



Rijksinstituut voor Volksgezondheid  
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Welzijn en Sport*

## Current public health problems related to pork

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Brussels, 25 October 2010

# Main hazards associated with pork consumption

- *Campylobacter* spp.
  - *Listeria monocytogenes*
  - *Mycobacterium* spp.
  - *Salmonella* spp.
  - *Staphylococcus aureus*
  - VTEC
  - *Yersinia* spp.
  
  - Hepatitis E virus
- *Ascaris suum*
  - *Echinococcus* spp.
  - *Cryptosporidium* spp.
  - *Taenia solium*
  - *Trichinella* spp.
  - *Toxoplasma gondii*
  
  - Antimicrobial resistance

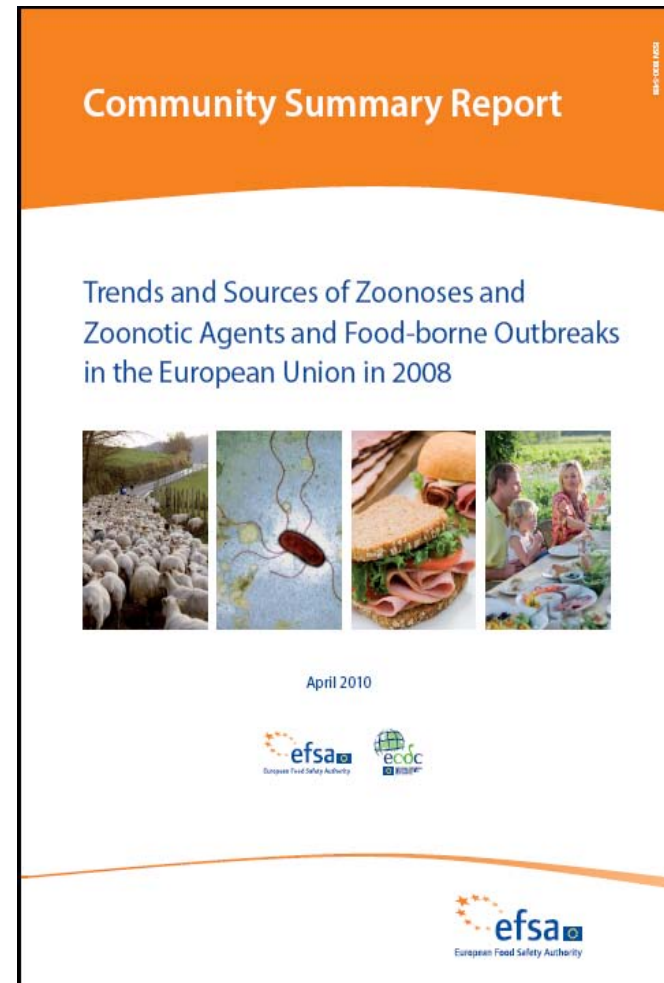
# What are the risks and how do they compare?

- Epidemiology
  - Incidence
  - Mortality
  - Severity
  - Attribution

- (Comparative) risk assessment
  - Risk Ranger
  - sQMRA
  - iRisk

# Data on human illness at EU level

- Available data in Annual Community Summary Report on Trends and Sources of Zoonoses and Zoonotic Agents and Food-borne Outbreaks in the European Union (Annual)



# Main hazards associated with pork consumption: data availability EU

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# Foodborne outbreaks in 2008

Figure OUT4. | *Distribution of implicated foodstuffs in verified outbreaks in the EU, 2008*

