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E. coli O157:H7 shedding in beef cattle

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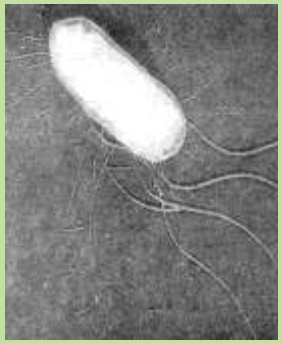


Overview

Background on *E.coli* O157:H7

Supershedding of *E.coli* O157:H7

Overview of collaborative study - MLA

Future research

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Background

- *Escherichia coli* are part of the normal flora in many animals
- Most strains do not cause disease in humans
- Some do cause disease

- Shiga-toxin-producing *E.coli* (STEC)
- Enterohaemorrhagic *E.coli* (EHEC)

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Background

- *E.coli* O157:H7 is the prototype EHEC serotype

  - it is the most commonly identified EHEC serotype worldwide

- Other EHEC serotypes (the big six)

  - O26, O45, O103, O111, O121 and O145

- USA has required port-of-entry (POE) testing for *E.coli* O157 since 2002 and the big 6 since 2012.

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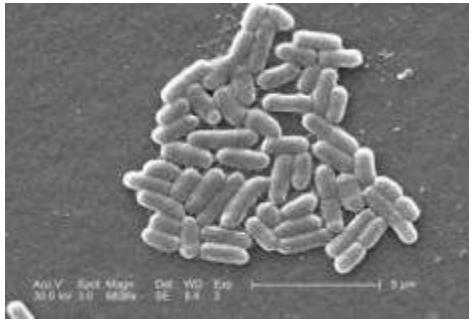
E.coli O157:H7



www.cdc.gov/nczved/dfbmd/disease_listing/stec_gi.html#3

- first identified as a pathogen in 1982
- commonly identified in outbreak investigations
- severe stomach cramps, diarrhea (often bloody), vomiting
- incubation period ~3-4 days (1–10 days)
- minimum infective dose as low as 10 bacteria

- ~5–10% of cases hemolytic uremic syndrome (HUS):
  - hemolysis, renal failure, death ~7 days post-exposure
- very young children, the elderly more likely to develop HUS

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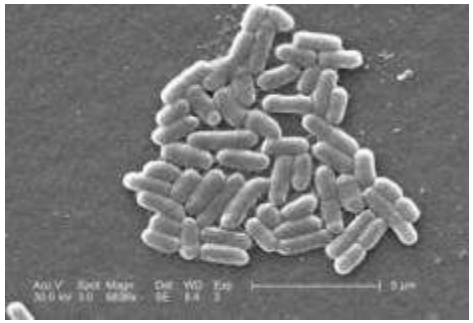
E.coli O157:H7

- potential exposures:
  - contaminated food, non-disinfected water
  - contact with faeces of infected people
  - **contact with cattle**
  - recreational



www.cdc.gov/nczved/dfbmd/disease_listing/stec_gi.html#3

- high-risk foods
  - unpasteurized (raw) milk
  - soft cheeses from raw milk
  - unpasteurised apple cider
  - **undercooked hamburger**
  - contaminated vegetables

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STEC cases – incidence by country

	Cases / 100,000
Scotland (O157 only)	4.3
Ireland (O157 only)	3.9
New Zealand	3.3
Sweden	3.3
Canada (O157 only)	2.7
South Australia	2.4
UK (O157 only)	1.9
USA (O157 only)	1.12
South Australia (O157 only)	1.5
Australia	0.12

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E.Coli O157 shedding in cattle

- Variation between herds

  - Most, if not all, farms and feedlots have positive animals at some time

  - Estimates of prevalence in Australia range from 1.9 – 15%

    - Barlow *et al* (2010)

