

A new dawn of leptospirosis in New Zealand “Turning prevalence to incidence”



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This presentation

- Background to leptospirosis in NZ
- Why a “New Dawn”
- Recent research results on prevalence
 - Livestock
 - Meatworkers
- Modelling to estimate under-reporting

But first: a promo!

\$87,500 raised for Lepto!

Rural Women New Zealand presented a jumbo-sized cheque to the value of \$87,500 to Massey University at our national conference in Blenheim on 19 May for further research into Leptospirosis, New Zealand's most important occupationally-acquired disease.



*Assoc Prof Cord Heuer and Dr Jackie Benshop of Massey University
with RWNZ national president Margaret Chapman*

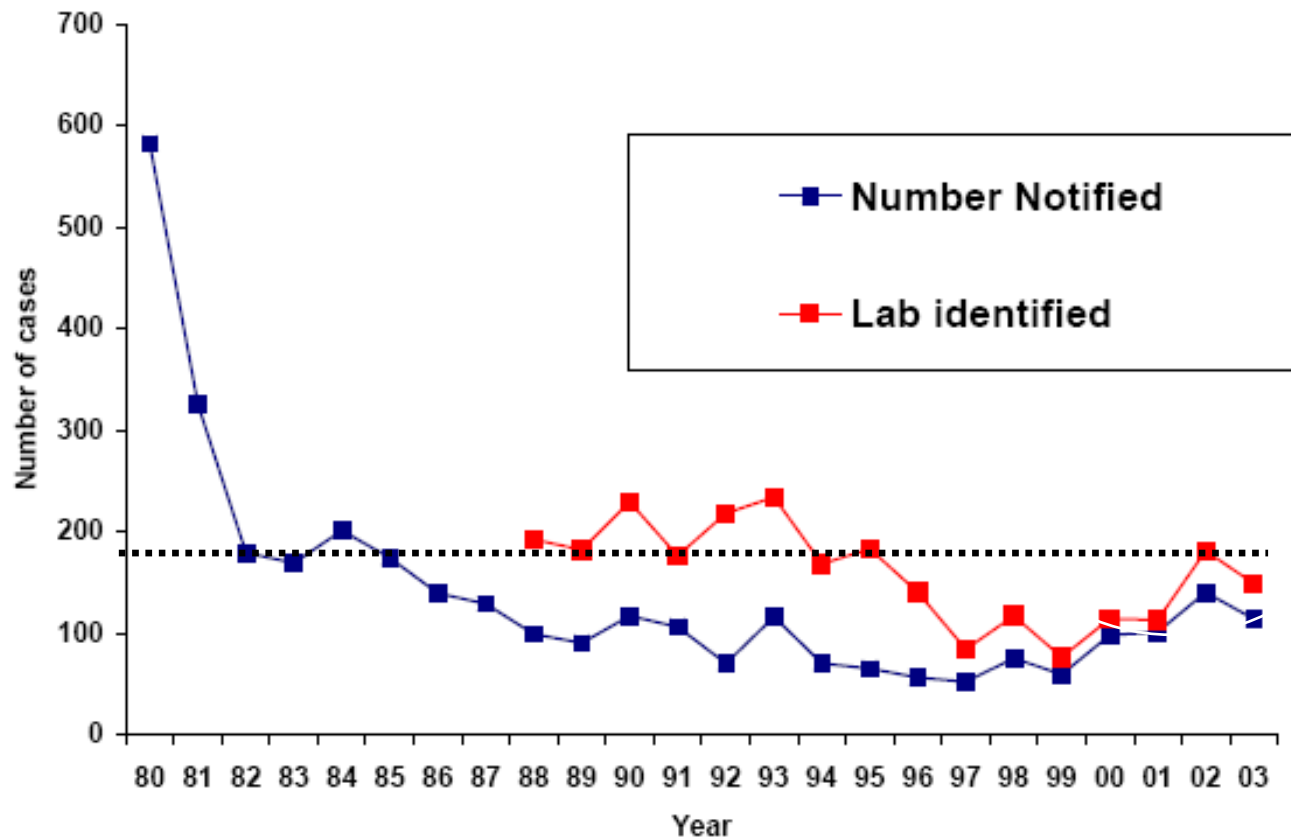
Background to lepto in NZ

- **High prevalence in humans in 1970s**
- **Late 70's – early 80's**
 - Dairy cattle research
 - Wildlife and potential reservoir populations
 - Vaccination and vaccination programmes
- **1980's**
 - Vaccination of dairy cow
 - OSH case against a dairy farmer
 - \$15000 fine
 - Attention was focussed!
- **Late 80's**
 - Research on pigs
 - Vaccination

