

# One Health and controlling zoonotic infections

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New Zealand  
**FOOD SAFETY SCIENCE  
& RESEARCH CENTRE**

Te Kunenga  
ki Pārehuroa



**MASSEY UNIVERSITY**

# One health

- Driver for change in approach to public health issues.
  - Food safety, control of zoonoses
  - Ecosystem health/services (food, water and recreation)
- Stimulus for closer collaboration between sectors
  - Human and animal health, environment agencies.
  - International movement supported by WHO, OIE and FAO (GHSA)
- Long history in NZ
  - Late 19<sup>th</sup> C to combat plague and TB.
  - Campylobacter and STEC in 21<sup>st</sup> C



***The health of humans, animals and the viability of ecosystems are inextricably linked***

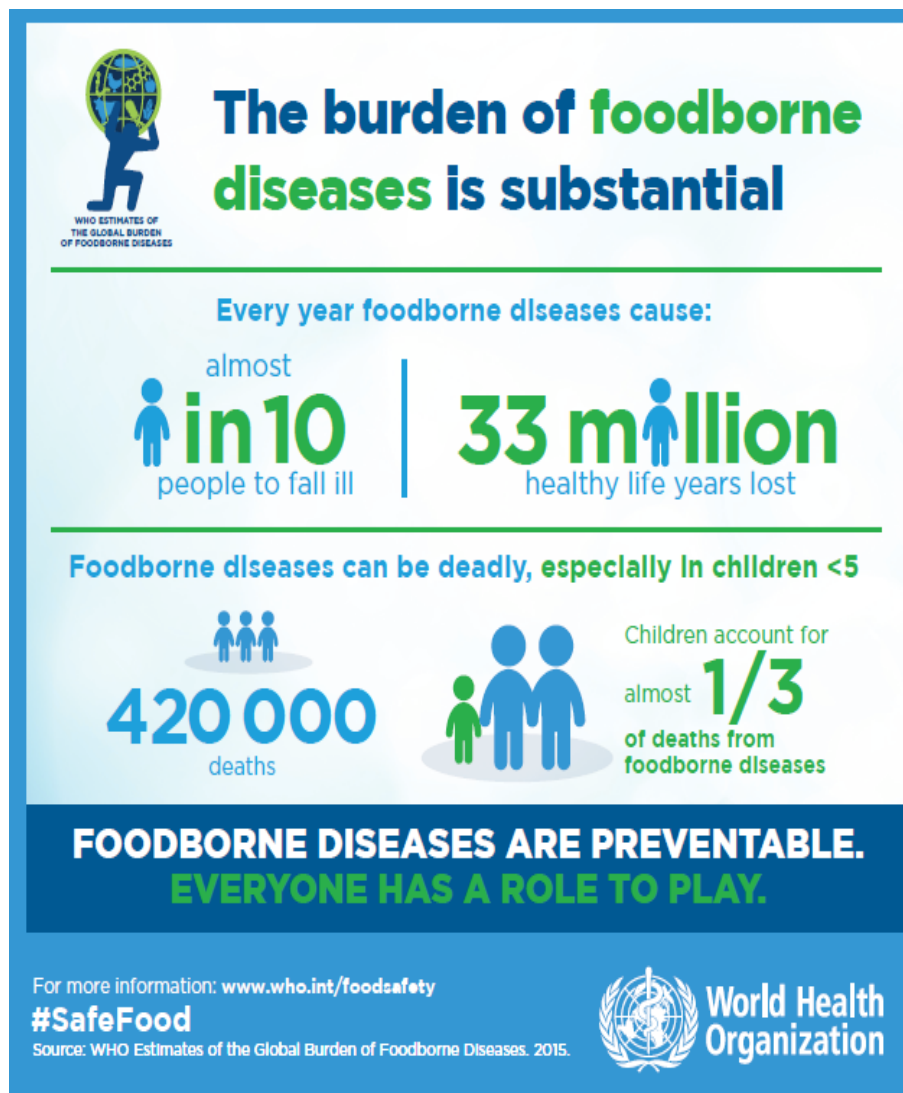
# Zoonoses in perspective

- Zoonotic epidemics cost >\$120Bn p.a.
- >200 zoonotic diseases of critical importance to human health
- 60% of human infectious disease agents zoonotic.
- Emerging infections: over 75% zoonoses (80% bioterror agents)
- Not minor problems
  - Epidemics and pandemics (SARS, H1N1, Nipah, Ebola, Zika, MERS..)
  - WHO: 2.3 billion human infections in developing countries caused by zoonotic diseases
  - 2.2 million deaths



# Foodborne zoonoses

- Global burden of foodborne infections
- A One Health approach to reducing the burden of foodborne disease
  - Interdisciplinary, whole of food chain approach
  - Source attribution – informing public health policy
  - Enteric zoonoses from the food production environment



# Campylobacter in NZ: 1980-2006

The New Zealand Herald • Friday, July 11, 2003 A5

## Stomach bug rise linked to effluent

**HEALTH:** Untreated manure infecting waterways, conference told

by Simon Collins  
science reporter

Cows producing the equivalent of untreated effluent from 52 million people are being partly blamed for an escalating epidemic of campylobacter food poisoning.

