Cryptosporidium parvum outbreak associated with Raccoons at a Virginia Wildlife Facility

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VDH VIRGINIA DEPARTMENT OF HEALTH

About *Cryptosporidium*

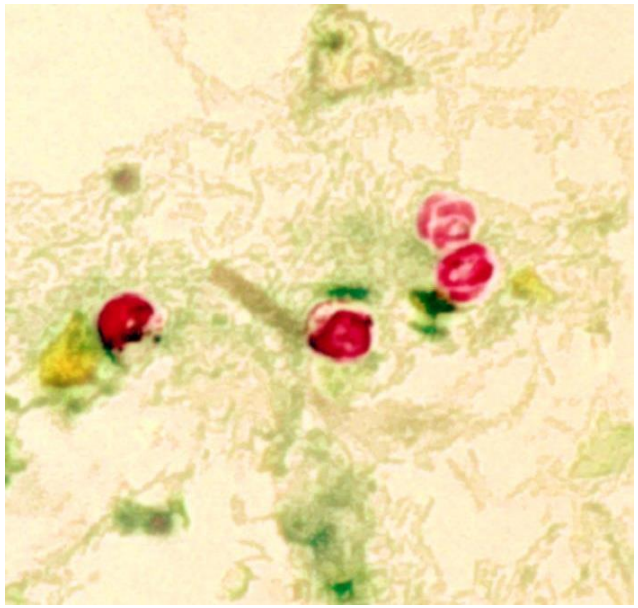

Image source: CDC Public Health Image Library

Protozoal parasite that causes diarrheal illness in people and animals

Two species are responsible for most cases of human infection

- *C. hominis* (primarily infects people)
- *C. parvum* (zoonotic disease)

Infection occurs after ingestion of infectious oocysts

- Person-to-person
- Animal-to-person
- Ingestion of contaminated food or water

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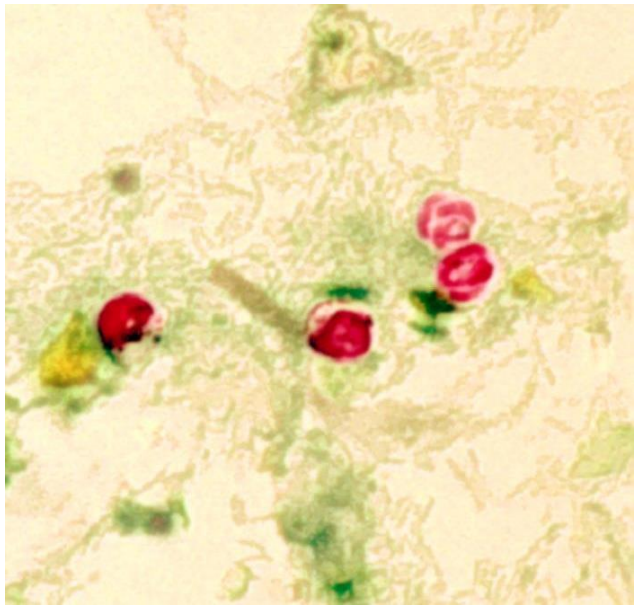

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Illness is characterized by watery diarrhea and abdominal cramping

Incubation period: 7-10 days

Illness duration: 7-14 days

Shedding of oocysts can continue after symptoms resolve

About *Cryptosporidium parvum*

Third leading cause of diarrhea associated with animal contact in the United States[1]

- **Domestic ruminants** (cattle, goats, and sheep) are the most common animal reservoir