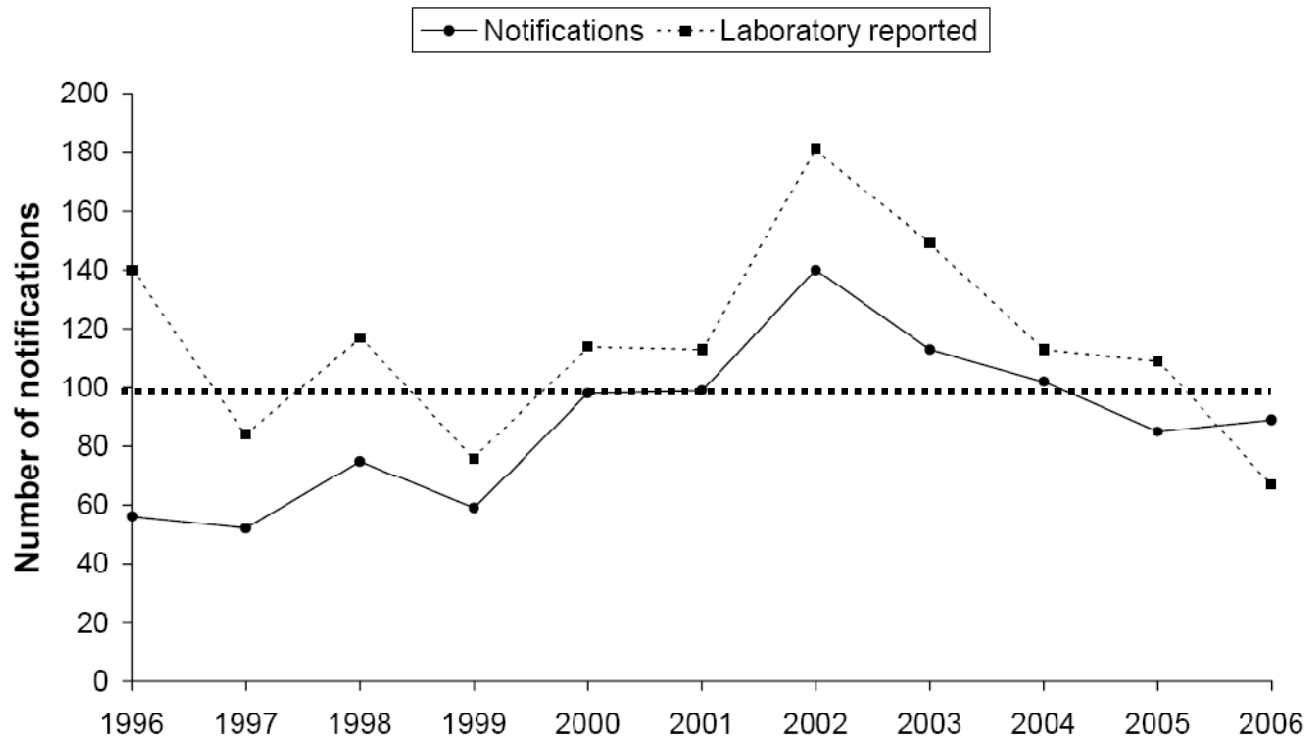
Background to lepto in NZ

- Early 90's
 - Deer prevalence survey
 - Sheep flock cases reported
- 2000's
 - Major deer lepto epidemiological studies
 - Farm-based
 - Vaccine evaluation in deer
 - Efficacy and production responses
- Profile increased
 - More human cases
 - Occupational disease