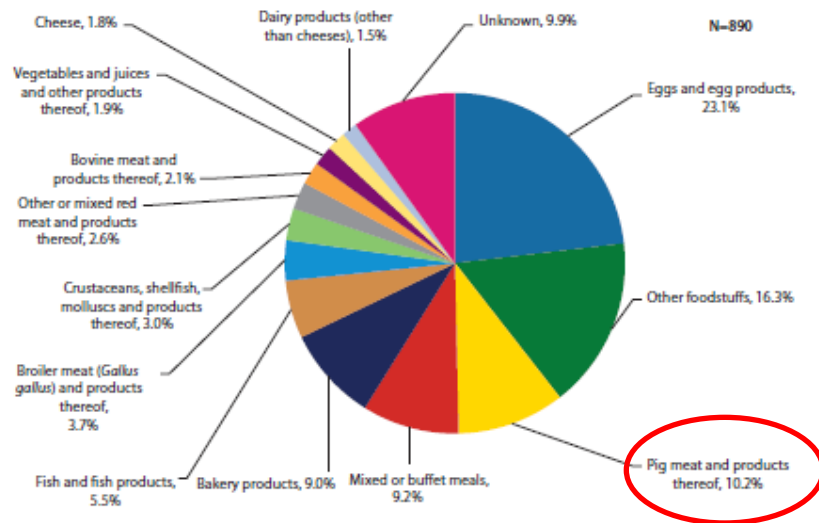
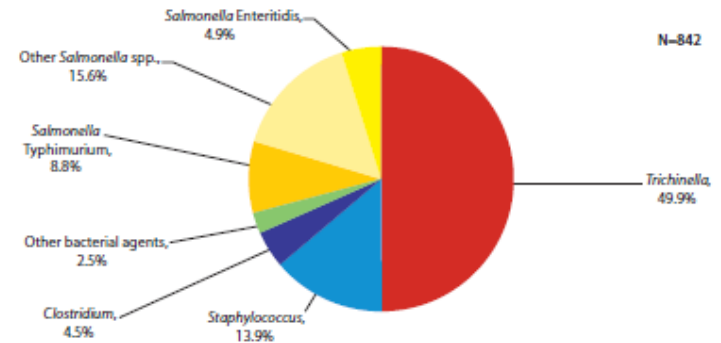
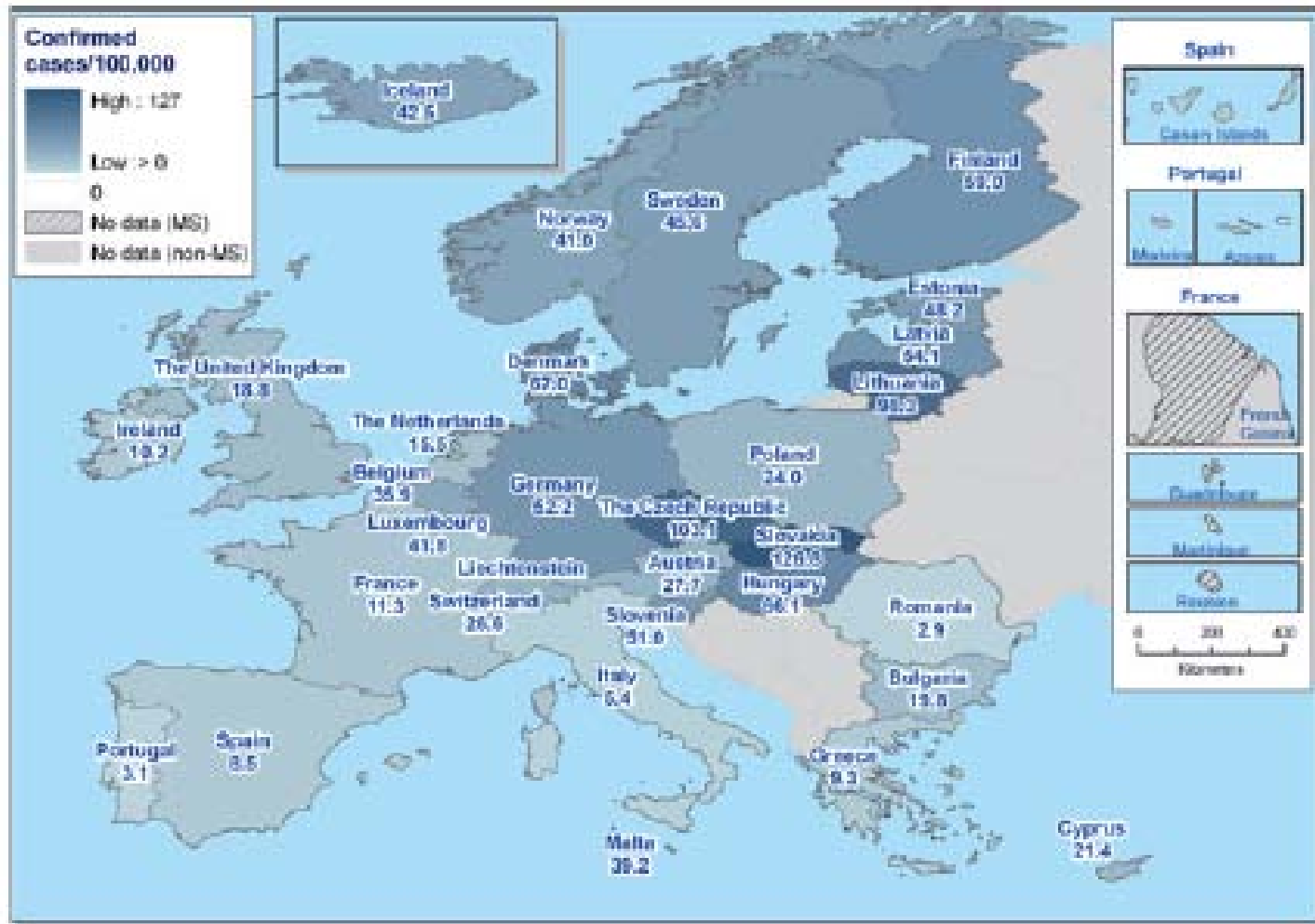


Figure OUT7. | *Distribution of human cases caused by pig meat and products thereof in the EU, 2008*



