

# Burden of Disease Studies; harnessing sparse epidemiological data for evidence-informed policy making

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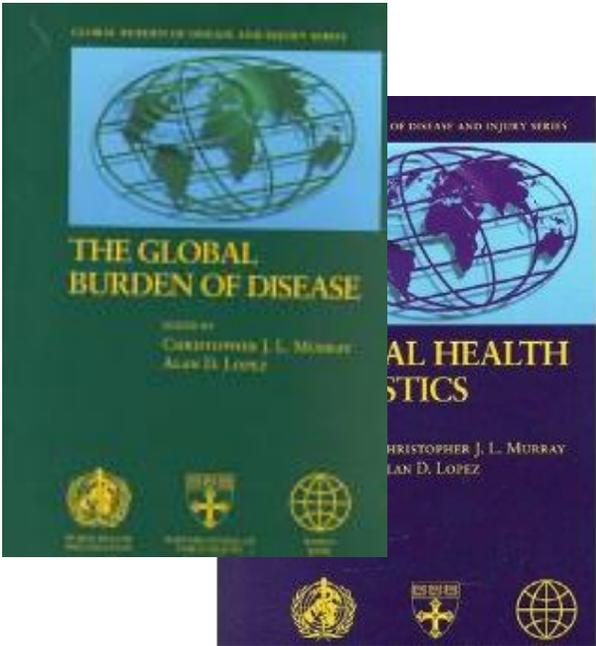
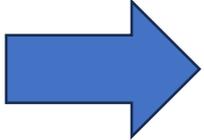
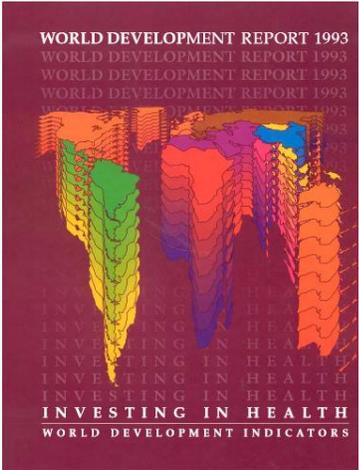
Preventive Medicine and Public Health Research Center

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# Burden of disease study

- Quantification of health loss to describe comparative magnitudes of diseases and injuries, and attributable burden to risk factors in a population
- Difference with general term of “disease burden”?
  - Any quantification of disease magnitude or severity at personal or population level
  - Not necessarily comparable

# Global Burden of Disease (GBD) project



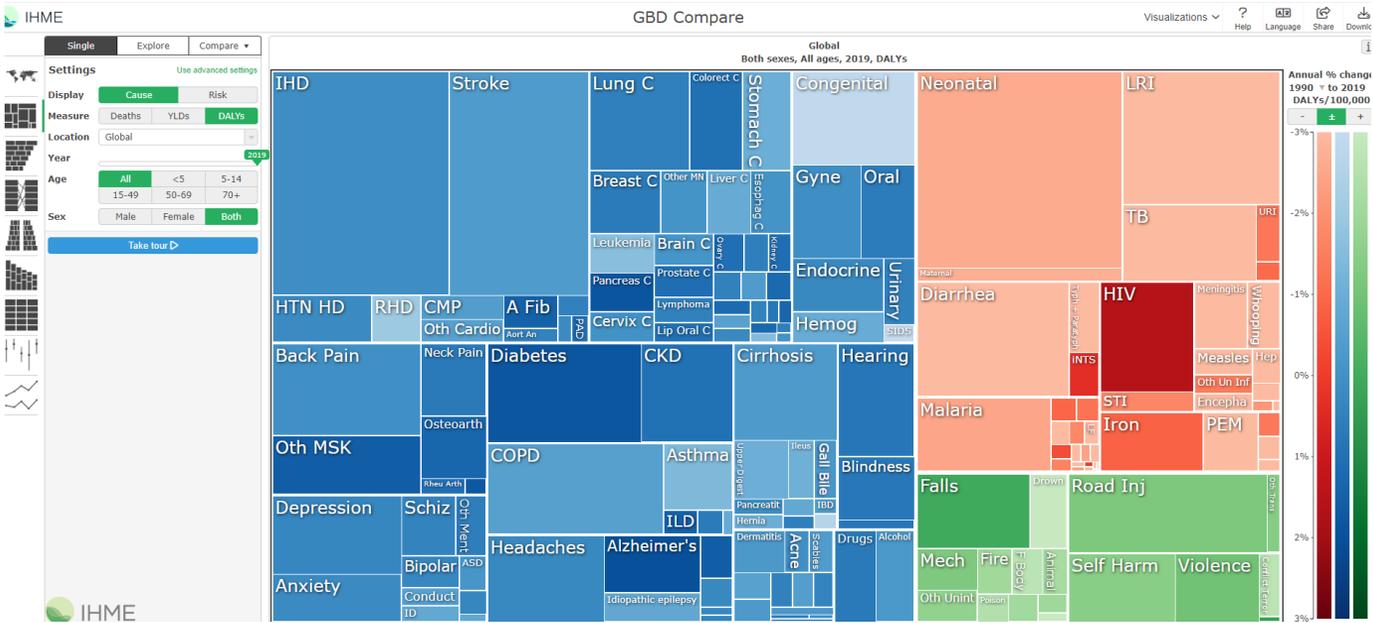
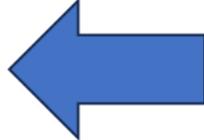
THE LANCET