Reported cases of campylobacter stomach bugs multiplied more than 10 times in the past 20 years, from 12 cases in 1982 to a record 12 cases in 2002.

New Zealand's dairy industry has opened up a new front in the battle against the stomach bug.

Next Article: Government probes claims NZ exported Agent Orange

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### Cattle linked to common stomach bug

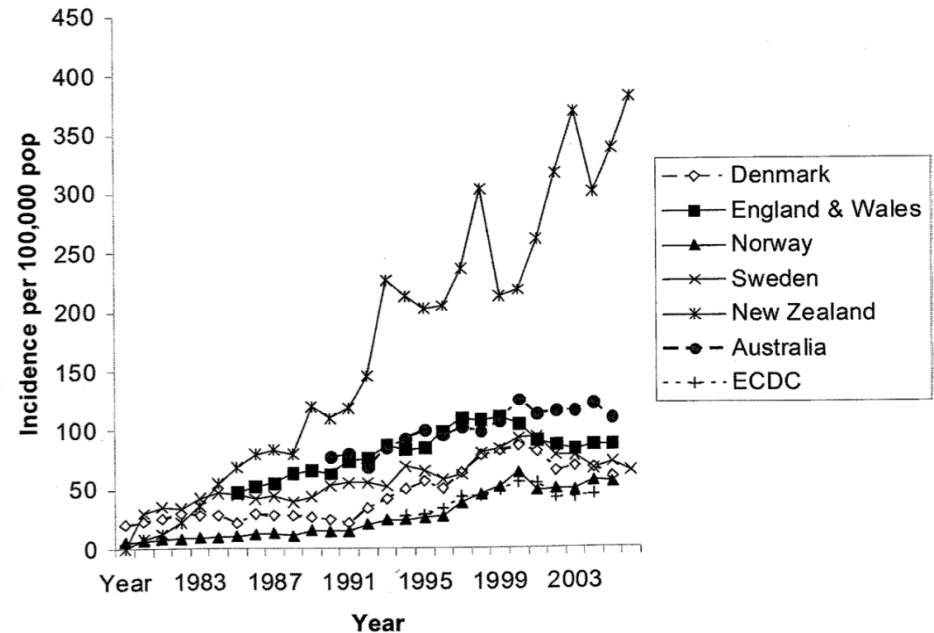
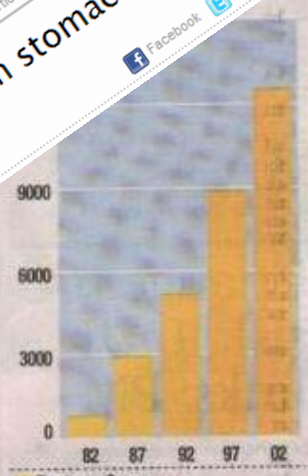
By Simon Collins  
5:00 AM Tuesday Jan 11 2005

Dr. [Name] said the difference in the incidence of campylobacter in New Zealand was due to the fact that one of the main sources of the bug was effluent from dairy farms. In 1990 and 2002, the national dairy herd increased 51 per cent to 6.2 million cows.

"They produce the equivalent of untreated effluent to 52 million people," she said.

"Only a very small proportion of that effluent is treated. Most lies around on pastures and ends up in agricultural runoff."

Rate of cases



## THE NEW ZEALAND MEDICAL JOURNAL

Vol 119 No 1243 ISSN 1175 8716

2006



### Regulation of chicken contamination urgently needed to control New Zealand's serious campylobacteriosis epidemic

Michael Baker, Nick Wilson, Rosemary Ikram, Steve Chambers, Phil Shoemack, Gregory Cook



# Source attribution

- Estimate of the relative contribution of different 'sources' to the burden of human illness.... to inform policy for prevention and control.
- Surveillance and monitoring
- Sporadic cases
- Requires One Health approach