Why a “New Dawn”: Notified cases increasing since 1999



Notifications 1996 – 2006 (Source ESR, 2008)



Research areas and results

1. **Leptospirosis in humans**
2. **Prevalence in livestock** (sheep, beef cattle, deer)
3. **Meat worker study 2008**
 - **Prevalence**
 - **Incidence**

Leptospirosis in humans

- Occupational disease
 - Abattoir workers, farmers, farm service personnel
- Abattoir exposure sheep/deer
 - 5-25 shedding carcasses per worker per day
 - Depending on throughput
 - Eviscerator, meat inspector, offal worker



Livestock infection prevalence in NZ

	n	Hardjo/Pomona	Reference
<u>Herds/flocks:</u>			
Beef herds	85	69.4%	Heuer et al, 2008
Sheep slaughter lines	95	44.2%	Dorjee et al., 2005
Deer slaughter lines/farms	110	85.4%	Wilson et al. 1998
<u>Animals:</u>			
Beef cattle	1265	38.7%	Heuer et al, 2008
Sheep	2758	5.7%	Dorjee et al., 2005
Deer	2016	61.8%	Wilson et al. 1998

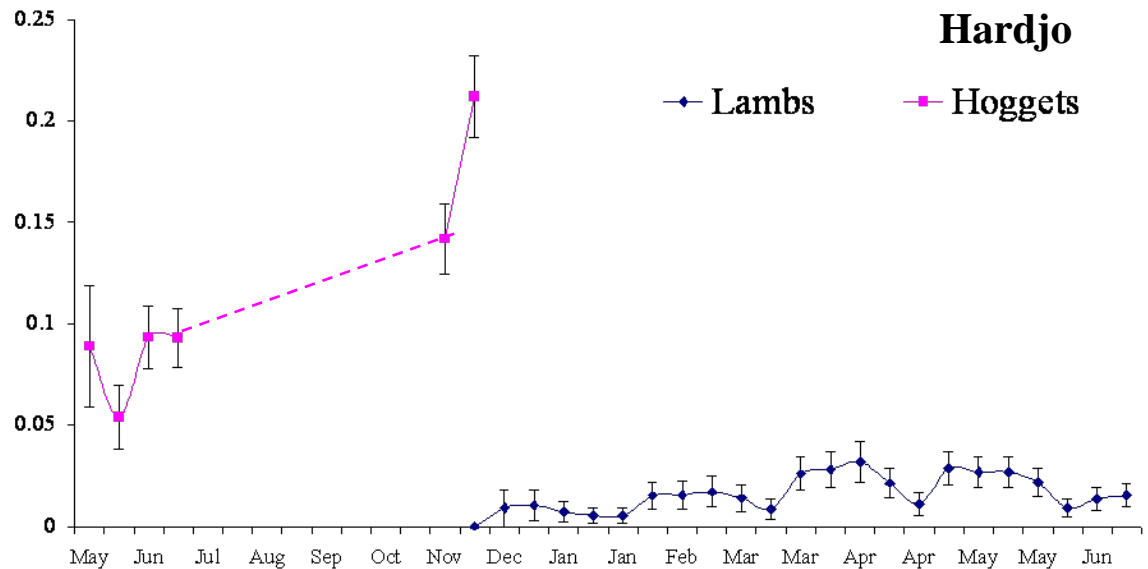
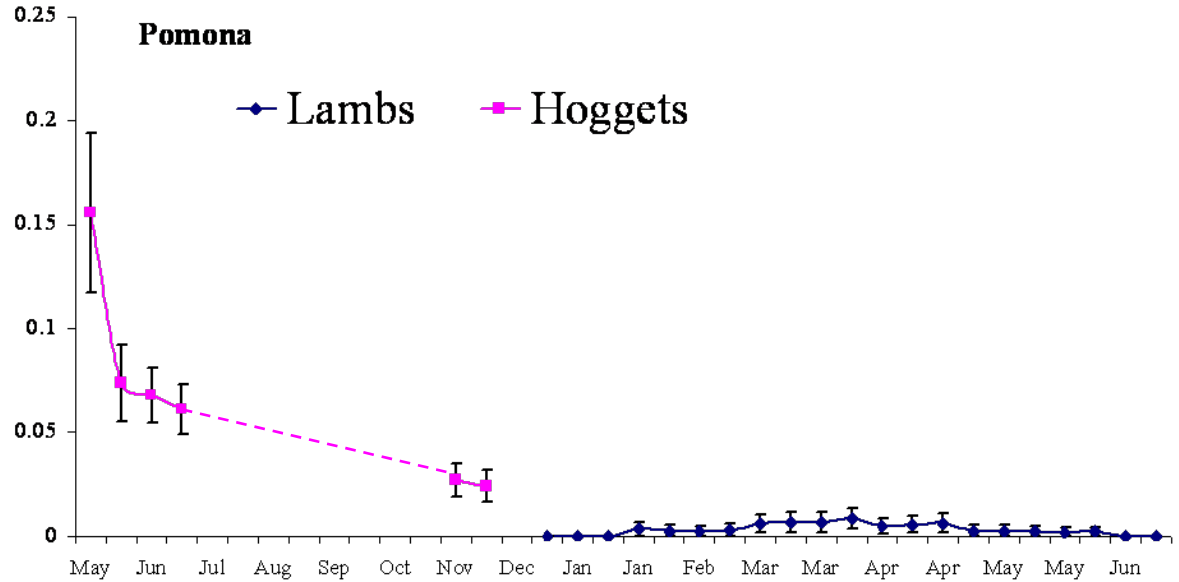
Species interaction !