The Global Burden of Disease Study 2017



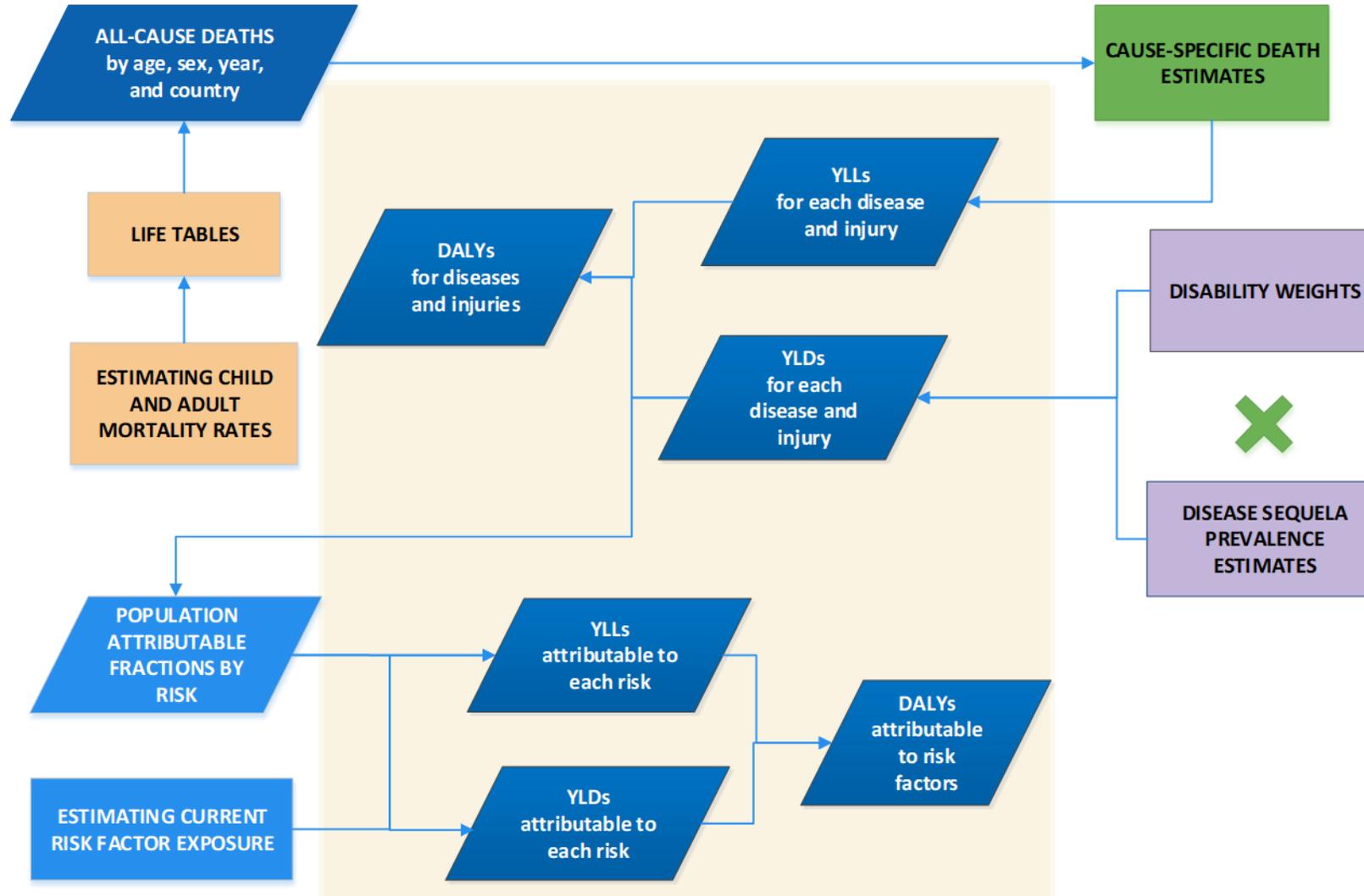
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Global Burden of Disease Study 2019

