

# Investigation and response to an outbreak of leptospirosis among raspberry workers, NSW, 2018

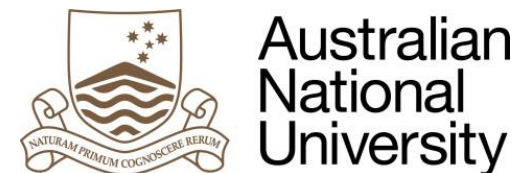


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 @AntheaKatelaris



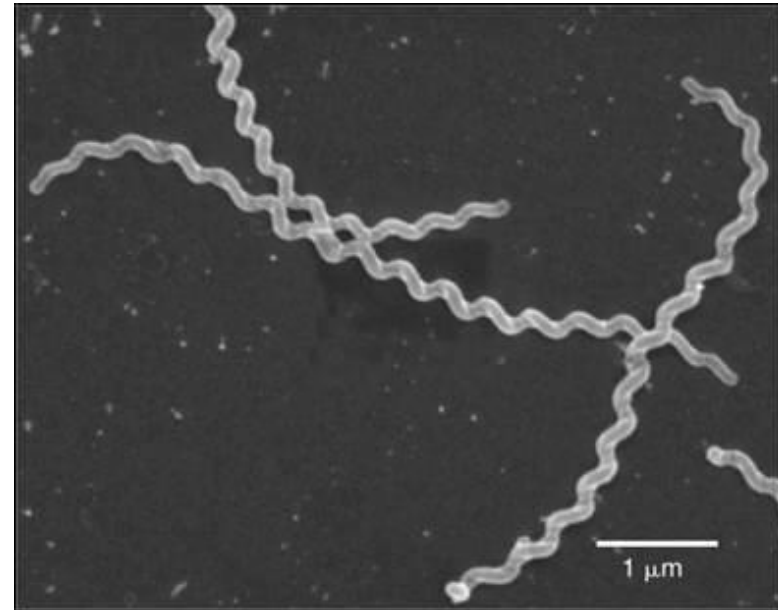
# Background

- June 2018 - cluster of febrile illnesses among berry pickers presenting to GP/ED on mid-north coast.
- Initial testing negative → lepto PCR+
- *Leptospira* serovar Arborea
  - Rodents predominant reservoir
- Initial case interviews
  - Single large berry farm
  - All raspberry workers
  - Backpackers, migrants, refugees.

