



World Health
Organization

The Global Burden of Foodborne Disease

**Martyn Kirk on behalf of the Foodborne disease
Epidemiology Reference Group (FERG)**

Overview

- ▶ FERG: why, what, how?
- ▶ Global overview of burden
- ▶ Regional differences
- ▶ Policy implications
- ▶ Further work
- ▶ Conclusions





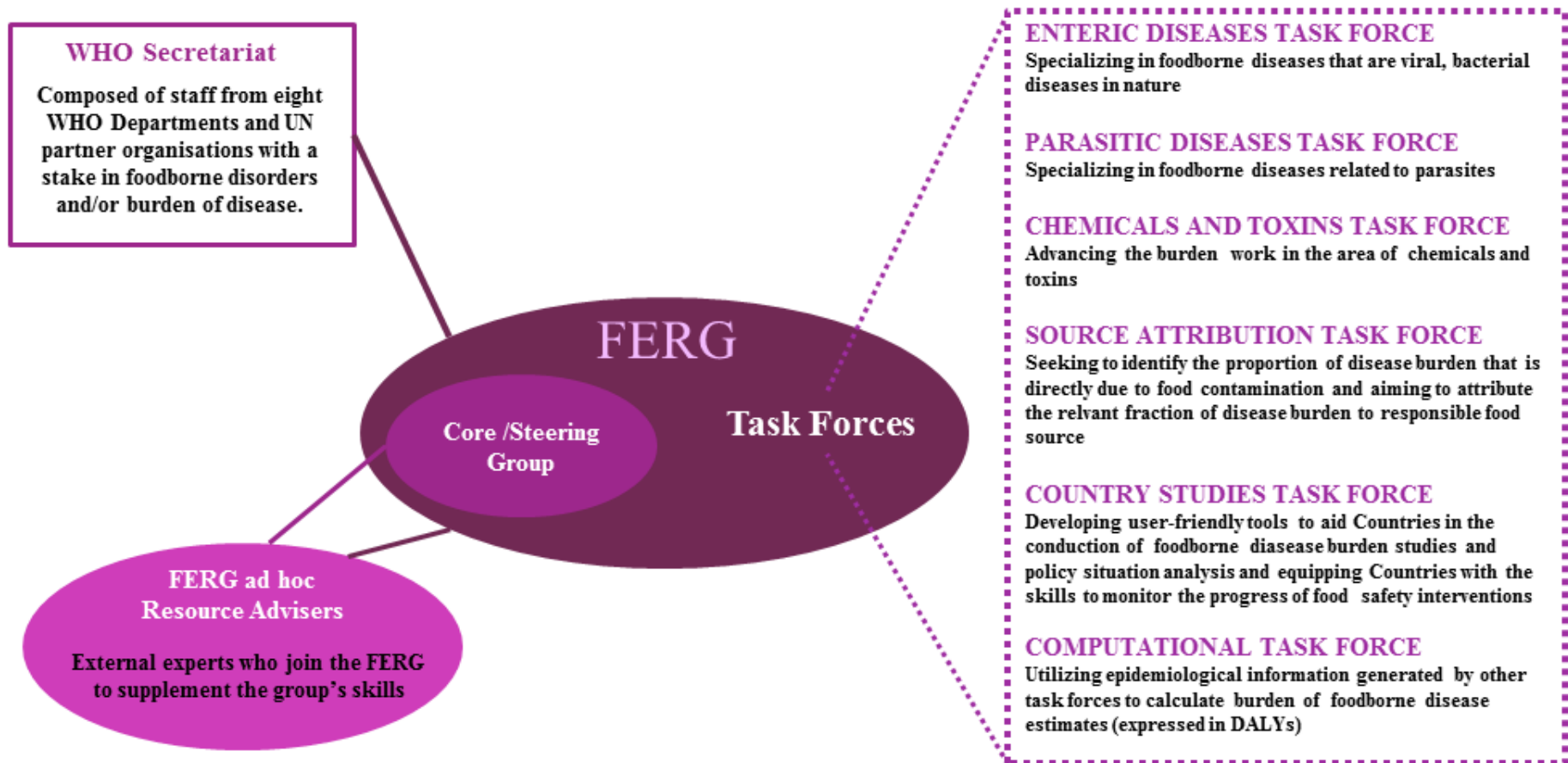


FERG Objectives

1. Mortality, morbidity and disability of foodborne diseases
2. Model disease burden where data lacking
3. Develop source attribution models
4. Tools to study foodborne burden in countries