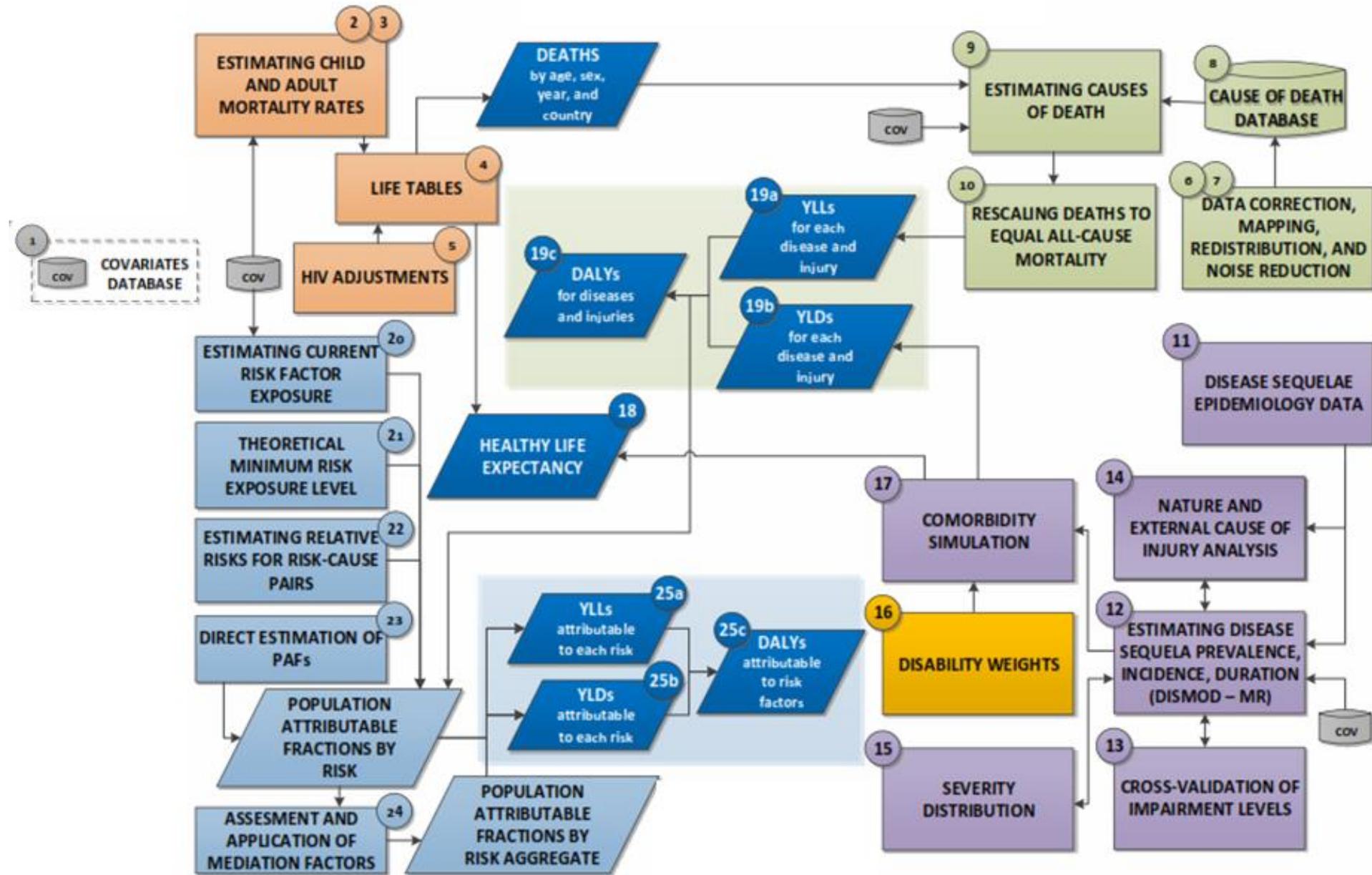




# Simplified GBD flow chart



# GBD data and model flow chart (more details)



# Direct outputs of GBD

- All-cause mortality, Life expectancy and Probability of Death
- Prevalence, Incidence and Mortality for each disease
- All-cause and cause-specific Years of Life Lost (YLL), Years Lived with Disability (YLD) and Disability-Adjusted Life Years (DALYs)
- Health-Adjusted Life Expectancy (HALE)
- Attributable death, YLL, YLD and DALYs to each risk factor
- Specific indicators: Neonatal Mortality Rate, Infant Mortality Rate, Under 5 Mortality Rate, Maternal Mortality Ratio

# Other products of GBD

- Population estimates
- Sociodemographic Index (SDI)
- Fertility estimates
- Summary Exposure Values (SEV) of risk factors and Population Attributable Fractions (PAF) for risk-outcome pairs
- Universal Health Coverage (UHC) index
- Health-related Sustainable Development Goals (SDG) indicators

# Critiques regarding GBD estimates

- Main concerns
  - Epidemiological measures where/when there is:
    - Poor-quality data
    - Inconsistent data
    - No data
  - Difference between different GBD rounds
    - Analytic process
    - Sources of data
  - Choice of measures and nominal values

# The experience with CLINICAL evidence

- Hierarchy of evidence
- Quality of evidence
- Level of evidence
- Strength of recommendations

