Emerging & re-emerging food-borne and zoonotic risks

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Chair, Communicable Diseases Network Australia.
Some of the “new” infectious diseases since I started medicine

1980    HTLV I
1980    Hepatitis E
1981    Staphylococcal TSS
1982    E.coli O:157 (EHEC)
1982    HTLV II
1982    Borrelia
1983    HIV
1983    Helicobacter pylori
1988    HHV-6
1989    Erlichioses
1989    Hepatitis C
1991    Venezuelan HF
1992    V. cholerae O139
1992    Bacillary angiomatosis
1993    Four-corner disease
1994    Brazilian HF
1994    Hendra virus
1995    Australian Bat Lyssavirus
1996    HHV-8 (Kaposi sarcoma)
1996    var Creutzfeldt-Jakob disease
1997    Avian influensa, Hong Kong
1999    Nipah virus
2000    West Nile fever in US
2001    Human metapneumovirus
2003    SARS coronavirus
2009    Influenza A/H1N1
2012    MERS-CoV

Idea from Johan Giesecke
Emerging infectious diseases

“We can define as emerging infections that have newly appeared in the population, or have existed but are rapidly increasing in incidence or geographic range.”

Stephen Morse in *Emerging Infectious Diseases* (1995)
http://www.cdc.gov/ncidod/eid/vol1no1/morse.htm
Factors in infectious disease emergence

- **International travel & commerce**
  - Human mobility
  - Refugee crises
  - Liberalised trade

- **Microbial adaptation & change**

- **Medical care & technology**

- **Technology & industry**
  - Intensive food production
  - Extensive irrigation

- **Ecological changes**
  - (including economic development & land use)
  - Climate change
  - Ecosystem disturbance

- **Human demographic & behavioural change**
  - Changing population age structure
  - IDU
  - Sexual behaviour

- **Urbanisation**

- **Transmission route**

- **Environment**

*after Morse, 1995 & McMichael 2001 & 2004*
Food-borne and zoonotic diseases
Outline

• Some Tasmanian food-borne & zoonotic risks
  – Tularaemia
  – Q fever
  – *Salmonella*
    • S. Mississippi
    • S. Typhimurium PT160
    • Antibiotic-resistant serovars
    • Recent trends in food-borne serovars
  – Listeriosis

• Some practical & strategic national responses
A zoonotic disease we’re not supposed to have, but ...
Tularaemia

- *Francisella tularensis*
  - 4 subspecies with different
    - Distribution
    - Ecology
    - Virulence
- Transmission
  - Inhalation
    => Pneumonia, Septicaemia
  - Direct inoculation or insect bite
    => Ulceroglandular
  - Via water or food
    => Oropharyngeal
Case 1: Zeehan Highway, about 3km on the Queenstown side of the Henty River Bridge
Case 1, February 2011

- Remote western Tasmania
- Ring-tailed possum bite to hand
- Ulceroglandular tularaemia
- Sequencing of genetic material from the affected tissues
  - *F. tularensis* subspecies *holarctica* biovar *japonica*
- Supported by DFA, real-time PCR & serology
- Treatment complicated, prolonged
Case 1
Case 2: Zeehan Highway, 150-200m NW of Westerway Creek
Sites of the two possum encounters during 2011, in February (Case 1) & September (Case 2)
Public Health Response

• Notifications - State, national, WHO
• Ruled out non-possum sources of infection
• Assessed likelihood of bioterrorism
• Alerts - field & lab workers, animal handlers, vets, doctors, public
• Sought unrecognised or historical cases
• Risk assessment of rainwater tanks
• Multi-agency, human & animal health
  – Field investigation
  – Surveillance
  – Response plans
She expected doctors to know why she was feeling seriously ill. But her case had local experts stumped.

Catherine Chick was spending the weekend bushwalking and visiting local artists on Tasmania’s stunning west coast. As she drove back towards Queenstown, where she was staying, the 45-year-old hospital technician noticed something on the road ahead and braked hard. It was a small, dazed ringtail possum.