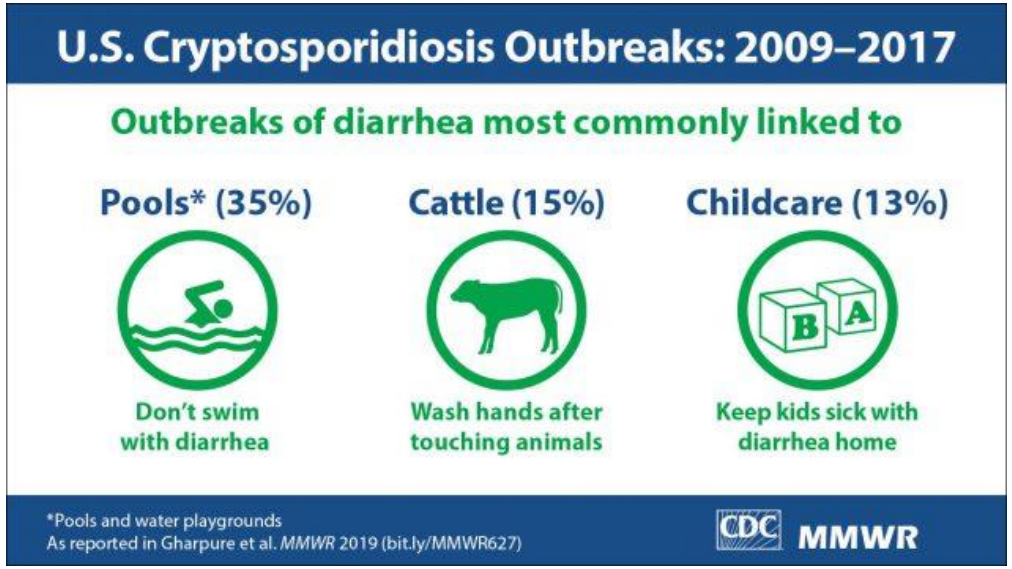

Image source: Gharpure R, Perez A, Miller AD, Wikswo ME, Silver R, Hlavsa MC. Cryptosporidiosis Outbreaks — United States, 2009–2017. MMWR Morb Mortal Wkly Rep 2019;68:568–572. DOI: http://dx.doi.org/10.15585/mmwr.mm6825a3

Outbreak Notification

June 19, 2019: A wildlife facility notified their local health department of a gastrointestinal illness outbreak

- 10 of 24 (42%) full-time staff members and interns ill
- Symptoms: vomiting and diarrhea
- Initial illness onset: June 8, 2019

Health district recommended norovirus testing and general infection control measures

June 20, 2019: One person tested positive for *Cryptosporidium* antigen

About the Wildlife Facility

Provides care for native animals

At the time of the outbreak notification, six juvenile raccoons were experiencing diarrhea

- Routine in-house fecal floatation testing was negative for ova and parasites

Other animals at the facility were healthy

Epidemiologic Investigation

Utilized a retrospective cohort study design

Developed and distributed a questionnaire to 49 facility personnel to collect:

- Demographic information
- Illness and healthcare
- Contact with animals (by species and type of care provided)
- Food and water exposures
- Use of personal protective equipment and adherence to cleaning protocols

Wildlife facility site visit

- Assessed opportunities for exposure
- Observed animal care, housing, feeding

Case Definition

Probable case: gastrointestinal illness occurring after June 6, 2019 in a person who worked or volunteered at the facility characterized by:

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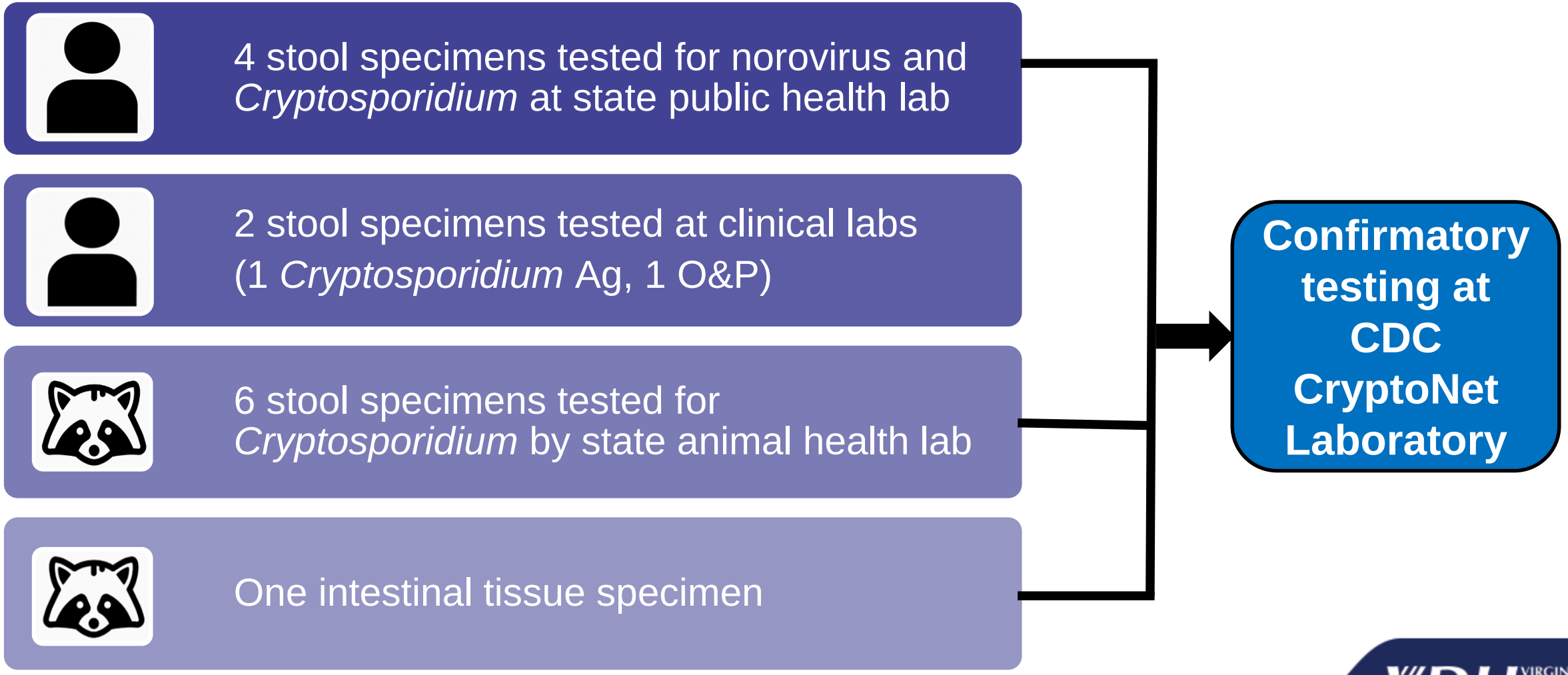
Confirmed case: probable case criteria **+ lab evidence** of *Cryptosporidium* infection

Laboratory Investigation

- 4 stool specimens tested for norovirus and *Cryptosporidium* at state public health lab
- 2 stool specimens tested at clinical labs (1 *Cryptosporidium* Ag, 1 O&P)
- 6 stool specimens tested for *Cryptosporidium* by state animal health lab
- One intestinal tissue specimen