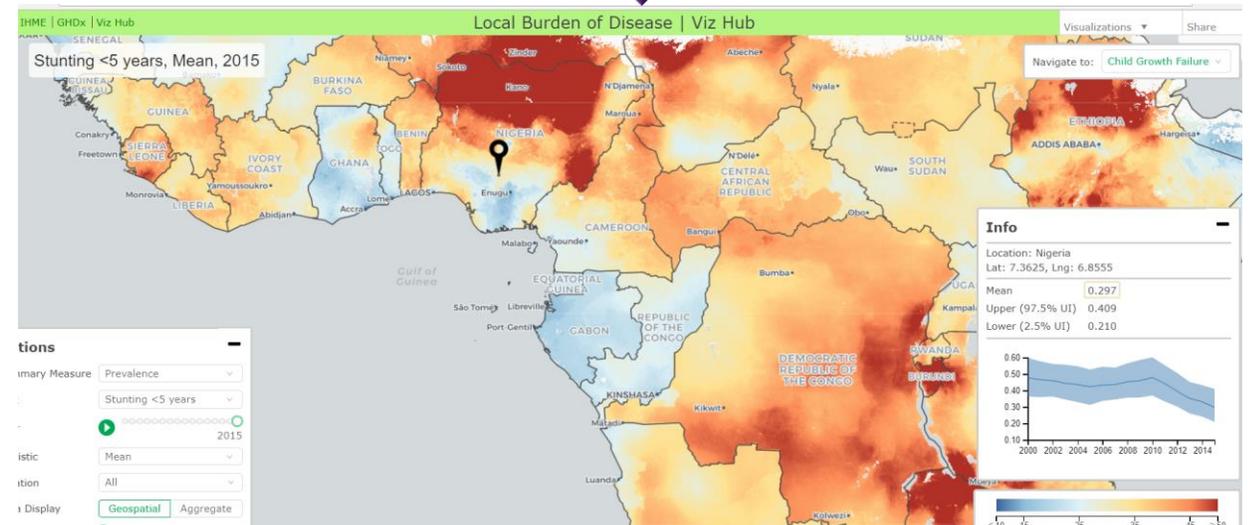
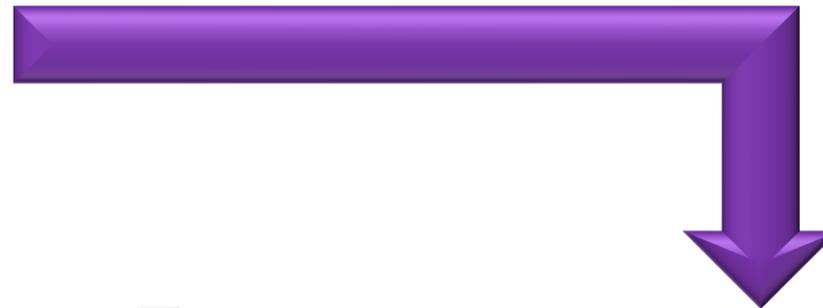
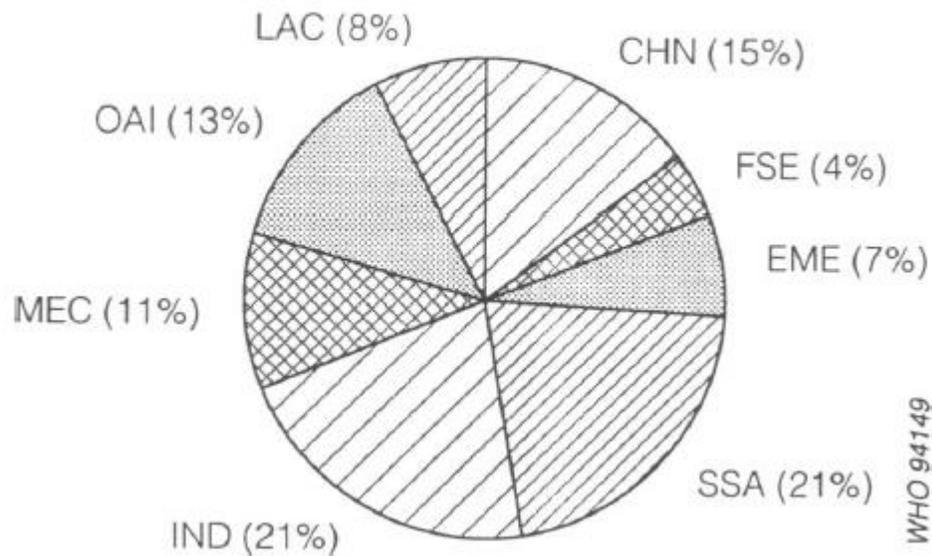
**Best available evidence for decision-making**

# GBD methodological improvements over the time

- Coverage of geographical locations
- Coverage of diseases and risk factors
- Different analytical approaches
- Updated tools for modeling
- Increasing number of input data
- Changes in normative values

# From *GLOBAL and REGIONAL* to *NATIONAL, SUBNATIONAL and LOCAL*

Fig. 2. Total DALYs, by region, as a percentage of global DALYs.



# More DISEASES and RISK FACTRS are covered

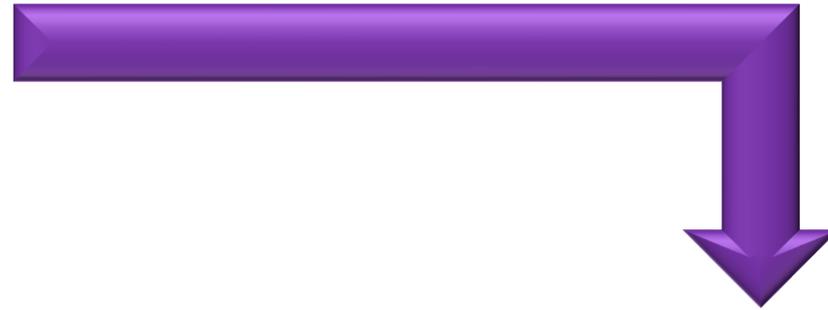
From 107 diseases and 10  
risk factors in GBD 1990