## THE GLOBAL VIEW OF CAMPYLOBACTERIOSIS

REPORT OF AN EXPERT CONSULTATION

UTRECHT, NETHERLANDS, 9-11 JULY 2012



World Health  
Organization

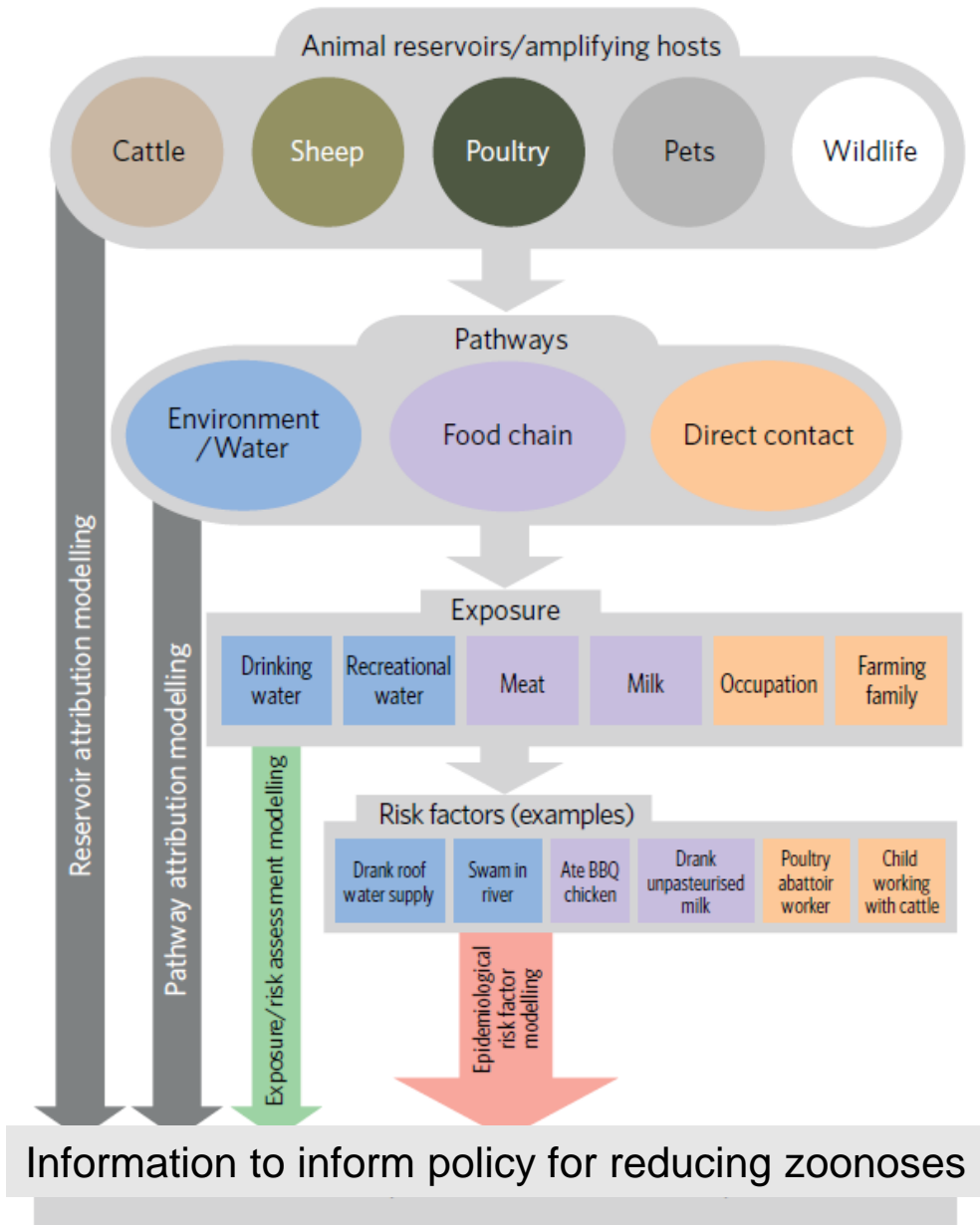
IN COLLABORATION WITH



# Source attribution framework

Wagenaar, French and Havelaar, 2013. *Clin Infect Dis*, 57, 1600-7  
**Preventing Campylobacter at the source: why is it so difficult?**