Catherine stopped her car and moved the creature to the side of the road. As she put it down, the animal nipped her on the index finger of her right hand, then scuttled off into the undergrowth.
• ProMED posting

• *Emerging Infectious Diseases* 2012; 18(9): 1484-6.
Tularaemia in Tasmania

• The ecology remains largely cryptic
• Advice to at risk is based on general principles
• Clinical vigilance and modern diagnostic methods are our sensors for further cases
A zoonotic disease we’re supposed to have ...
Q fever

- Pan-global distribution ...

except ...
Q fever

- Pan-global distribution ...

  except ...

  ... and ???
## Q fever notifications, 1995 to 2014

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<tr>
<th>Region</th>
<th>Annual Case count</th>
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- 6- to 80-fold lower rate than elsewhere in Australia
- 3 cases in 20 years

NNDSS, 24-Nov-15
Risks?

Meredith goat’s cheese maker’s million-dollar push to find Q fever vaccine

October 23, 2015 11:18am

Mandy Squires  Geelong Advertiser

Goat farmer Sandy Cameron, and Dr John Stenos. Picture: Mike Dugdale

THE owner of Meredith Dairy is spending more than $1 million to fund the development of a vaccine to fight a Q fever outbreak on his property.
Risks?

Do changing agricultural practices pose a risk of introduction & establishment?

Geelong

Meredith goat’s cheese maker’s million-dollar push to find Q fever vaccine

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Goat farmer Sandy Cameron, and Dr John Stenos. Picture: Mike Dugdale

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Salmonella
Salmonella in Tasmania, 1995 to 2014
Salmonella *Mississippi*

- Most common serotype in Tasmania
  - Serotype-specific rate very high
  - Environmental exposure, native animals, raw water
  - Very rare elsewhere in Australia
- Restaurant outbreak, late 2012
  - Epidemiological link to salad, mostly Tasmanian
  - Coincident increase in community cases
  - Are we missing foodborne transmission?
  - Changing production or consumption patterns?
Salmonella Typhimurium PT 160

- Rare in Australia before 2008
- New Zealand
  - Epidemic and enzootic from ~2000
- Emerged in Hobart in 2008
  - Human cases
    - Suburban & semi-rural
    - Some direct and indirect bird contact
  - Coincident sparrow deaths, isolates of STm 160
  - Infection in other birds & mammals uncommon
Human Cases of *Salmonella* Typhimurium PT 160, Tasmania, 2008 to late 2015 *

* Notifications to CDPU, to 24-Nov-15
Resistant monophasic *Salmonella* - Tasmania

- *Salmonella* subsp I ser 4,5, 12:i:- (PT 193)
- Resistant to amp, strep, sulpha
- September 2015
  - 3 cases
  - farmer, abattoir worker, contact with ill calf
  - reports of salmonellosis in cattle (similar time & region)
Salmonella Typhimurium - Tasmania

• Large egg-associated outbreaks
  – 2005, 2007-08
  – Producer closed
  – Raw egg guideline developed

• Fewer, small outbreaks

• Phage types of sporadic disease now mostly similar to mainland Australia
Salmonella - Australia

• Highest rates ever, almost everywhere

• S. Typhimurium
  – 40 - 50% of cases in most states
  – Major contributor to overall increase, esp. egg-associated phage types

• Emerging evidence of S. Typhimurium linked to eggs
  – *Salmonella* outbreaks with egg-containing vehicles, 2001 to 2012 (n=166) *
    • 150 were S. Typhimurium (PT 170/108, PT 44, PT9)
  – Trace-backs & environmental testing *
    • ~50% of tested farms had strains of S. Typhimurium matching outbreak strain
  – Source attribution studies #
    • Modelled South Australian data for 2000 to 2010
    • Eggs were major source (~50%) of human salmonellosis

• Risk of contamination per egg very low, but ...
  • Egg consumption massive
  • Pooled eggs amplify risk

