

Health at Risk: Long-Term Health Effects of a Foodborne Illness



Partnership for
Food Safety
Education





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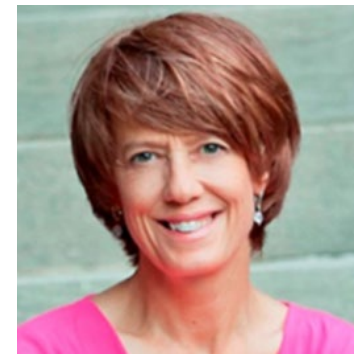
Dr. Barbara Kowalcyk

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Michael Batz

Operations Research Analyst
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Moderator

Shelley Feist

Executive Director
Partnership for Food
Safety Education

Health at Risk: Long-Term Effects of a Foodborne Illness



Barbara Kowalcyk, Ph.D.



Food Safety is a Global Public Good



- **Critical to food security, nutrition**
- **Serious public health issue**
 - 600 million illnesses/year
 - Children bear most of burden
 - Associated with long-term health outcomes
- **Significant economic impact**
 - Medical costs, lost productivity
 - Loss of consumer confidence
 - Reduced market access
 - Increased food loss and waste

Every year foodborne diseases cause:

almost
 **in 10**
people to fall ill

33 million
healthy life years lost

Foodborne diseases can be deadly, especially in children <5


420 000
deaths



Children account for
almost **1/3**
of deaths from
foodborne diseases

For more information: www.who.int/foodsafety

#SafeFood

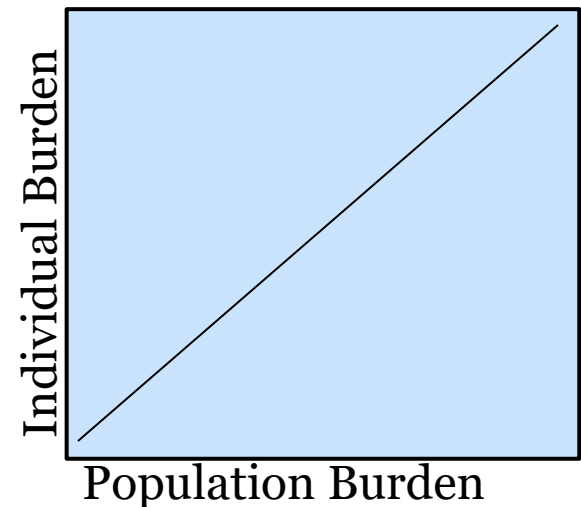
Source: WHO Estimates of the Global Burden of Foodborne Diseases, 2015.



**World Health
Organization**

What is Burden of Disease?

- **Need to make comparisons across diseases, populations**
- **Two types of burden**
 - Population: illnesses, hospitalizations, deaths
 - Individual: severity, duration, disability, quality of life
- **Aggregate morbidity and mortality**
 - Age at disease or death
 - Duration/severity of disability
 - Should be equal across cultures, SES levels, etc.
 - Assume best life expectancy

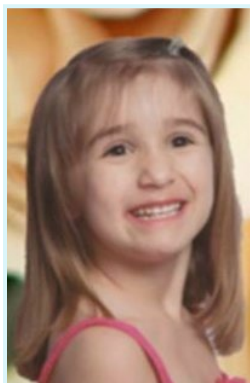


The Population Burden



- **48 million** illnesses, **128,000** hospitalizations, **3,000** deaths
- **\$78 billion** in lost productivity, medical expenses, premature deaths and pain and suffering
- **Vulnerable populations:** children, pregnant/post-partum women, senior citizens and those with compromised immune systems are at high risk for serious illness

The Individual Burden



Abby
Died, Age 7
E. coli O157:H7



Ruby
Died, Age 81
E. coli O157:H7



Kevin
Died, Age 2
E. coli O157:H7



Joseph
Died, Age 8
E. coli O157:H7



Kayla
Died, Age 14
E. coli O111



Ryan
Salmonella



Ashley
E. coli O157:H7



Tammy
Salmonella



Mariah
E. coli O157:H7



Jake
Salmonella

Poll #1

Which set of long-term health disorders do you most associate with foodborne illness?

1. Autoimmune Disorders
2. Digestive Disorders
3. Kidney Failure
4. Neurological Disorders
5. None of these

Long-term Health Outcomes (LTHOs)

Autoimmune Disorders	Reactive Arthritis – associated with many foodborne pathogens; rates vary from 2.3% to 15% Guillain-Barre Syndrome – Campylobacter is common trigger and accounts for 40% of cases in U.S.
Digestive Disorders	Irritable Bowel Syndrome – associated with many foodborne pathogens; causes estimated 17% of cases Irritable Bowel Disease – includes Crohn's Disease, Ulcerative Colitis
Neurological Disorders	Sepsis, Meningitis, Respiratory distress Paralysis, palsies, seizures, epilepsy Cognitive impairment, visual/hearing impairment
Renal Failure & Associated Sequelae	Hemolytic Uremic Syndrome (HUS) – severe, life-threatening illness; leading cause of acute kidney failure in children under age 5 in U.S.; associated with STEC, Shigella Chronic kidney disease, End stage renal failure, Chronic hypertension, Pancreatitis, Diabetes mellitus – often secondary to HUS
Emerging Issues	Schizophrenia, psycho-social disorders – recent studies have found increased risk for toxoplasmosis but not well understood Urinary tract infections

Autoimmune Disorders



Ryan
Salmonella



John
Listeria

■ Reactive arthritis

- Painful, swollen joints
- *Campylobacter* (3%–13%)
- *E coli* O157:H7 (0%–9%)
- *Salmonella* (2%–15%)
- *Shigella* (1%–10%)
- *Yersinia* (0%–14%)

■ Guillain-Barré Syndrome

- Causes acquired paralysis.
- *Campylobacter* common trigger.
- Accounts for 40% of 5,500 GBS cases per year in U.S.

Digestive Disorders



Tammy
Salmonella

- **Irritable Bowel Syndrome (IBS)**
 - Affects 10% – 20% globally
 - Associated with *E. coli*, *Yersinia*, *Salmonella*, *Campylobacter*, *Shigella*, Norovirus, *Giardia*, *Trichnella*
 - Causes ~17% of IBS cases
 - 3- to 7-fold increase in risk following GE
- **Irritable Bowel Disease (IBD)**
 - Crohn's Disease
 - Ulcerative Colitis
- **Dyspepsia**
- **Celiac Disease**

Neurological Disorders

- Severe sepsis, meningitis, respiratory distress
- Visual, hearing impairment
- Paralysis, palsies, seizures, epilepsy
- Cognitive impairment
- Psychosocial
- Listeriosis
 - 20·2–67·3% of neonates with CNS infection
 - 2·4–25·1% of non-perinatal cases with CNS infection
- Toxoplasmosis
 - 80% show impairment by age 17



Mariah
E.coli O157:H7

Renal Failure and Associated Sequelae



Ashley
E.coli O157:H7

- **4.2% – 17.2% of STEC cases develop Hemolytic Uremic Syndrome (HUS)**
- **Leading cause of acute kidney failure in children under age 5 in U.S.**
- **Long-term outcomes can be serious:**
 - Renal dysfunction (20% – 30%)
 - Hypertension (8% – 12%)
 - Proteinuria (10% – 20%)
 - Diabetes (0% – 15%)
 - CNS dysfunction (2% – 3%)
- **Follow-up of 72 cases (median 6.5 yrs) found 51% had ≥ 1 systemic abnormality**

Emerging LTHOs

- **Psychosocial disorders**

- Associated with diagnosis and severity of functional gastrointestinal disorders
- Schizophrenia, depression associated with toxoplasmosis
- Anecdotal reports of personality changes, behavioral disorders