To 371 diseases/ injuries,  
3,499 sequelae and 87  
risk factors in 2021

# More advanced ANALYTIC approaches

Simple generic  
model (excel-based)



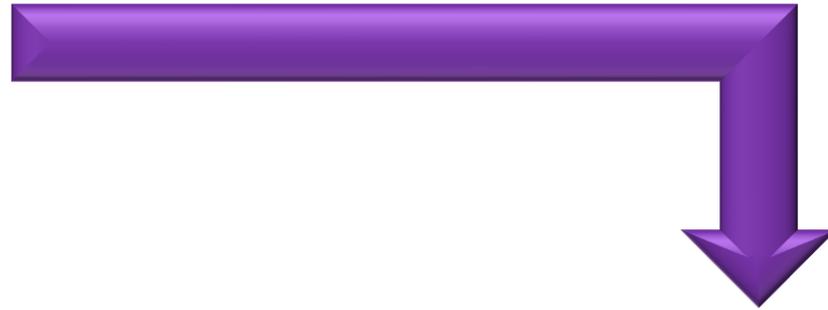
More advanced generic model  
(Bayesian Meta-regression)

+

Custom models

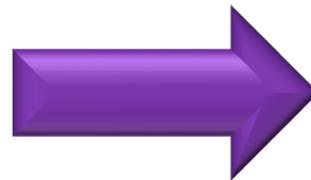
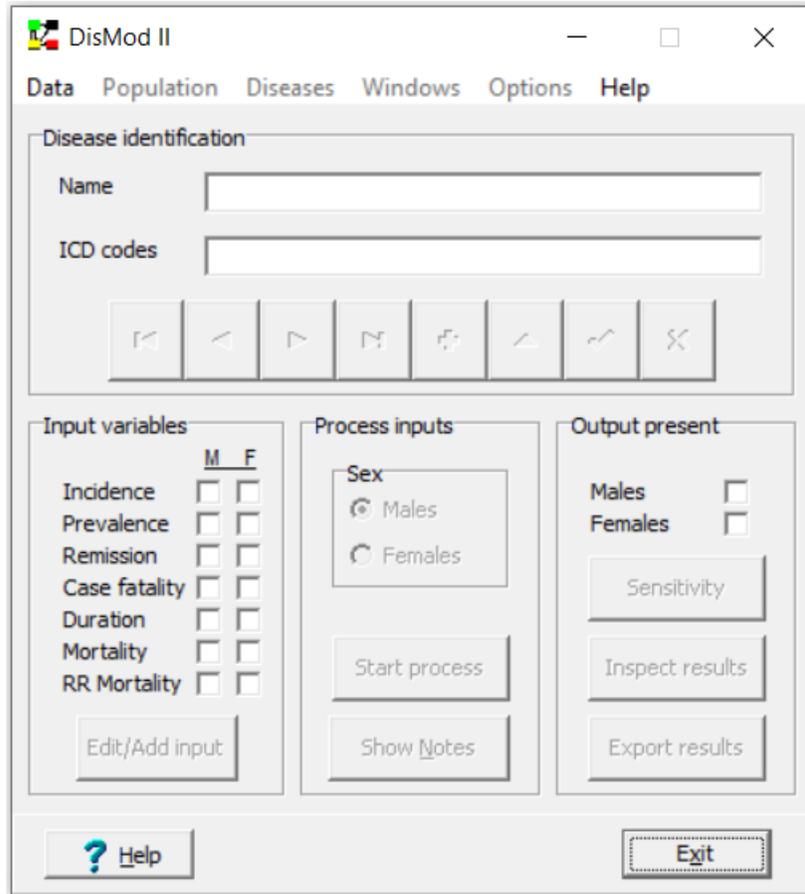
# More prominent role of COVARIATES in analysis