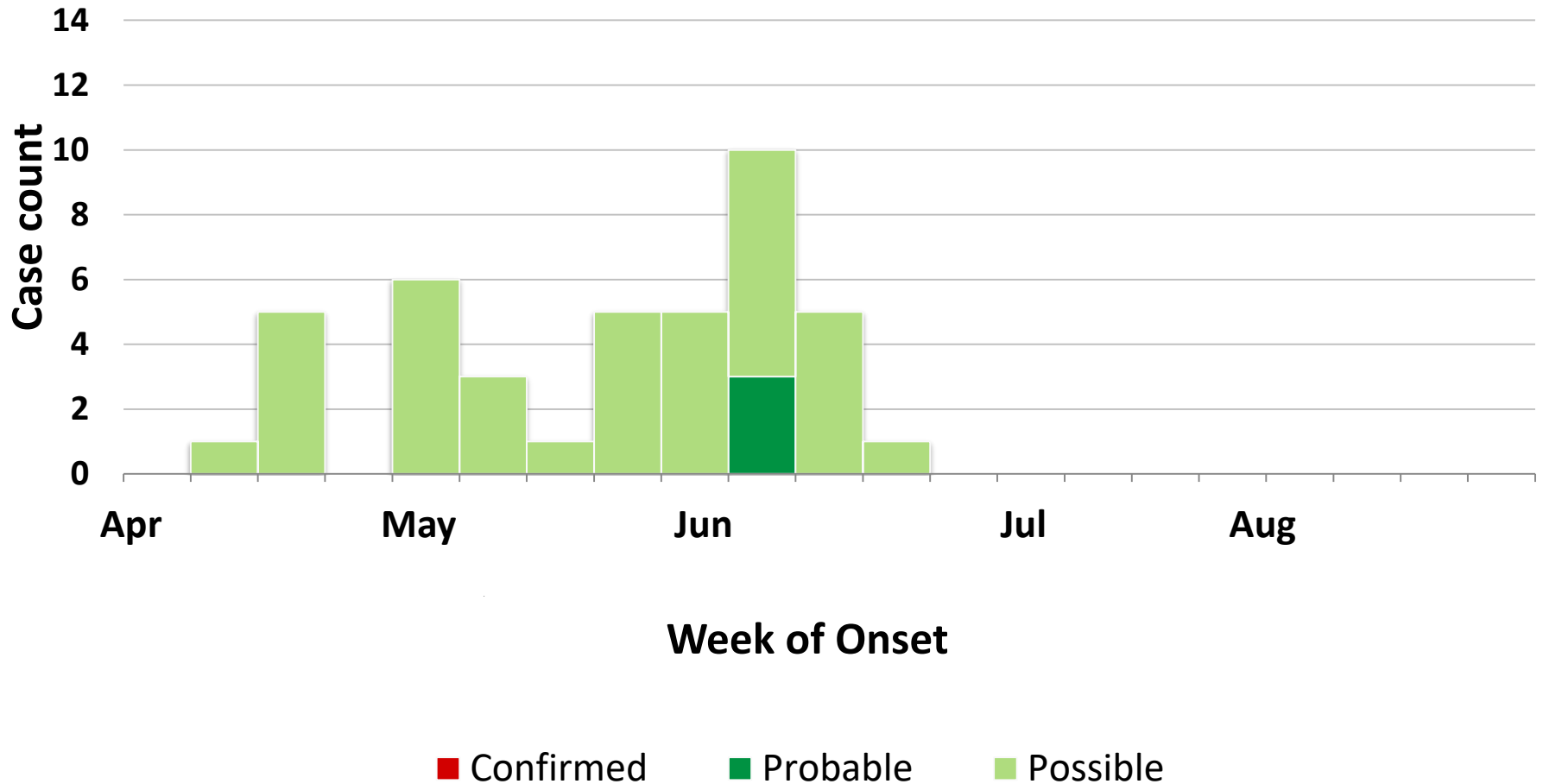


# Leptospirosis

- Incubation 2-30 days (usual 5-14)
- Acute phase → immune phase
- Serology, PCR, (culture)
- Transmission: infected animal urine → skin abrasions, ingestion, mucous membranes.
- Global: endemic tropically
- Nationally notifiable
  - 10-40/yr cases in NSW



# Leptospirosis cases at time of outbreak detection, 21 June 2018, by case status (n=42)





# Aim

Investigation conducted to identify the outbreak source and risk factors for infection, to guide prevention and control measures.



# Case-control study

## Population

- Raspberry workers on the Farm  
(pickers, packers, supervisors)

## Cases

- Active & passive surveillance
- Worked in raspberry team in exposure period
- Case definitions based on national criteria

**Confirmed:** 4x rise *OR* 1x  $\geq 400$  & IgM+

**Probable:** PCR+ *OR* IgM+

**Possible:** clinical

- Interviewed about behaviours during 4 week exposure period



# Case-control study

## Controls

- Selected from current raspberry workers
- Had to have worked since before outbreak detection
- Serology collected to screen for asymptomatic infection
- Asked about exposures in May (representative period during outbreak)