FERG Structure



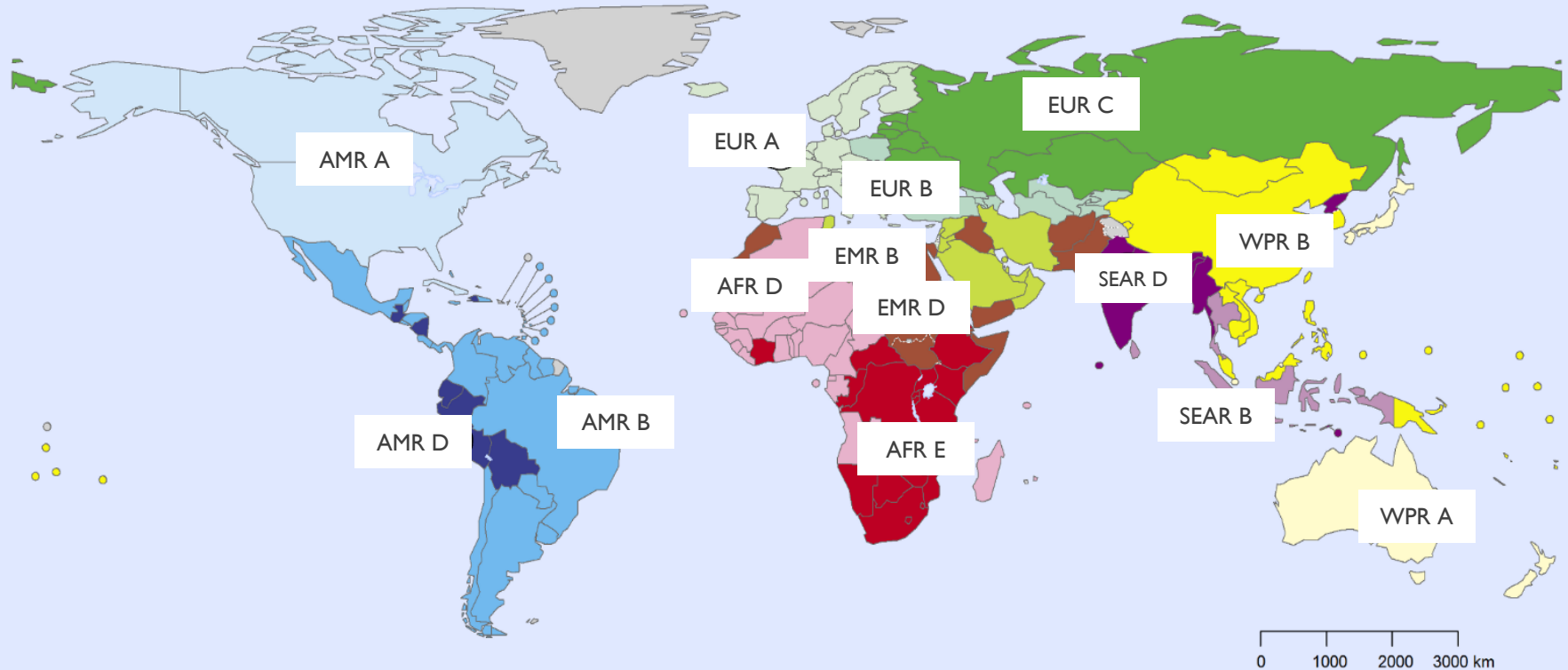
FERG Methods

- ▶ Global estimate incidence & mortality for 31 hazards
 - ▶ 11 acute diarrheal diseases
 - ▶ 7 invasive infectious disease
 - ▶ 10 helminths
 - ▶ 3 chemicals
- ▶ Estimates for high-income countries for 4 hazards
 - ▶ 4 bacterial toxins; 1 allergen
- ▶ Imputation and expert knowledge to fill data gaps
 - ▶ Uncertainty distribution instead of point estimate
 - ▶ Median, 95% uncertainty interval
- ▶ Calculated at country level

Disease Outcome Trees,
including sequelae



14 Sub-Regions



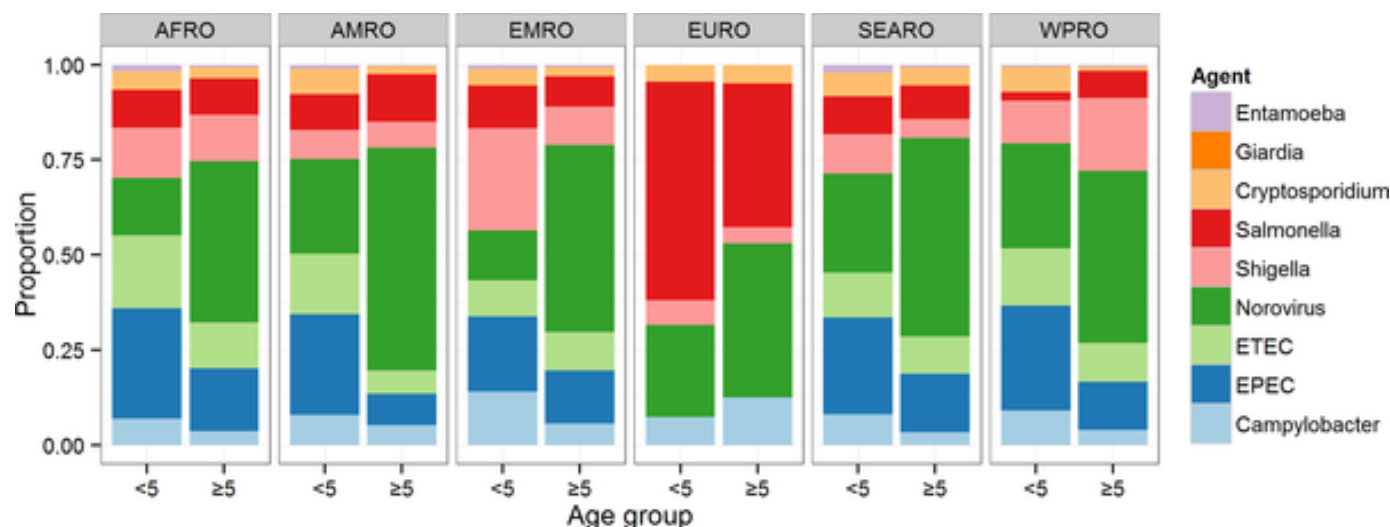
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Ezzati M, Lopez AD, Rodgers A, Vander Hoorn S, Murray CJ, Comparative Risk Assessment Collaborating Group. Selected major risk factors and global and regional burden of disease. *Lancet*. 2002;360(9343):1347–60.