No or simple use of  
study-level covariates



Common use of study-level  
and location-level covariates

# Change in analytical approaches

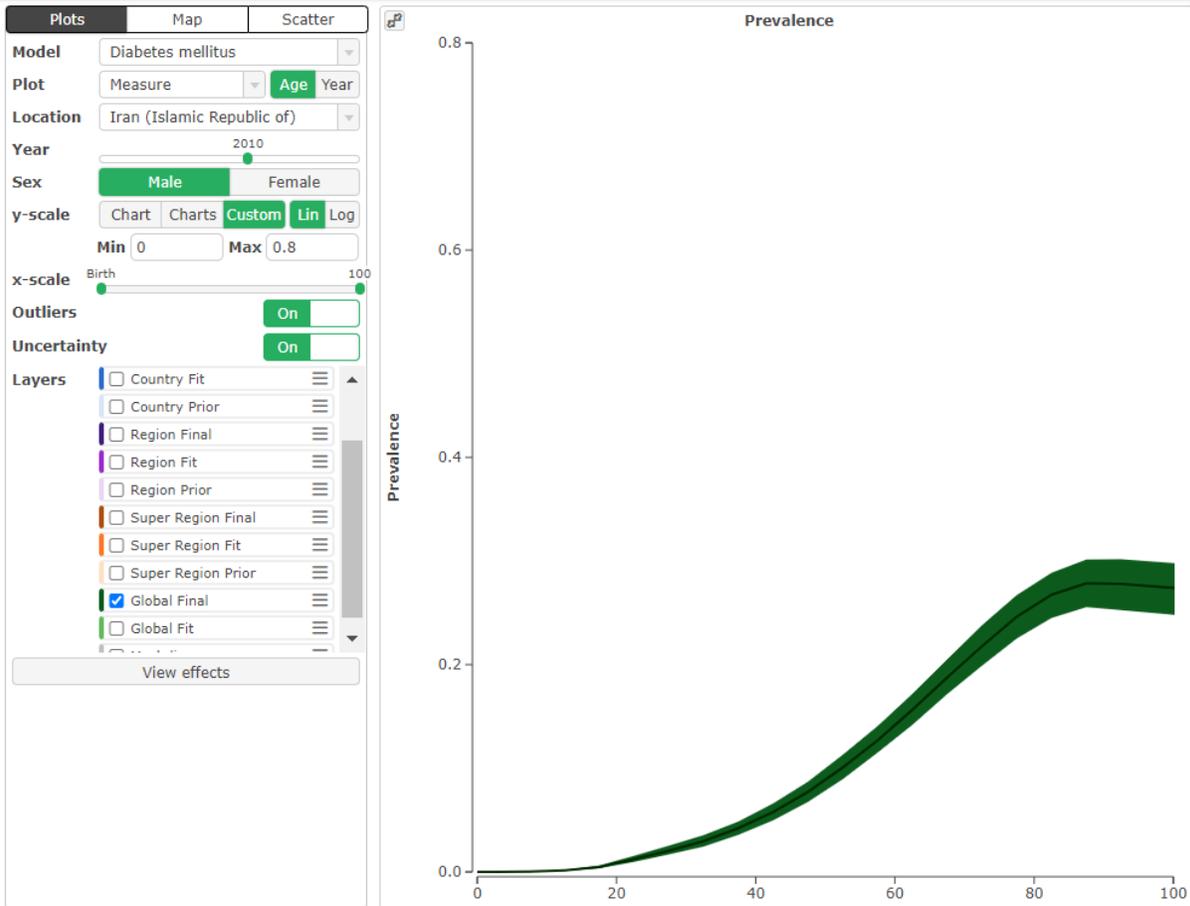


- DisMod MR, a Bayesian meta-regression tool
- Causes of Death Ensemble model (CODEm)
- Spatiotemporal Gaussian Process Regression (ST-GPR)