# Reported incidence of human salmonellosis in the EU

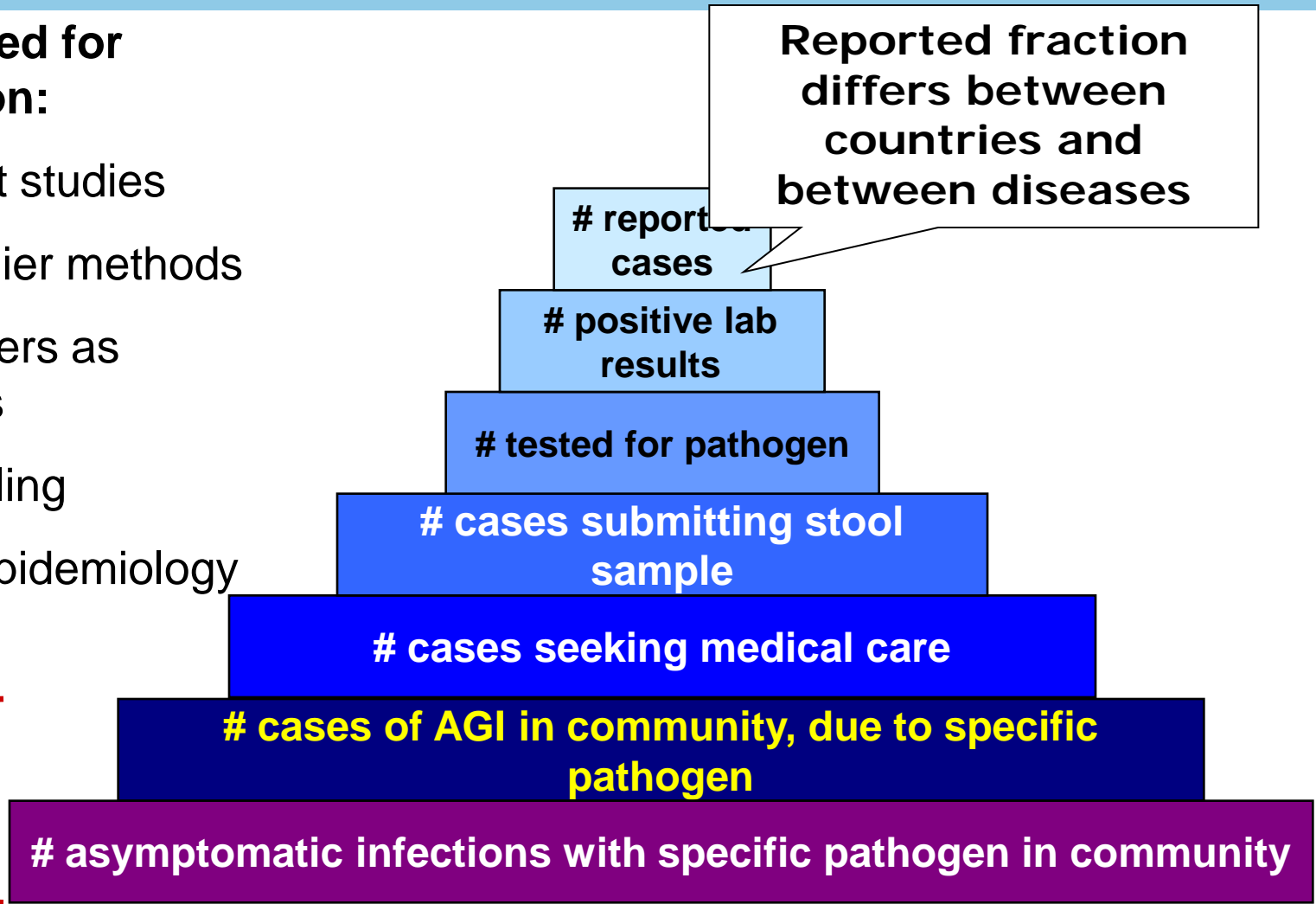


# The surveillance pyramid for gastrointestinal pathogens

## Methods used for calibration:

- Cohort studies
- Multiplier methods
- Travelers as sentinels
- Modelling
- Seroepidemiology