► The Global Burden of Foodborne Disease

Diarrheal Diseases – CHERG Approach

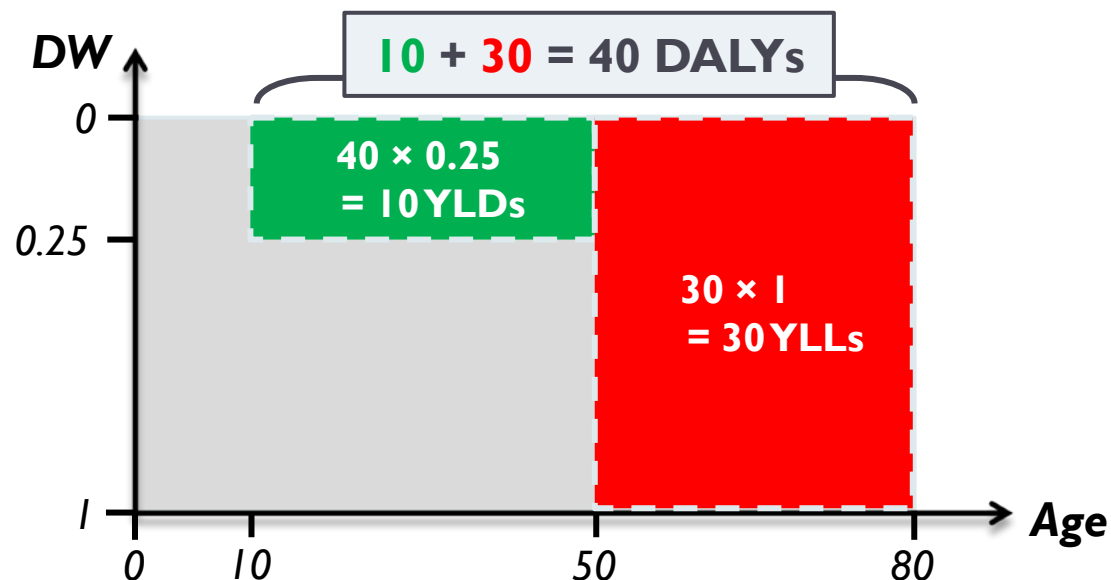
1. Envelope of diarrheal disease
 - ▶ Systematic reviews of diarrheal disease incidence
 - ▶ WHO estimate of diarrheal mortality
2. Systematic review of etiological agents in stool
 - ▶ Assumed inpatient proportion equated to mortality
3. Extrapolated to 133 middle & high mortality countries
 - ▶ Estimates by region
 - ▶ Global median applied to outliers & countries without data



Diarrheal Diseases – National Approach

- ▶ National etiology-specific estimates of foodborne incidence & mortality
 - ▶ Australia
 - ▶ Canada
 - ▶ France
 - ▶ New Zealand
 - ▶ The Netherlands
 - ▶ United Kingdom
 - ▶ United States of America
- ▶ Median & UI applied to 61 low mortality countries
 - ▶ EUR A, B, C, AMR A, WPR A