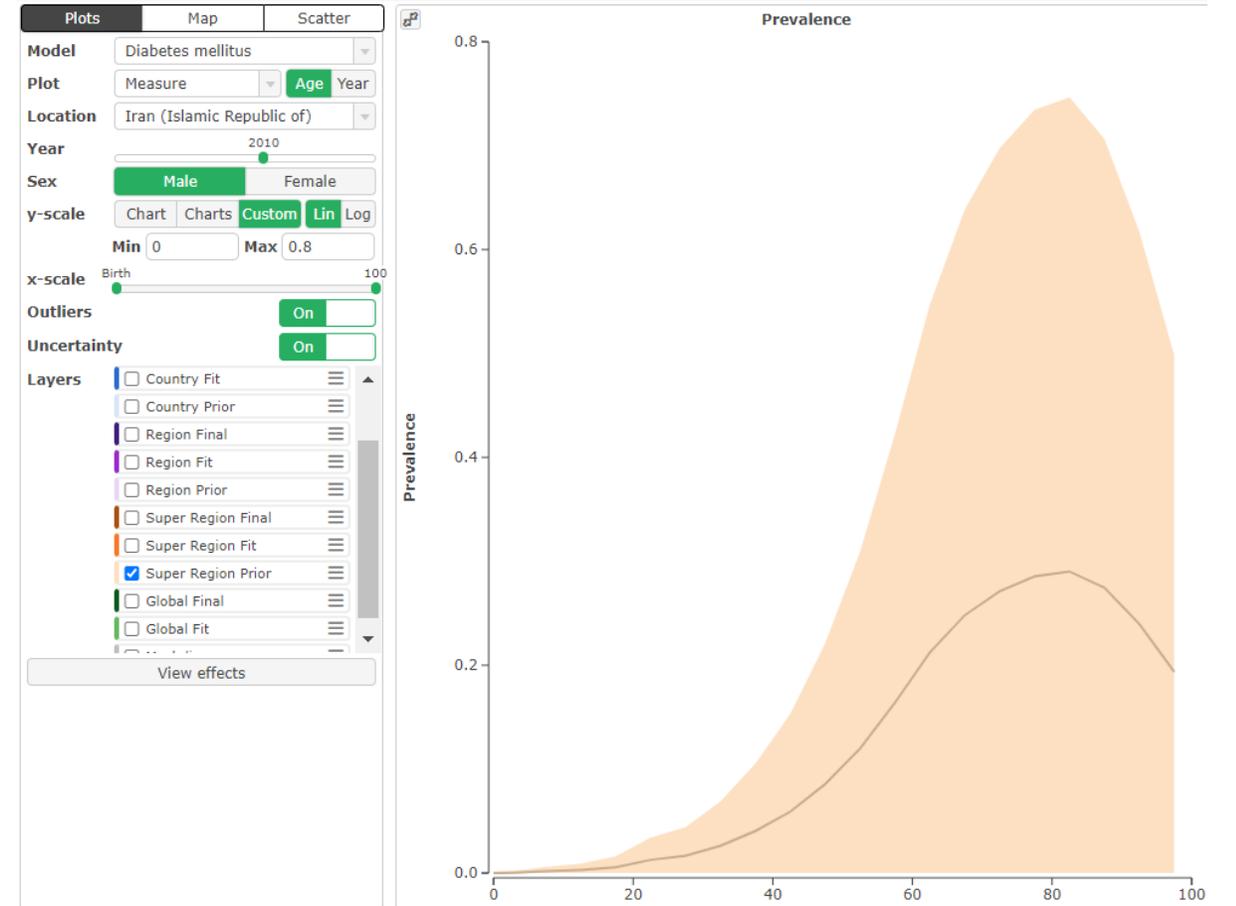
# Bayesian meta-regression approach

- Priors:
  - Global/ super-region/ Region for national levels
  - Experts' priors
  - Input local data
- Covariates
  - Study-level
  - Location-level

# Bayesian meta-regression approach



Global final



Super-region prior

# Bayesian meta-regression approach

Plots | Map | Scatter

Model: Diabetes mellitus

Plot: Measure | Age | Year

Location: Iran (Islamic Republic of)

Year: 2010

Sex: Male | Female

y-scale: Chart | Charts | Custom | Lin | Log

Min: 0 | Max: 0.8

x-scale: Birth | 100

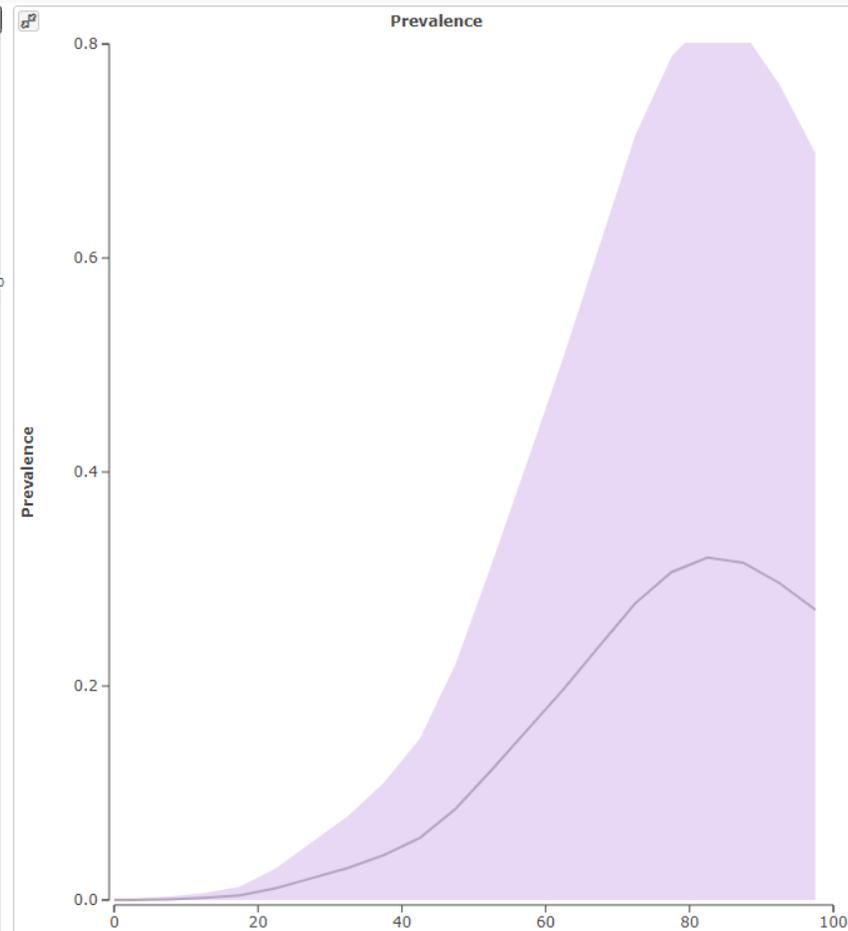
Outliers: On

Uncertainty: On

Layers:

- Country Fit
- Country Prior
- Region Final
- Region Fit
- Region Prior
- Super Region Final
- Super Region Fit
- Super Region Prior
- Global Final
- Global Fit