sero-  
survey of  
population

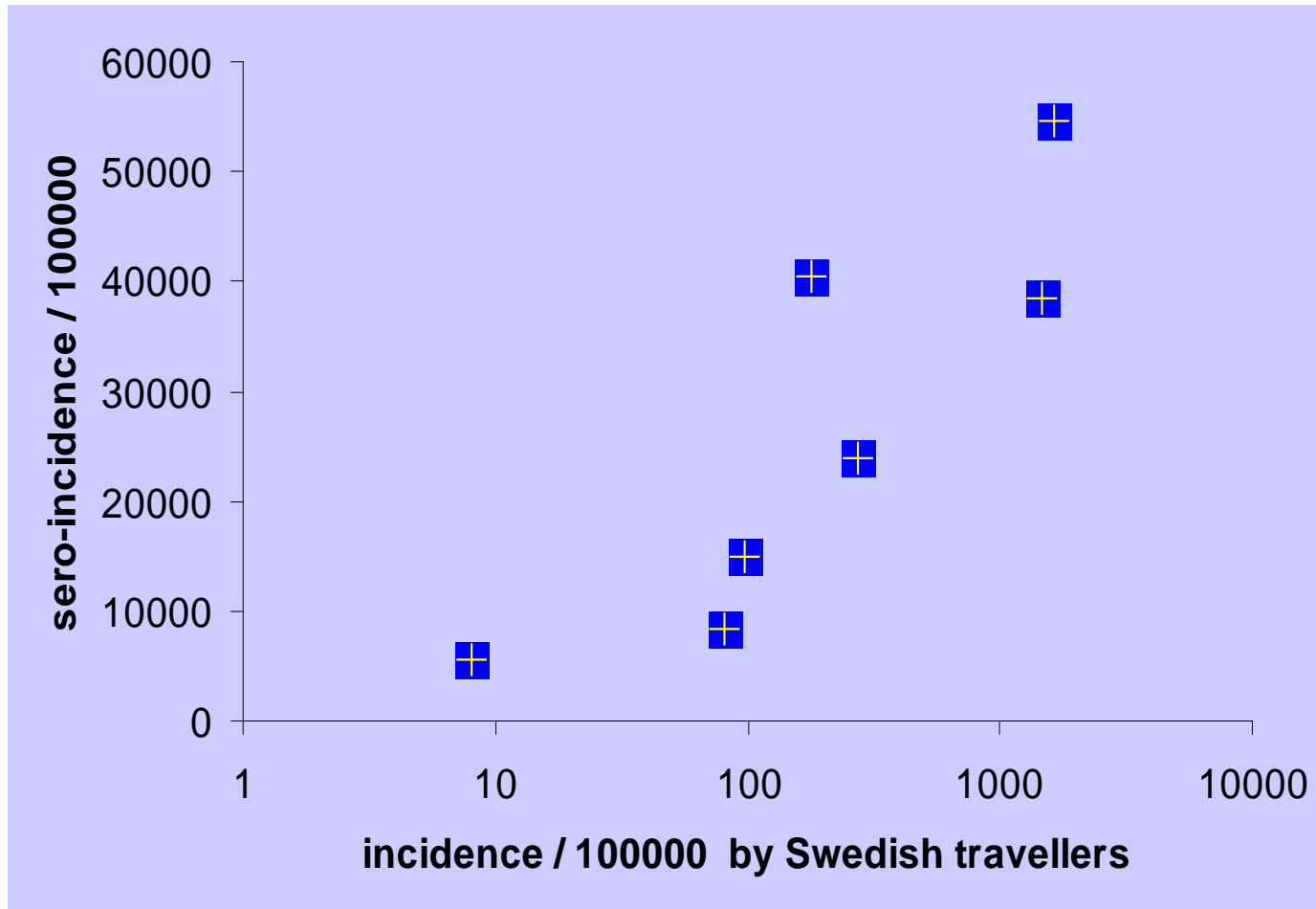








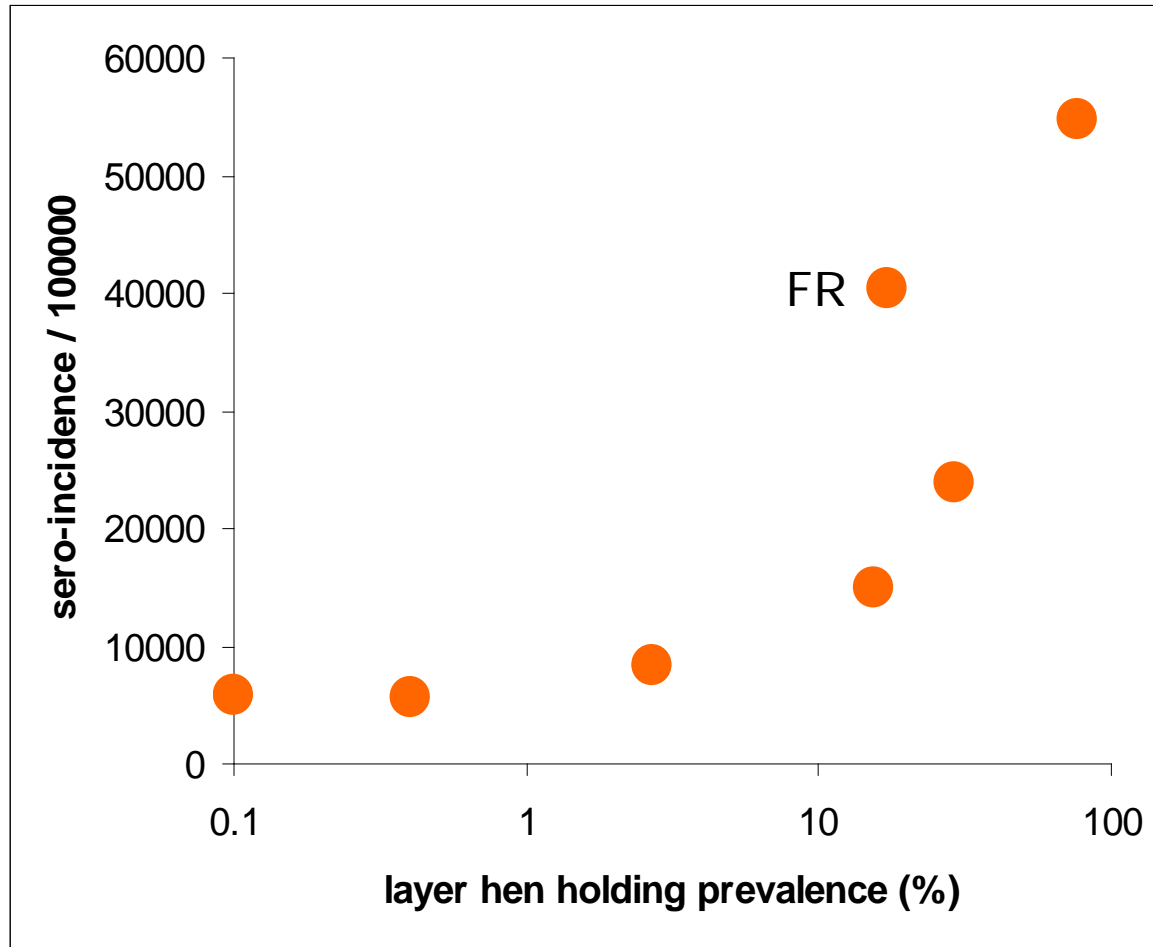
# Salmonella sero-incidence and incidence estimates in Swedish travelers



**Spearman's rho=0.9, p=0.007**

\* Data from: de Jong B, Ekdahl K. The comparative burden of salmonellosis in the European Union member states, associated and candidate countries. BMC Public Health 2006; 6:4 doi:10.1186/1471-2458-6-4

# Salmonella prevalence in layers (baseline study, all serovars) and sero-incidence



**Spearman's  $\rho=0.90$ ,  $p=0.005$**

# What are the priorities?

Outcome	Norovirus	Rotavirus	Campylobacter	Salmonella
Gastro-enteritis	640,000	300,000	79,000	43,000
GE – visit to GP	16,000	21,000	19,000	7,600
GE – hospital	2,000	4,400	570	650
GE – death	6	2	46	47
Reactive arthritis	-	-	1,500	1,700
Guillain-Barré S.	-	-	65	-
Irr. Bowel Syndrome	-	-	6,900	3,900

# HALYs: integrated measures of disease burden

- Integrate morbidity and mortality
- Incorporate age and health status of those affected
- Address incidence, severity and duration of adverse health consequences
- One example, frequently used in public health:  
Disability Adjusted Life Years