- **Urinary tract infections**

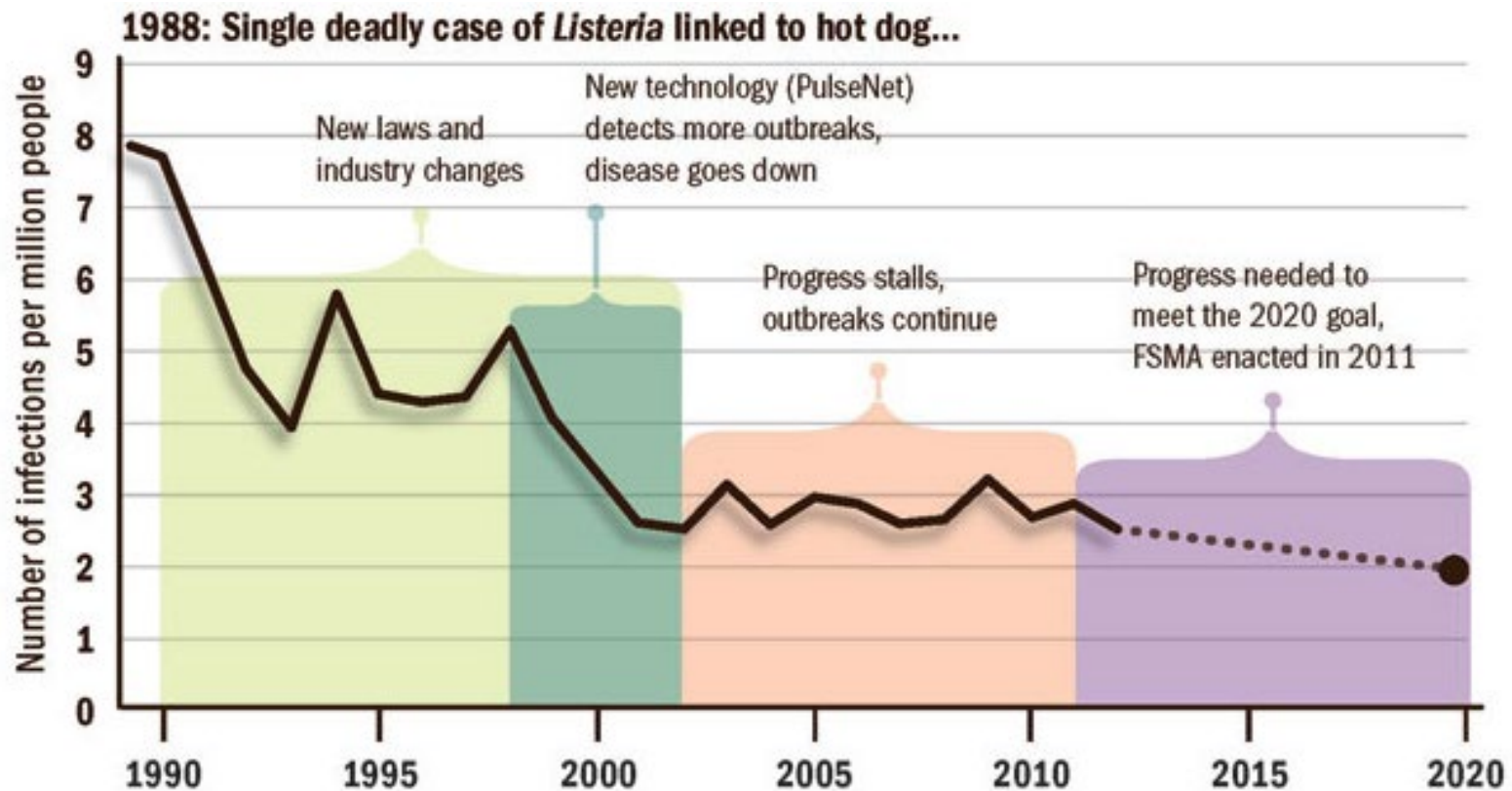
- **Malnutrition, growth impairment**

Why is Disease Burden Important?

- **Foundation for risk-based decision making**
- **Set public health goals (Healthy People 2020)**
- **Attribute and rank risks**
- **Economic assessments**
- **Prioritize interventions**
- **Allocate resources**
- **Measure success**



Critical to Prevention

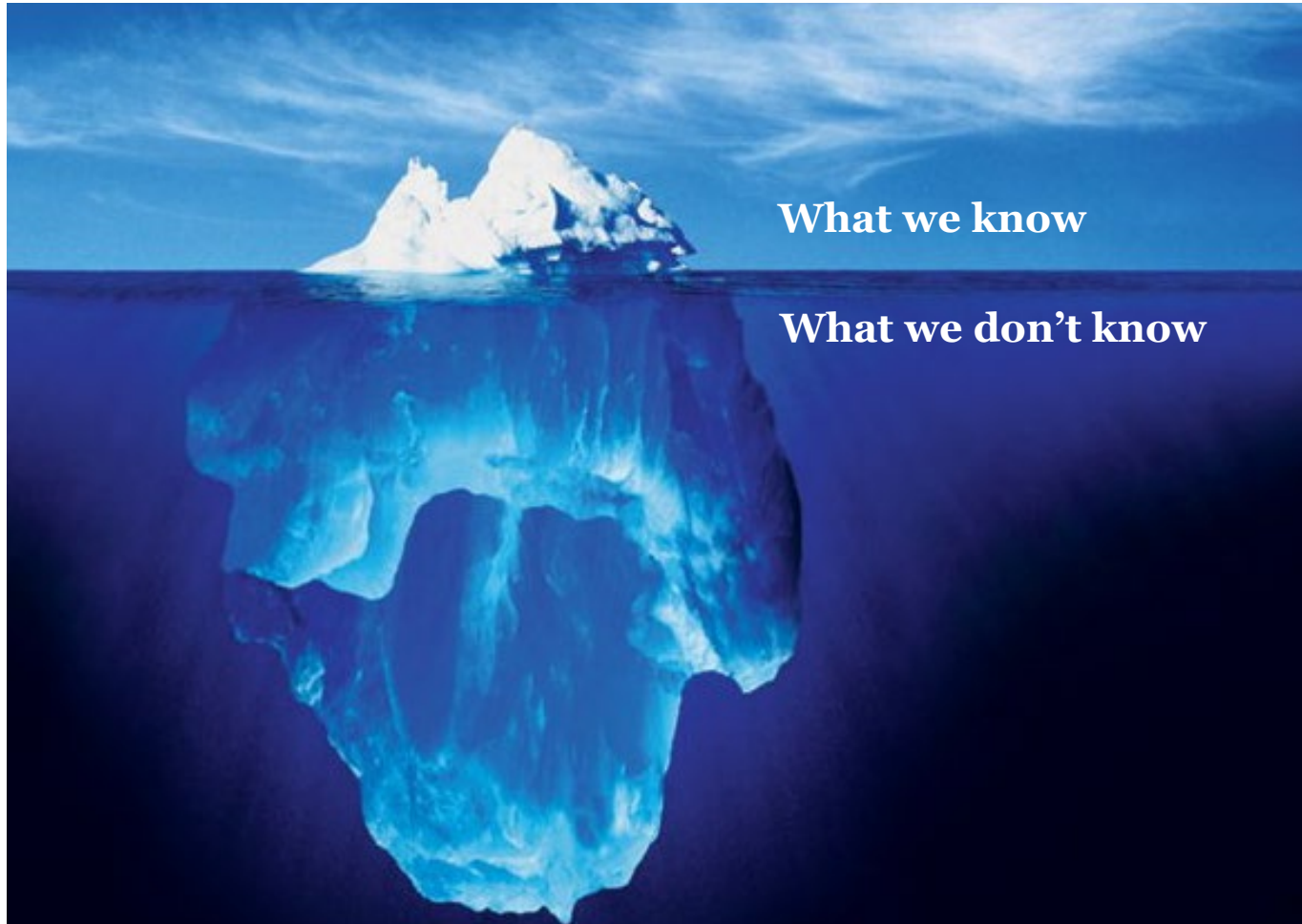


SOURCES: JAMA, 1995; CDC, 2012

Take-Aways

- **Foodborne illness causes significant acute and long-term health outcomes (LTHO)**
- **LTHO important to:**
 - Understanding burden of disease
 - Patient management
- **LTHO often not included in disease burden estimates**
 - Disease mechanism of LTHO not well understood
 - Lack of systematic data collection
 - Lack of prospective epidemiologic studies
 - Difficult to prove causality

The Challenge



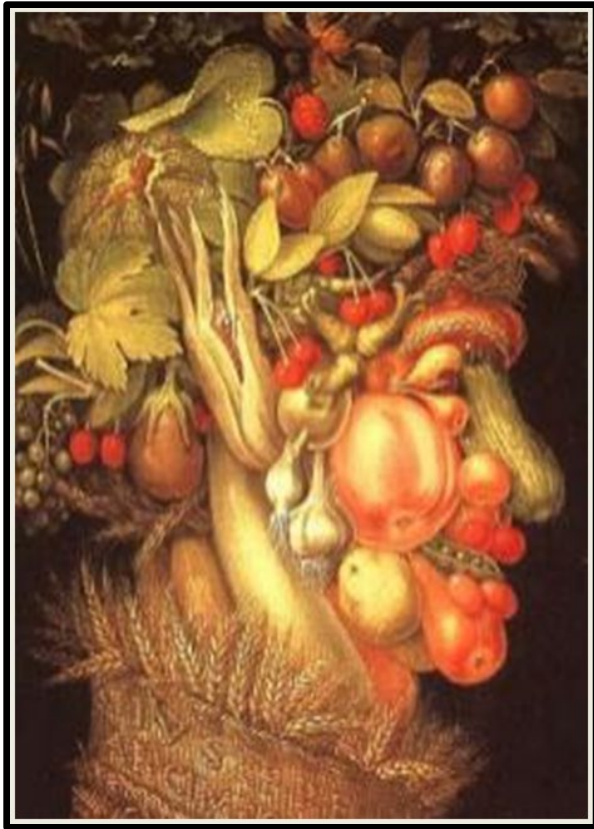
Poll #2

Does this information cause you to reconsider your own hand hygiene and food safety behaviors at home?