- **Factors associated with O157 carriage in cattle:**

  - Young age, Diet, Season, Day length, Group housing, Transport

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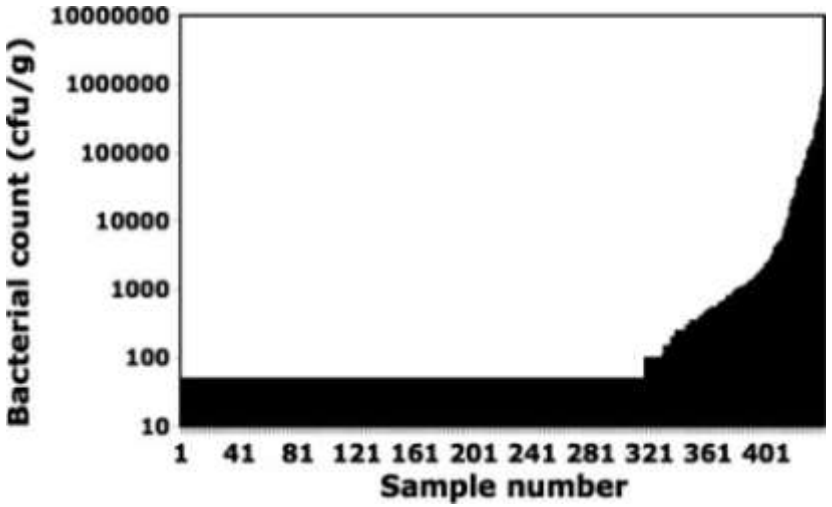
E.Coli O157 shedding in cattle

- Variation between animals

  - Effect of individual animals on overall prevalence

- Relatively few cattle responsible for the majority of *E.coli* O157 shed (Matthews et al., 2006)



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E.Coli O157 shedding in cattle

- **Supershedding**

  - when an animal sheds the pathogen at markedly higher levels than others (≥10^3 CFU/gram faeces)

  - risk factor for increased herd-level faecal prevalence, hide prevalence and hide load

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E.Coli O157 shedding in cattle

- Lack of longitudinal studies to track the within animal variation in shedding and quantity of pathogen shed

- What factors, if any, contribute to the development of shedding, or to the occurrence of a supershedding event?

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Project A.MFS.0247

- *E.coli* O157 colonisation and shedding in cattle

  - time frame April 2011 – April 2015

  - review available microbiological techniques for detection

  - identify effective and efficient detection methodology

  - estimate frequency of occurrence and predictors of shedding and supershedding

mla MEAT & LIVESTOCK AUSTRALIA

Charles Sturt University

THE UNIVERSITY OF SYDNEY

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Project A.MFS.0247

A. Literature review

B. Technical training and pilot study

C. Laboratory skills validation

D. Longitudinal study

E. Expert opinion exercise

F. Simulation modelling

G. National Forum

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Project A.MFS.0247 – longitudinal study

- Study individual and population transmission dynamics of *E. coli* O157:H7

- Identify and quantify risk factors for shedding

Field work

- October 2012 – June 2013
- Herd of 23 grass-fed Herefords

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Methods

Data collected

Explanatory variables	
Individual variables	Temperature, faecal consistency, hide contamination, weight, body condition score, faecal cortisol levels
Environmental variables	Rainfall, temperature, daylight duration, humidity, hours of sunshine
	Pasture type, quantity, quality
	Contamination of the drinking water
Outcome variable	Shedding (Y/N)

Results

Descriptive results

- 172/1326 (13.2%) positive samples
- 152/172 (88.4%) $<10^2$ CFU per g of faeces
- 10/172 (5.8%) between 10^2 – 10^3 CFU per g of faeces
- 10/172 (5.8%) $\geq 10^3$ CFU per g of faeces

