



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

Burden of Foodborne Disease in the Netherlands

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Background

- FBDs still have substantial public health and economic impact
- Empirical approach (to generate evidence): measure the burden and costs of FBD to inform policy
- Performed yearly since 2008 under mandate of MoH
- Agreed-upon standard panel of 14 enteric pathogens

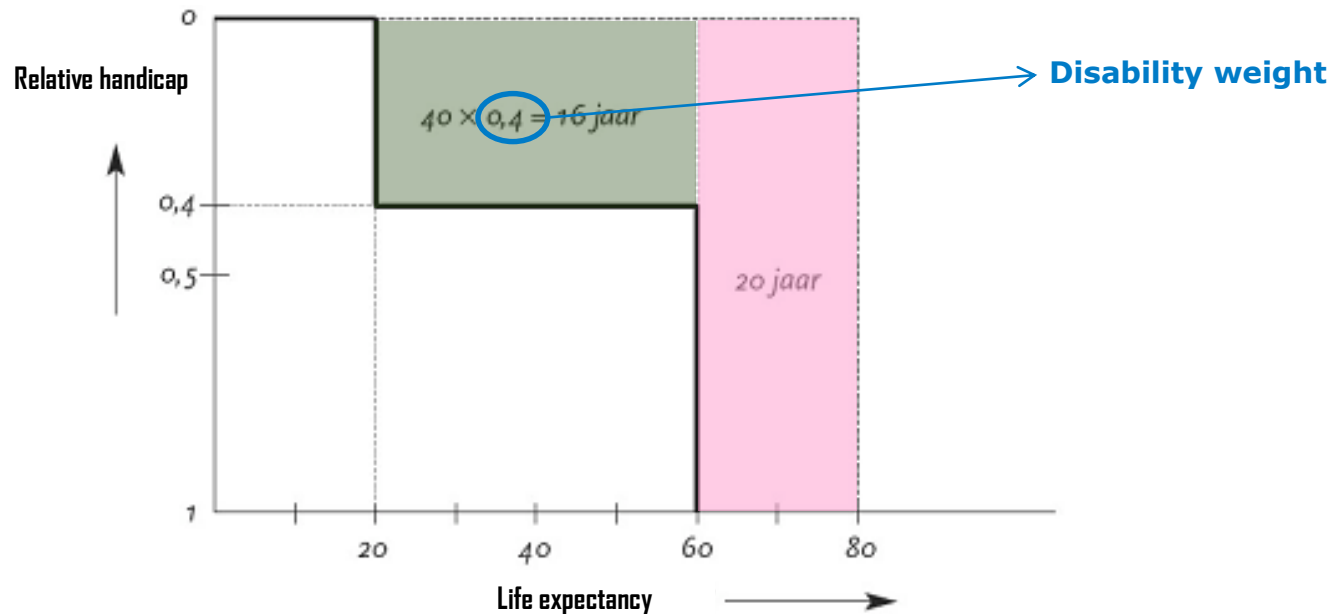




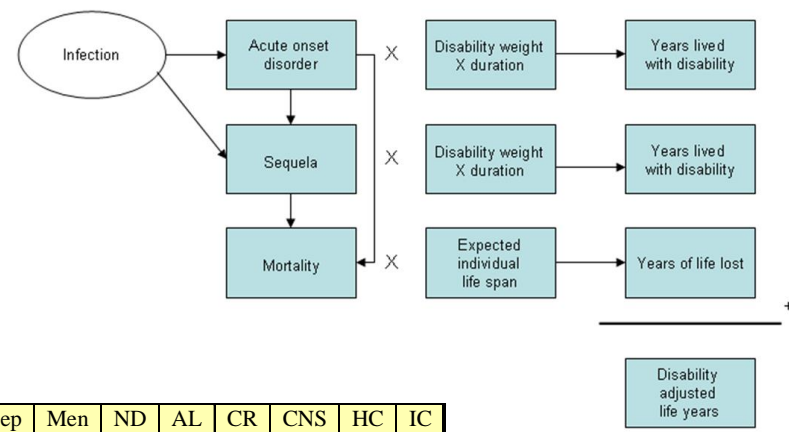
Metrics

BoD measured in DALYs = function of the **incidence**, **duration** and **severity** of the health effects

DALY = years lived with disability (YLD) + years of life lost (YLL)



CoI (€) includes healthcare costs, costs for the patient and caregivers (e.g. travel, external care), productivity losses