# Outbreak description

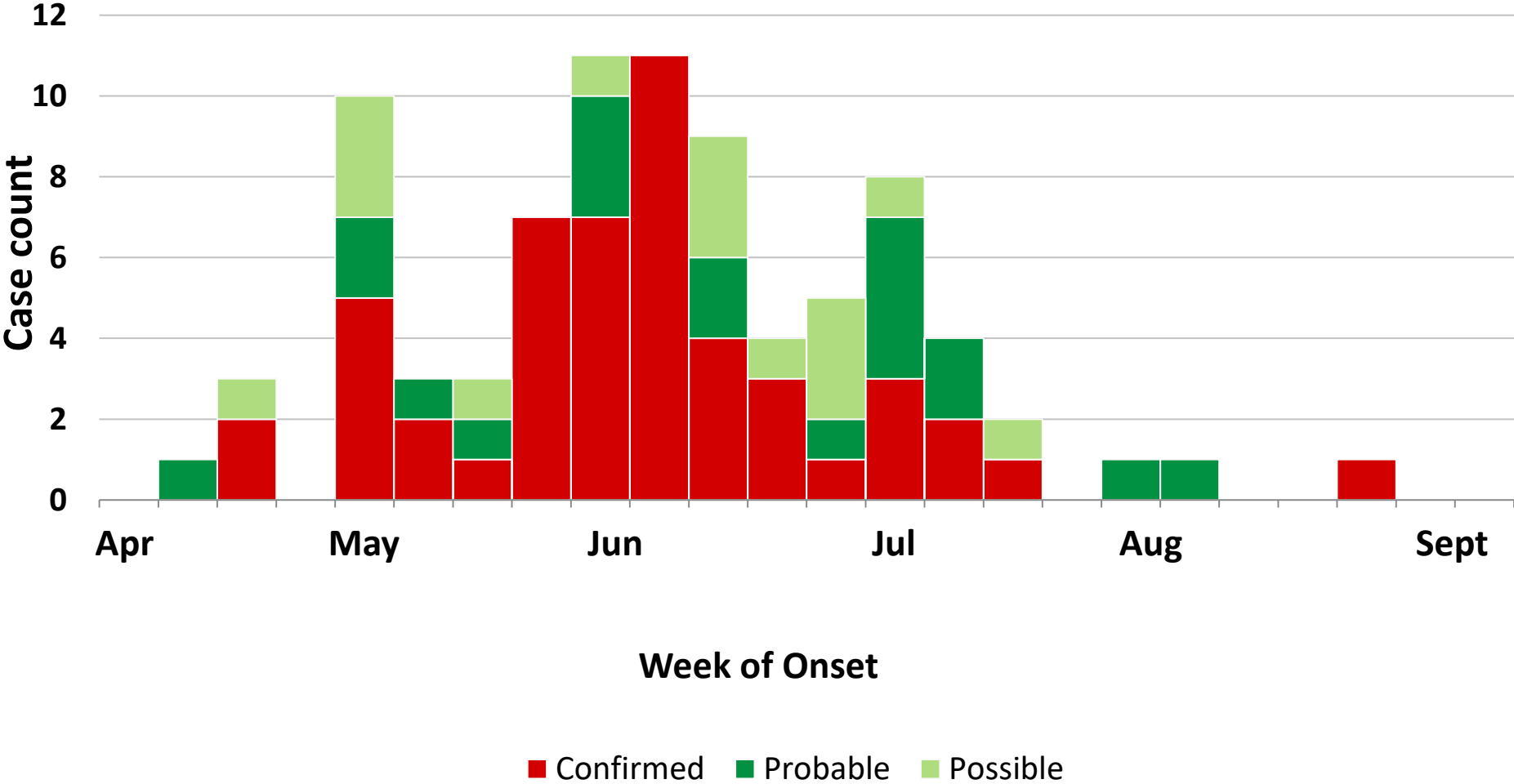
- 84 cases



- 640 raspberry workers → crude AR 11% (conf/prob)
- Clinical disease mostly mild
  - no severe complications or deaths



# Leptospirosis outbreak cases, by case status



# Results: Case-control study

- Crude & adjusted ORs calculated from logistic regression
- Only confirmed & probable cases with qus (n=67) & asymptomatic seronegative controls (n=69) in 1<sup>o</sup> analysis

# Results: Case-control study

## Multivariable model

Cases (%)	Controls (%)	Variable	Adj OR*	95% CI	p value**
39/67 (58)	53/69 (77)	Any glove use	0.3	0.1-0.8	0.01
0.54	1	Median years employed	0.8	0.6-0.9	0.02
10/67 (15)	2/69 (3)	Rodent sighting	7.1	1.3-38.9	0.02
32/66 (48)	18/65 (28)	Interpreter required	4.0	1.6-9.9	0.003

\*Adjusted for all other variables in model (n=120) \*\*Wald test p value

# Results: Case-control study

## Crude association only

Cases	(%)	Controls	(%)	Variable	Crude OR	95% CI	p value*
15/67	(22)	26/69	(38)	<b>Scratches:</b> Never	1		
11/67	(16)	11/69	(16)	Rarely	1.7	0.6-5.0	0.3
13/67	(19)	14/69	(20)	Often	1.6	0.6-4.3	0.3
28/67	(42)	18/69	(26)	<b>Always</b>	<b>2.7</b>	1.1-6.4	0.03
25/55	(45)	17/68	(25)	<b>Mud contact</b>	<b>2.5</b>	1.2-5.4	0.02
61/67	(91)	54/69	(78)	<b>Drinks water from trailer</b>	<b>2.8</b>	1.0-7.8	0.045
65/67	(97)	60/69	(87)	<b>Raspberry picking</b>	<b>4.9</b>	1.0-23.5	0.048

\*Wald test p value

# Results: Case-control study

## No association

Cases	(%)	Controls	(%)	Variable	Crude OR	95% CI	p value*
29/67	(43)	31/69	(45)	Any berry eating	0.9	0.5-1.8	0.9
23/64	(36)	17/69	(25)	Irrigation water contact	1.7	0.8-3.63	0.2
58/58	(100)	69/69	(100)	Handwashing	†		

\*Wald test p value †Odds ratio undefined due to 0 values.



# Environmental Investigations

## 3 farm inspections by EHO

- PPE inconsistent and inadequate
- No significant opportunities for drinking water contamination identified from source → storage



# Environmental Investigations

- Evidence of rodent activity seen around raspberry plants
- Additional rodent traps
- Mice (*Mus musculus*) caught
  - 3/12 MAT+ *Leptospira* Arborea & PCR+



# Cause?

- Workers likely infected through scratches → came into contact with leptospire from mouse urine in environment
- Raspberry workers at increased risk due to thorns + inadequate glove use





# Study limitations

- Self reported
- Biases
  - Recall
  - Social desirability
  - Selection biases



# Other questions

? Leptospirosis in other wildlife on farm

? Baseline prevalence in rodents

? Environmental changes contributed to outbreak occurring





# Public health response

- Multiple control measures implemented (with SafeWork)
  - Enhanced glove use with compliance monitoring
  - Additional rodent control
- Prophylaxis clinic July
  - Weekly doxycycline x4 weeks
  - 114 / 230 raspberry workers administered
  - Limited evidence
  - Ethical considerations



# Conclusions

- Largest known outbreak in Australia
- Important occupational risk among raspberry workers, requiring ongoing protective measures.
- PCR assists in early diagnosis → should be included in surveillance case definitions.