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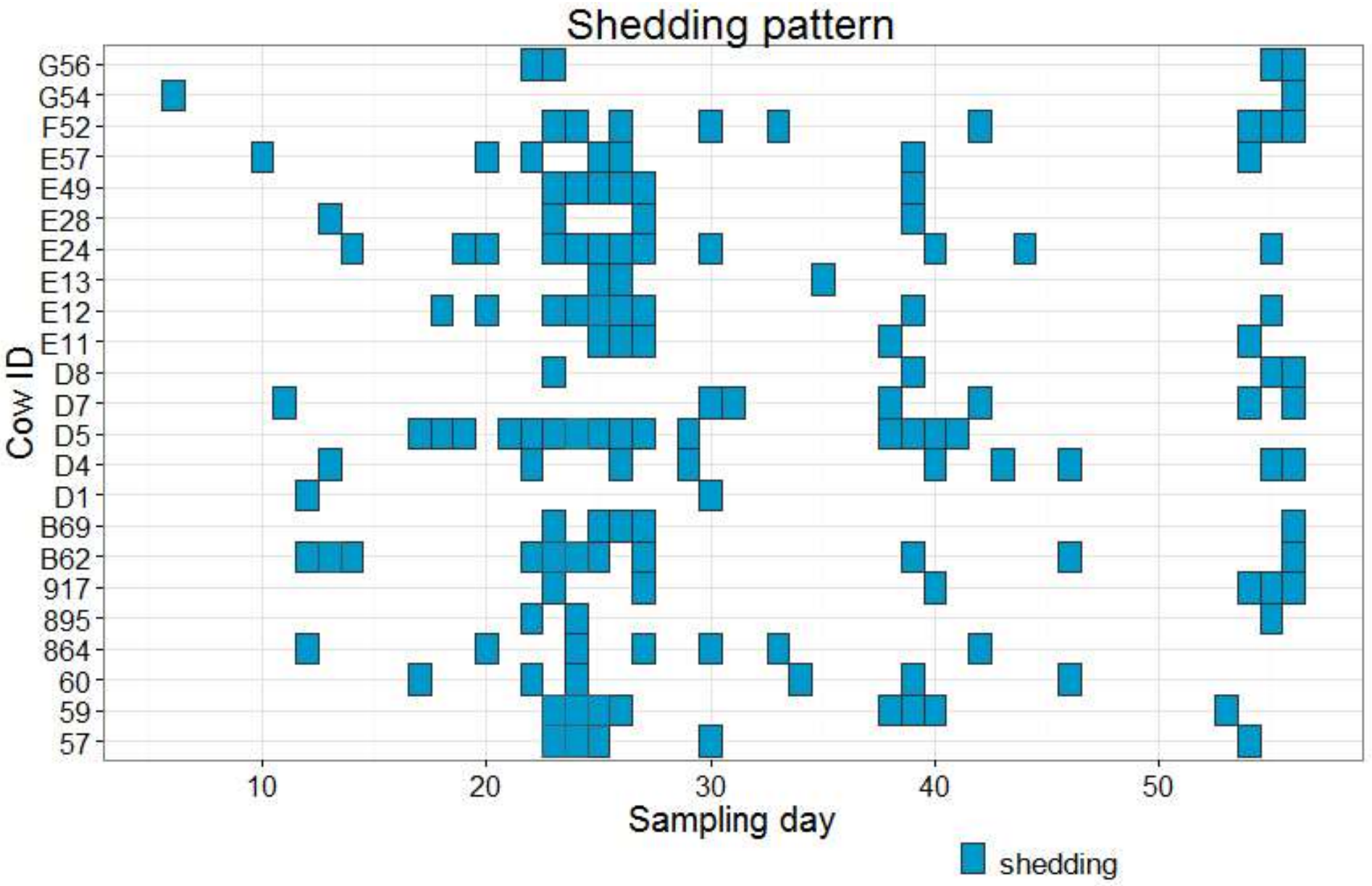
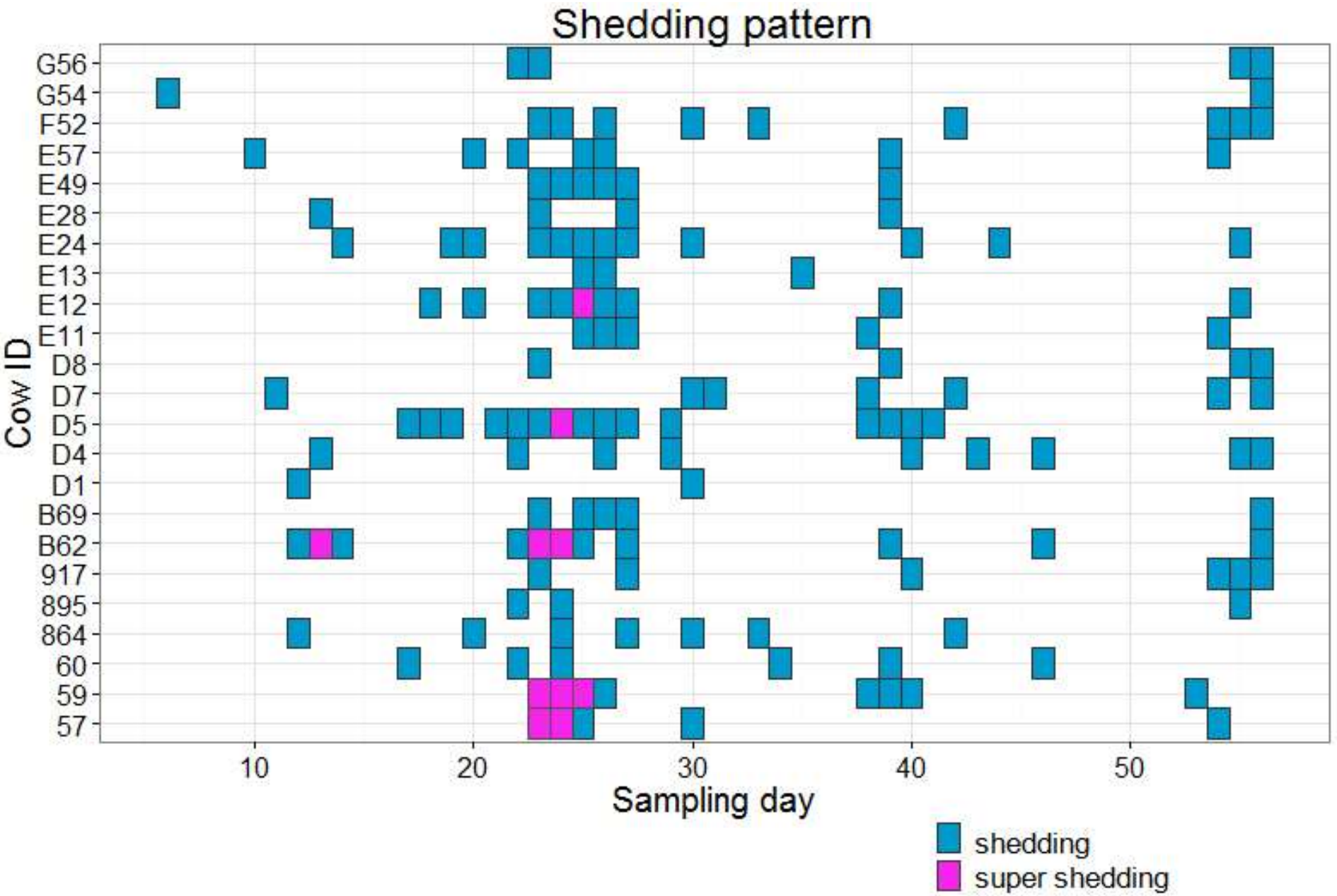