Health effects

Infectious gastroenteritis

Toxin producers

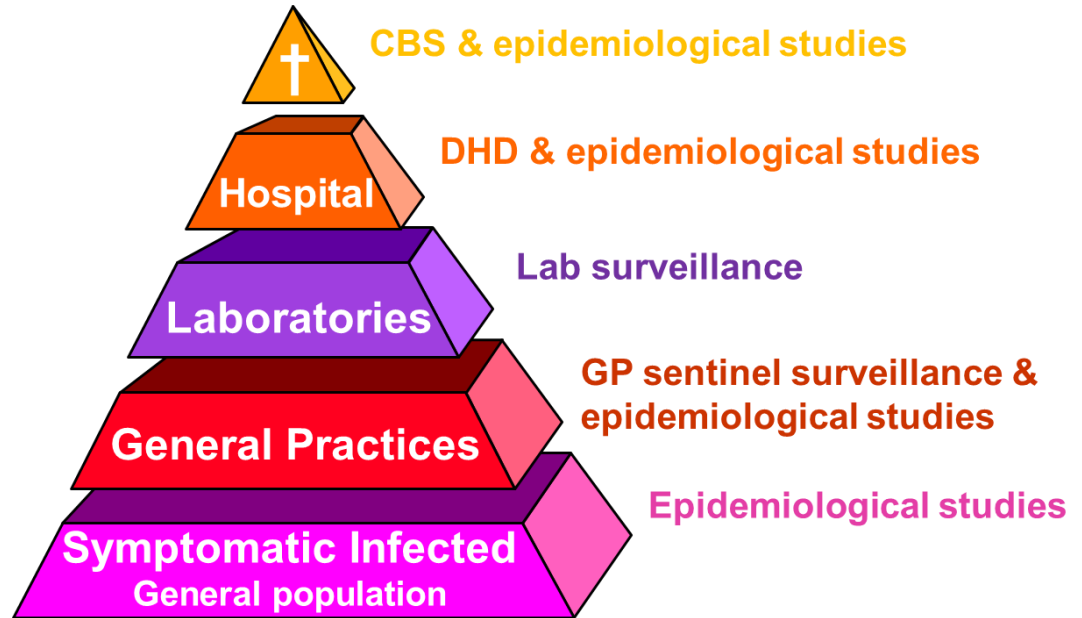
Systemic infections

Pathogen	D*	GE	GBS	ReA	IBD	IBS	HUS	ESRD	Hep	Men	ND	AL	CR	CNS	HC	IC
<i>Campylobacter</i> spp.	X	X	X	X	X	X										
STEC O157	X	X					X	X								
<i>Salmonella</i> spp.	X	X		X	X	X										
Norovirus	X	X														
Rotavirus	X	X														
<i>Cryptosporidium</i> spp.	X	X														
<i>Giardia lamblia</i>	X	X														
<i>B. cereus</i> toxin		X														
<i>C. perfringens</i> toxin	X	X														
<i>S. aureus</i> toxin	X	X														
<i>L. monocytogenes</i>																
- perinatal	X									X	X					
- acquired	X									X	X	X				
Hepatitis-A virus	X								X							
Hepatitis-E virus	X								X							
<i>Toxoplasma gondii</i>																
- perinatal	X												X	X	X	X
- acquired													X			



Data sources

- N : Incident cases
Surveillance and scientific literature
- t : Duration of disease
Scientific literature
- w : disability weight
Scientific literature
- D : mortality
Dutch Central Bureau of Statistics
- e : life expectancy at the age of death
Dutch Central Bureau of Statistics