- deer farms grazing cattle: RR = 17 (Subharat et al. 2007)

Kidney culture

Sheep (2006) (n = 542)	Sero+	9/43	20.9%
	Sero-	5/499	1.0%
Deer (1992/3) (n = 204)	Sero+	10/137	7.3%
	Sero-	0/67	(0%)

Sero-prevalence of carcasses at a sheep slaughter plant \pm standard error



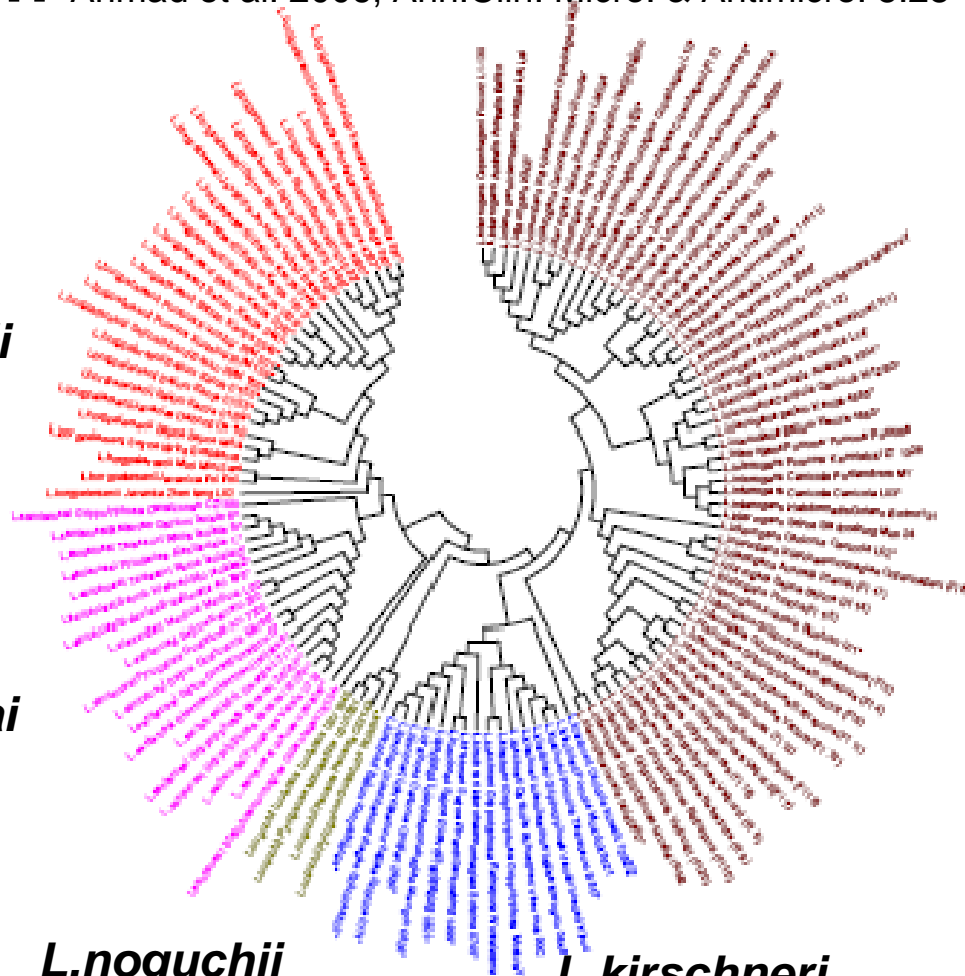
Lepto: MLST genotyping, a tool for serovar identification