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

- mortality: years of life lost

$$\text{YLL} = \sum_{\text{all diseases}} (D \times e)$$

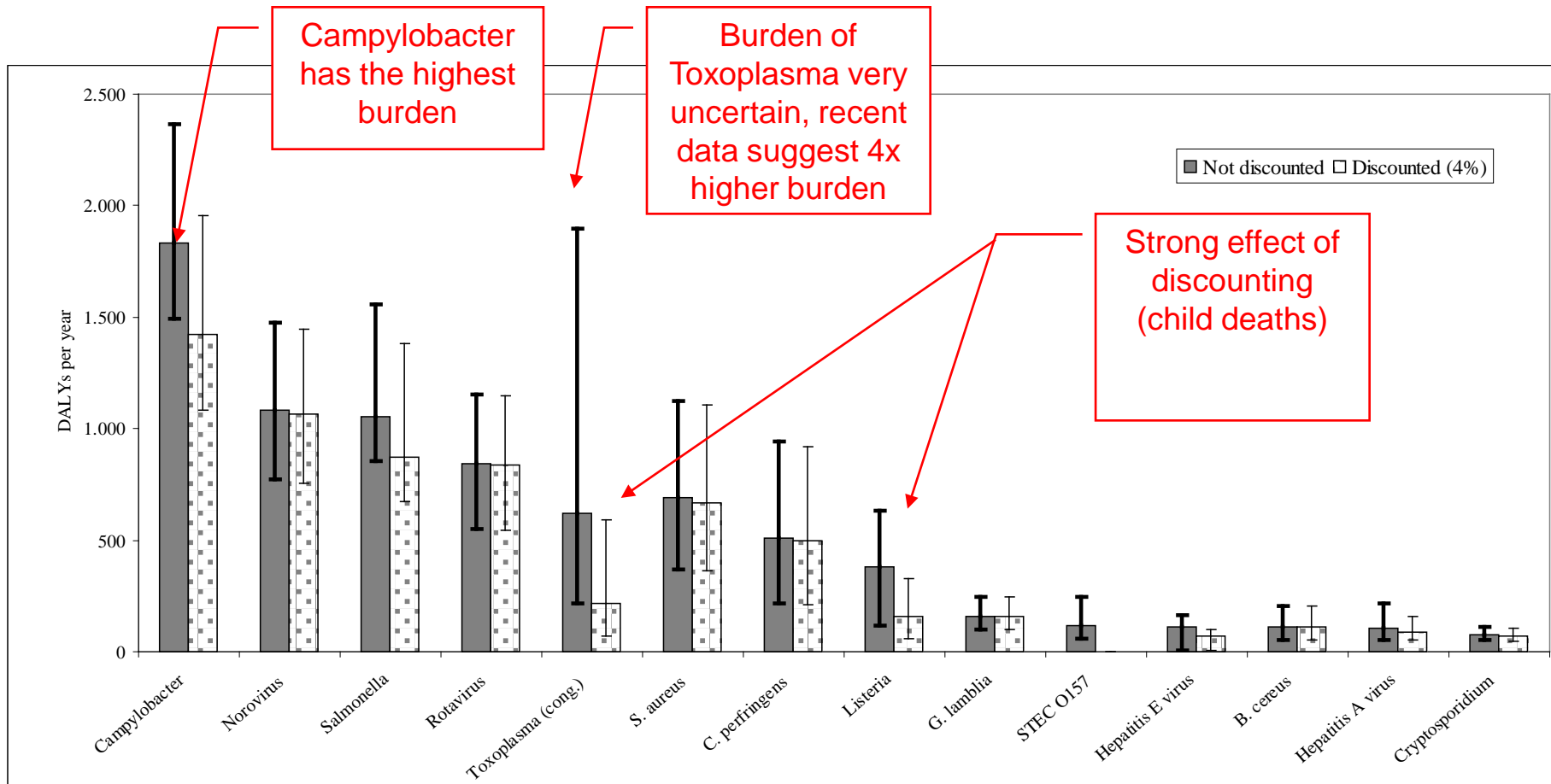
D: number of deaths; e: life expectancy of fatal cases

- morbidity: years lived with disability, weighted for severity of illness

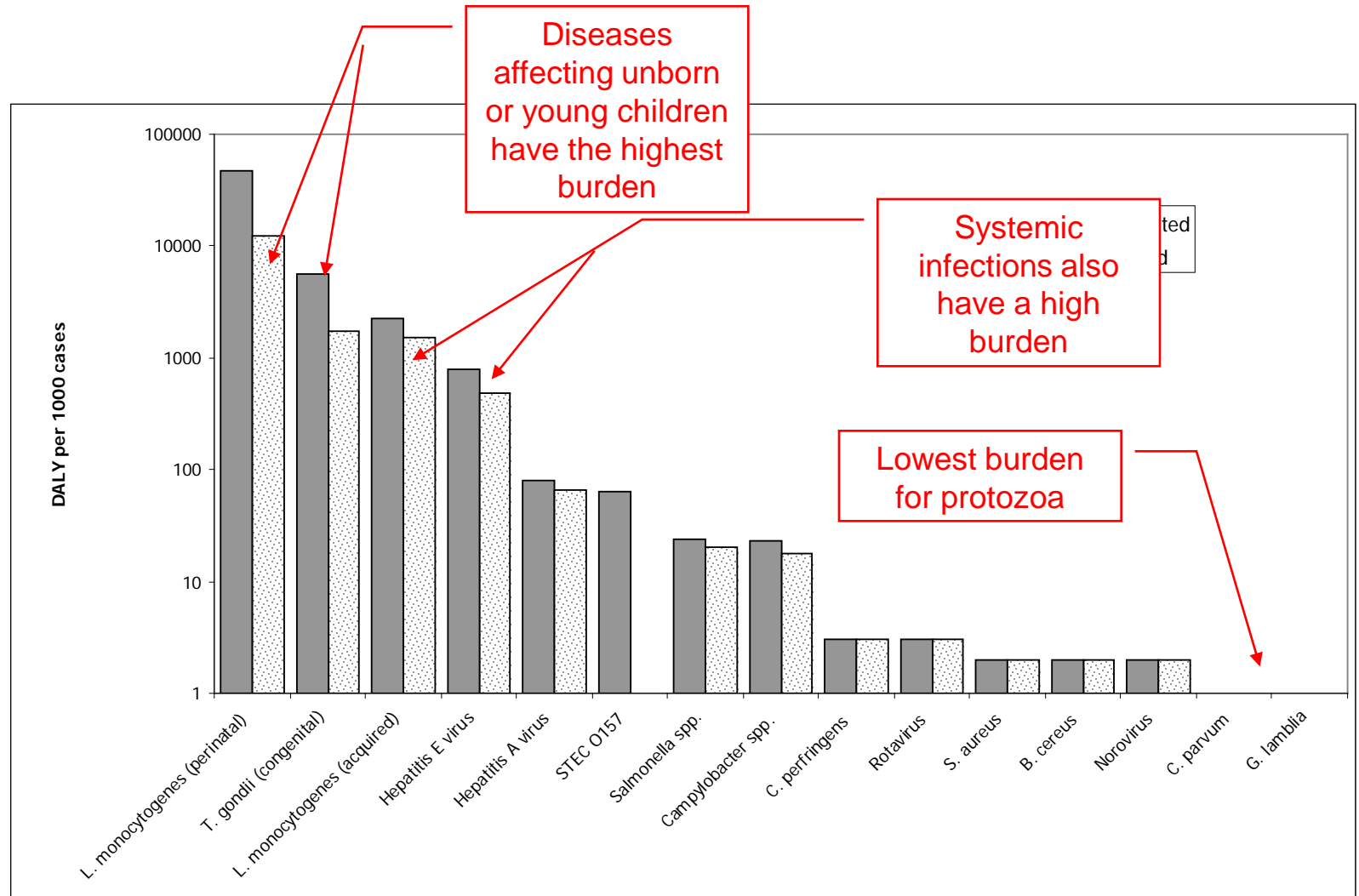
$$\text{YLD} = \sum_{\text{all diseases}} (N \times t \times w)$$