1. Yes
2. No
3. Not sure

References

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- Guiseppe Arcimboldo

**“As for the future,
your task is not to foresee it,
but to enable it.”**

- Antoine de Saint-Exupery
French Writer, 1900-1944

Thank You!

Dr. Barbara Kowalczyk

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Hidden Costs: The Long-Term Consequences of Foodborne Illness



Michael Batz

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**U.S. FOOD & DRUG
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FDA Disclaimer

The views and opinions presented here represent those of the speaker and should not be considered to represent advice or guidance on behalf of the U.S. Food and Drug Administration.



You Dropped Food on the Floor Do You Eat It?

Was it sticky? — No. — Did anyone see you? — YES.

No.

YES.

Is it an
Emausaurus?

Is it a
raw steak?

Was it a
boss/lover/parent? — No.

**EAT
IT.**

YES.

Was it expensive? — YES.

Can you cut off
the part
that touched
the floor?

Are you a
Megalosaurus?

Did the cat
lick it?

Are you
a puma?

Is it bacon?

YES.

No.

YES.

No.

YES.

No.

No.

YES.

YES.

No.

**DON'T
EAT IT**

**EAT
IT.**

**DON'T
EAT IT**

**EAT
IT.**

Is your cat
healthy?

YES.

No.

**YOUR
CALL**

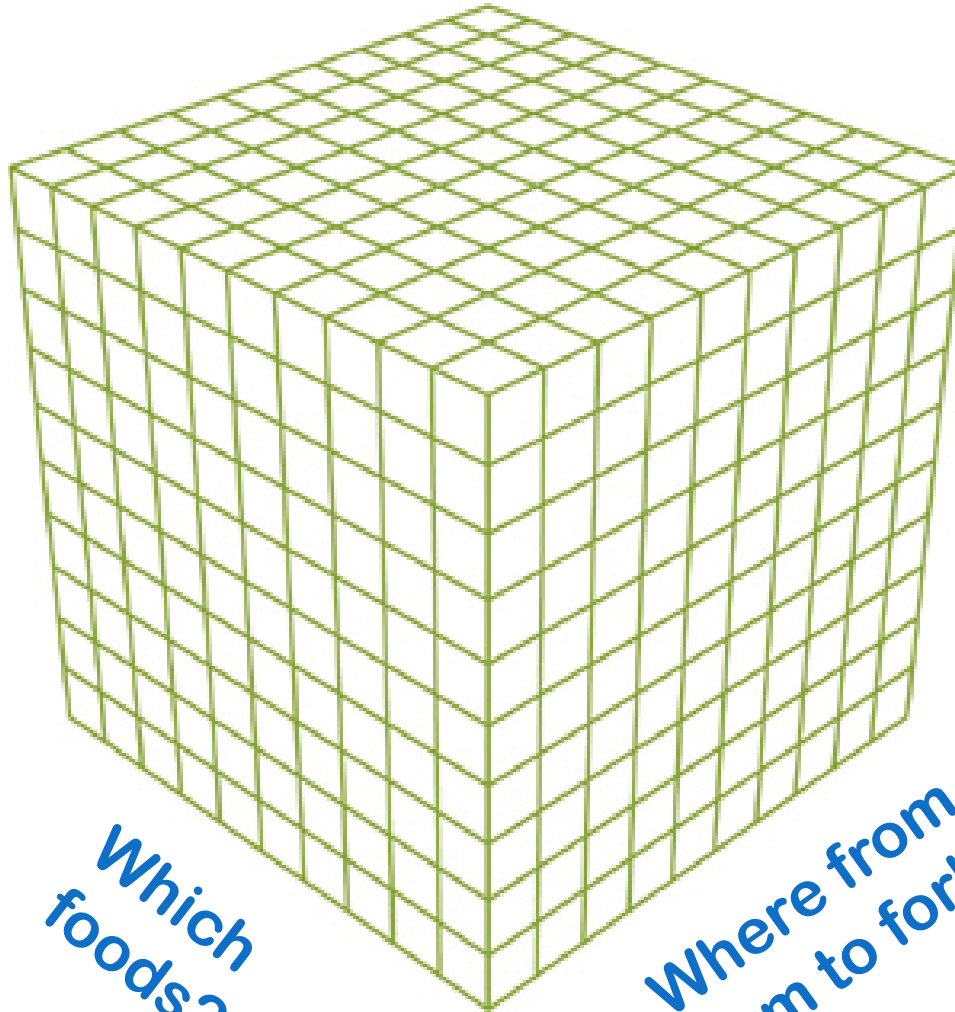
**EAT
IT.**



Source: NAS. *Enhancing Food Safety*. 2010 (p. 82)

Where should we focus effort?

Which
pathogens?

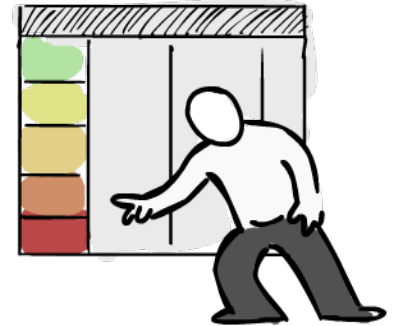


Which
foods?

Where from
farm to fork?

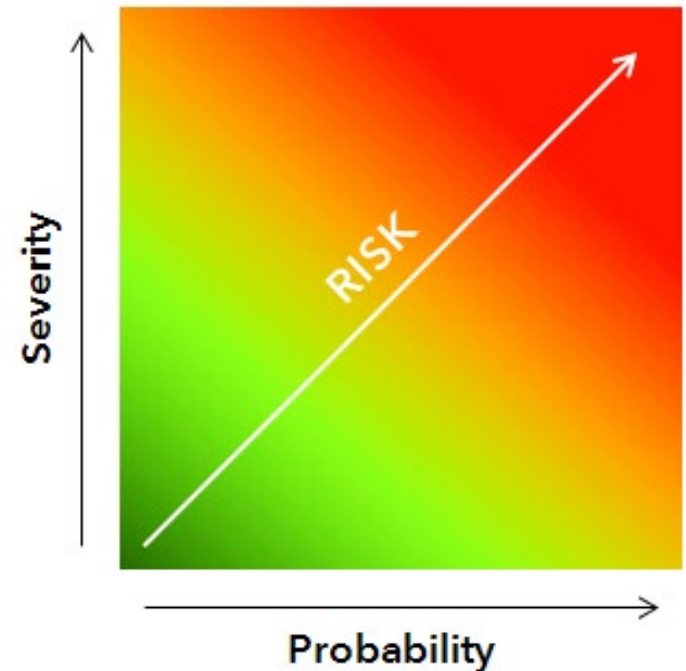
The starting point

- Which pathogens – in which foods – have the most significant impacts on public health?
- To answer this question, we estimate the disease burden associated with each pathogen, then figure out which fraction is associated with which foods

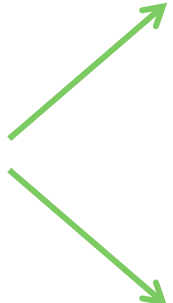


What is disease burden?

- Reflects population risk:
 - Probability of illness
 - Severity of illness
- Summary statistics
(per year in the United States)
 - Number of illnesses
 - Number of hospitalizations
 - Number of deaths



Foodborne illness in the U.S.

- 48 million annual foodborne illnesses
 - 128,000 hospitalizations
 - 3,000 deaths
 - 9.4 million cases due to 31 major pathogens
 - 56,000 hospitalizations
 - 1,400 deaths
 - 38.4 million cases due to all other agents
 - 72,000 hospitalizations
 - 1,700 deaths
- 

Sources:

Scallan et al. 2011 *EID* 17(1):7-15

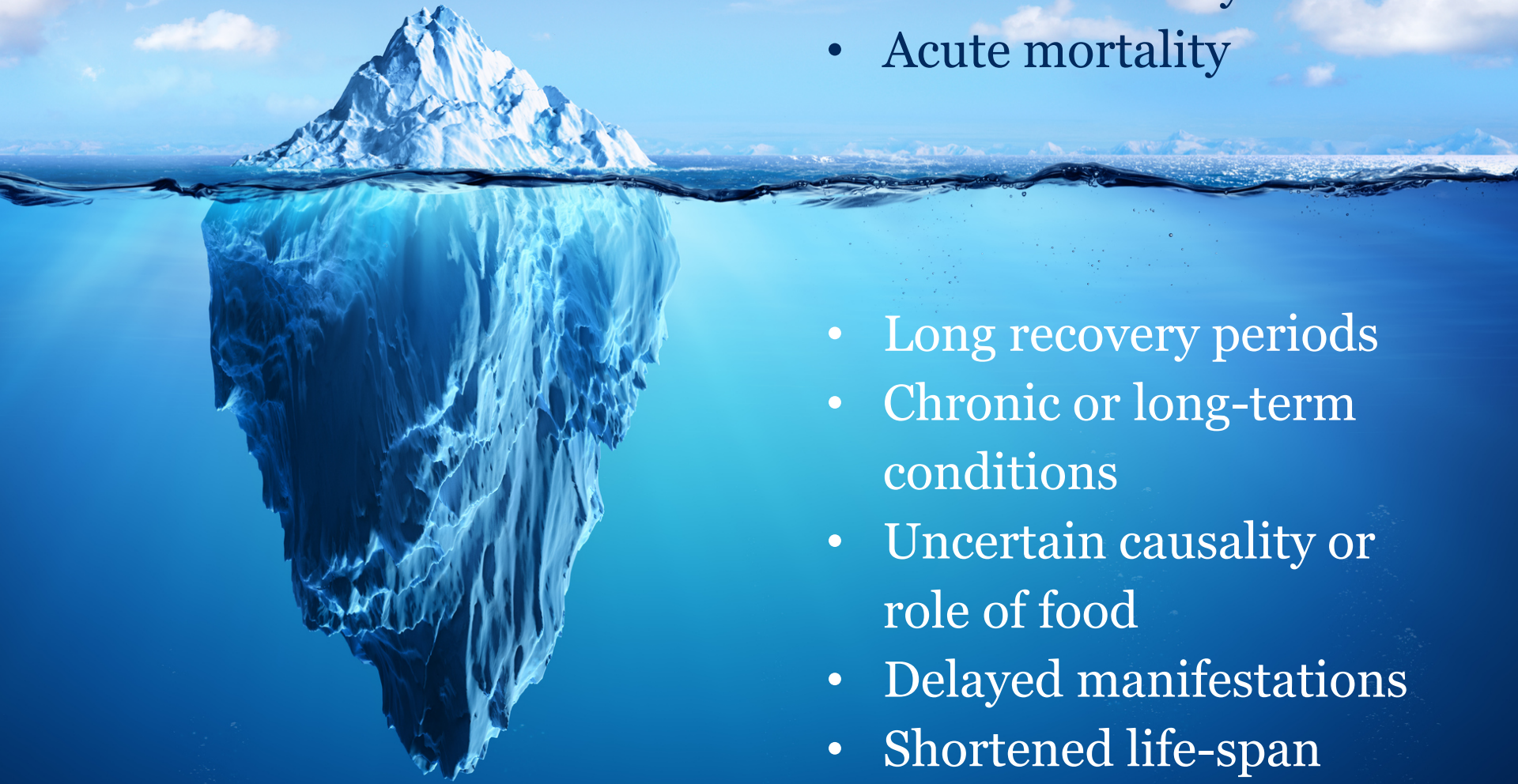
Scallan et al. 2011 *EID* 17(1): 16-22



Disease Burden

- Acute morbidity
- Acute mortality

- Long recovery periods
- Chronic or long-term conditions
- Uncertain causality or role of food
- Delayed manifestations
- Shortened life-span



Some Long-Term Conditions

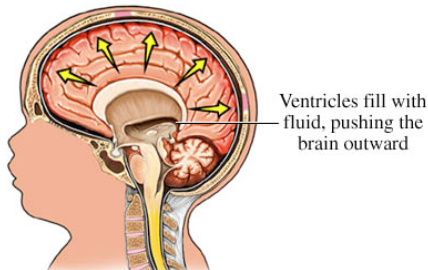
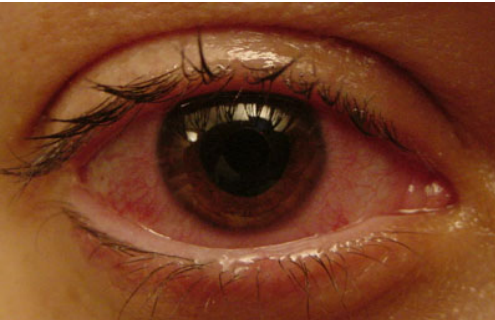
- *Salmonella*
 - Irritable Bowel Syndrome, reactive arthritis
- *Campylobacter*
 - Guillain-Barre Syndrome, Irritable Bowel Syndrome, reactive arthritis
- *E. coli* O157 (and other STECs)
 - Renal dysfunction, hemolytic uremic syndrome (HUS), kidney disease/failure, systemic disorders resulting from HUS (diabetes, hypertension, cardiovascular disease, neurological disorders)
- *Listeria monocytogenes*
 - Congenital: stillbirths, miscarriages, neurological disorders



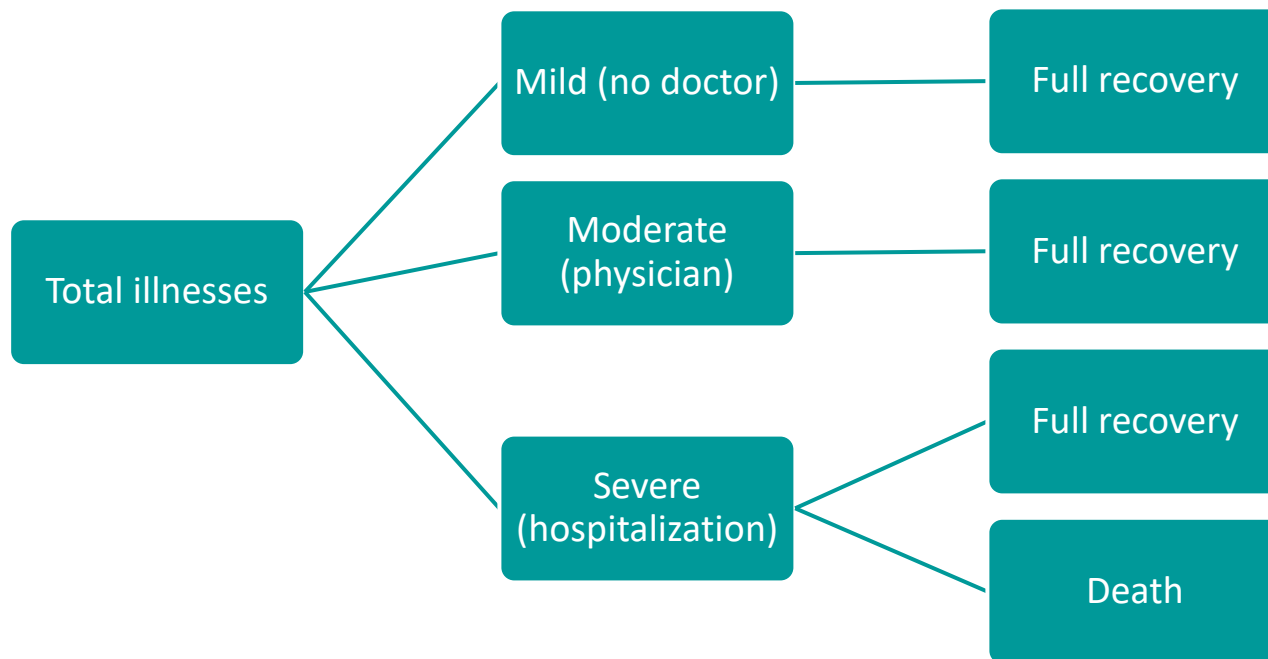


Some Long-Term Conditions

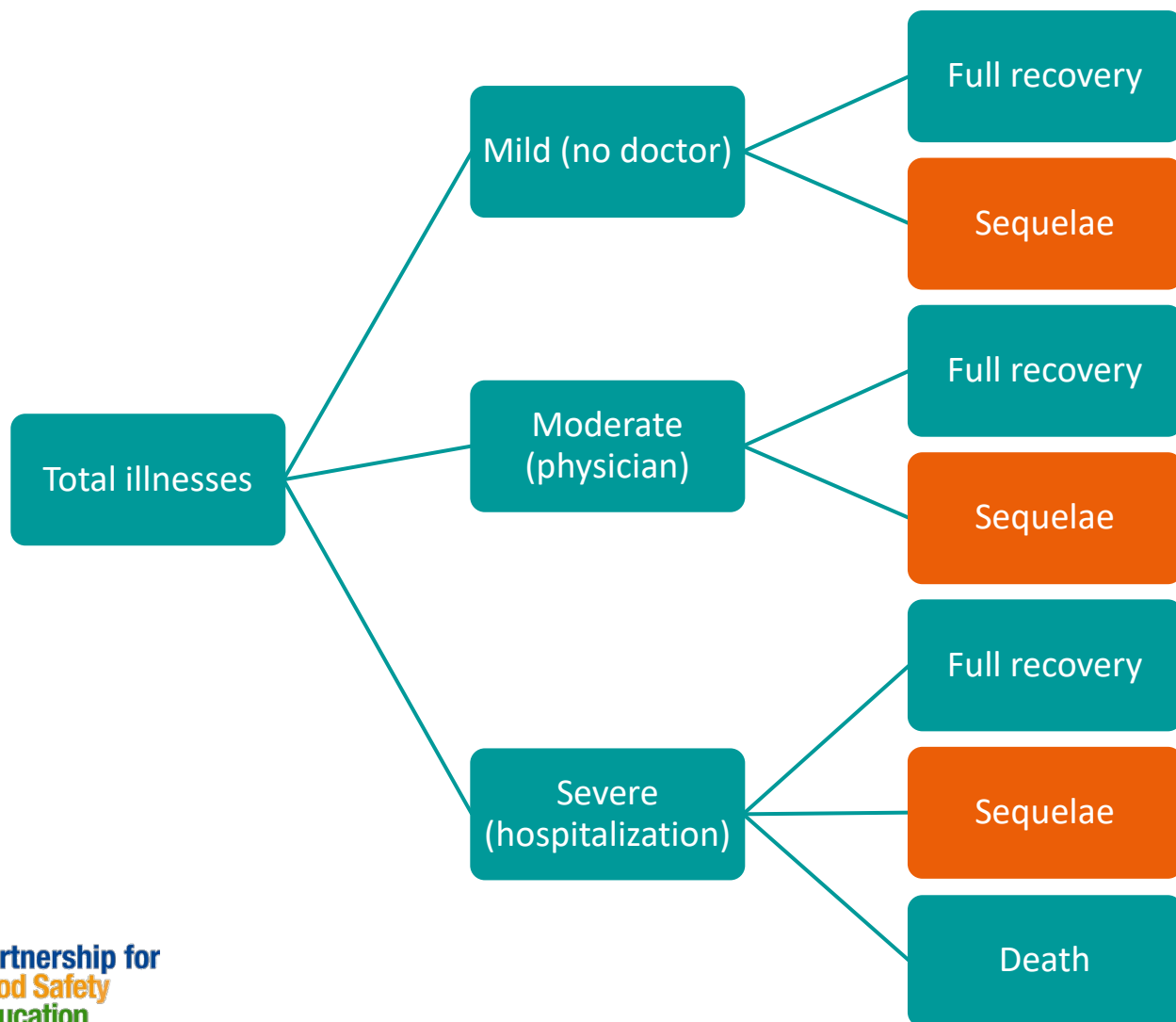
- Norovirus
 - Irritable Bowel Syndrome (suspected)
- *Cryptosporidium* and *Giardia*
 - Chronic diarrhea, reactive arthritis
- *Toxoplasma gondii*
 - Congenital: stillbirths, miscarriages, neurological disorders, vision loss, physical disabilities
- Additional sequelae
 - Long-term systemic damage due to severe acute infection
 - Inflammatory bowel disease
 - Depression, schizophrenia, psychosocial disorders