# Acknowledgements



Health

## Health Protection NSW

Enteric & Zoonotic Diseases  
PHO trainees  
Emergency Response Coordination Unit

## North Coast Public Health Unit

## Pathology North

## Coffs Harbour Hospital ED

Dr Alison Winning (Tweed Hospital)

Dr Mim Morgan (NBM PHU)



## Leptospirosis Reference Laboratory, QHFSS

Dr Scott Craig, Ellena Heading, Mary-Anne Burns



Dr Matthew O'Sullivan



SafeWork NSW



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Prof Martyn Kirk

Dr Colleen Lau



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Local Land Services  
North Coast

Dr Ian Poe

Dr Michael Walsh (USyd)

Prof John Kaldor (UNSW)

Local GPs



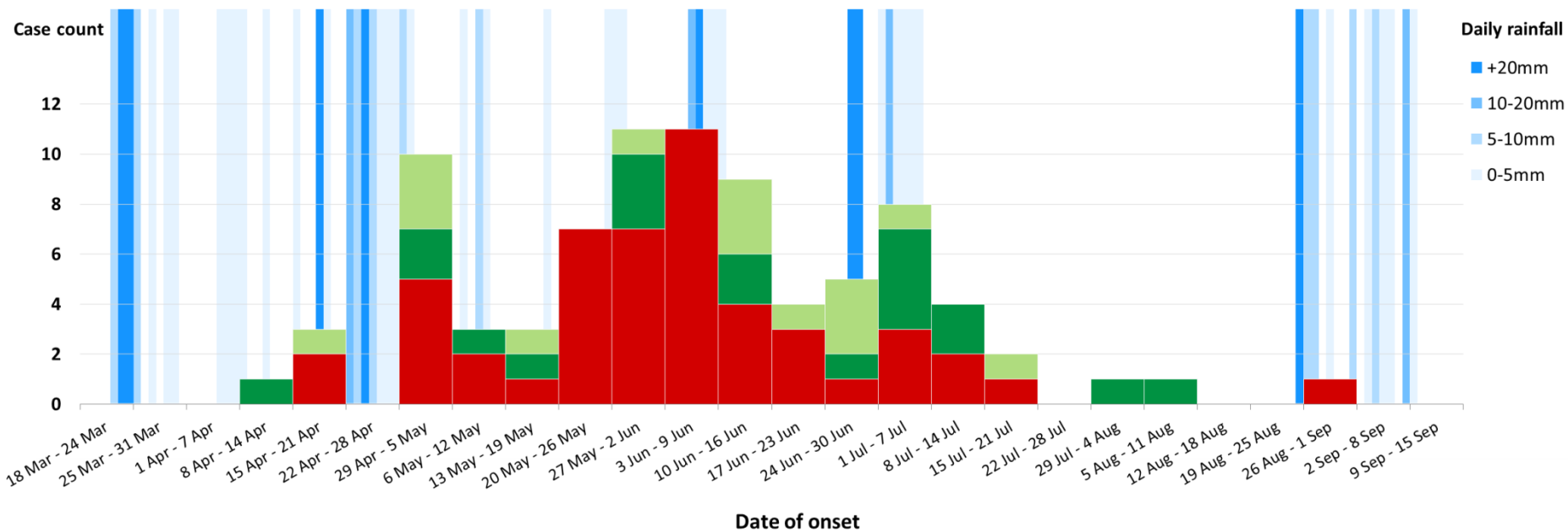
Food Authority

Study participants

Farm management

# APPENDIX SLIDES

# Epicurve of leptospirosis outbreak cases (n=84) by cases status, overlaid with daily rainfall (Glenreagh weather station)





## 2018, mean and median monthly rainfall, Glenreagh NSW (BoM)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2018	49.0	30.8	162.0	48.2	11.4	61.8	20.2	49.6	53.4				
Mean	143.2	124.5	115.6	83.5	77.9	88.2	28.3	51.9	38.1	95.6	108.2	114.1	1245.8
Median	77.2	74.5	104.7	60.2	36.9	53.6	22.1	28.0	24.6	55.8	91.1	81.7	1274.3