Shedding pattern
Cow ID
G56
G54
F52
E57
E49
E28
E24
E13
E12
E11
D8
D7
D5
D4
D1
B69
B62
917
895
864
60
59
57
10
20
30
40
50
Sampling day
shedding


Shedding pattern
Cow ID
G56
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E12
E11
D8
D7
D5
D4
D1
B69
B62
917
895
864
60
59
57
10
20
30
40
50
Sampling day
shedding
super shedding

Results cont.

Variable	Category	Proportion of animals	OR (95%CI)	P value
Faecal consistency	1	58/1335		
	2	860/1335	**0.4** (0.14-0.98)	**0.04**
	3	384/1335	0.5 (0.16-1.33)	0.16
	4	33/1335	0.5 (0.13-2.24)	0.40
Calf-at-foot	yes	588/1339	**10.1** (4.02-25.44)	**<0.001**
	no	751/1339		
Pasture quantity			**0.997** (0.996-0.998)	**<0.001**
Rainfall in previous week (ml)			**1.04** (1.01-1.08)	**0.02**

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Conclusion

- First study to look at change in shedding in animals over a prolonged period of time

- Faecal consistency, nursing, rainfall and pasture quantity are the 4 main factors associated with O157 shedding in this model

  - different to findings in dairy herd…

- Day-to-day variability has a greater effect than cow-to-cow variability on O157 shedding

  - shedding is not more likely to occur from one individual than another

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Conclusion

- **if** this was true for supershedding as well it would support the fact that we should look to control supershedding **events** rather than supershedding **animals**

- Remember this study was performed in a single herd and is subject to the variation in weather (or lack thereof) that occurred during the time period studied

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Future research

Short intensive study

- Focus on the individual animal

  - allow reduced time intervals for data collection

- Repeat longitudinal study in a population that allows identification of risk factors associated with supershedding

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Future research

Expert opinion exercise

- Gather group of experts

Simulation modelling

- Include data that reflects within animal variation in previous models
- Assess likelihood of identifying positive animal if it is present in the herd

National Forum

- Dissemination of results
- Discussion about control

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