Campylobacter Outcome Tree: Acute illness

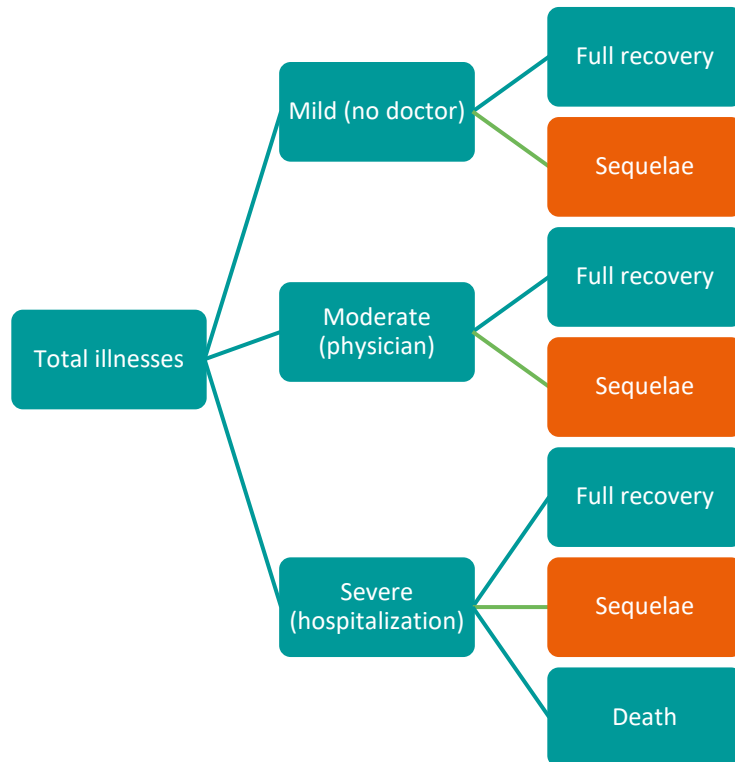


Campylobacter Outcome Tree: Acute + Sequelae



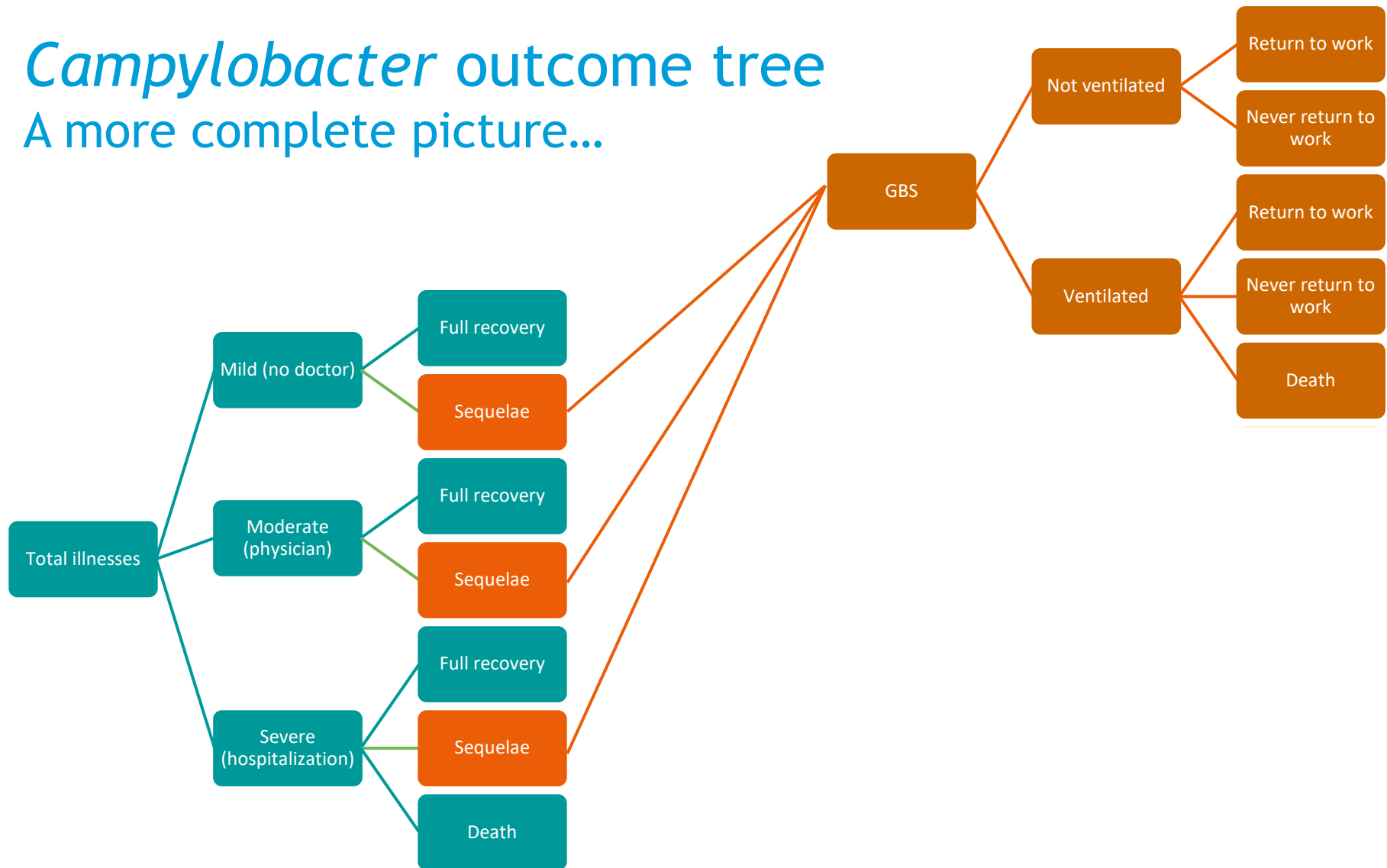
Campylobacter outcome tree

A more complete picture...