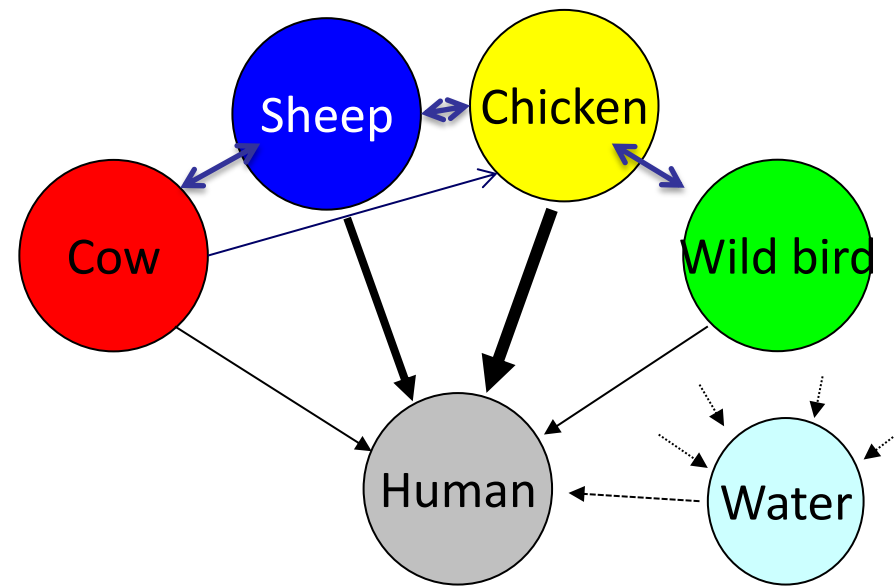
Example: Cattle  
(**reservoir**) contaminates food chain (**pathway**)  
hazard in the milk supply  
(**exposure**) risk associated with the consumption of raw milk (**risk factor**).



# Reservoir attribution

## ‘Asymmetric Island model’ (AIM)

- Population genetics / evolutionary modelling approach
- Used to find out source of human infections
- Flow into the human “island” from animal “islands”



OPEN ACCESS Freely available online

PLOS GENETICS

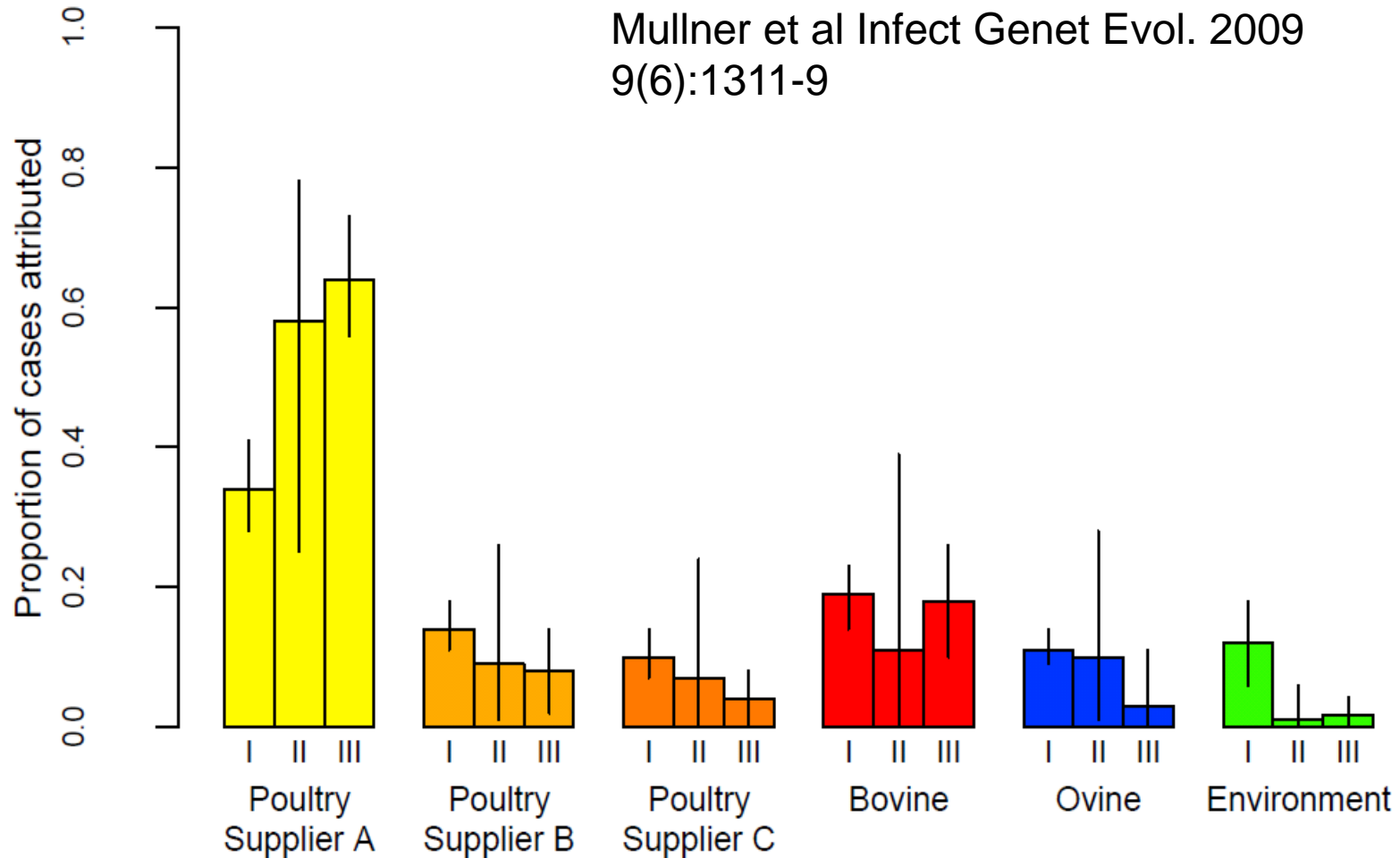
## Tracing the Source of Campylobacteriosis