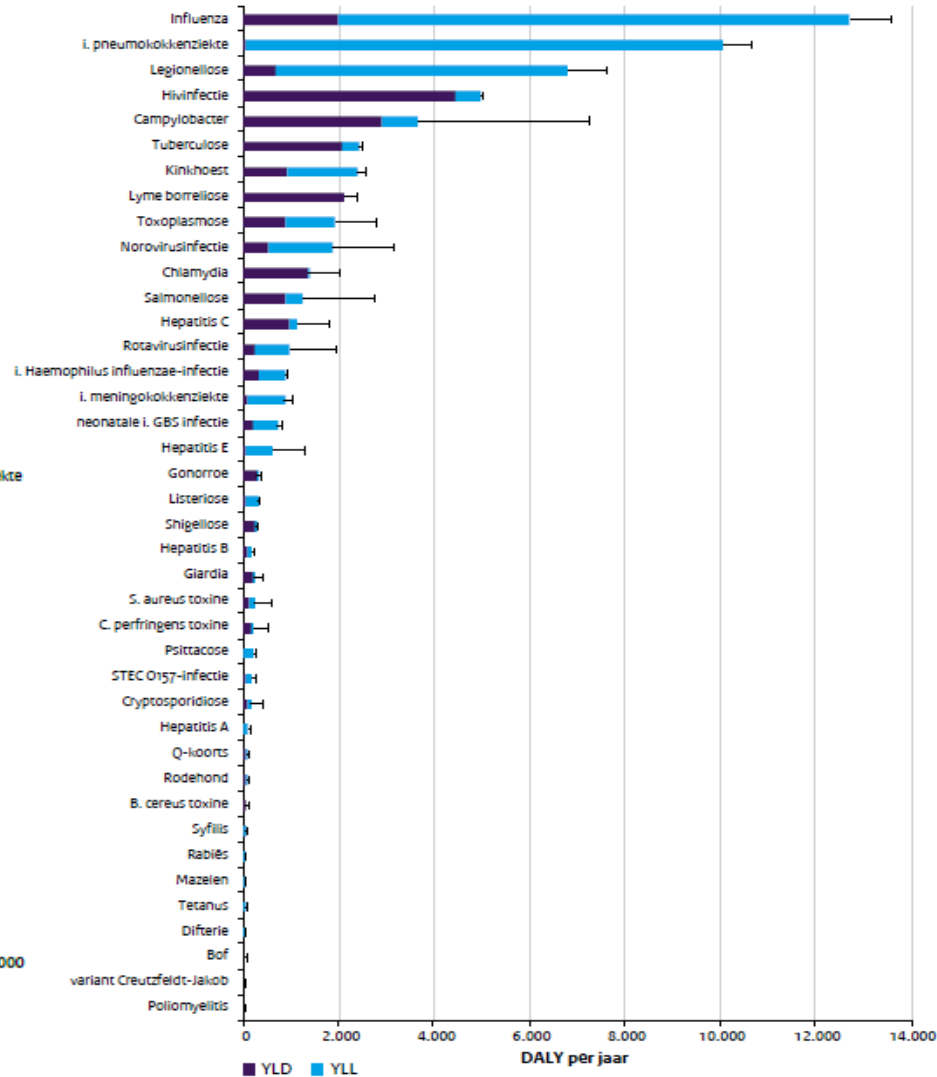
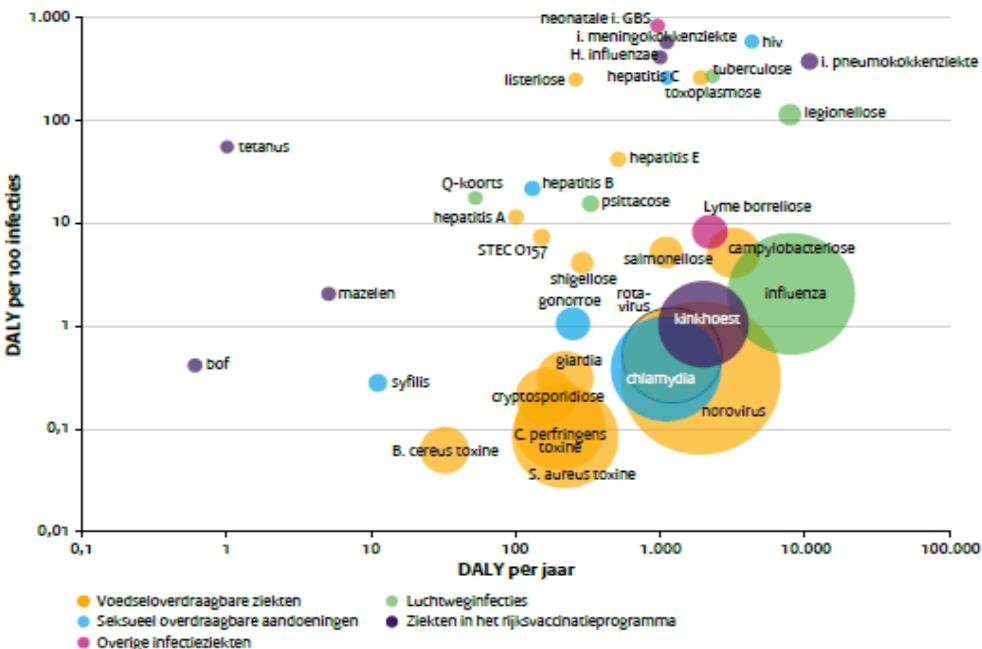