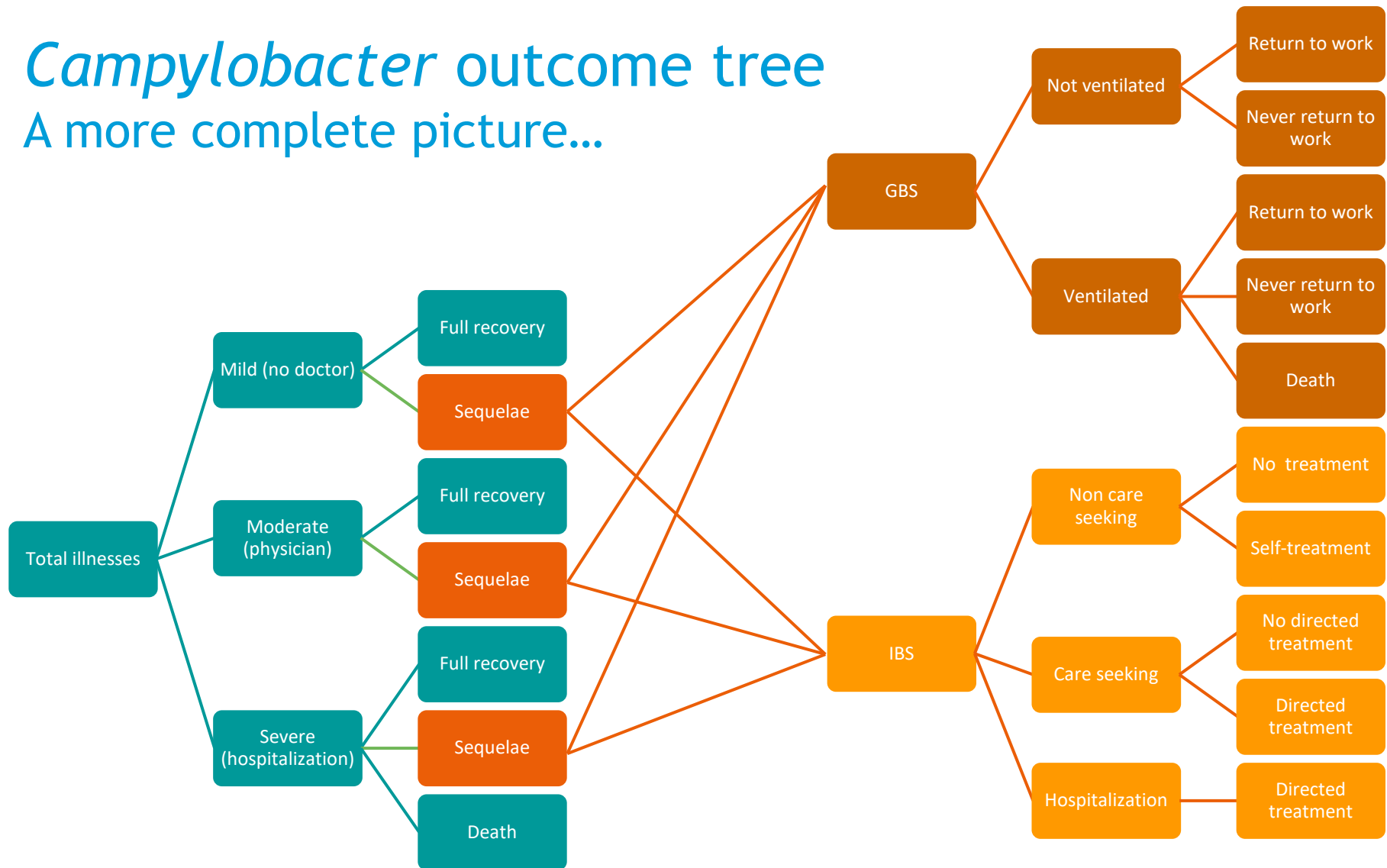
Campylobacter outcome tree

A more complete picture...



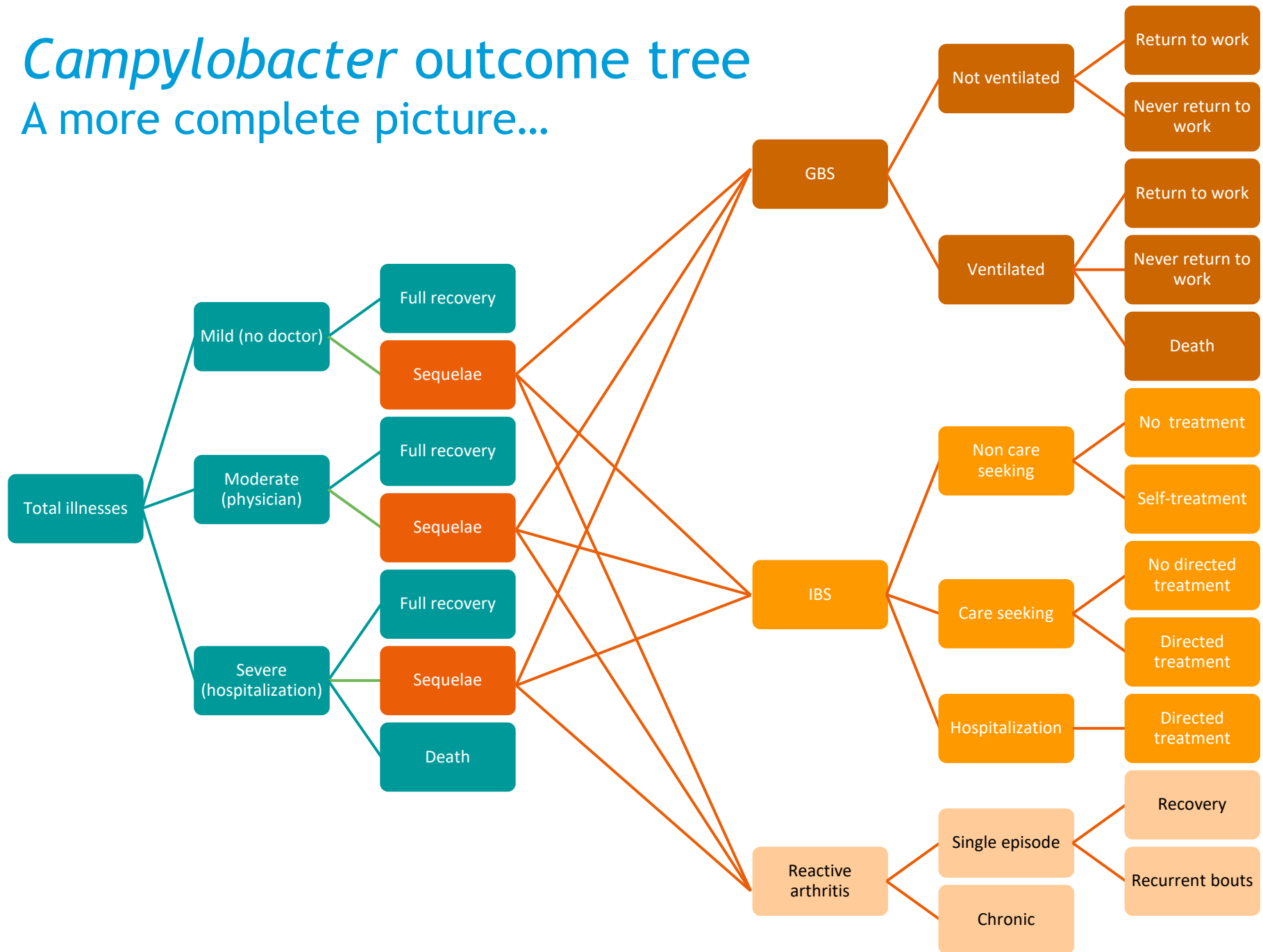
Campylobacter outcome tree

A more complete picture...



Campylobacter outcome tree

A more complete picture...