Daniel J. Wilson<sup>1a\*</sup>, Edith Gabriel<sup>2ab</sup>, Andrew J. H. Leatherbarrow<sup>3</sup>, John Cheesbrough<sup>4</sup>, Steven Gee<sup>4</sup>, Eric Bolton<sup>5</sup>, Andrew Fox<sup>4,5</sup>, Paul Fearnhead<sup>1</sup>, C. Anthony Hart<sup>6†</sup>, Peter J. Diggle<sup>2</sup>



# Reservoir attribution

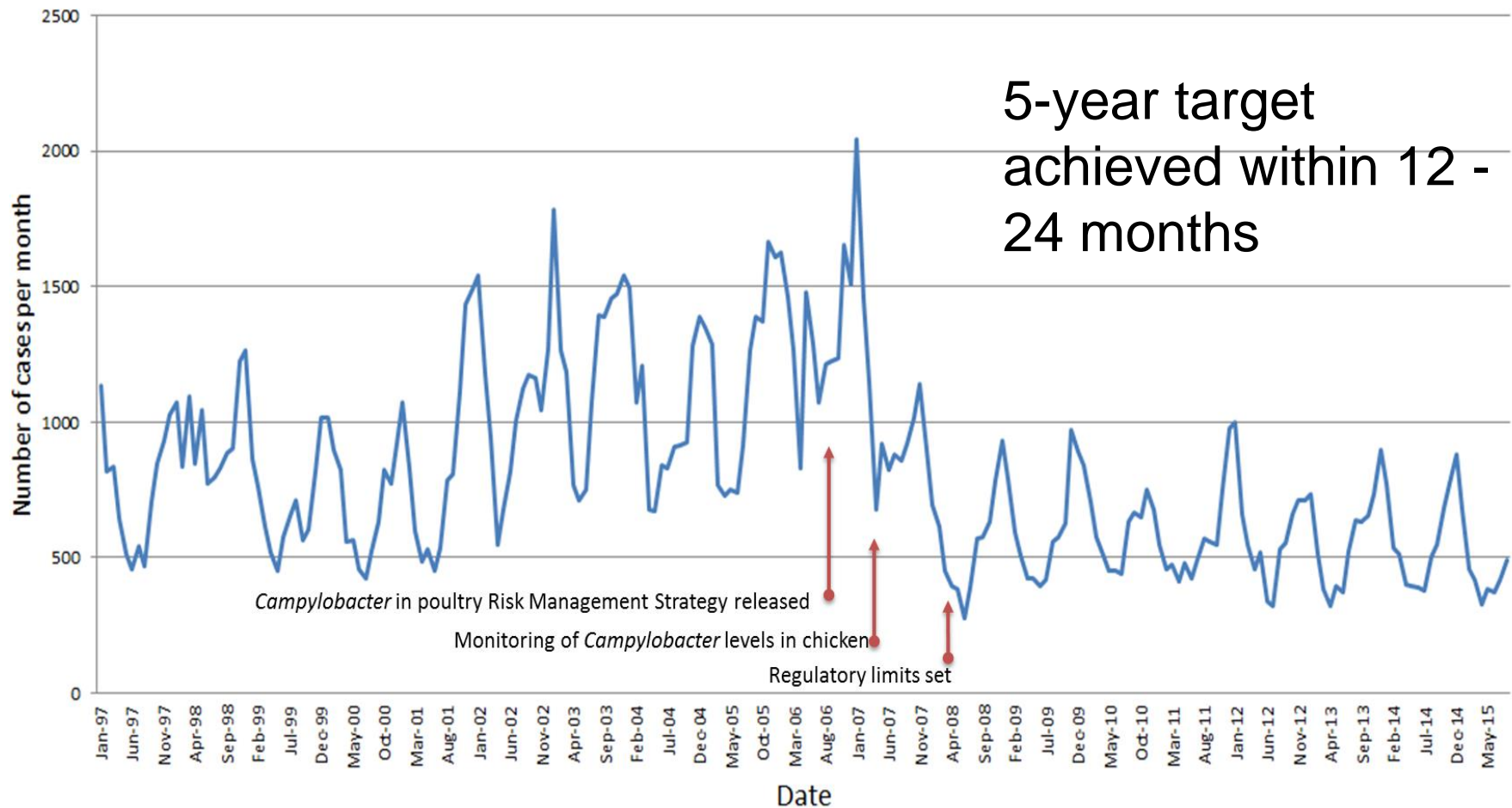
Mullner et al Infect Genet Evol. 2009  
9(6):1311-9