Laboratory Investigation



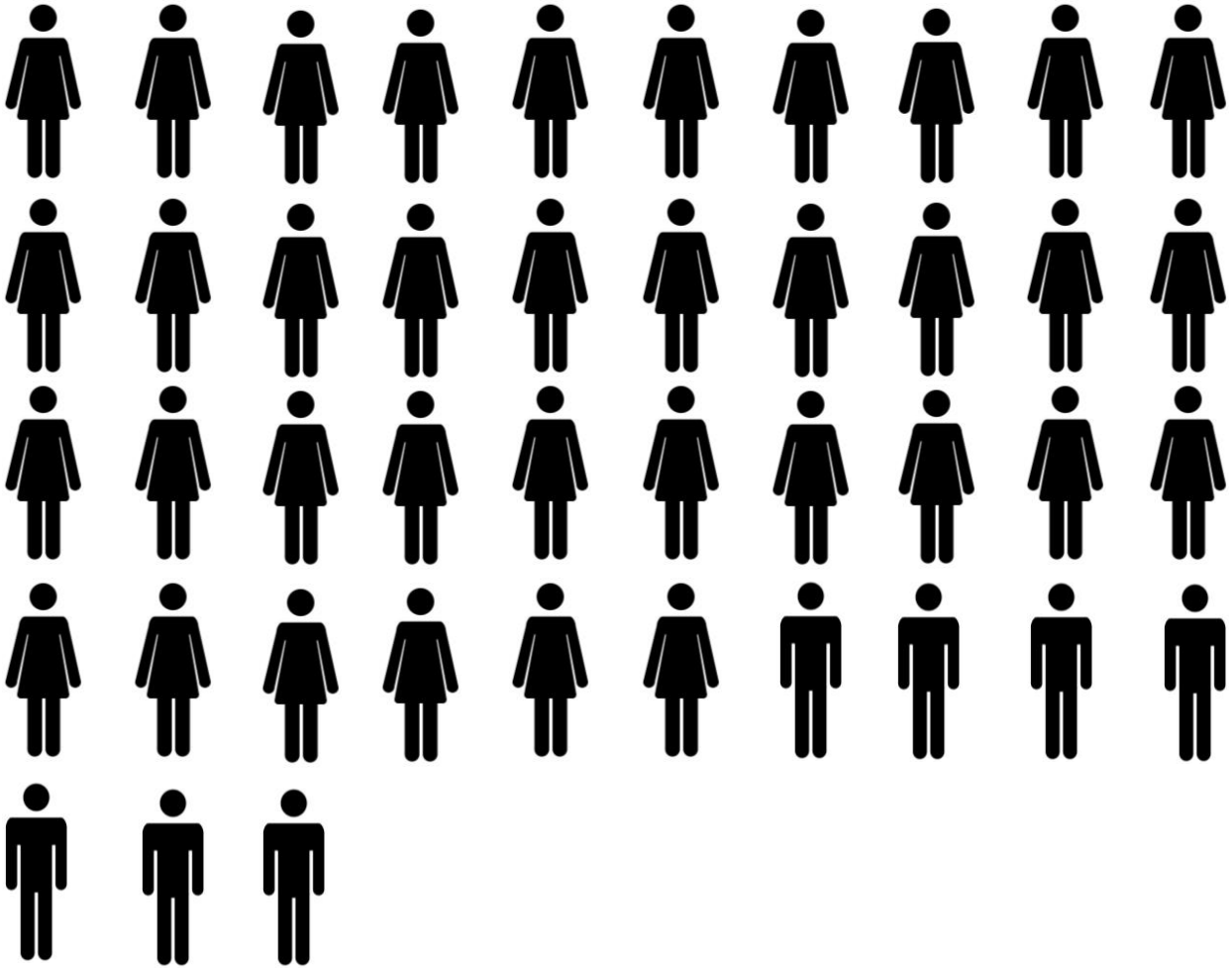
Environmental Investigation

Private well water

Collected samples from three pretreatment