N: number of non-fatal cases; t: duration, w: severity weight

# Disease burden in the Netherlands (all sources)



# Disease burden per case

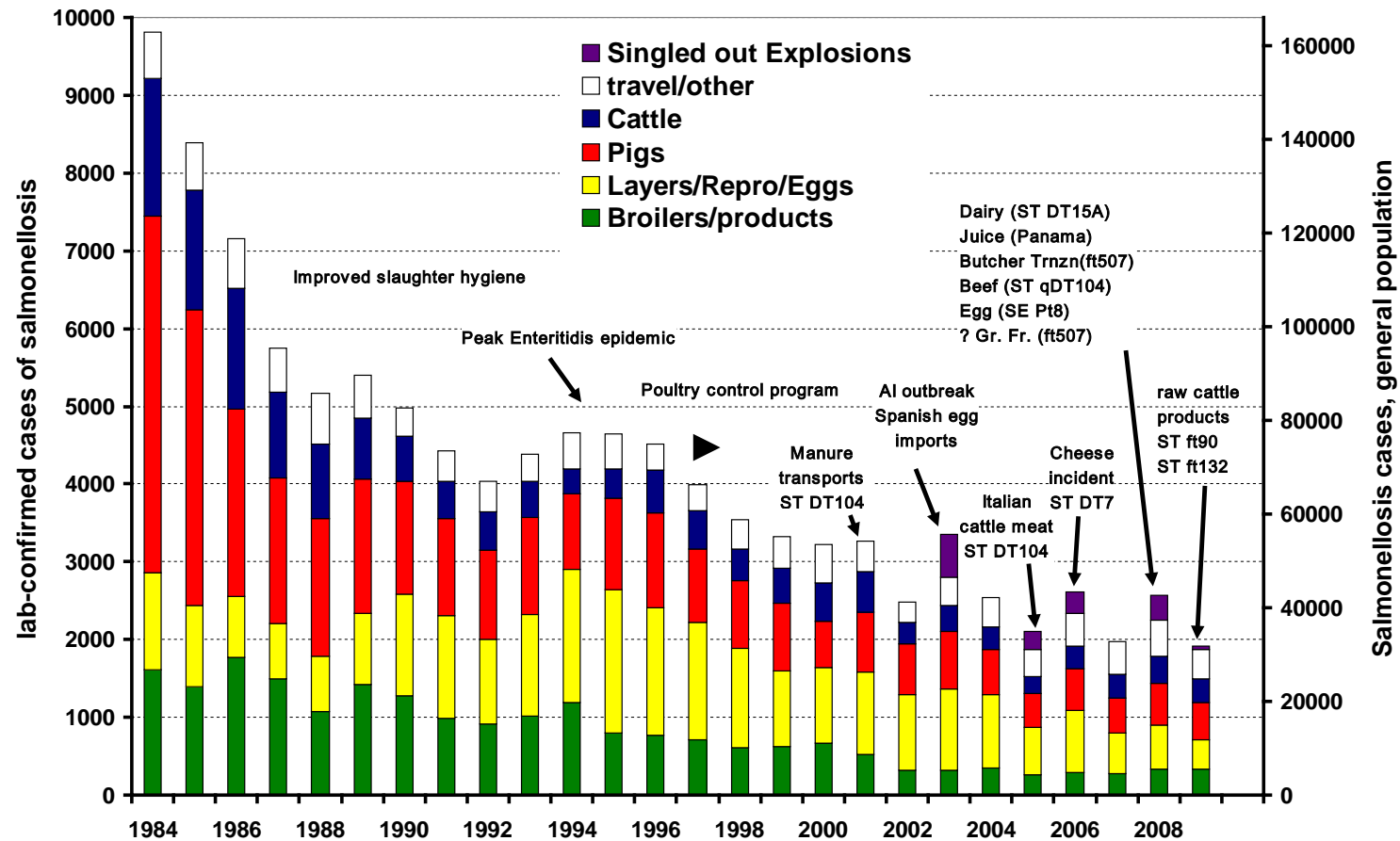




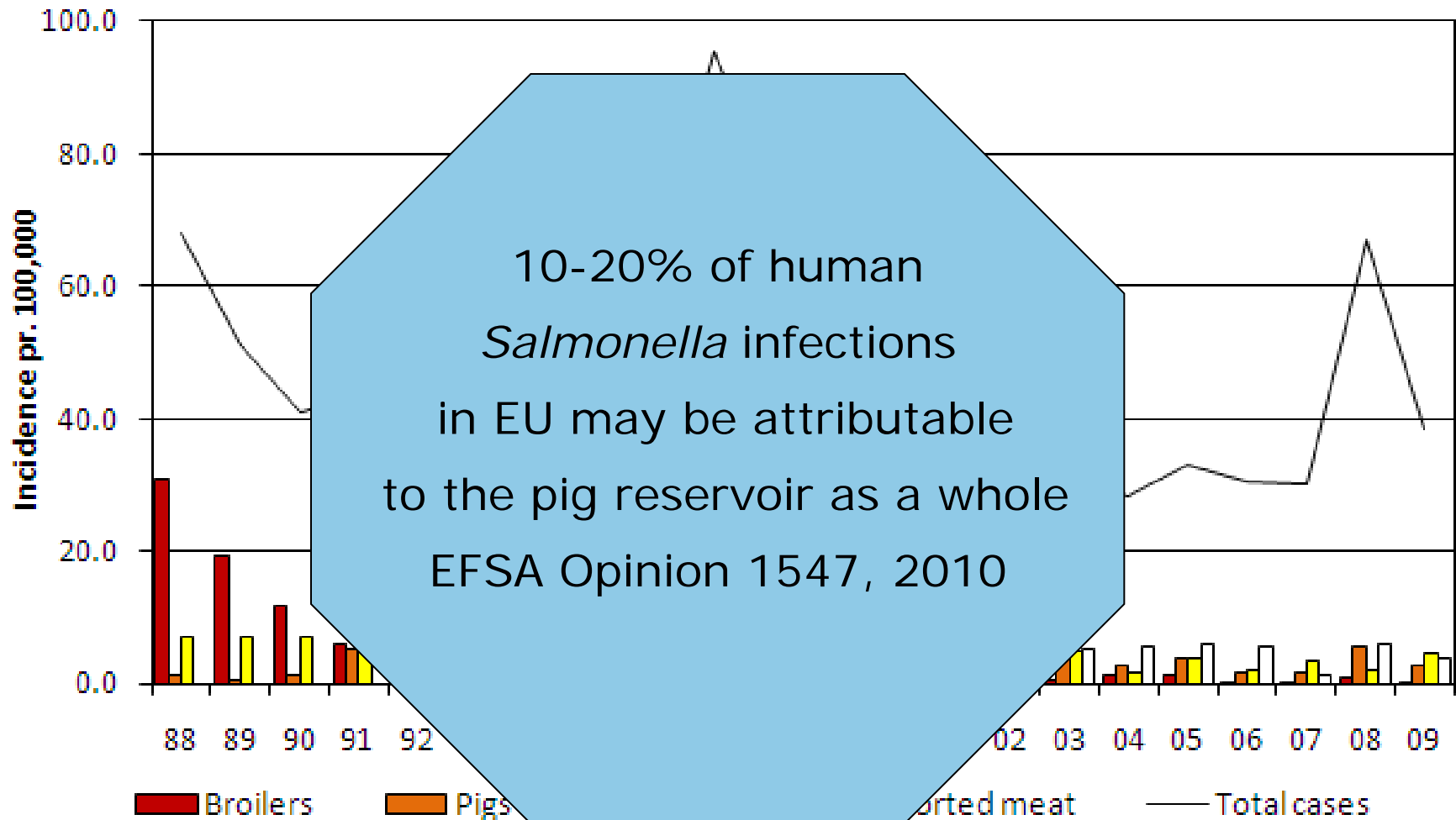
# Attribution

- The partitioning of the human disease burden of one or more foodborne infections to specific sources (animal reservoirs and vehicles such as foods)
- Microbiological approaches
  - Microbial subtyping
