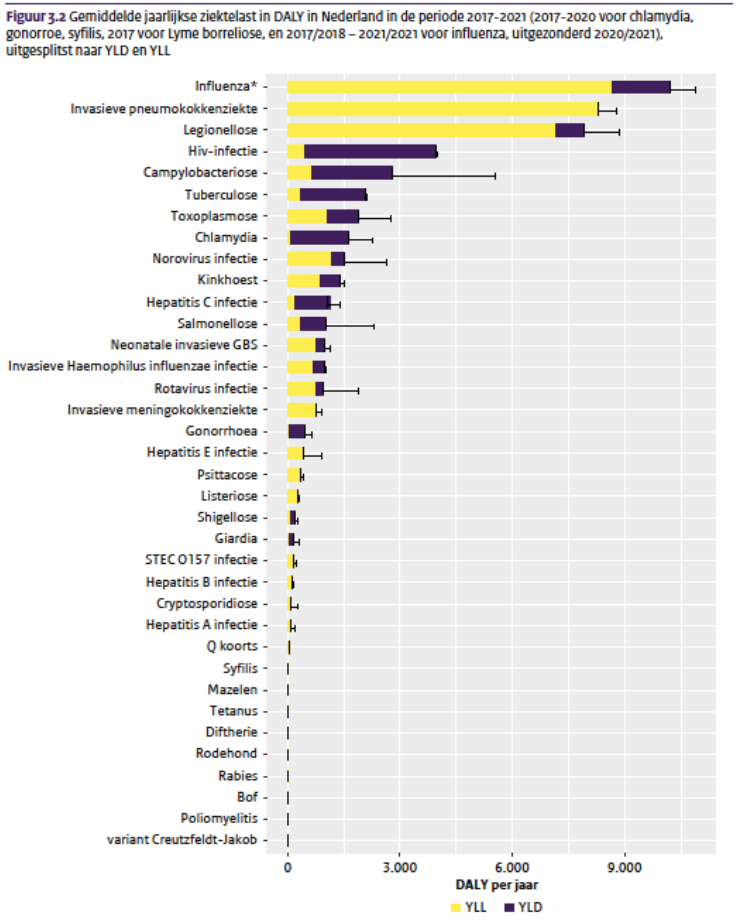
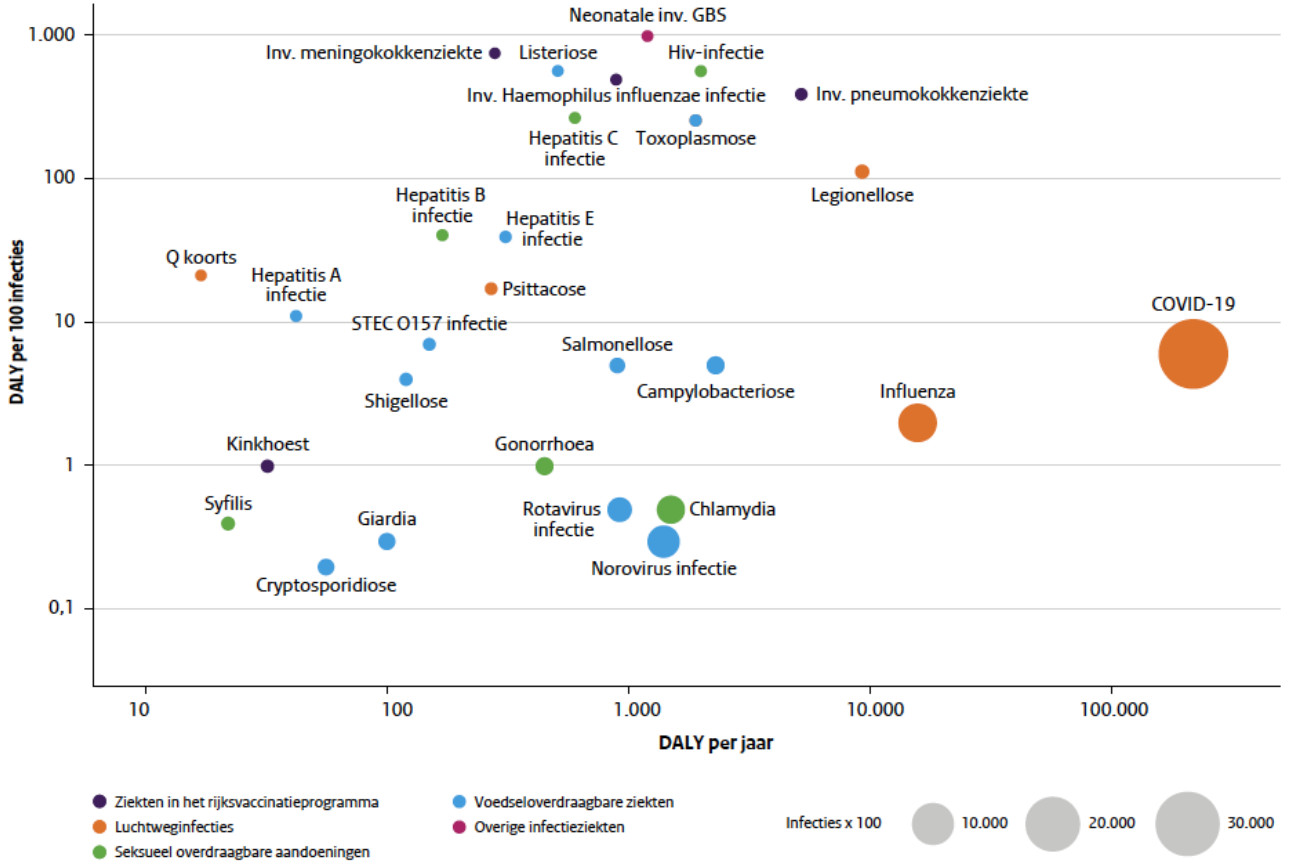
Average burden of infectious diseases 2017 - 2020