# Marked *Campylobacteriosis* Decline after Interventions Aimed at Poultry, New Zealand

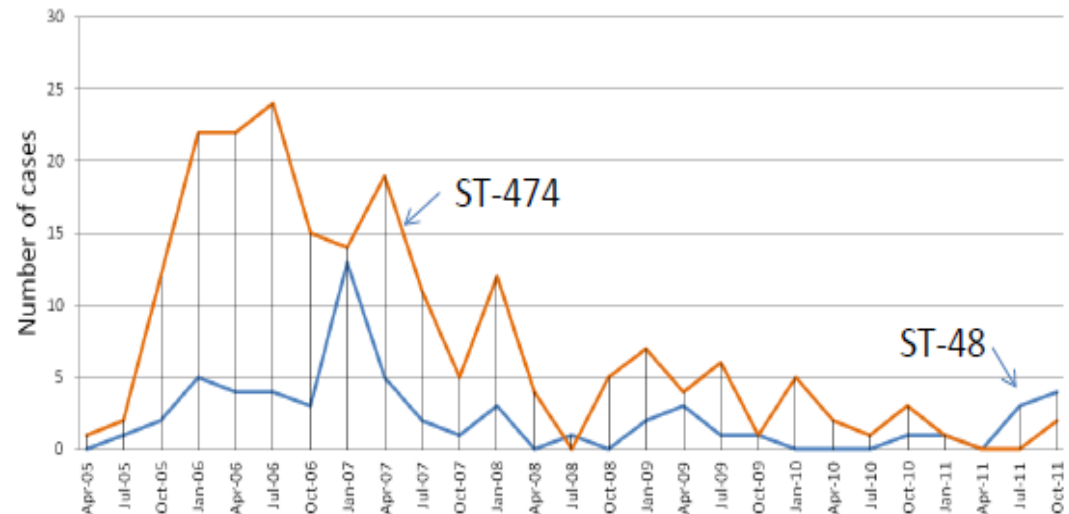
Ann Sears, Michael G. Baker, Nick Wilson, Jonathan Marshall, Petra Muellner, Donald M. Campbell, Robin J. Lake, and Nigel P. French

Sears et al 2011,  
*Emerging Infectious Diseases* 17, 1007-15



# Surveillance and monitoring: Rise and fall of epidemic strain *C. jejuni* ST 474 and the use of WGS

- ST-474 found more commonly in multiple sources later in 'epidemic'
- Early WGS revealed rapid evolution
- Recombination >> mutation



Biggs et al 2011, PLoS One, 6 (11) e27121

French et al, 2014. *Campylobacter Ecology and Evolution*, 221-240.