  - Comparative exposure assessment
- Epidemiological approaches
  - Case-control studies of sporadic infections
  - Outbreak investigations
- Intervention studies
  - Surveillance after new legislation
  - Natural experiments
- Expert elicitation
  
- Currently most data available for Salmonella

# Attribution of salmonellosis in the Netherlands, 1984-2009



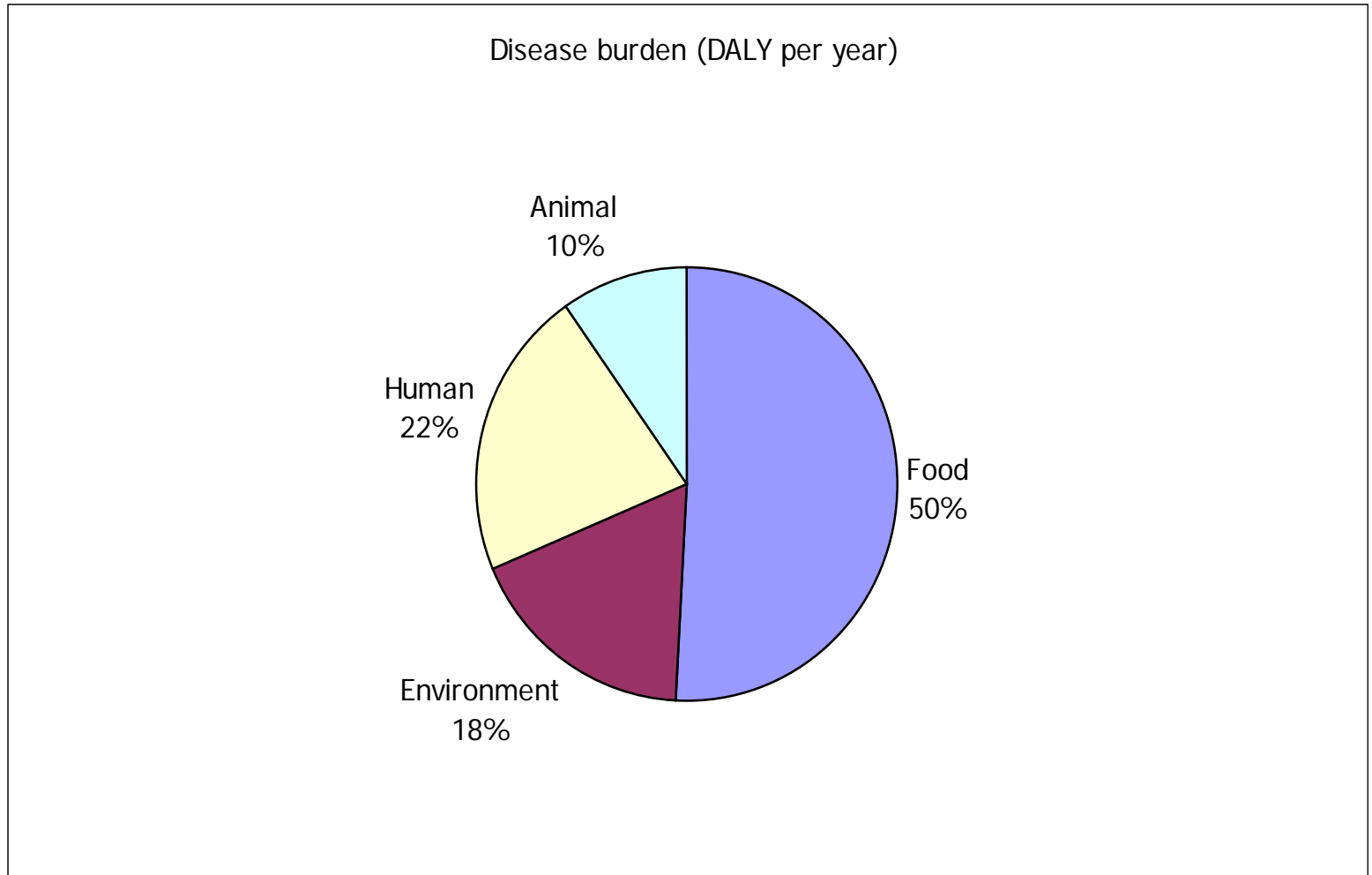
# Estimated major sources of human salmonellosis in Denmark, 1988-2009