For Covid-19 the burden is for 2021

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Disease burden, aging, and vaccination

Vaccine 34 (2016) 942–949

Contents lists available at ScienceDirect

Vaccine

journal homepage: www.elsevier.com/locate/vaccine

Burden of four vaccine preventable diseases in older adults

Maartje Kristensen[a,1], Alies van Lier[a,1], Renske Eilers[a,b], Scott A. McDonald[a], Wim Opstelten[c], Nicoline van der Maas[a], Wim van der Hoek[a], Mirjam E. Kretzschmar[a,c], Mark M. Nielen[d], Hester E. de Melker[a,*]

McDonald *et al. BMC Public Health* 2012, **12**:1046
http://www.biomedcentral.com/1471-2458/12/1046

BMC Public Health

RESEARCH ARTICLE Open Access

The impact of demographic change on the estimated future burden of infectious diseases: examples from hepatitis B and seasonal influenza in the Netherlands

Scott A McDonald[1*], Alies van Lier[1], Dietrich Plass[2] and Mirjam EE Kretzschmar[1,3]

McDonald *et al. BMC Infectious Diseases* 2013, **13**:120
http://www.biomedcentral.com/1471-2334/13/120

BMC Infectious Diseases

RESEARCH ARTICLE Open Access

Effects of an ageing population and the replacement of immune birth cohorts on the burden of hepatitis A in the Netherlands

Scott A McDonald[1*], Marie-Josée J Mangen[2], Anita Suijkerbuijk[3], Edoardo Colzani[4] and Mirjam EE Kretzschmar[1,2]

RESEARCH

Disease burden of varicella versus other vaccine-preventable diseases before introduction of vaccination into the national immunisation programme in the Netherlands

Alies van Lier[1], Brechje de Gier[1], Scott A McDonald[1], Marie-Josée J. Mangen[1], Maarten van Wijhe[1,2], Elisabeth A.M. Sanders[1,3], Mirjam E. Kretzschmar[1,4], Hans van Vliet[1], Hester E. de Melker[1]

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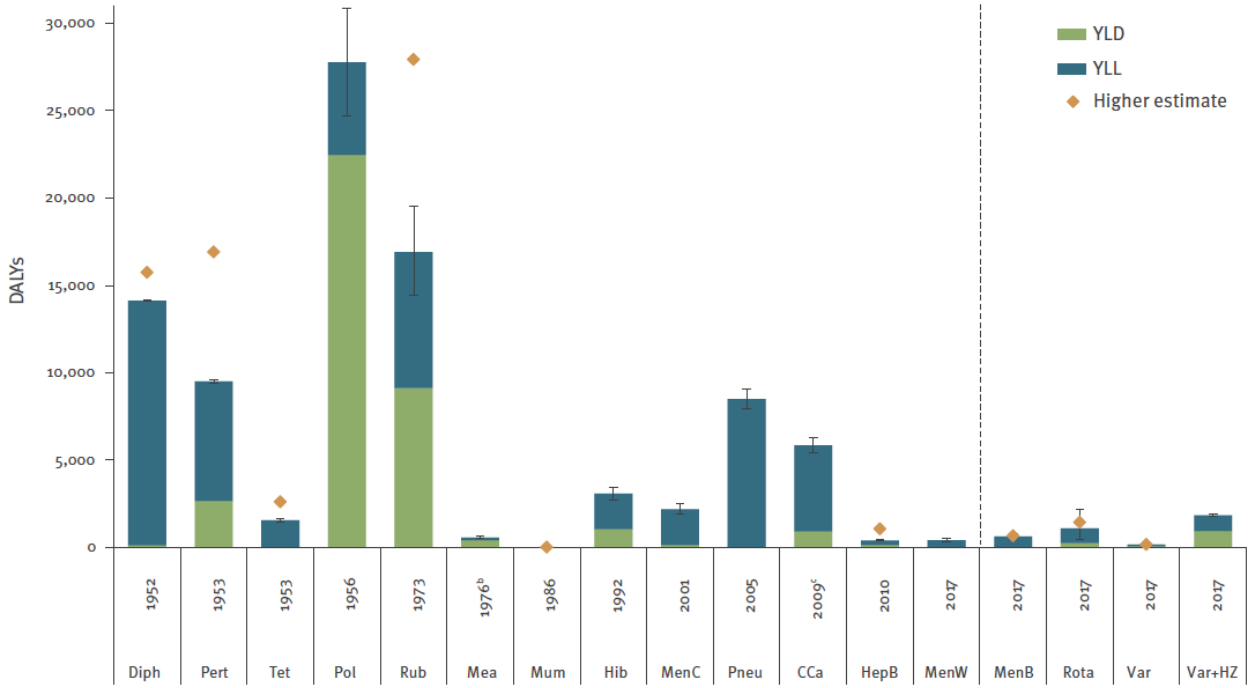
Disease burden of vaccine-preventable diseases