# Genome sequencing of epidemic strain ST 474, 420 ST 474 Isolates 12 years

Tree scale: 0.1

## company

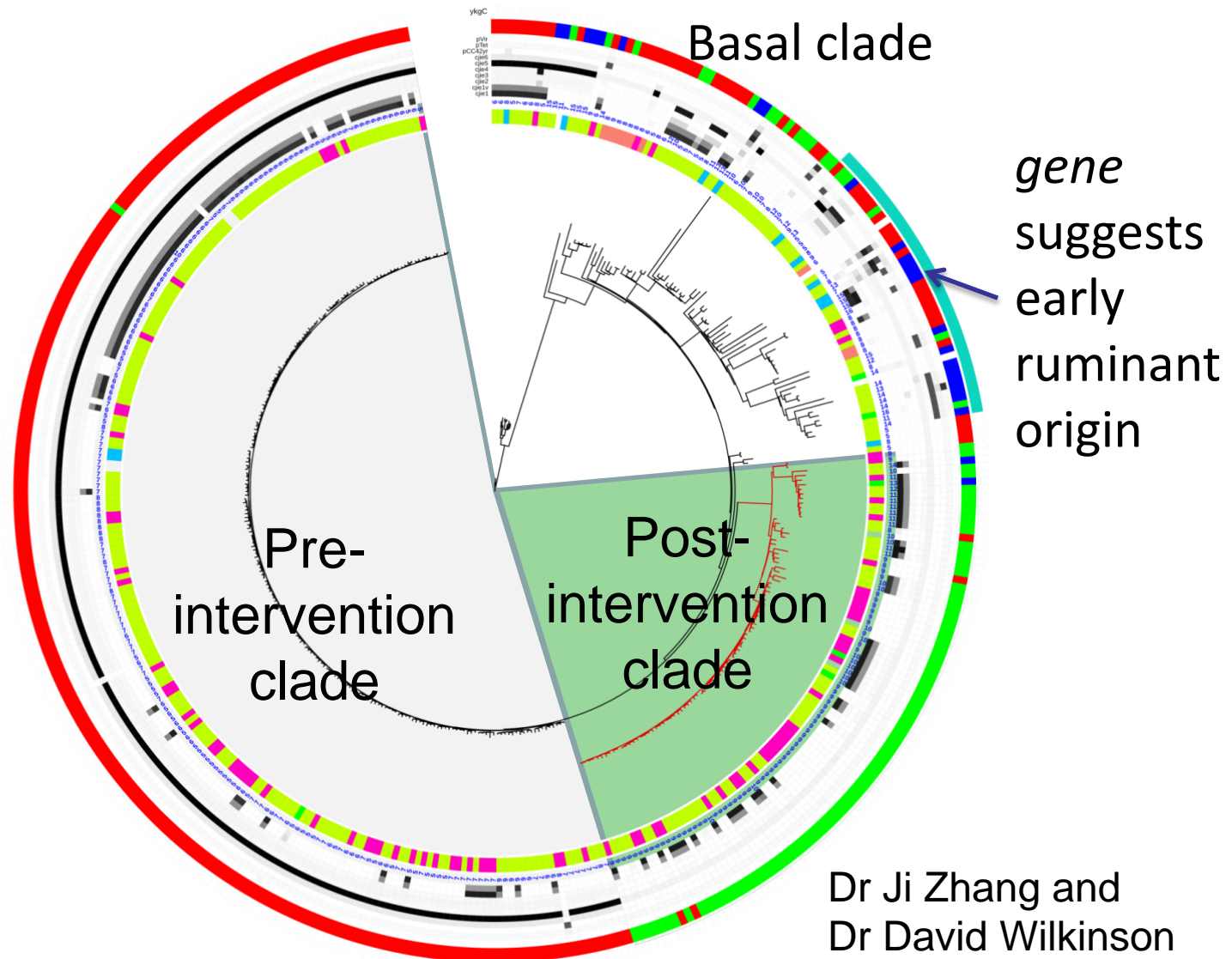
- Poultry A
- Human
- Ruminant
- Water
- Poultry other
- Other\_poultry

## mobile\_elements\_likelihood

- 0
- 0.1
- 0.2
- 0.3
- 0.4
- 0.5
- 0.6
- 0.7
- 0.8
- 0.9
- 1

## time\_period

- Early 2005-2008
- Mid 2009-2012
- Late 2013-2016



# Recent development: Arrival of ST-6964 in 2014 and Antimicrobial Resistance (AMR)

SUNDAY STAR+TIMES  
November 22, 2015

NEWS A3

## Superbug found in chicken

Scientists are alarmed at the unprecedented discovery of a strain that resists drugs and has crossed into humans around NZ, writes Susan Edmunds.

A new superbug has been found in chicken from three of New Zealand's four major poultry suppliers. Groundbreaking research reveals the new antibiotic-resistant strain of campylobacter spreads to humans, which could make it hard to treat serious cases of infections. Campylobacter occurs naturally in the gut of chickens but is the leading cause of food poisoning, with about 7000 cases reported in New Zealand each year.

The antibiotic-resistant strain was first found in 2014 and has now been identified in human cases in Manawatu, Auckland and Wellington.