$$YLD = \sum_{\text{all symptoms}} N \times t \times w$$

$$YLL = \sum_{\text{all symptoms}} D \times e$$

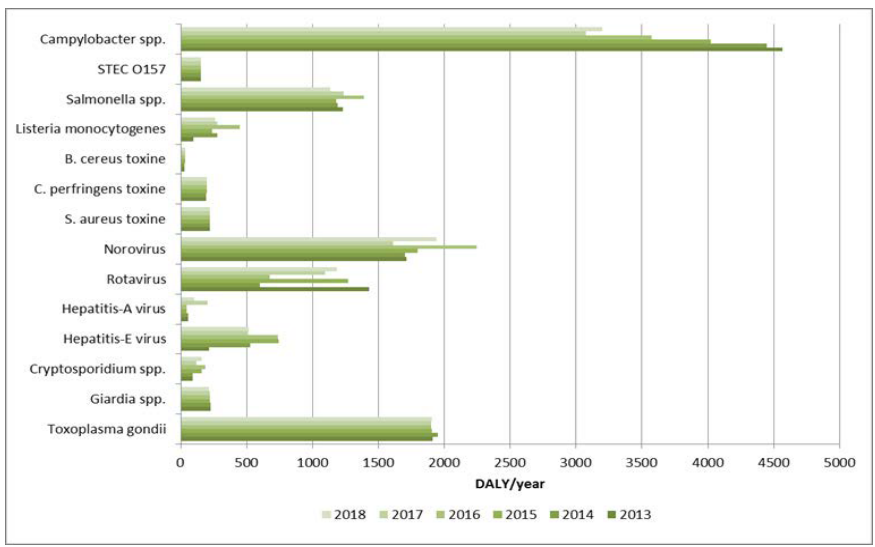
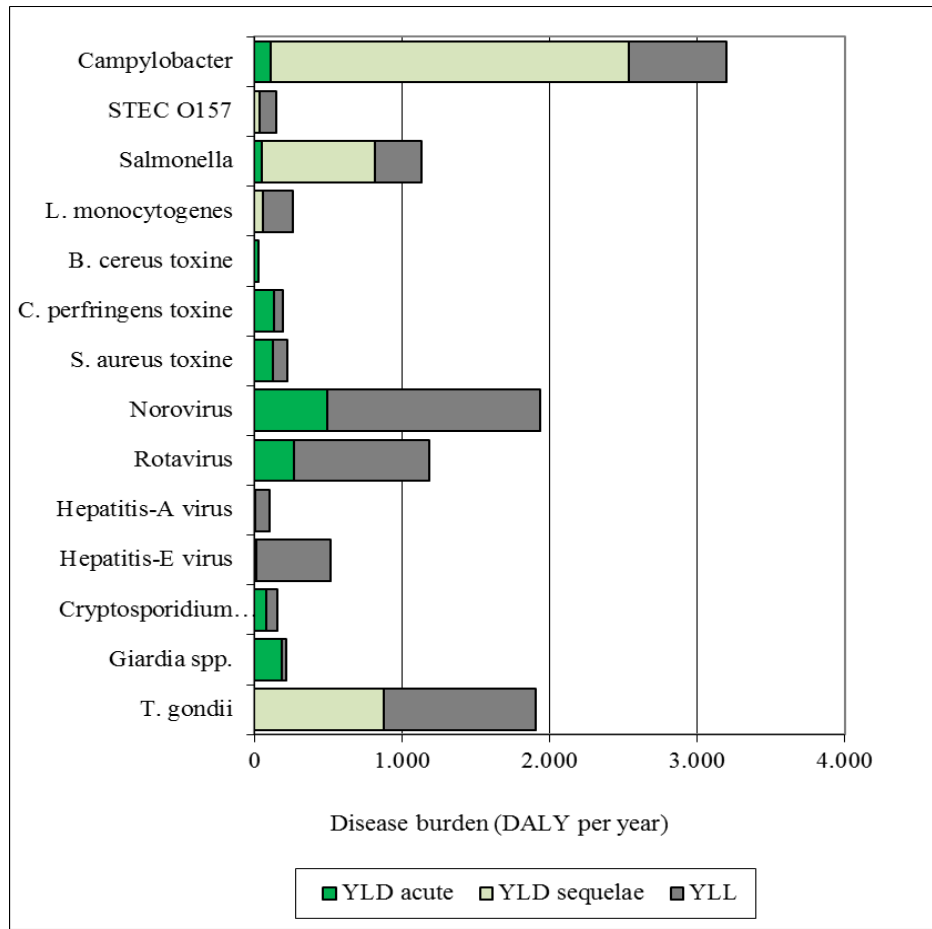
Staat van infectieziekten in Nederland 2018

Dit rapport bevat een extractie
d.d. 08-07-2019 op pagina 42
en d.d. 10-05-2019 op pagina 43