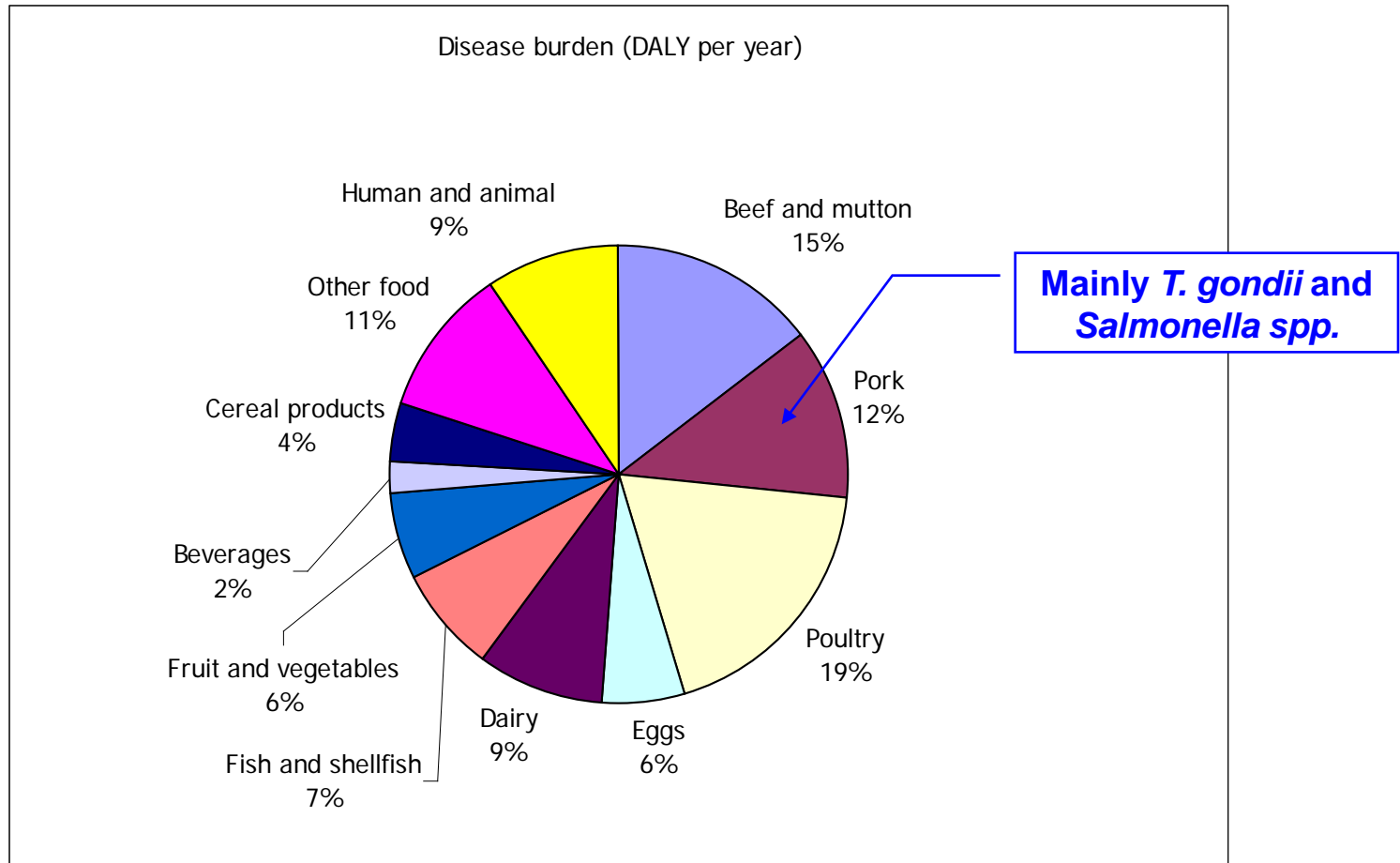
# Monophasic Salmonella (1,4,[5],12:i)

- ... are regarded as variants deriving from *S. Typhimurium*
- ... have been shown to have similar virulence and antimicrobial resistance characteristics to strains of *S. Typhimurium*
- ... the third most common serovar from human infections
- .... the second most common serovar from pigs
- .... the third serovar from bovine samples

# Attribution of the burden of 14 pathogens to major pathways in the Netherlands



# Attribution of the foodborne burden of 14 pathogens to food groups in the Netherlands



# Filling the data gaps

- ECDC
  - Burden of Communicable Diseases in Europe
  - Sero-epidemiology of Salmonella and Campylobacter
- WHO
  - Foodborne Epidemiology Disease Burden Reference Group

# Conclusions

- Surveillance systems for the main pathogens in pork are in place in the EU, but coverage varies between Member States
- Reported data represent only a fraction of all cases in the population
- The reported fraction varies strongly between Member States and between pathogens
- Severity of acute illness, sequelae and mortality need to be taken into account when deciding about public health priorities
- Data for attribution of human illness to animal reservoirs and foods are poorly available
- Major international projects are on-going to fill data gaps, but Member States need to invest in more systematic surveillance
- Based on current evidence, *Salmonella* spp., *Toxoplasma gondii* and *Trichinella* spp. appear to be the most important pathogens in pork