Integrated Measures of Disease Burden

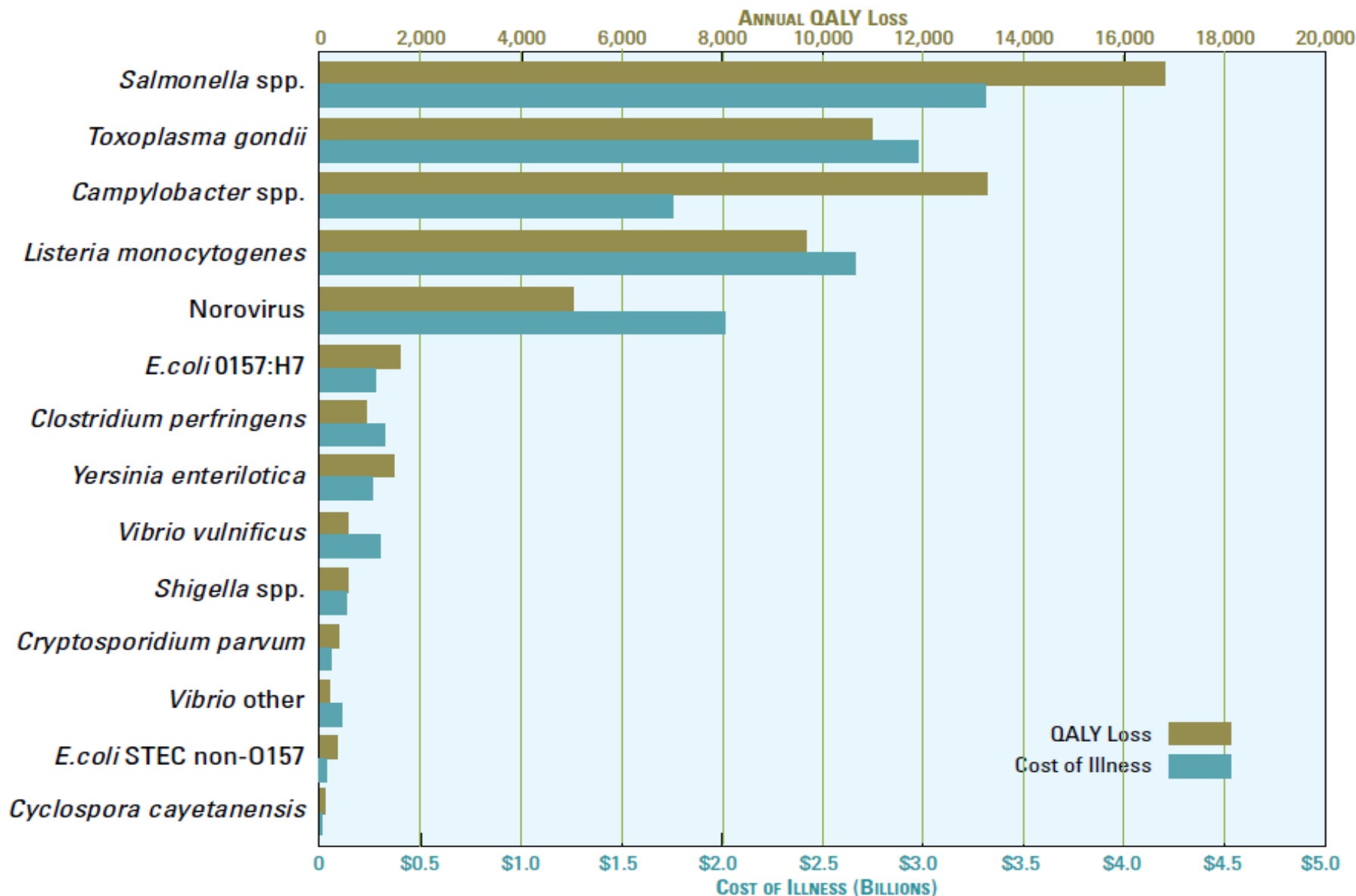
- Two broad approaches to combine morbidity and mortality into a single, comprehensive measure
- Life-year approaches
 - Most are based on measuring health-related quality of life on a zero to 1 scale and multiplying by duration of symptoms
 - Disability-adjusted life years (DALYs)
 - Quality adjusted life years (QALYs)
- Monetary approaches like cost of illness
 - Usually capture medical costs, lost wages, and measure of welfare (pain and suffering)

See: Mangen, et al. 2010. *Risk Analysis* 30(5): 782-97.

Studies for the U.S.

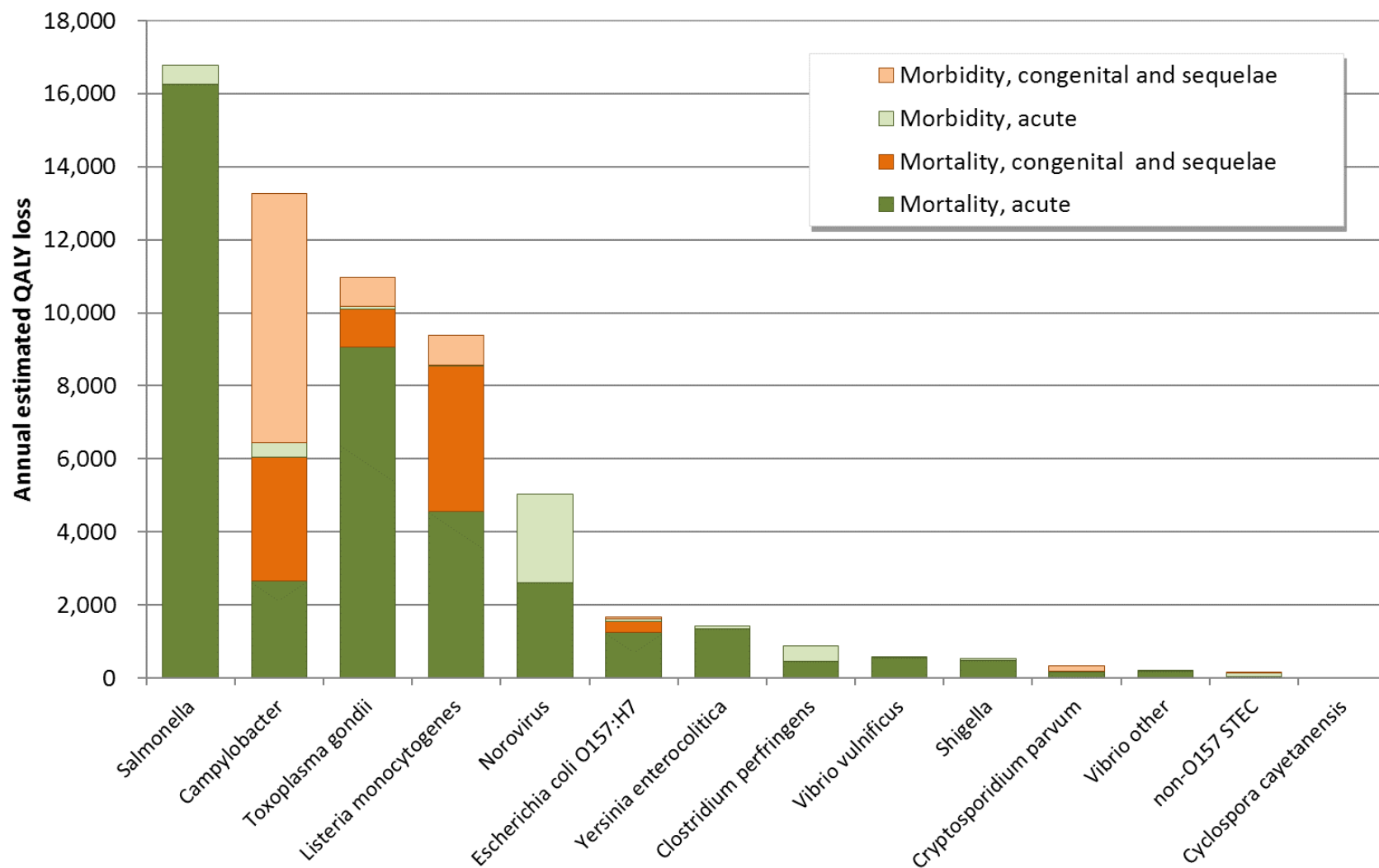
- Ohio State (Scharff) 2012
 - \$51-78 billion due to 30 pathogens
- UF (Batz, Hoffmann, Morris) 2012
 - \$14 billion due to 14 pathogens
 - 62,000 QALYs lost due to 14 pathogens
- ERS (Hoffmann, Macculloch, Batz) 2015
 - \$15.5 billion due to 15 pathogens
- FDA (Minor, Lasher, Klontz, *et al.*) 2015
 - \$36 billion due to foodborne illness (35 specified pathogens plus those from unspecified pathogens)
- CDC (Scallan, Hoekstra, Mahon, *et al.*) 2015
 - 112,000 DALYs due to 7 pathogens

FIGURE 3-1: RANKED FOODBORNE PATHOGENS, BASED ON ESTIMATES OF QALY LOSS AND COST OF ILLNESS



Source: Batz et al. 2012. Ranking the Risks Report. University of Florida.

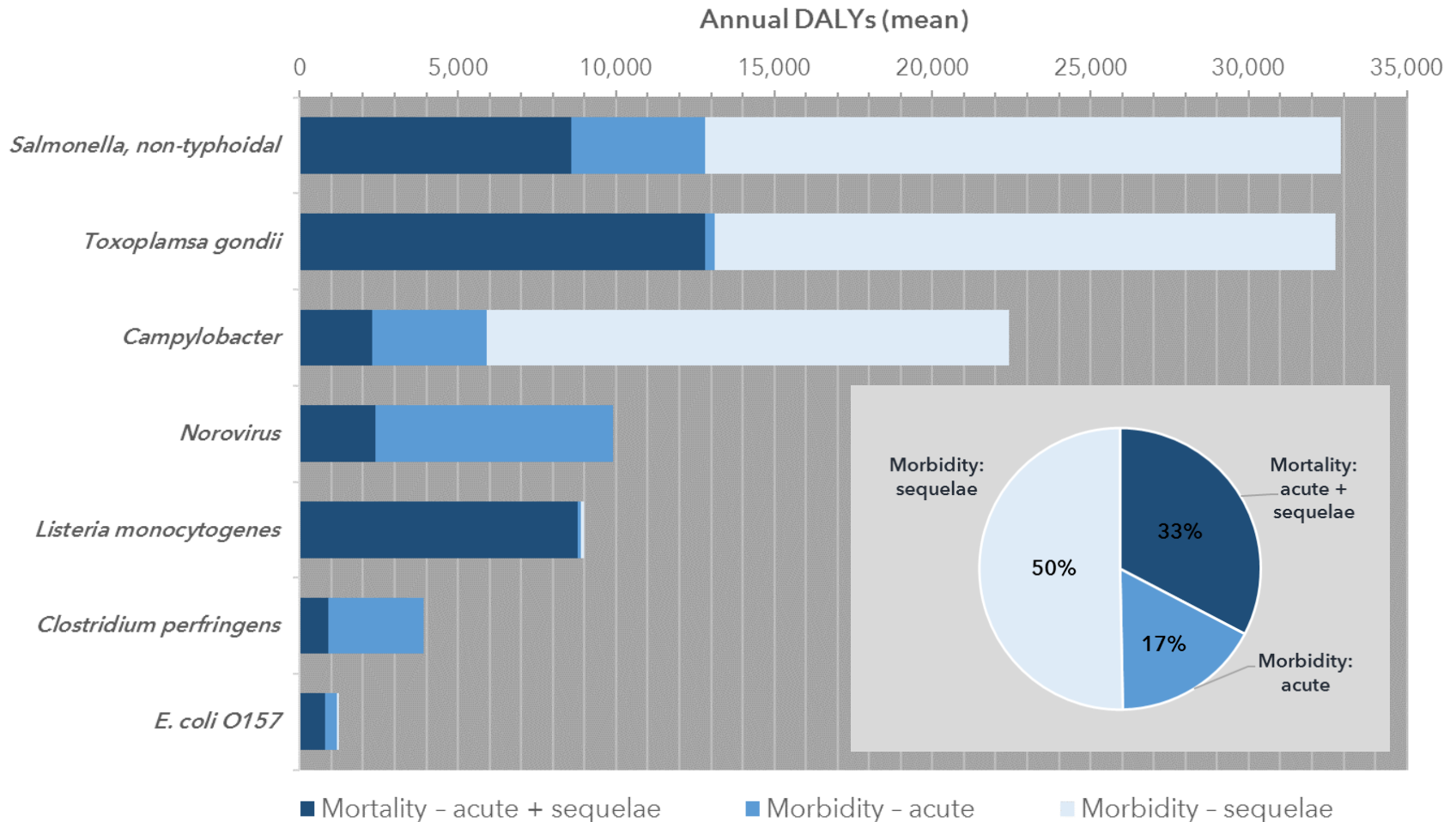
Components of QALY Estimates for U.S. (2012)