# Case finding

Routine lab notifications

Local GPs contacted & alert to GPs/EDs - ↑ testing

Farm alerted

Other farms asked

Referred by other cases

Rapid ED syndromic

surveillance alert

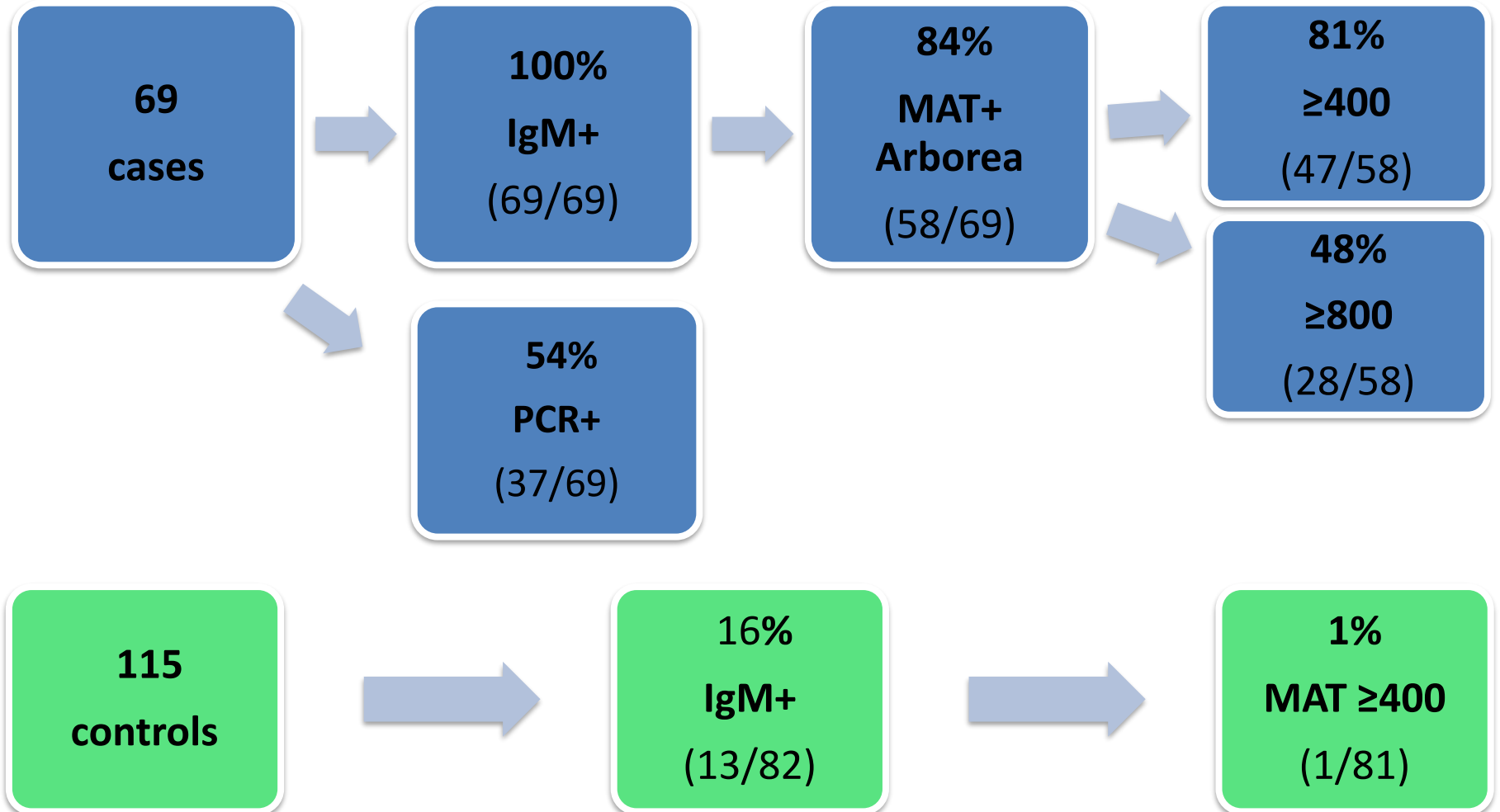


# Case finding

(raspberry | blueberry | berry | pick\* | farm) AND  
(Coffs & Grafton ED)

Problem	Nursing assessment
Fever	Fever + headache 2/7. Nil gastro sx. Pt works as raspberry <b>picker.</b> {Temp=40.0}
Pain, back	2/12 pain to back when <b>picking</b> up heavy objects. Nil neuro sx. {GCS=15}