Disability-Adjusted Life Years

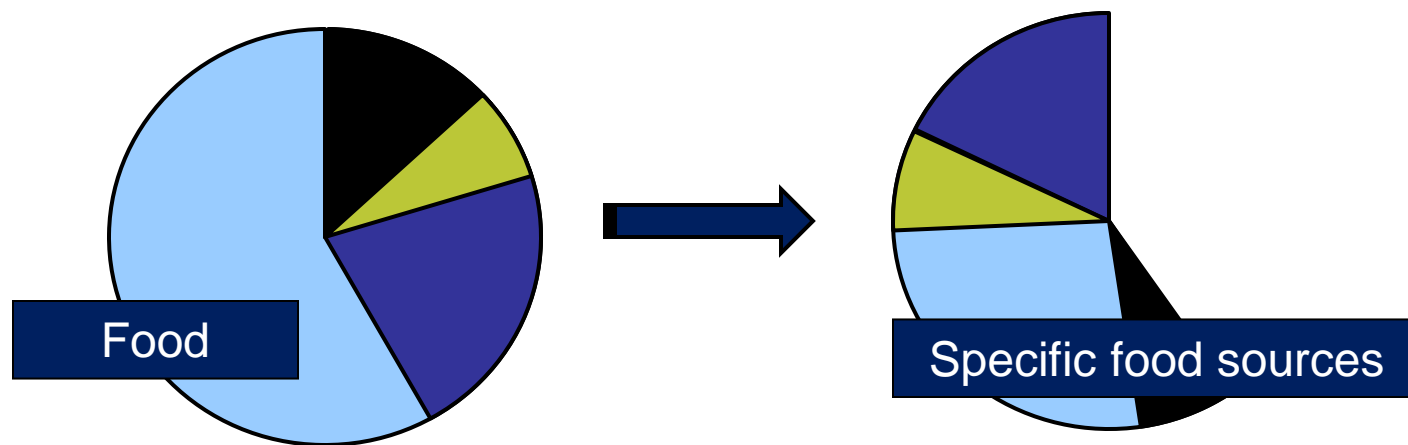


$$\text{DALY} = \text{YLD} + \text{YLL}$$

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

Source Attribution

- ▶ Proportion of disease attributable to food
- ▶ Identify reservoirs and/or food commodities
- ▶ Expert elicitation applied to hazards
 - ▶ Except those 100% foodborne
 - ▶ Hazards prioritised by thematic task forces
- ▶ Cooke's classical model



Expert Elicitation



Global Burden Foodborne Disease

Hazard group	Foodborne illnesses (millions)	Foodborne deaths (thousands)	Foodborne DALYs (millions)
All	600	420	33
Diarrheal	549	230	18
Invasive	36	117	8
Helminths	13	45	6
Chemicals	0.2	19	0.9



Most Frequent Global Foodborne....

- ▶ Illnesses: norovirus, *Campylobacter* spp.
- ▶ Deaths: non-typhoidal *Salmonella enterica*, *Salmonella* Typhi, *Taenia solium*, hepatitis A virus, aflatoxin
- ▶ DALYs: non-typhoidal *S. enterica*, enteropathogenic and enterotoxigenic *Escherichia coli*; *Taenia solium*, norovirus, *Campylobacter* spp.