taps inside and outside building

Tested for fecal contamination

Cohort Characteristics



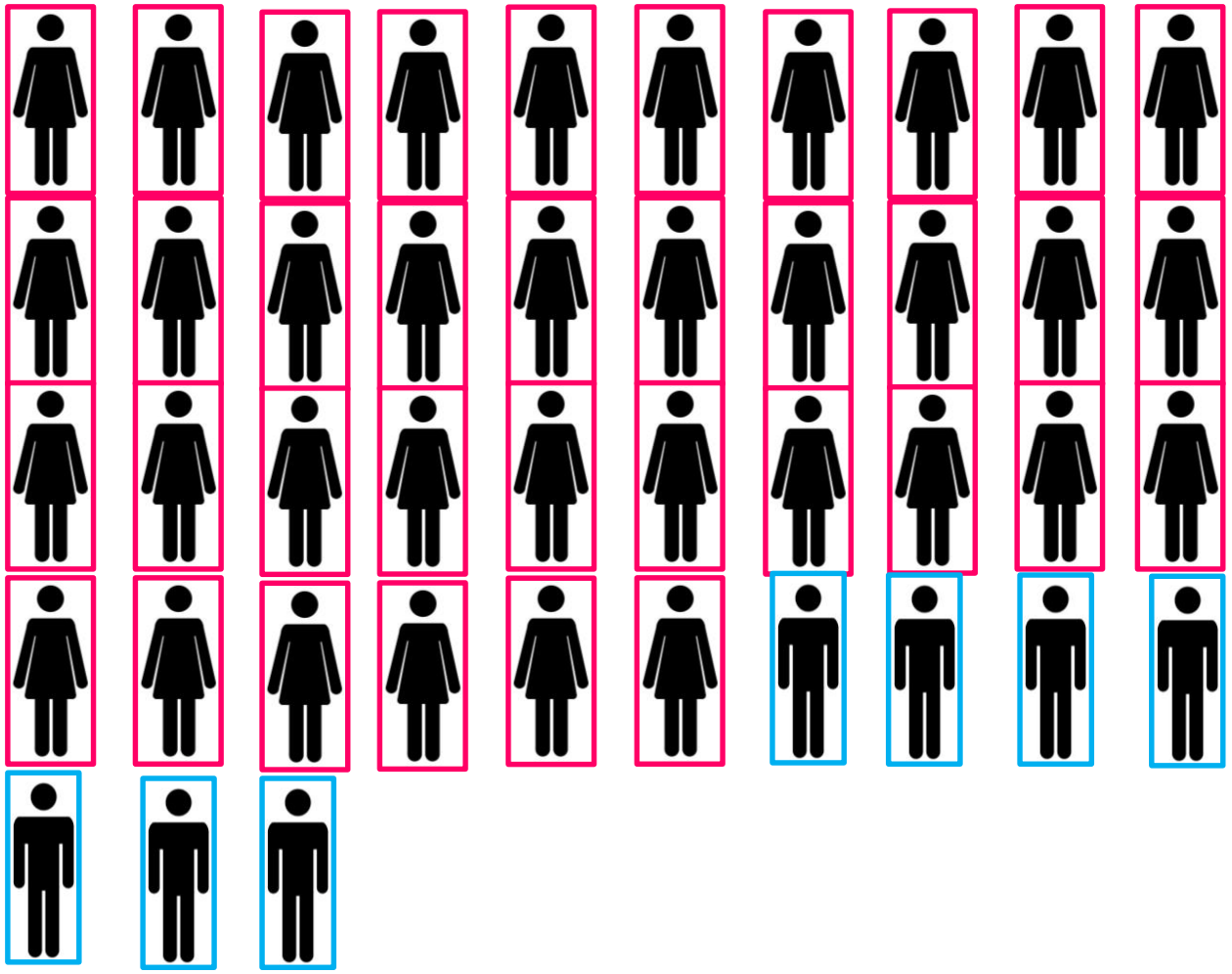
N = 43

6 full-time employees