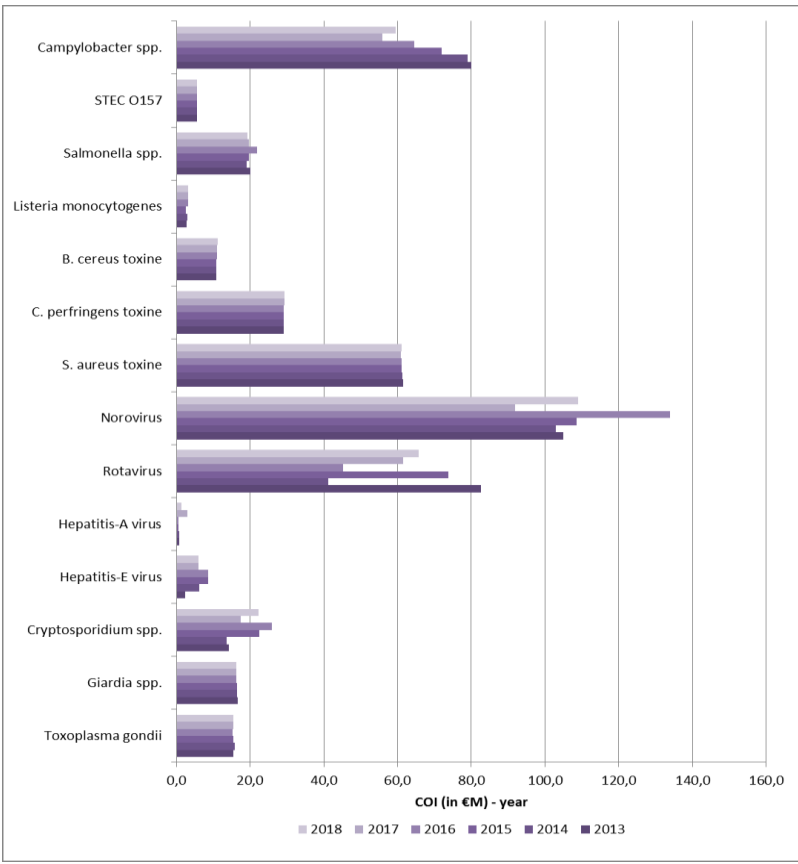
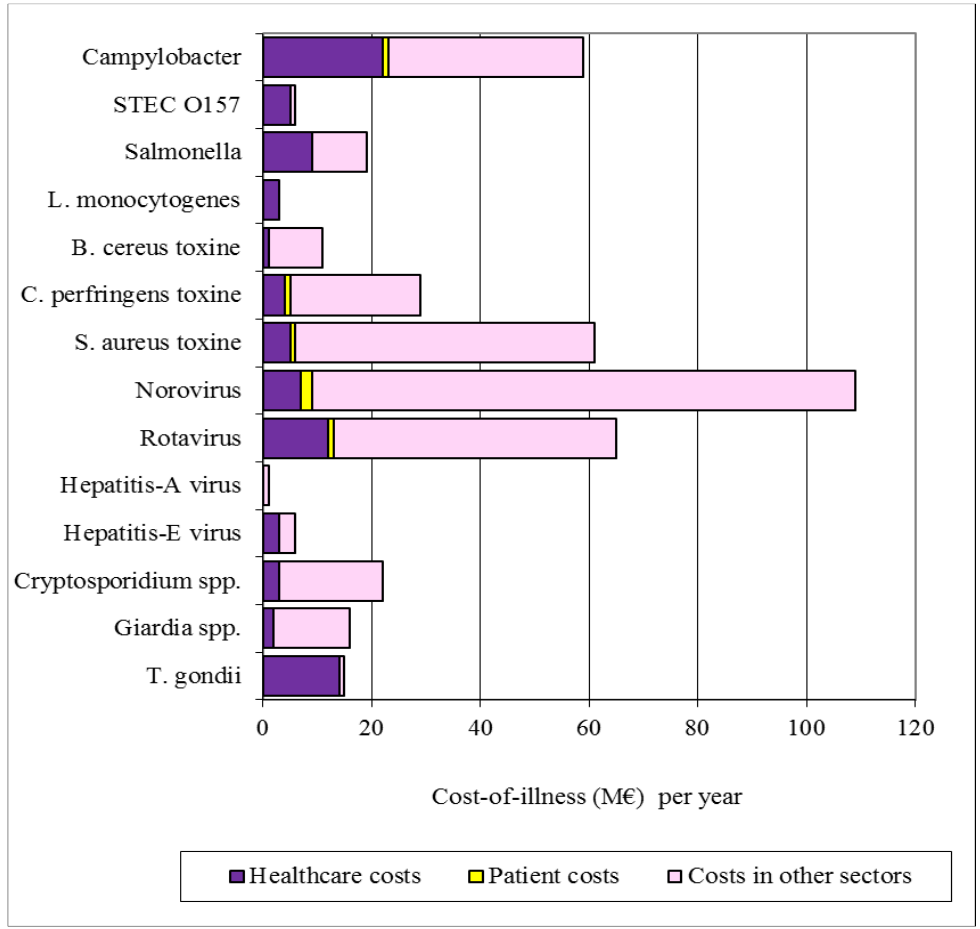
BoD 2018