Source: Batz et al. 2012. Ranking the Risks Report. University of Florida.

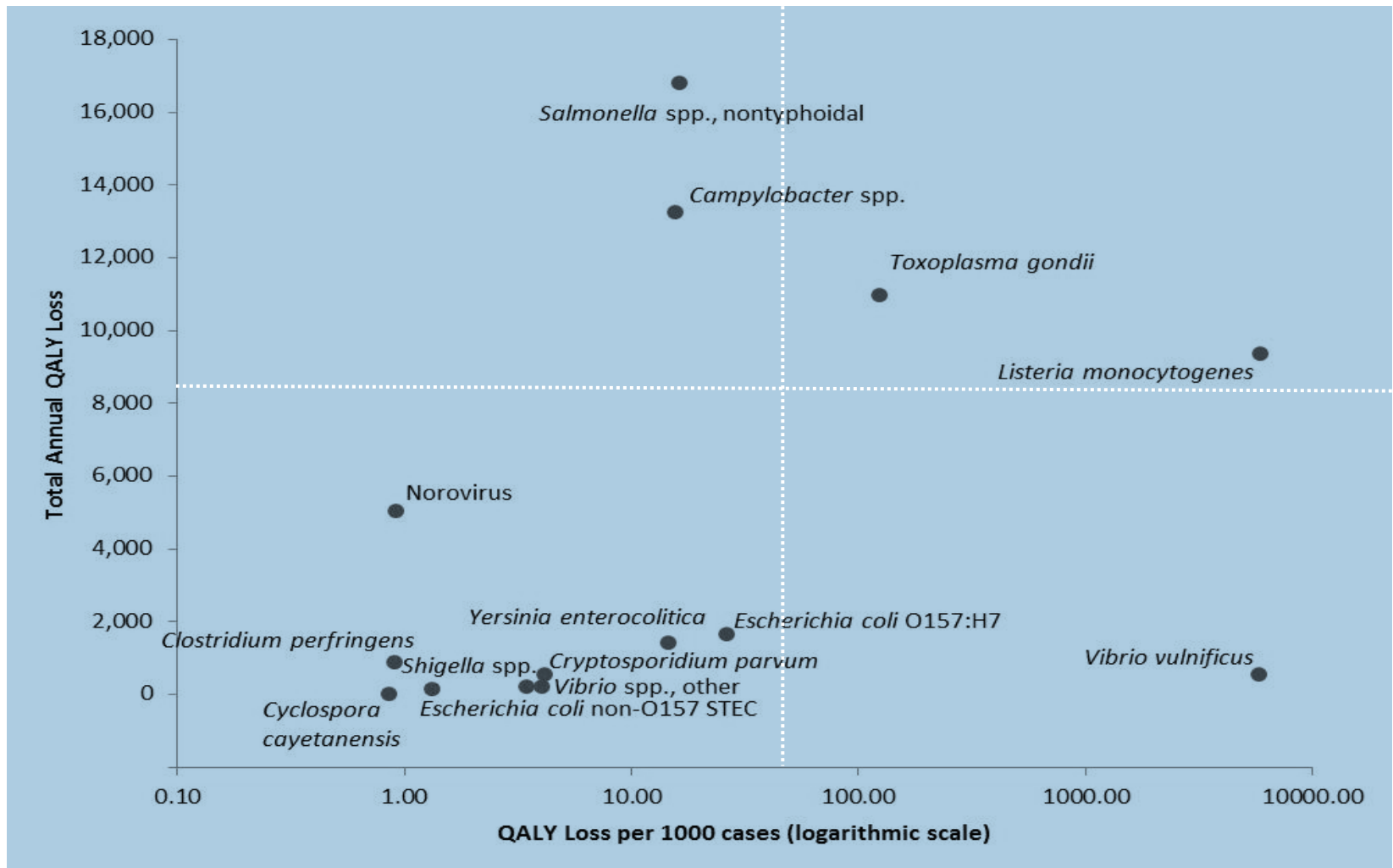
Components of DALY estimates for U.S. (2015)

Includes additional sequelae such as IBS and reactive arthritis



Source: Based on Scallan et al. 2015 *Clin Infect Dis*

Population vs. Individual Burden



Source: Batz et al. 2014. Foodborne Path Dis 11(5): 395-402

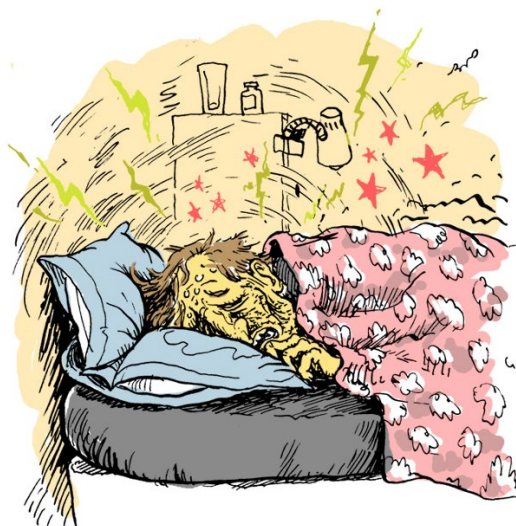
Conclusions

- When long-term conditions are included, estimates of the overall public health impacts of foodborne illness go up, and also changes the relative rankings of pathogens
- Considering the hidden costs of long-term conditions is critical to a rational, risk-based approach to food safety



Lessons for consumers

- Foodborne illness is more than a tummy ache: increasing evidence links chronic conditions such as irritable bowel syndrome, inflammatory bowel disease, and reactive arthritis to foodborne infection
- Consumers willing to risk a few days of diarrhea may not be so eager to risk protracted illness, permanent injury, or recurring/chronic disease
- Some individuals are more susceptible to severe and long-term outcomes



Thank you!



Michael Batz

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A Cold Fridge Will Help You Reduce Your Risk of Foodbo

Why do pregnant women need to be extra vigilant with home food safety? When pregnant, a woman's immune system is at increased risk of contracting a foodborne illness. Certain foods like raw sprouts, smoked seafood, unpasteurized dairy products can be especially risky for pregnant women. Each year, about one in seven (14%) illness, occurs during pregnancy.¹ Listeriosis can pass from pregnant women to their fetuses and newborns, with about 1 in 10 newborn deaths. A pregnant woman is 10 times more likely to contract Listeriosis than is another healthy

DON'T WORRY! THERE'S GOOD NEWS!

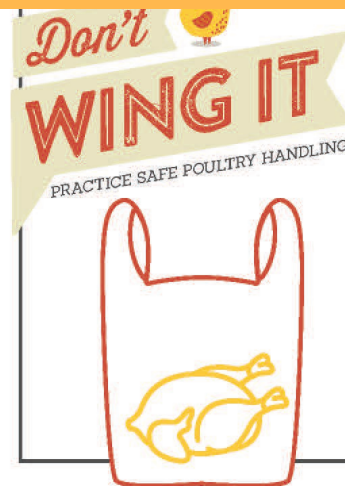


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Survey

A **survey** will pop up immediately following this webinar.



Please respond to it.

Then we'll know how to serve you better!

Thank you!

Thank You!



Dr. Barbara Kowalcyk

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