Ahmad et al. 2006, Ann.Clin. Micro. & Antimicro. 5:28

5 species:

L.borgpetersenii

L.santarosai



L.interrogans

L.noguchii

L.kirschneri

Abattoir worker study 2008

- Originally controversy among participants (workers and bosses!)
- Death of a meat worker 2007
- 242 meat workers sampled at a sheep-only plant (Takapau)
- High protection abattoir
- 9.5% pos. Hardjo/Pomona
- 60% positives reported clinical disease
- Titre duration variable/unknown

The New Zealand Herald

nzherald.co.nz

WEDNESDAY FEBRUARY 13, 2008
12:38PM NZT

News Business Sport Technology Entertainment Lifestyle Travel
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[Meat industry Story](#)



Widow wants meat workers protected

5:00AM Thursday May 03, 2007

A Bay of Plenty meat worker is confirmed as the first New Zealander to die from leptospirosis – an animal-borne disease he caught at work.

Now Johnny Taewa's widow Cathy says steps must be taken so others do not suffer the "heart-breaking" tragedy she has.

Her husband of nearly 21 years Tehaena (Johnny) Cairns Taewa, died in January last year, aged 50.



Cathy Taewa - whose husband, Johnny, died from complications of the leptospirosis he caught at Affco Rangioru - also contracted the disease while working at the plant. Photo / Bay Of Plenty Times

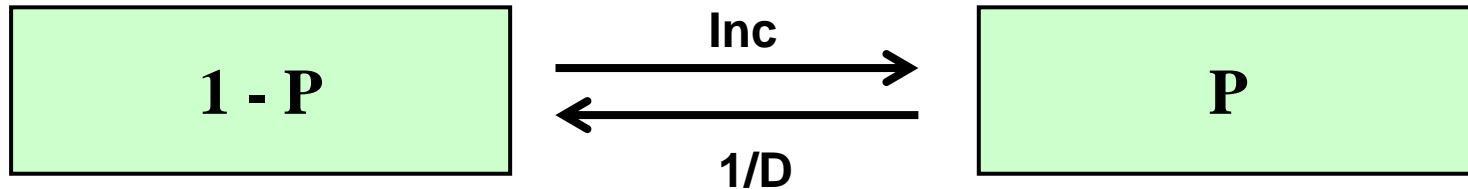
Abattoir worker study 2008

- Demographics: sampled population
 - 60% male, 45% Maori, 45-60 yrs, most <10 yrs. meat works, 74% urban, 32% smokers, 18% hunting^{ns}
- Positions in plant (no variation):
 - 50% slaughter board
 - 6% popping/pulling kidneys
- Risk factors
 - Male
 - Popping/pulling kidneys
 - Home slaughter
- Protective factor
 - Working in the boning/cutting room (out of the urine firing line!)