View effects



Region prior

Plots | Map | Scatter

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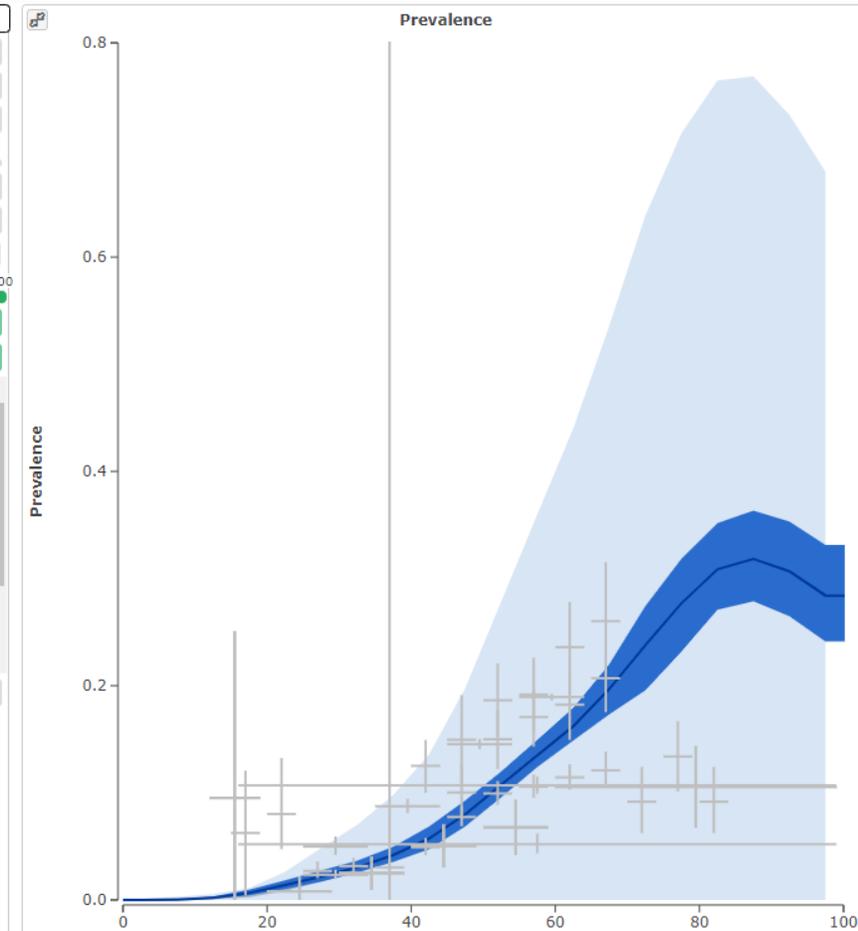
Outliers: On

Uncertainty: On

Layers:

- Input data
- Value: Unadjusted | Adjusted
- Country Final
- Country Prior
- Region Final
- Region Fit
- Region Prior
- Super Region Final
- Super Region Fit
- Super Region Prior

View effects



Country prior/ Country final/ Local input data

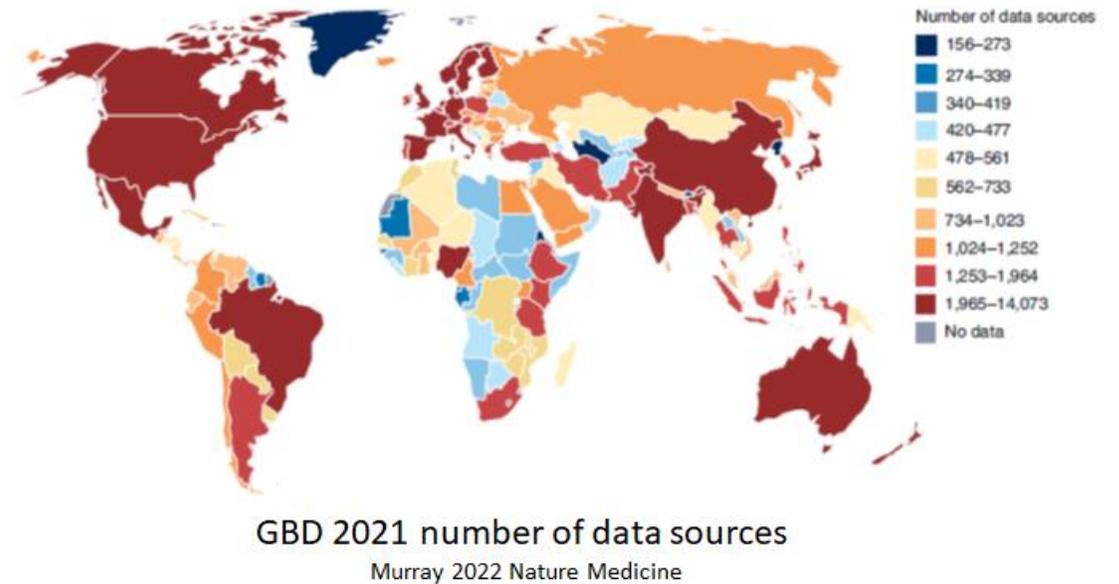
# Relative risk estimates

- Strength of risk-outcome relationship
  - Five-star rating
  - Risk-outcome score
  - Burden of proof; <https://vizhub.healthdata.org/burden-of-proof/>



# Differences between different GBD rounds

- Main reasons
  - Different sources of data that feed models
    - Access to more data through bilateral or multilateral agreements, individual level data
    - More sensitive electronic searches
  - Advanced computational approaches
  - GBD collaborators' role on improvement of data and methods



# Conclusion

- Burden of diseases/injuries and risk factors
  - Using the best available data to inform policies
  - Transparency in methods and reporting uncertainties
- Solutions for locations with sparse and poor-quality data
  - Systematic collection and analysis of data
  - Adjustment of input data
  - Bayesian meta-regression (and alternative statistical approaches)

**THANKS** for your attention!