16 interns

21 volunteers

Cohort Characteristics



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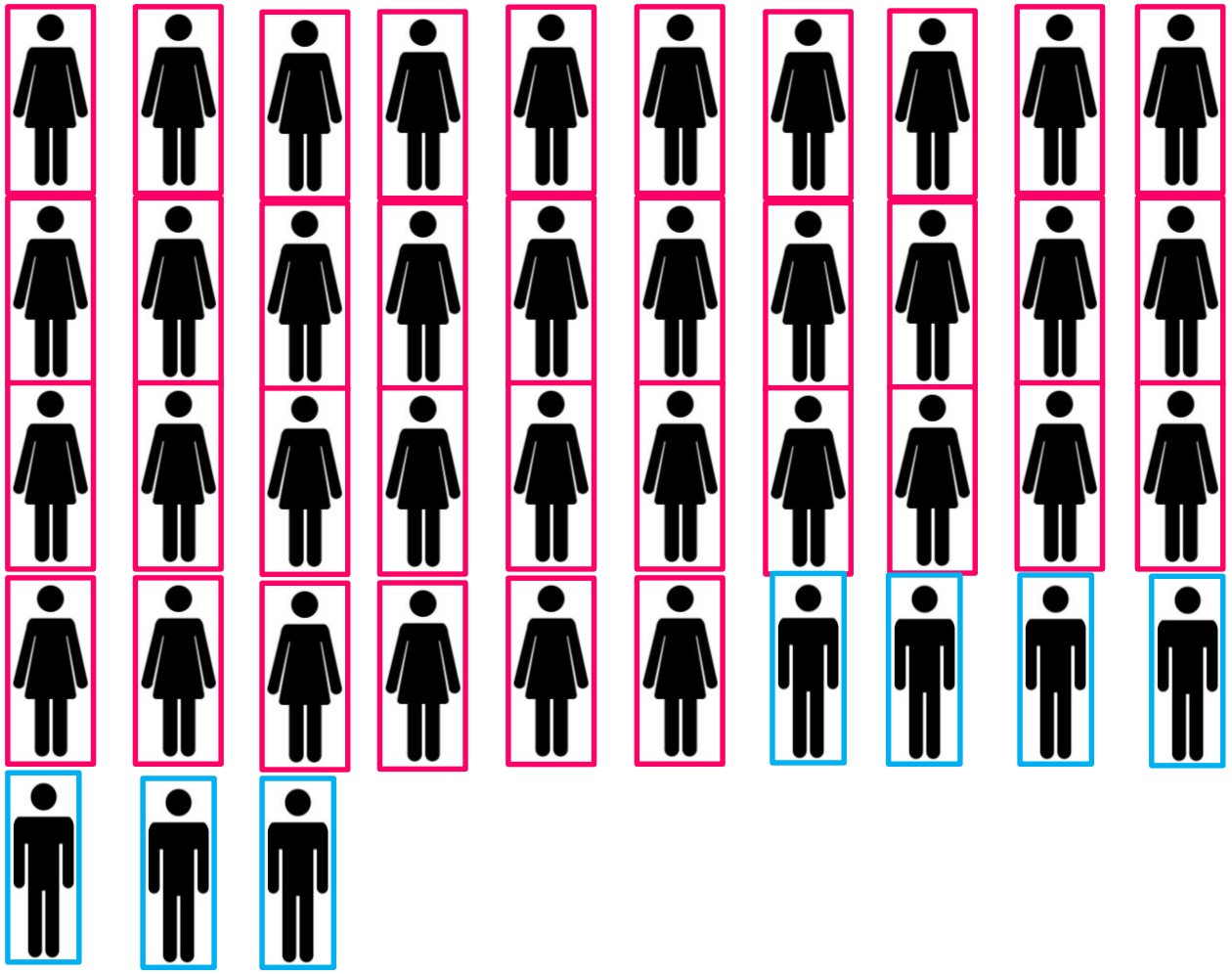