11,000 (4300 FBD) DALYs



Col 2018



€426 (171 FBD) million costs



Attribution

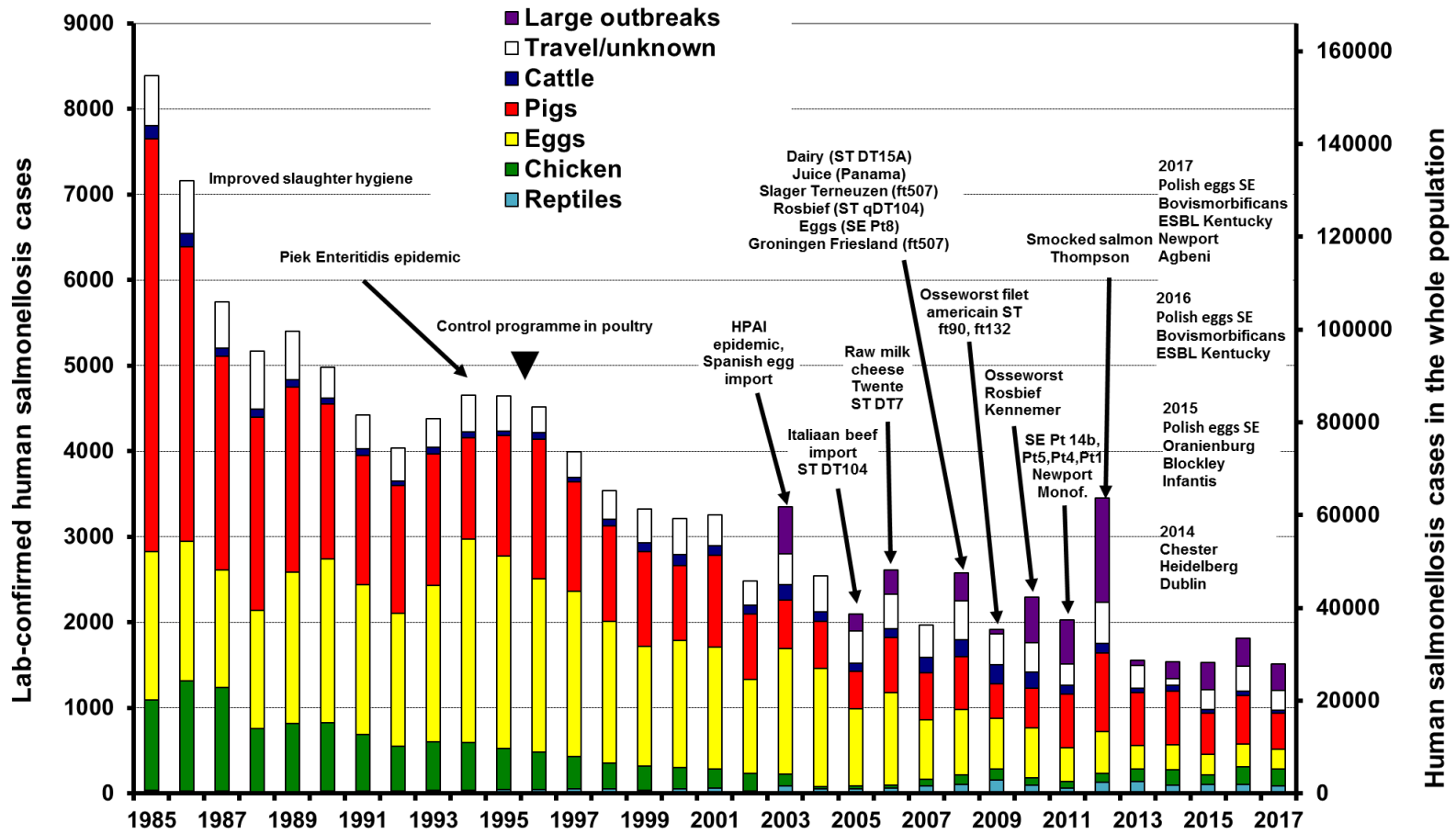
Pathogen	Experts	Fraction (%) transmitted by pathway ^a				
		Food	Environment	Human	Animal	Travel
<i>Campylobacter</i> spp.	12	42 (16–84)	21 (0–73)	6 (0–12)	19 (0–60)	12 (0–29)
Shiga toxin-producing <i>E. coli</i> O157	3	40 (15–83)	17 (0–47)	10 (0–23)	21 (0–76)	12 (0–27)
Non-O157	3	42 (21–78)	14 (0–29)	10 (0–20)	28 (11–48)	6 (0–10)
<i>Listeria monocytogenes</i>	7	69 (47–98)	7 (0–18)	5 (0–13)	5 (0–13)	13 (0–40)
<i>Mycobacterium avium</i>	4	42 (0–79)	19 (0–58)	18 (0–57)	9 (0–27)	12 (0–39)
<i>Salmonella</i> spp.	8	55 (32–88)	13 (0–29)	9 (0–19)	9 (0–19)	14 (3–26)
<i>Bacillus cereus</i> toxin	4	90 (68–100)	1 (0–4)	1 (0–4)	1 (0–4)	7 (0–91)
<i>Clostridium perfringens</i> toxin	4	91 (72–100)	2 (0–5)	2 (0–5)	2 (0–5)	3 (0–9)
<i>Staphylococcus aureus</i> toxin	4	87 (73–100)	4 (0–9)	3 (0–8)	2 (0–5)	4 (0–10)
Enterovirus	2	6 (0–16)	25 (0–60)	60 (30–92)	2 (0–2)	7 (0–15)
Hepatitis A virus	2	11 (0–20)	11 (0–19)	18 (0–42)	0 (0–0)	60 (7–80)
Hepatitis E virus	2	14 (0–38)	25 (0–75)	8 (0–20)	11 (0–29)	43 (0–68)
Norovirus	5	17 (16–47)	14 (0–43)	55 (42–88)	5 (0–10)	9 (0–20)
Rotavirus	3	13 (13–28)	17 (0–46)	58 (43–90)	3 (0–5)	9 (0–19)
<i>Cryptosporidium parvum</i>	2	12 (0–20)	28 (10–39)	27 (10–38)	13 (5–19)	20 (4–29)
<i>Giardia lamblia</i>	3	13 (0–24)	24 (10–37)	35 (10–56)	11 (0–20)	18 (5–29)
<i>Toxoplasma gondii</i>	3	56 (26–88)	36 (6–66)	1 (0–1)	3 (0–3)	5 (0–9)

^aMean (5th and 95th percentile) after resampling. Bold type indicates poor fit with Decision Maker.