Modelling of suspected under-reporting

- Notification rates low
 - Range of symptoms moderate – severe
 - Low likelihood of testing by GP
 - Tests paid by patients
 - Low sensitivity of screening ELISA
 - Case definition (OSH/ACC) is bizarre
 - 4x titre increase!!!
 - PCR/Culture not accepted!!
- Hypothesis: high rate of under-reporting
 - Want incidence from prevalence to estimate actual risk and under-reporting rate

SI-Model to estimate Incidence



- Equilibrium:

- $Inc (1 - P) = 1/D * P$

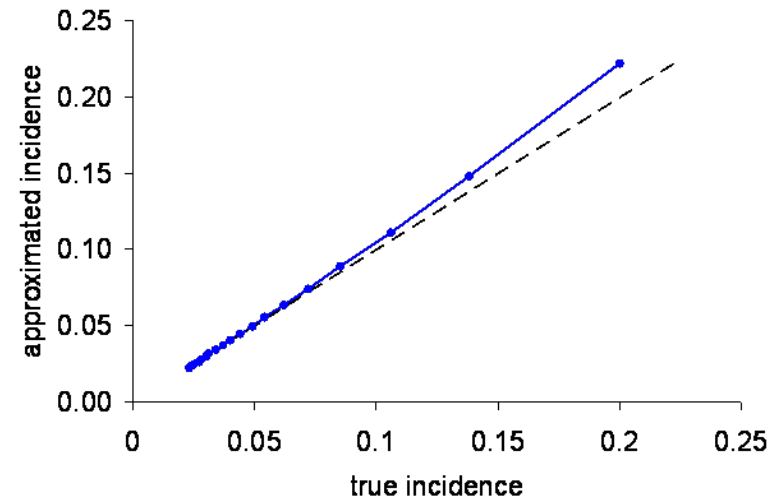
- Approximation:

- $P = Inc * D / (1 + Inc * D)$

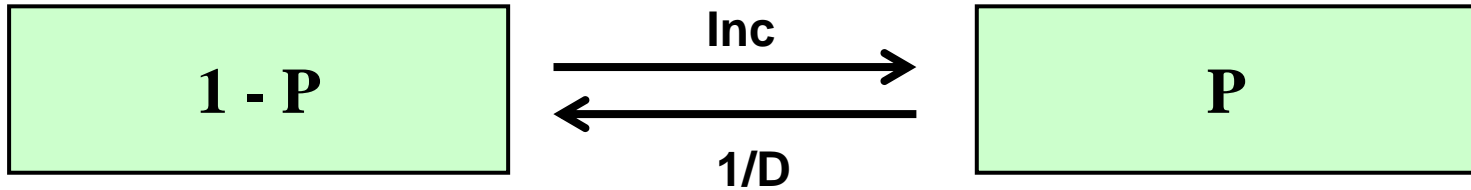
- $Inc = P / (D - D * P)$

- Cumulative Inc: $CI = 1 - \exp^{-TrueInc}$

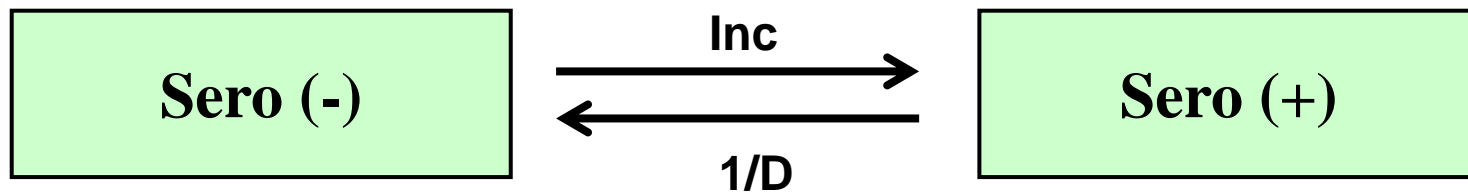
$Inc = P / (D - D * P) \neq \text{true incidence}$



Assumptions



- Infected can become fully susceptible
- Equilibrium and constant P
- Constant duration of antibody-titre
- 20,000 slaughter workers
- 24 cases reported per annum (Source: ESR)