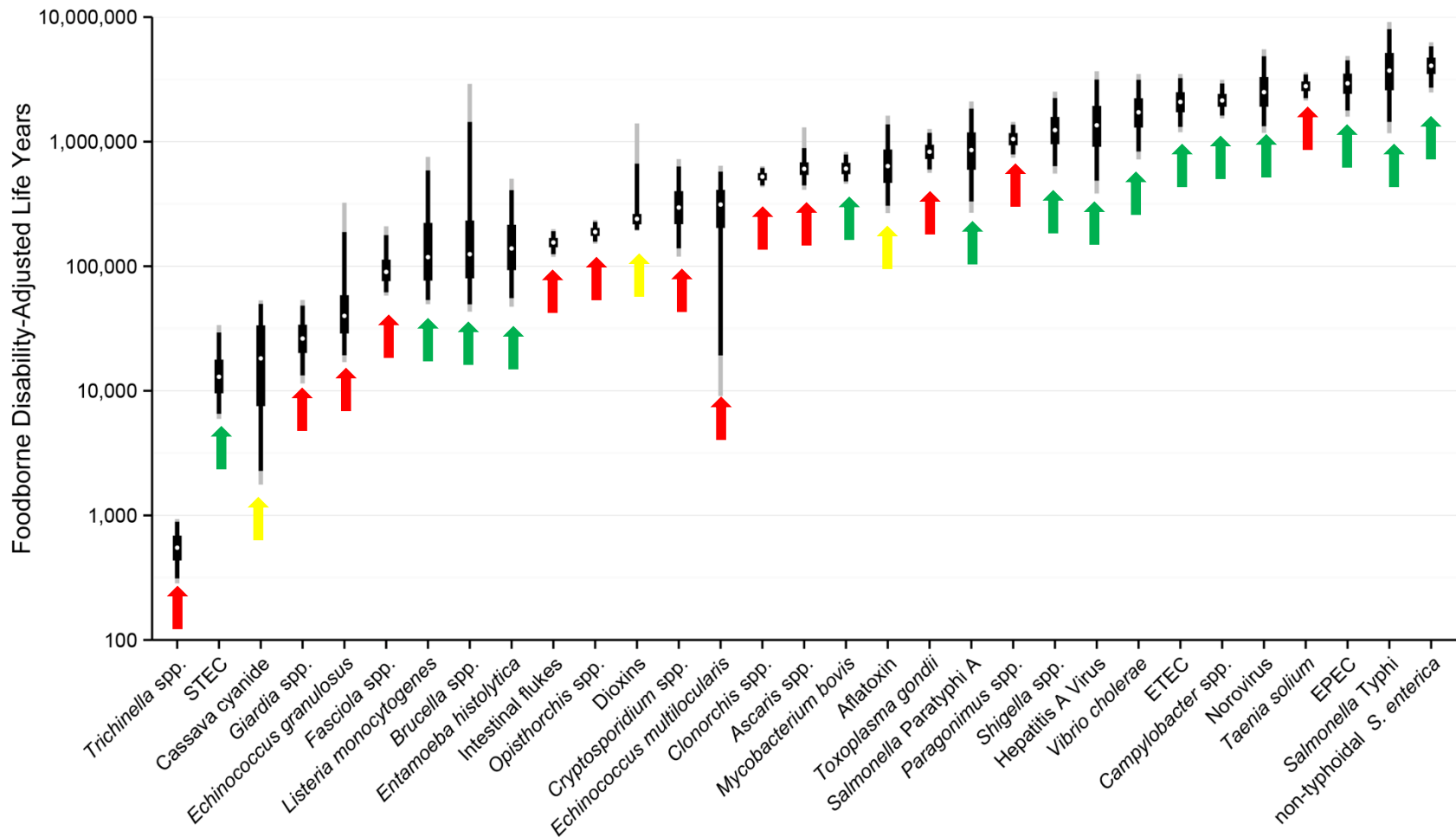


Global Findings

- ▶ 1 in 10 people in the world affected annually
- ▶ Diarrhea most common cause
 - ▶ 550,000 million cases
 - ▶ 230,000 deaths
 - ▶ non-typhoidal *Salmonella enterica* causes 60,000 deaths
 - ▶ including 22,000 iNTS deaths in non-HIV patients
- ▶ Diarrhea >50% global foodborne DALYs