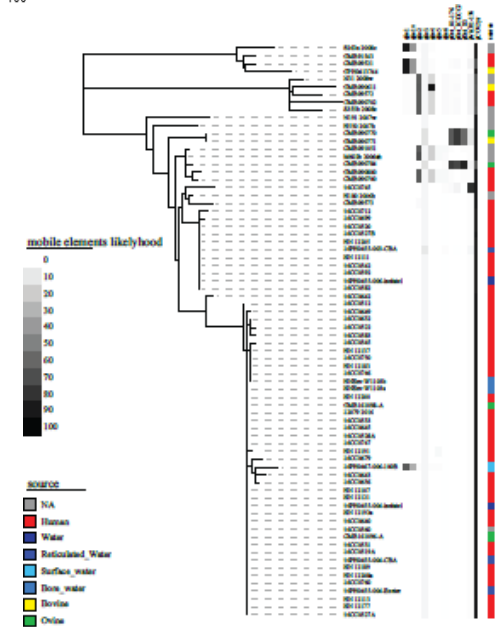
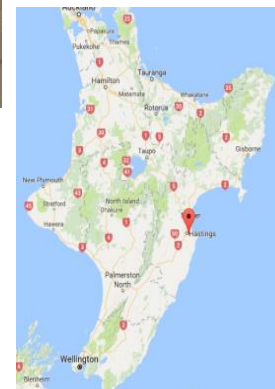
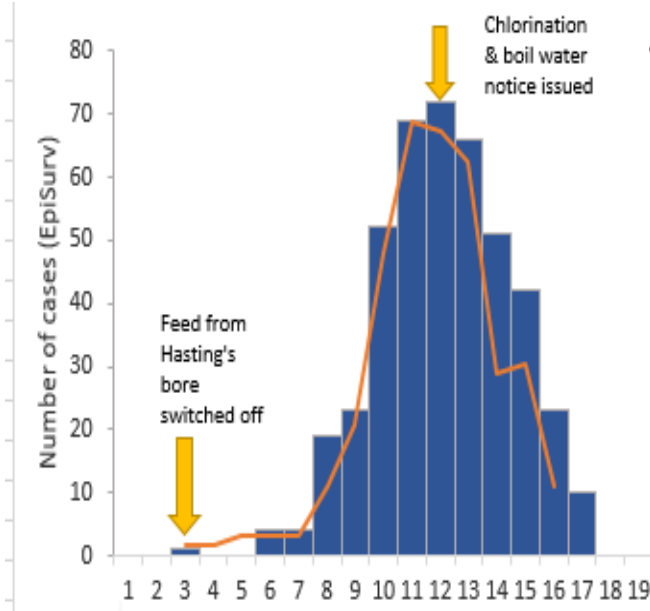
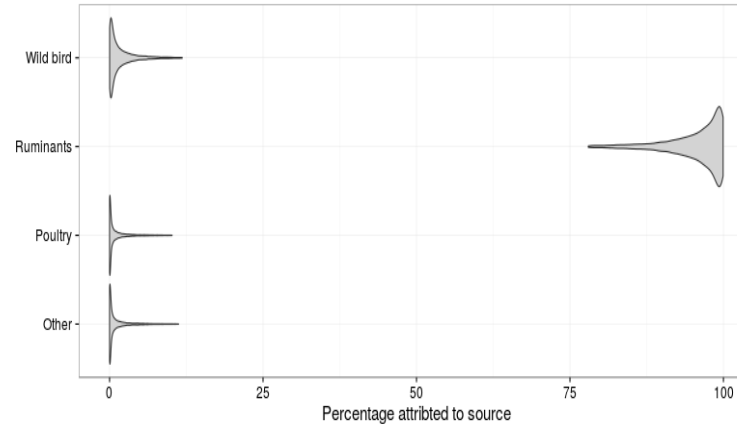
The study, by Nigel French of Massey University and ESR microbiologist Debbie Williamson, found three of the major poultry suppliers in the North Island tested positive for the strain. A fourth was still waiting for test results. The pair would not name the companies.

The resistance means two antibiotics – fluoroquinolones and tetracyclines – would fail in treating the infection. But erythromycin, which is most





# If the chicken doesn't get you the groundwater will: the Havelock North incident, August 2016



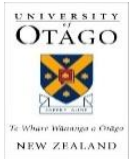
>5000 people affected  
Untreated groundwater  
*Campylobacter jejuni* ST42 predominant cause



# Conclusions

- One health, integrated approach essential for investigation of zoonotic disease outbreaks and determining source of sporadic cases
- Identification of 'source' and inter-host transmission
  - Crucial for effective public health policy
  - Can have a major impact
- Understanding foodborne hazards requires whole of food chain approach and interdisciplinary research
- New tools and technology helping to understand and control emerging risks
- Food production impacts environmental health and public health

# One Health Aotearoa



## University of Otago

- Webster Centre for Infectious Diseases
- The Infection Group
- Centre for International Health
- Ngāi Tahu Māori Health Research Unit
- Health, Environment, Infection Research Unit

Annual symposium



## Massey University

- <sup>m</sup>EpiLab
- EpiCentre
- IDReC
- Centre for Public Health Research
- Institute of Natural and Mathematical Sciences
- International Development Group



## ESR

- Environmental Science Group
- Health Programme

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