# Laboratory investigation



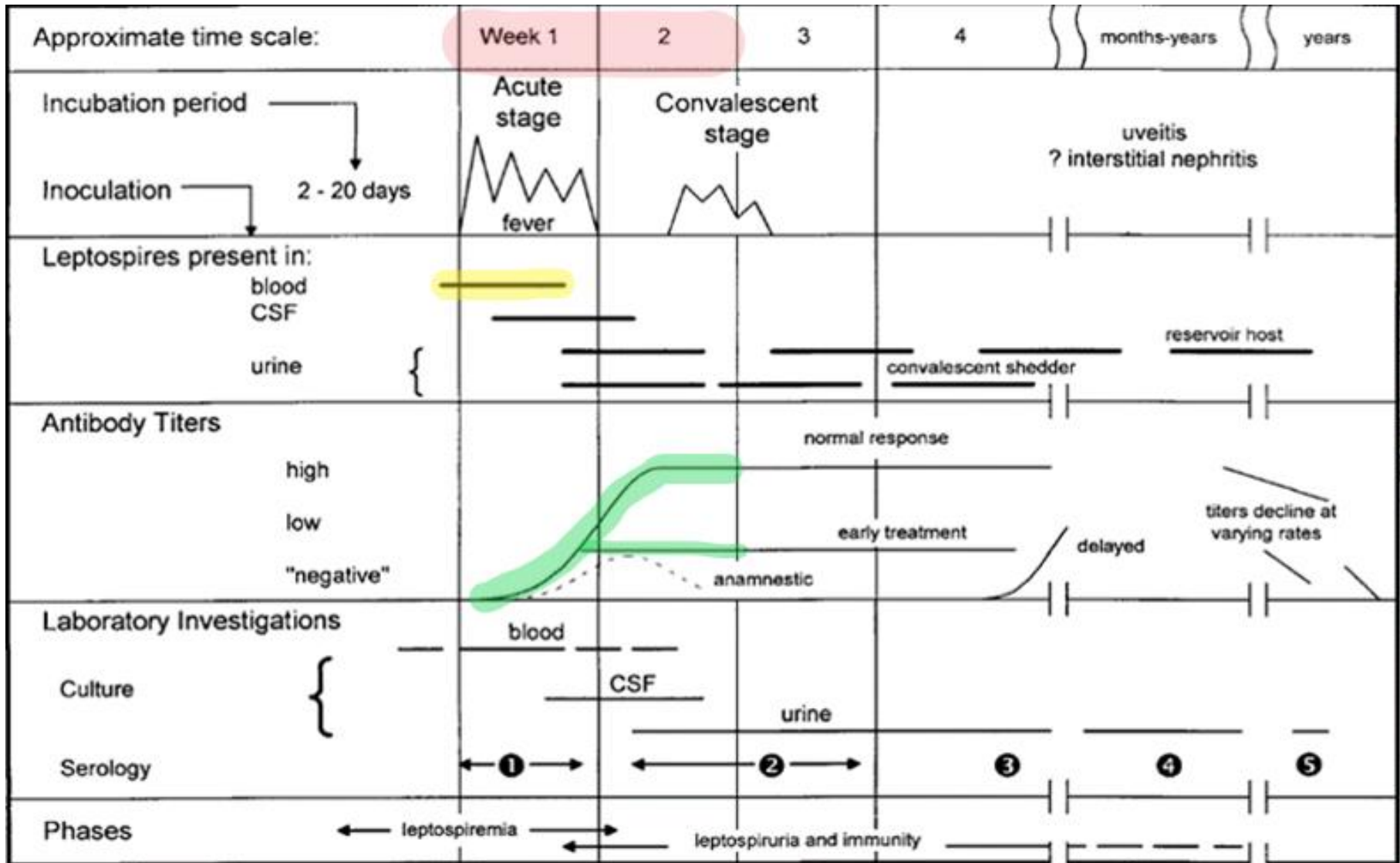
# Laboratory investigation

- Serum screened via Leptospira IgM ELISA (Panbio)
- MAT – antibodies against panel of 22 serovars (Leptospirosis Reference Laboratory, Qld)
- PCR (<7 days) – Taqman real-time PCR, targets rrs gene
  - not NATA accredited; high sensitivity (96.4%) & specificity (99.5%) vs culture

**Leptospiral serovars used in the current routine microscopic agglutination test (MAT) panel at the WHO/FAO/OIE Collaborating Centre for Reference and Research on Leptospirosis, Brisbane, Australia.**

<b>Species</b>	<b>Serovar</b>	<b>Strain</b>
<i>L. interrogans</i>	Pomona	Pomona
<i>L. interrogans</i>	Hardjo	Hardjoprajitno
<i>L. borgpetersenii</i>	Tarassovi	Perepelitsin
<i>L. kirschneri</i>	Grippotyphosa	Moskva V
<i>L. weilii</i>	Celledoni	Celledoni
<i>L. interrogans</i>	Copenhageni	M20
<i>L. interrogans</i>	Australis	Ballico
<i>L. interrogans</i>	Zanoni	Zanoni
<i>L. interrogans</i>	Robinsoni	Robinson
<i>L. interrogans</i>	Canicola	Hond Utrecht IV
<i>L. interrogans</i>	Kremastos	Kremastos
<i>L. interrogans</i>	Szwajizak	Szwajizak
<i>L. interrogans</i>	Medanensis	Hond HC
<i>L. kirschneri</i>	Bulgarica	Nicolaevo
<i>L. kirschneri</i>	Cynopteri	3522C
<i>L. borgpetersenii</i>	Arborea	Arborea
<i>L. interrogans</i>	Bataviae	Swart
<i>L. interrogans</i>	Djasiman	Djasiman
<i>L. borgpetersenii</i>	Javanica	Veldrat Batavia 46
<i>L. noguchii</i>	Panama	CZ 214
<i>L. santarosai</i>	Shermani	1342K
<i>L. weilii</i>	Topaz	94-79970/3