* OzFoodNet data (unpublished)
# Glass K et al. Bayesian Source Attribution of Salmonellosis in South Australia. Risk Anal. 2015 Jul 1 (in press)
Listeriosis
Listeriosis – National surveillance 1.0

• Virgin chicken wrap outbreak, 2009

• Surveillance activities woven together
  – Commonwealth & jurisdictional Health Depts
  – Public Health Labs
  – Diagnostic and testing Labs
  – Limitations
    • Typing nomenclature complex, interpretation difficult
    • Lack of central coordination & regular reporting
Listeriosis – National surveillance 2.0

- OzFoodNet Epidemiological coordination
- Agreed suite of typing & nomenclature

<table>
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<tr>
<th>Molecular serotype</th>
<th>Binary Type</th>
<th>PFGE patterns</th>
<th>MLVA</th>
<th>MLST</th>
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<tbody>
<tr>
<td>1/2c, 3c</td>
<td>82</td>
<td>8E:110B:2T</td>
<td>04-20-20-04-03-13-10-04-00</td>
<td>9</td>
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- Regular reporting
- More potential links identified
  - Cases with shared typing – more, smaller clusters
  - Case & product “pairs”. Significance?
Listeriosis

• 3 cases, all at high risk
  – Onset 30 September 2012
  – Onset 15 September 2013
  – Onset 11 August 2014

• All exposed to hospital during incubation
Listeriosis

• 3 cases, all at high risk
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• All same molecular subtype
Listeriosis

• 3 cases, all at high risk
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  – Onset 11 August 2014

• All exposed to hospital during incubation

• All same molecular subtype

• Extensive investigation, testing & cleaning after second & third cases
  – Implicated subtype detected after third case in kitchen equipment & sandwiches

• Low *Listeria* diets?
Listeriosis – National surveillance 3.0

- Further building on existing processes
  - Efficient use of genomics, laboratory capacity, bioinformatics
  - Epidemiological hub (OzFoodNet)
  - Fortnightly reporting
Challenges – 1

• Genomics & bioinformatics
• Culture independent diagnostics
• Cost, clinical versus public health imperatives

• Underlying determinants of EIDs
  – political, economic, industrial, legal, social
• Risk communication
Challenges – 2

• Infection control & prevention around EIDs
  – Practically often straightforward
  – *But* emerging pathogens may be unfamiliar
    (first responders, animal & human health clinical and laboratory agencies)
    • Different processes
    • Difficult risk communication

• Managing public health aspects of EID needs ...
  – “One Health” thinking & relationships & capacity
  – Engaged hospital & healthcare services
    • particularly IPC and S&Q domains
Practical & Strategic National Responses
Series of National Guidelines (SoNGs)

- Avian influenza
- Dengue
- Ebolavirus
- *Haemophilus influenzae* type b
- Hendra virus
- Hepatitis A
- Hepatitis C
- HIV
- Invasive Meningococcal Disease
- Influenza
- Legionellosis
- Measles
- MERS-CoV
- Murray Valley Encephalitis
- Pertussis
- Rabies & ABLV
- Syphilis
- Trachoma
- Tuberculosis

National Framework for Communicable Disease Control

• Focus of initial Implementation Plan …
  – Leadership & governance
  – Surveillance & public health laboratory testing
  – Information systems & research capacity

Practical & Strategic National Responses

- *Emergency Response Plan for Communicable Diseases of National Significance*
- Networks such as OzFoodNet
- Centres and CREs for EIDs, Biosecurity, Emergency Responses, Antimicrobial Resistance ...
Thank-you

• Colleagues
  – Michelle Harlock (OzFoodNet, Tas)
  – Public Health Services
  – DPIPWE
  – CDNA
  – NCEPH, ANU
  – UTas
  – MDU, University of Melbourne
  ...
  in Infectious Diseases, Infection Control, Microbiology, Public Health
Sheoak on Second Bluff
Lola Burrows