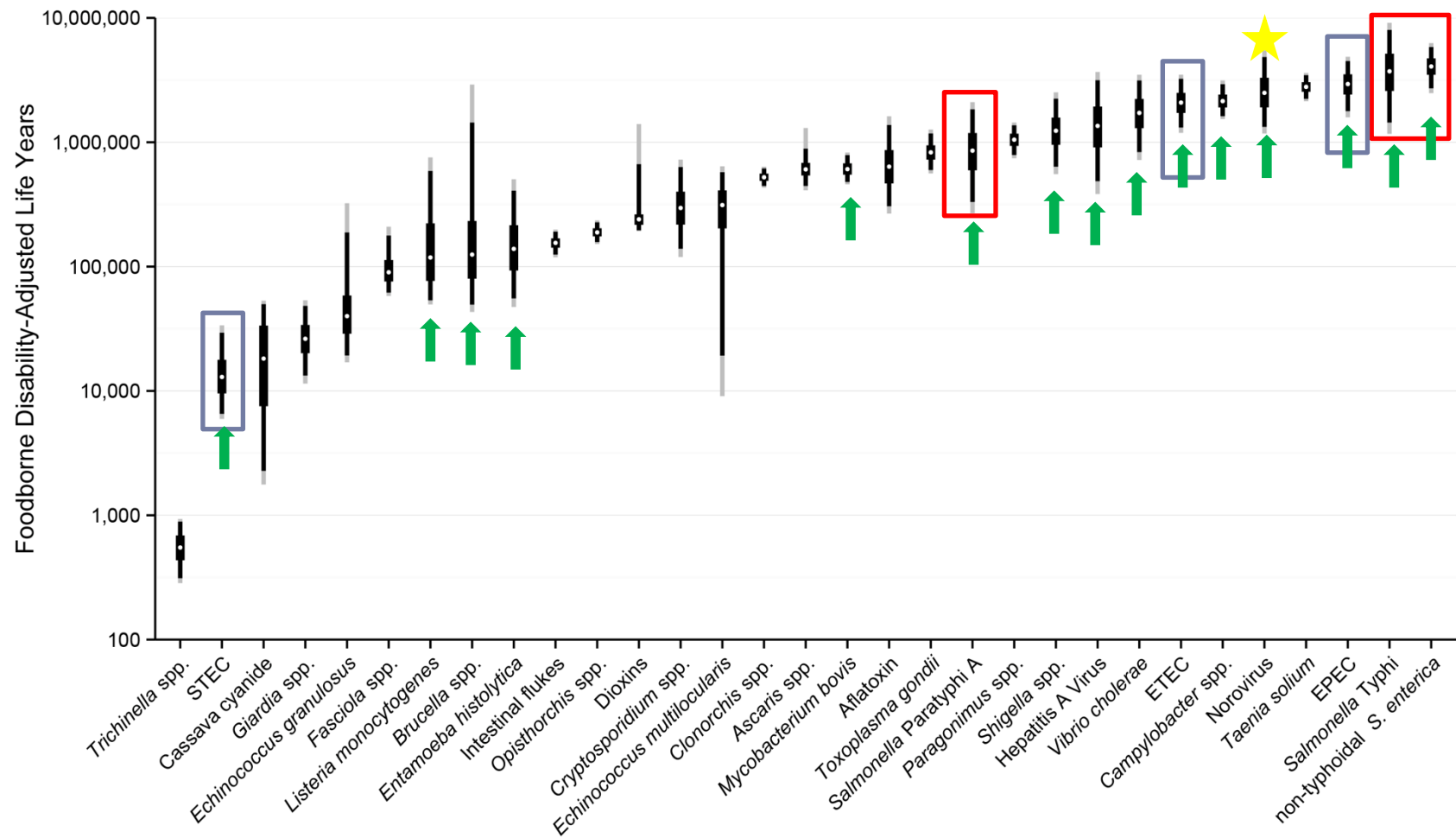


Foodborne Hazards Ranking DALYs

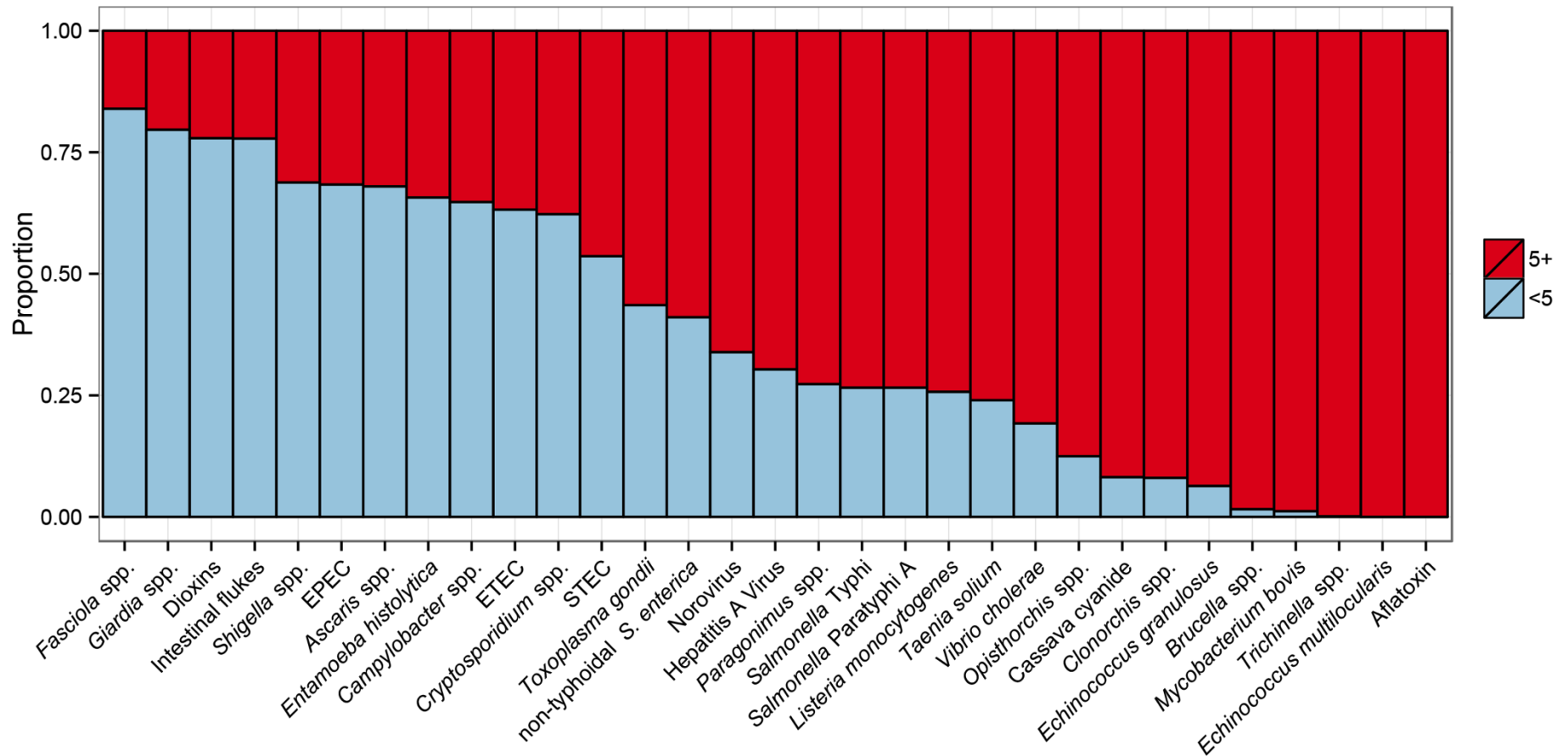


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Foodborne Hazards Ranking DALYs