# Course of illness and diagnosis





# Case definitions

<b>Confirmed</b>	Laboratory-definitive evidence of <i>Leptospira</i> infection <ul style="list-style-type: none"><li>• 4x rise in MAT titre</li><li>• Single high titre (<math>\geq 400</math>) &amp; IgM+</li><li>• Isolation</li></ul>
<b>Probable</b>	Laboratory-suggestive evidence, with clinically compatible symptoms <ul style="list-style-type: none"><li>• PCR</li><li>• IgM+ (with convalescent serology pending or not available).</li></ul>
<b>Possible</b>	Clinically compatible symptoms <ul style="list-style-type: none"><li>• Fever or chills/rigors AND at least one of: myalgia; arthralgia; headache; jaundice; conjunctival suffusion, rash, GI symptoms, aseptic meningitis; pulmonary complications; cardiac arrhythmias; ECG abnormalities; renal insufficiency; haemorrhage; jaundice with acute renal failure.</li></ul> OR Clinical treating team suspicion of leptospirosis for other or unknown reasons.

# Inclusion criteria

**Case:** Any person who

- met any of the outbreak case definitions (since 1<sup>st</sup> April 2018)
- worked in a raspberry picking team on the Farm in their exposure period

## **Controls**

Selected from current raspberry picking workers (raspberry pickers, packers, carriers, supervisors and QA staff).

### *Inclusion criteria*

- Worked in a raspberry picking team since 2 weeks prior to 1<sup>st</sup> EHO visit (7/6/18)

### *Exclusion criteria*

- Reported symptoms (recruit as case)

# Full inclusion and exclusion criteria

## CASES

### Exclusion criteria

Cases will be excluded from the study if:

- They cannot be contacted after: 3 attempts by phone over 3 different days at different times of the day, AND 3 attempts by SMS over 3 different days at different times of the day, AND 3 attempts by phone to next of kin (if available) over 3 different days at different times of the day.
- Treating team think an alternative cause of illness is more likely, or laboratory testing shows strong evidence of an alternative cause of illness.
- They are unable to answer questions or refuse consent, or an appropriate interpreter cannot be located (in person or via translation phone service)

## CONTROLS

### Control group recruitment inclusion criteria

People will be recruited to be a control if they:

- Are part of the raspberry picking staff on the Farm (including pickers, packers, carriers, supervisors and quality assurance staff)
- Have worked in a raspberry picking team for at least 2 weeks between 14/3/18 (30 days pre- first case) to 20/6/18 (date of first farm visit).
- Consent to participating in the study, including completing the questionnaire, plus/minus having a blood sample collected for serological testing.

### Control group exclusion criteria

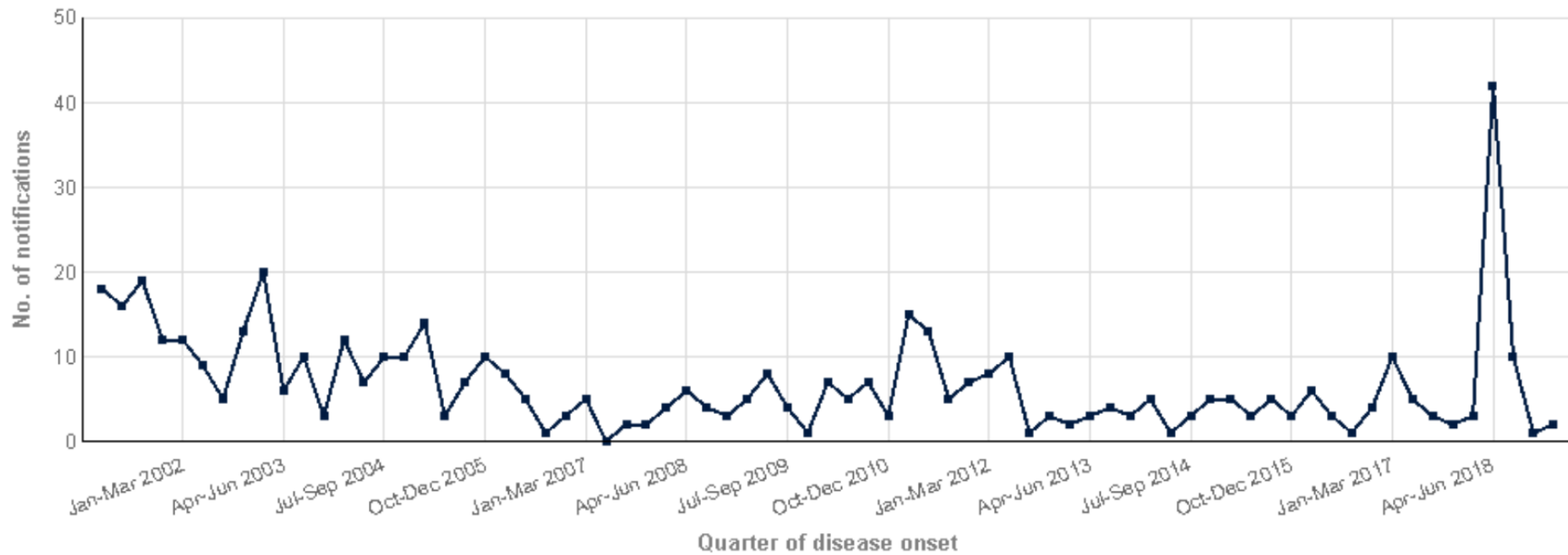
People will be excluded from recruitment if they:

- They report symptoms that are clinically compatible with leptospirosis, since 1st April 2018, as per the possible case definition (recruit as case)
- They are unable to answer questions or refuse consent.
- An appropriate interpreter cannot be located (in person or via translation phone service)
- They cannot recall if they worked on the farm between 14 March to 9 June 2017
- Did not work as part of the raspberry picking teams for any of their employment period

## Number of notifications of Leptospirosis, received from State and Territory health authorities in the period of 2000 to 2017 and year-to-date notifications for 2018 (NNDSS)

	ACT	NSW	NT	QLD	SA	TAS	VIC	WA	Aust
<b>2000</b>	1	<b>53</b>	9	133	8	0	36	4	<b>244</b>
<b>2001</b>	0	<b>66</b>	4	127	3	5	37	2	<b>244</b>
<b>2002</b>	0	<b>39</b>	3	94	2	2	18	2	<b>160</b>
<b>2003</b>	0	<b>39</b>	4	69	2	0	8	6	<b>128</b>
<b>2004</b>	0	<b>40</b>	2	121	1	0	8	5	<b>177</b>
<b>2005</b>	0	<b>35</b>	5	71	3	0	10	5	<b>129</b>
<b>2006</b>	0	<b>17</b>	2	115	1	1	6	3	<b>145</b>
<b>2007</b>	0	<b>9</b>	1	76	1	0	16	5	<b>108</b>
<b>2008</b>	0	<b>17</b>	1	88	0	0	4	1	<b>111</b>
<b>2009</b>	2	<b>18</b>	4	105	0	0	11	1	<b>141</b>
<b>2010</b>	1	<b>22</b>	2	85	2	1	14	5	<b>132</b>
<b>2011</b>	1	<b>40</b>	2	155	2	1	10	3	<b>214</b>
<b>2012</b>	0	<b>22</b>	1	64	2	0	13	3	<b>105</b>
<b>2013</b>	0	<b>12</b>	4	58	2	0	9	0	<b>85</b>
<b>2014</b>	0	<b>14</b>	2	56	1	1	7	3	<b>84</b>
<b>2015</b>	1	<b>17</b>	4	40	0	2	7	1	<b>72</b>
<b>2016</b>	0	<b>14</b>	1	90	2	1	16	6	<b>130</b>
<b>2017</b>	0	<b>20</b>	14	94	1	0	15	3	<b>147</b>
<b>2018</b>	0	<b>56</b>	6	54	0	0	13	2	<b>131</b>

# Leptospirosis notifications in NSW residents, by quarter of onset. Jan-Mar 2001 to Jan-Mar 2019





# Results: Case-control study

Cases	(%)	Controls	(%)	Variable	Crude OR	95% CI	p value*	Adj OR**	95% CI	p value*
39/67	(58)	53/69	(77)	<b>Any glove use</b>	0.42	0.20-0.88	0.022	0.30	0.12-0.75	0.010
0.54		1		<b>Median years employed</b>	0.84	0.71-0.96	0.045	0.76	0.61-0.95	0.015
10/67	(15)	2/69	(3)	<b>Rodent sighting</b>	5.88	1.24-29.93	0.026	7.09	1.29-38.93	0.024
32/66	(48)	18/65	(28)	<b>Interpreter required</b>	2.46	1.19-5.08	0.015	4.00	1.63-9.86	0.003
15/67	(22)	26/69	(38)	<b>Never having scratches</b>	1					
11/67	(16)	11/69	(16)	Rarely	1.73	0.61-4.95	0.31			
13/67	(19)	14/69	(20)	Often	1.61	0.60-4.32	0.34			
28/67	(42)	18/69	(26)	Always	2.70	1.13-6.43	0.025			
25/55	(45)	17/68	(25)	<b>Mud contact</b>	2.50	1.17-5.36	0.019			
61/67	(91)	54/69	(78)	<b>Drinks water from trailer</b>	2.84	1.02-7.79	0.045			
65/67	(97)	60/69	(87)	<b>Raspberry picking</b>	4.87	1.01-23.48	0.048			
29/67	(43)	31/69	(45)	<b>Any berry eating</b>	0.94	0.48-1.84	0.85			
23/64	(36)	17/69	(25)	<b>Irrigation water contact</b>	1.72	0.81-3.63	0.16			
58/58	(100)	69/69	(100)	<b>Handwashing</b>	†					

\*Wald test p value \*\*adjusted for all other variables in model (n=120) †Odds ratio undefined due to 0 values.