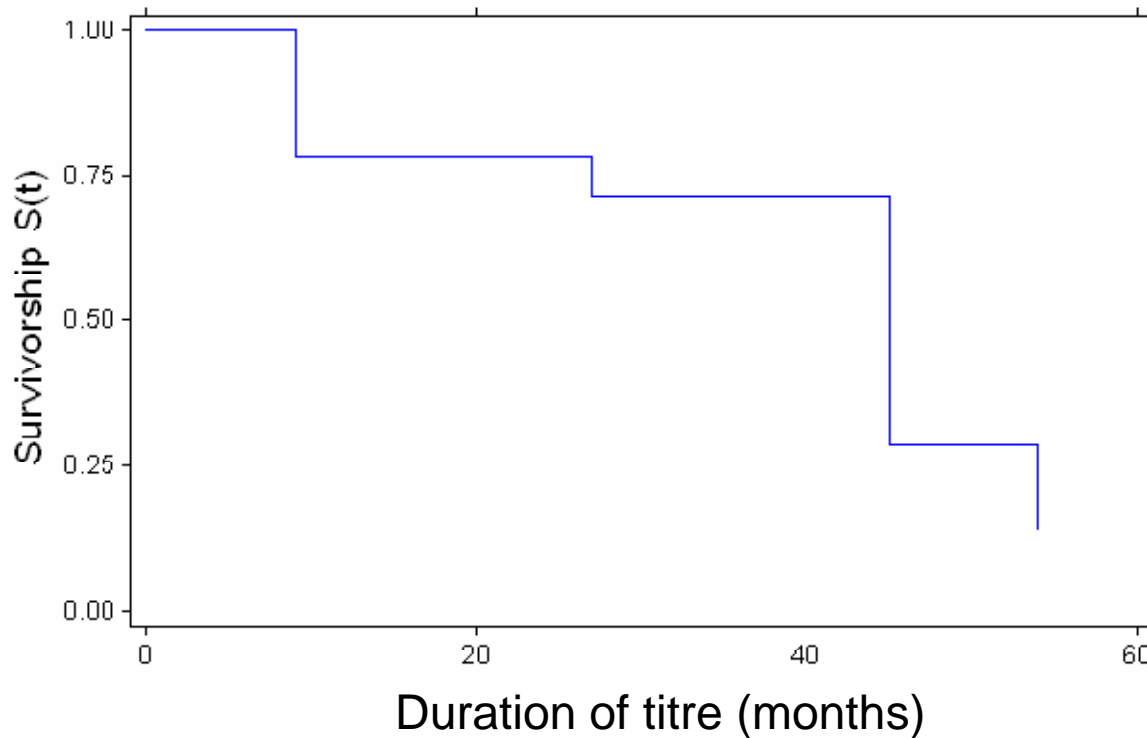
Differential equations:

$$dS^-/dt = -inc * S^- + 1/D * S^+$$

$$dS^+/dt = inc * S^- - 1/D * S^+$$

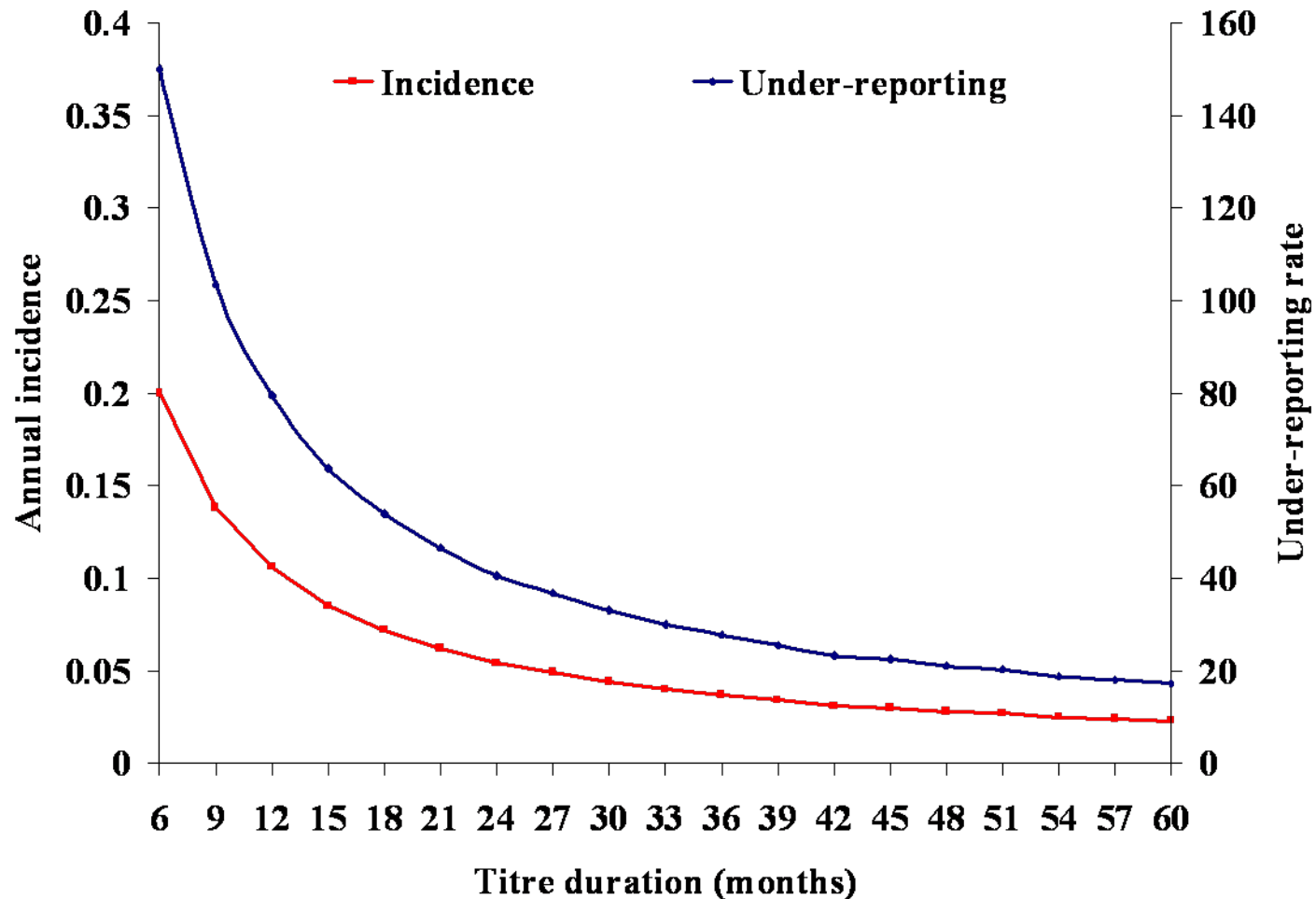
- Population at start: $N = 20,000$ workers
 - $S^- = 0.9 * N$
 - $S^+ = 0.1 * N \rightarrow P=10\%$
- Inc at D required to result in $P=10\%$
 - Cumulative annual Incidence (CI):
 $CI = 1 - \exp^{-Inc * 365d}$

Lupidi et al. 1991: outbreak data



Romero et al. 1998: 6 – 13 months (Brazil)

Incidence risk and under-reporting



Summary

- Notification rates decreasing (<100/yr)
- Prevalence high in ruminant livestock
- High human exposure rates from shedding carcasses
- Potentially high human exposure from livestock
- Likely low reporting rates
 - Esp. in farmers, farms service personnel
- ➔ potentially very high human infection rates
 - Hypothesis: Farmers >> abattoir workers

Where to from here

- **Longitudinal study to test the under-reporting model**
- **Diagnostic criteria and case definition**
 - Working with abattoir public health medicos
 - Sero-conversion/disease/blood and urine PCR
 - Effect of treatment on immunological and culture/PCR
- **Other occupations**
 - Farmers/stock handlers/vets
 - Urban community sampling as a “negative exposure” control
- **Livestock**
 - Multi-species farms
 - Epidemiology/strain typing/transmission risks, production responses
 - Sheep disease in particular

Questions?