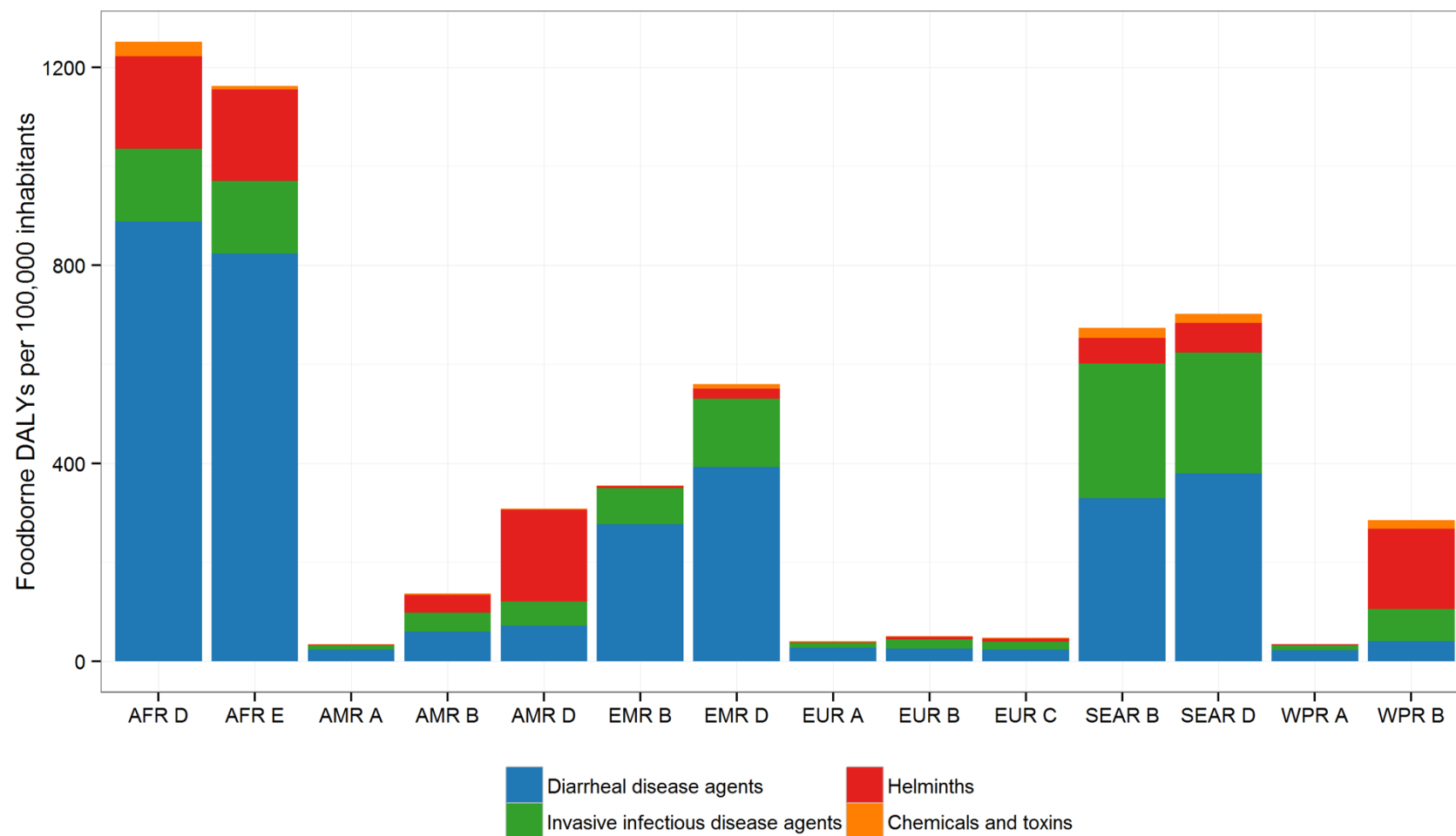
Age Distribution DALYs



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- 
- ▶ **9% of world population**
 - ▶ **38% of foodborne illnesses**
 - ▶ **30% of foodborne deaths**
 - ▶ **40% of foodborne DALYs**

Regional Differences



- 
- ▶ 41% of the world population
 - ▶ 53% of foodborne illnesses
 - ▶ 75% of foodborne deaths
 - ▶ 72% of foodborne DALYs

Food Safety Implications

- ▶ Unsafe food results in significant burden
 - ▶ Particularly for children
- ▶ Regional differences highlight preventability
 - ▶ Economic development & effective food safety systems
 - ▶ Need preventive risk-based systems
- ▶ Regional food safety strategies
- ▶ Globally important pathogens need novel controls
- ▶ Food safety needs new intelligence base

Limitations

- ▶ Data availability and quality
 - ▶ Particularly low-income countries
 - ▶ Imputation and expert judgment
 - ▶ Presentation at regional level rather than country level
 - ▶ Large uncertainty intervals
- ▶ Underestimation
 - ▶ Limited number of hazards
 - ▶ Not all endpoints considered, eg - stunting
 - ▶ HIV-positive burden excluded
 - ▶ Metrics do not quantify full societal impact
 - ▶ Indirect transmission of disease agents from food production

Next Steps...

- ▶ High-level advocacy
- ▶ Country studies
- ▶ Elucidate burden from chemicals
- ▶ Intervention studies focusing on food
- ▶ Burden estimates for specific food commodities
- ▶ Animal & human vaccines
- ▶ Economic analysis

Conclusions

- ▶ WHO established comprehensive estimates
- ▶ Address lack of data for food safety policy
- ▶ Burden considerable...despite gaps & limitations
- ▶ Largely borne by children & low-income countries
- ▶ Priority hazards differ between regions
- ▶ Control methods exist for many hazards
- ▶ Need novel interventions

More information

- ▶ **WHO website**

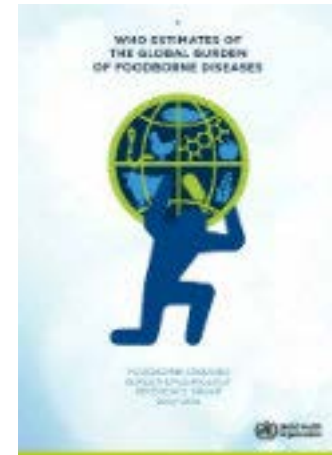
http://www.who.int/foodsafety/areas_work/foodborne-diseases/ferg/en/