Pathogen	Experts	Fraction (%) transmitted by food group ^a										
		B&L	Pork	Poultry	Eggs	Dairy	(S)F	F&V	Bev	Grains	Comp	H&A
<i>Campylobacter</i> spp.	11	4 (0–17)	5 (0–19)	54 (17–86)	3 (0–10)	9 (0–44)	7 (0–27)	5 (0–25)	2 (0–4)	2 (0–6)	3 (0–10)	5 (0–18)
Shiga toxin-producing <i>E. coli</i> O157	7	44 (16–88)	6 (0–25)	3 (0–9)	2 (0–5)	7 (0–28)	3 (0–8)	7 (0–28)	4 (0–12)	3 (0–8)	4 (0–12)	17 (0–7)
Non-O157	3	62 (0–79)	9 (0–19)	3 (0–9)	1 (0–4)	5 (0–25)	3 (0–5)	4 (0–19)	4 (0–13)	2 (0–9)	2 (0–9)	6 (0–22)
<i>Listeria monocytogenes</i>	9	11 (5–29)	9 (0–26)	7 (0–17)	4 (0–12)	25 (14–50)	18 (0–46)	8 (0–25)	3 (0–7)	6 (0–16)	6 (0–19)	5 (0–9)
<i>Mycobacterium avium</i>	4	6 (0–45)	41 (0–86)	6 (0–7)	2 (0–0)	5 (3–3)	7 (0–15)	2 (0–9)	5 (0–8)	1 (0–1)	4 (0–15)	20 (0–35)
<i>Salmonella</i> spp.	13	13 (5–28)	14 (6–36)	15 (5–47)	22 (11–54)	7 (0–25)	4 (0–10)	6 (0–20)	3 (0–9)	4 (0–12)	6 (0–18)	6 (0–18)
<i>Bacillus cereus</i> toxin	5	7 (4–4)	3 (0–18)	2 (0–0)	4 (0–2)	6 (0–30)	2 (0–0)	2 (0–10)	2 (0–7)	17 (7–95)	54 (0–75)	2 (0–4)
<i>Clostridium perfringens</i> toxin	4	48 (20–94)	8 (0–65)	7 (0–54)	3 (0–9)	4 (0–21)	6 (0–37)	7 (0–35)	2 (0–8)	3 (0–9)	8 (0–53)	4 (0–18)
<i>Staphylococcus aureus</i> toxin	4	8 (0–28)	8 (0–29)	8 (0–29)	3 (0–10)	15 (0–29)	6 (0–20)	2 (0–5)	2 (0–4)	7 (0–29)	30 (5–49)	12 (0–77)
Enterovirus	2	Problem	in-feasible									
Hepatitis A virus	2	0 (0–0)	0 (0–0)	0 (0–0)	0 (0–0)	0 (0–0)	13 (0–40)	13 (0–39)	4 (0–10)	4 (0–10)	3 (0–5)	63 (0–99)
Hepatitis E virus	2	0 (0–0)	74 (0–100)	0 (0–0)	0 (0–0)	0 (0–0)	5 (0–11)	7 (0–19)	4 (0–6)	0 (0–0)	0 (0–0)	10 (0–31)
Norovirus	5	3 (0–9)	3 (0–10)	3 (0–9)	2 (0–5)	2 (0–5)	16 (0–57)	7 (0–41)	3 (0–9)	5 (0–19)	5 (0–19)	51 (0–87)
Rotavirus	3	0 (0–0)	3 (0–5)	0 (0–0)	0 (0–0)	2 (0–2)	19 (0–59)	24 (2–59)	4 (0–9)	7 (0–19)	5 (0–10)	36 (5–77)
<i>Cryptosporidium parvum</i>	2	26 (24–56)	4 (2–9)	3 (1–5)	3 (0–5)	9 (6–20)	22 (21–38)	21 (20–38)	3 (0–4)	0 (0–0)	3 (0–5)	6 (4–11)
<i>Giardia lamblia</i>	3	20 (0–49)	5 (0–9)	3 (0–5)	0 (0–0)	8 (0–18)	13 (0–28)	33 (0–69)	3 (0–5)	0 (0–0)	3 (0–5)	12 (0–30)
<i>Toxoplasma gondii</i>	3	23 (0–47)	50 (21–99)	5 (0–14)	0 (0–0)	5 (0–14)	4 (0–10)	6 (0–18)	0 (0–0)	0 (0–0)	2 (0–50)	6 (0–19)

^aMean (5th and 95th percentile) after resampling. Bold type indicates poor fit with Decision Maker.