FIGURE 1

Estimated disease burden[a] of vaccine-preventable diseases in the year before introduction of vaccination into the national immunisation programme, or in 2017, with the years lived with disability and the years of life lost components shown separately, Netherlands, 1952–2017



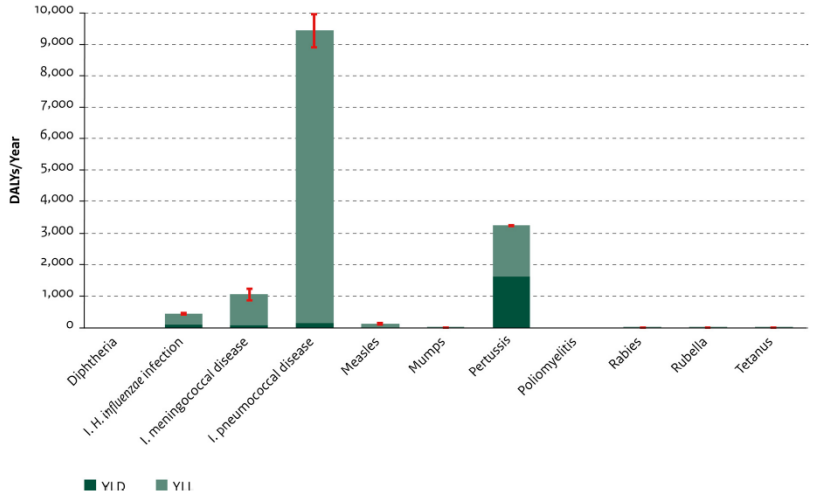


Fig 3. Average annual disease burden in the Netherlands in 2007–2011 for new cases of vaccine-preventable diseases. YLD and YLL components are shown separately. Red lines indicate 95% uncertainty intervals. (DALY = Disability-Adjusted Life Year, YLD = Years Lived with Disability, YLL = Years of Life Lost, I. = invasive).

Year before introduction of vaccination

Comparison: Average 2007 - 2011

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Other spin-off projects

Comparing burden of influenza and Q fever

Disease burden of HAI and AMR

Epidemiol. Infect., Page 1 of 10. © Cambridge University Press 2014
doi:10.1017/S0950268813003531

Comparing the impact of two concurrent infectious disease outbreaks on The Netherlands population, 2009, using disability-adjusted life years

R. J. BROOKE[1,2]*, A. VAN LIER[2], G. A. DONKER[3], W. VAN DER HOEK[2] AND M. E. E. KRETZSCHMAR[1,2]

Attributable deaths and disability-adjusted life-years caused by infections with antibiotic-resistant bacteria in the EU and the European Economic Area in 2015: a population-level modelling analysis

*Alessandro Cassini, Liselotte Diaz Högberg, Diamantis Plachouras, Annalisa Quattrocchi, Ana Hoxha, Gunnar Skov Simonsen, Mélanie Colomb-Cotinat, Mirjam E Kretzschmar, Brecht Devleesschauwer, Michele Cecchini, Driss Ait Ouakrim, Tiago Cravo Oliveira, Marc J Struelens, Carl Suetens, Dominique L Monnet, and the Burden of AMR Collaborative Group**

Lancet Infectious Diseases 2019

PLOS MEDICINE

PLoS Medicine 2016

RESEARCH ARTICLE

Burden of Six Healthcare-Associated Infections on European Population Health: Estimating Incidence-Based Disability-Adjusted Life Years through a Population Prevalence-Based Modelling Study

Alessandro Cassini[1,2☯*], Diamantis Plachouras[1☯*], Tim Eckmanns[3], Muna Abu Sin[3], Hans-Peter Blank[3], Tanja Ducomble[3], Sebastian Haller[3], Thomas Harder[3], Anja Klingeberg[3], Madlen Sixtensson[3], Edward Velasco[3], Bettina Weiß[3], Piotr Kramarz[1], Dominique L. Monnet[1], Mirjam E. Kretzschmar[2,4], Carl Suetens[1]

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