- ▶ **PLOS collection**

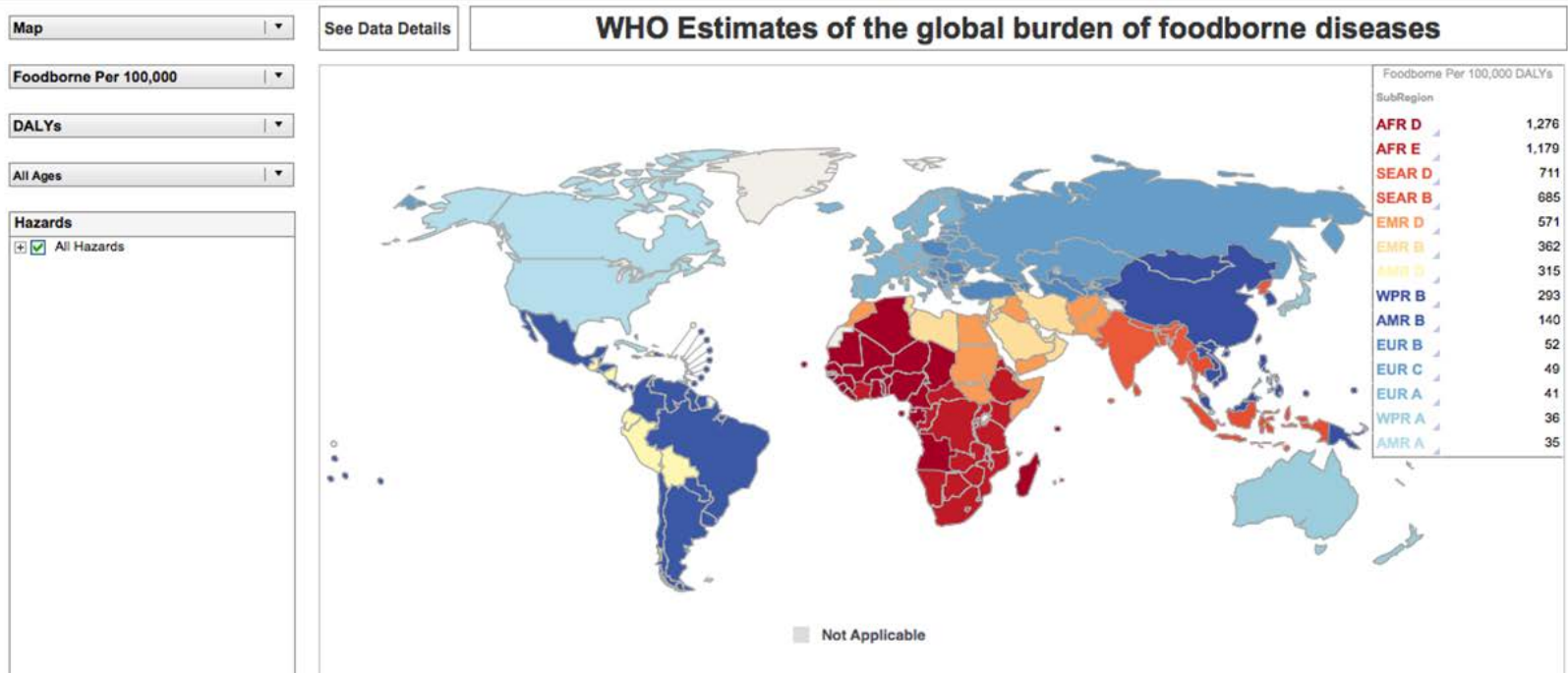
<http://collections.plos.org/ferg2015>

- ▶ **Interactive tool**

https://extranet.who.int/sree/Reports?op=vs&path=/WHO_HQ_Reports/G36/PROD/EXT/FoodborneDiseaseBurden



Interactive tool



Data provided is for 2010, Median

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Intestinal flukes * Includes selected species of the families Echinostomatidae, Fasciolidae, Gymnophallidae, Heterophyidae, Nanophyetidae, Neodiplostomidae and Plagiorchiidae (depending on data availability).

¹ The subregions are defined on the basis of child and adult mortality as described by Ezzati et al (1). Stratum A: very low child and adult mortality, Stratum B: low child mortality and very low adult mortality, Stratum C: low child mortality and high adult mortality, Stratum D: high child and adult mortality, and Stratum E: high child mortality and very high adult mortality. The use of the term 'subregion' here and throughout the text does not identify an official grouping of WHO Member States, and the 'subregions' are not related to the six official WHO regions. AFR = African Region; AMR = Region of the Americas; EMR = Eastern Mediterranean Region; EUR = European Region; SEAR = South-East Asia Region; WPR = Western Pacific Region. ² South Sudan was reassigned to the WHO African Region in May 2013. As this study relates to time periods prior to this date, estimates for South Sudan were included in the WHO Eastern Mediterranean Region.

The boundaries and names shown and the designations used on this map do not imply the expression of any opinion whatsoever on the part of the World Health Organization concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Dotted and dashed lines on maps represent approximate border lines for which there may not yet be full agreement.

Data Source: World Health Organization Map Production: Foodborne Disease Burden Epidemiology Reference Group (FERG), World Health Organization



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Acknowledgements

- ▶ FERG Core Group
- ▶ FERG members
- ▶ Resource advisers
- ▶ Attribution experts
- ▶ WHO secretariat
- ▶ IHME, Seattle, WA
- ▶ ECDC, Solna, Sweden
- ▶ Stakeholders
- ▶ Funding: Netherlands, Japan, CDC, FDA, FSIS, individual scientists, WHO member states supporting FERG experts

Questions?