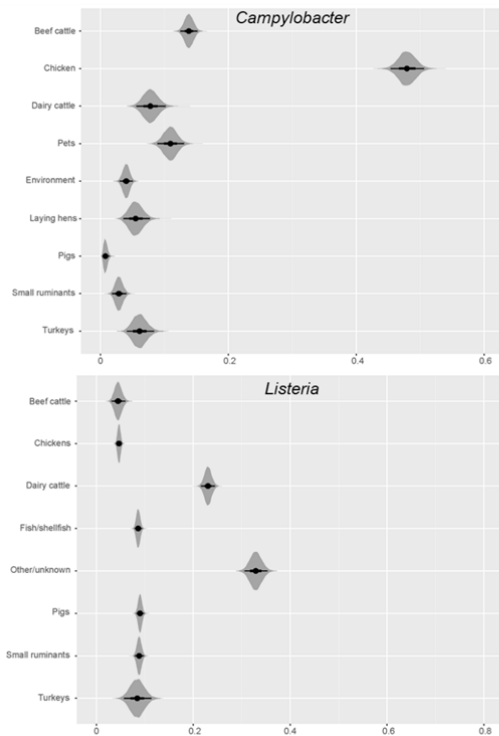
B&L, beef and lamb; (S)F, fish and shellfish; F&V, fruit and vegetables; bev, beverages; grains: bread, grains, pastas and bakery products; comp, other foods including composite foods; H&A, infected humans or animals.



-85% human salmonellosis cases in 3 decades, and **-90%** egg-associated human salmonellosis cases in 2 decades!



Combining experts opinions with empirical data



Pathogen	Foodborne exposure	PAFs (normalized)	Experts estimates, from Havelaar <i>et al.</i> [30]	Synthesized attribution (PAFs with experts' est)
<i>Campylobacter</i> spp.	Beef/lamb	11.0% (22.2%)	4.0%	18.0% (15.6-20.5%)
	Pork	N/A	5.0%	4.9% (0.7-12.6%)
	Poultry meat	28.0% (54.9%)	54.0%	44.8% (41.6-48.0%)
	Eggs	N/A	3.0%	3.5% (0.4-10.2%)
	Dairy	3.0% (5.2%)	9.0%	4.3% (3.1-5.8%)
	Fish/shellfish	4.0% (7.9%)	7.0%	6.4% (4.9-8.0%)
	Fruit/vegetables	N/A	5.0%	4.8% (0.7-12.6%)
	Beverages	N/A	2.0%	2.6% (0.3-9.1%)
	Grains	N/A	2.0%	2.6% (0.3-8.6%)
	Composite foods	1.0% (2.0%)	3.0%	1.6% (0.9-2.5%)
Food handlers, vermin	4.0% (7.8%)	5.0%	6.4% (4.9-8.0%)	
Nontyphoidal <i>Salmonella</i> spp.	Beef/lamb	4.0% (9.8%)	13.0%	6.9% (4.1-10.4%)
	Pork	14.0% (39.7%)	14.0%	18.6% (13.1-25.9%)
	Poultry meat	N/A	15.0%	14.0% (3.8-23.3%)
	Eggs	9.0% (24.4%)	22.0%	14.5% (10.7-18.6%)
	Dairy	N/A	7.0%	8.0% (1.7-19.2%)
	Fish/shellfish	N/A	4.0%	4.6% (0.9-14.6%)
	Fruit/vegetables	N/A	6.0%	7.0% (1.4-18.1%)
	Beverages	N/A	3.0%	3.4% (0.7-10.9%)
	Grains	N/A	4.0%	4.6% (0.9-15.5%)
	Composite foods	N/A	6.0%	6.9% (1.4-18.1%)
Food handlers, vermin	9.4% (26.2%)	6.0%	11.5% (7.5-16.2%)	
STEC O157	Beef/lamb	59.0% (83.0%)	44.0%	57.5% (52.4-62.5%)
	Pork	12.0% (17.0%)	6.0%	11.3% (8.3-14.7%)
	Poultry meat	N/A	3.0%	2.6% (0.4-8.3%)
	Eggs	N/A	2.0%	2.0% (0.3-6.7%)
	Dairy	N/A	7.0%	4.2% (0.7-11.7%)
	Fish/shellfish	N/A	3.0%	2.6% (0.4-8.3%)
	Fruit/vegetables	N/A	7.0%	4.3% (0.7-11.5%)
	Beverages	N/A	4.0%	3.1% (0.5-9.5%)
	Grains	N/A	3.0%	2.7% (0.3-8.3%)
	Composite foods	N/A	4.0%	3.1% (0.5-9.2%)
Food handlers, vermin	N/A	17.0%	6.4% (1.4-14.9%)	
<i>Listeria monocytogenes</i>	Beef/lamb	N/A	11.0%	1.4% (0.4-3.2%)
	Pork	25.0% (17.4%)	9.0%	15.7% (12.3-19.6%)
	Poultry meat	17.0% (11.4%)	7.0%	10.2% (7.4-13.3%)
	Eggs	N/A	4.0%	1.0% (0.2-2.6%)
	Dairy	50.0% (34.6%)	25.0%	31.6% (27.4-37.1%)
	Fish/shellfish	39.0% (27.0%)	18.0%	27.2% (22.3-31.3%)
	Fruit/vegetables	14.0% (9.6%)	8.0%	8.6% (6.0-11.4%)
	Beverages	N/A	3.0%	0.9% (0.2-2.4%)
	Grains	N/A	6.0%	1.2% (0.3-2.9%)
	Composite foods	N/A	6.0%	1.2% (0.3-2.8%)
Food handlers, vermin	N/A	5.0%	1.1% (0.4-2.6%)	



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Thank you!

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