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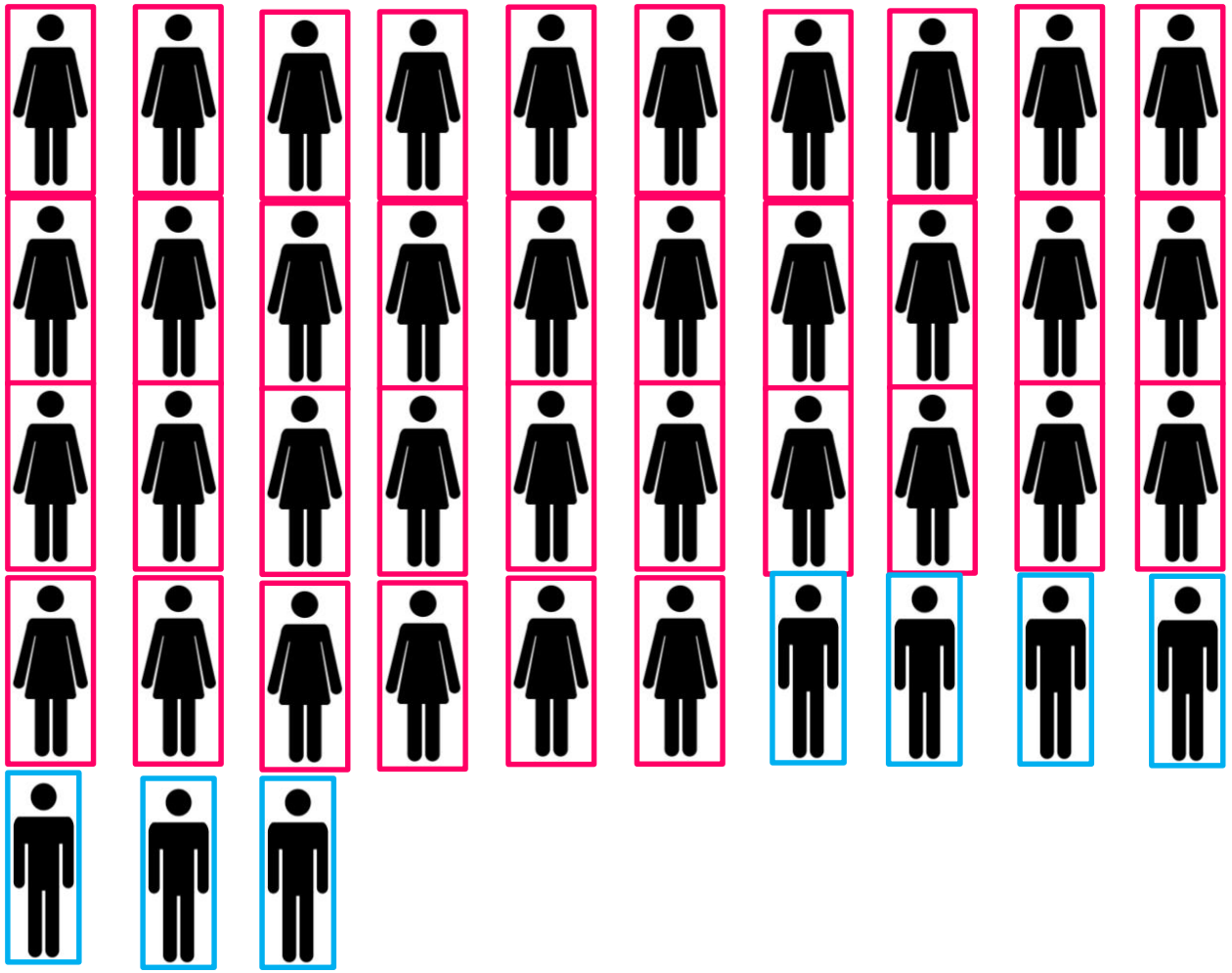

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Median age: 25 (18-74)

15 (35%) met confirmed or probable case definition

Selected Animal and Environmental Exposures

	Exposed		Unexposed		Risk Ratio (95% CI*)	*p*-value
	Ill/Total	Attack Rate (%)	Ill/Total	Attack Rate (%)		
Cottontails	**12/23**	**52.2**	**3/16**	**18.8**	**2.8 (0.9-8.3)**	**<.05**
Foxes	**11/16**	**68.8**	**4/23**	**17.4**	**4.0 (1.5-10.2)**	**<.01**
Opossums	14/35	40.0	1/4	25.0	1.6 (0.3-9.2)	1
Turtles	12/33	36.4	3/6	50.0	0.7 (0.3-1.8)	.7
Raccoons	**11/15**	**73.3**	**4/24**	**16.7**	**4.4 (1.7-11.3)**	**<.01**
Squirrels	6/17	35.3	9/22	40.9	0.9 (0.4-1.5)	.8
Drink well water	**10/15**	**66.7**	**4/23**	**17.4**	**3.8 (1.5-10.0)**	**<.01**
Recreational water	4/7	57.1	9/30	30.0	1.9 (0.8-4.4)	.2

CI = Confidence interval

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Multivariable Logistic Regression

Fox and raccoon contact were not independent

- Both required handlers to be rabies pre-exposure vaccinated
- Foxes were reported to be healthy, raccoons had diarrheal illness

	Adjusted Odds Ratio	95% CI	*p*-value
Cottontails	2.5	0.3-18.2	.4
Raccoons	**12.0**	**1.9-76.4**	**<.01**
Drinking well water	**7.6**	**1.2-48.8**	**<.05**

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Environmental Investigation Findings

Well water samples had low levels of total coliforms

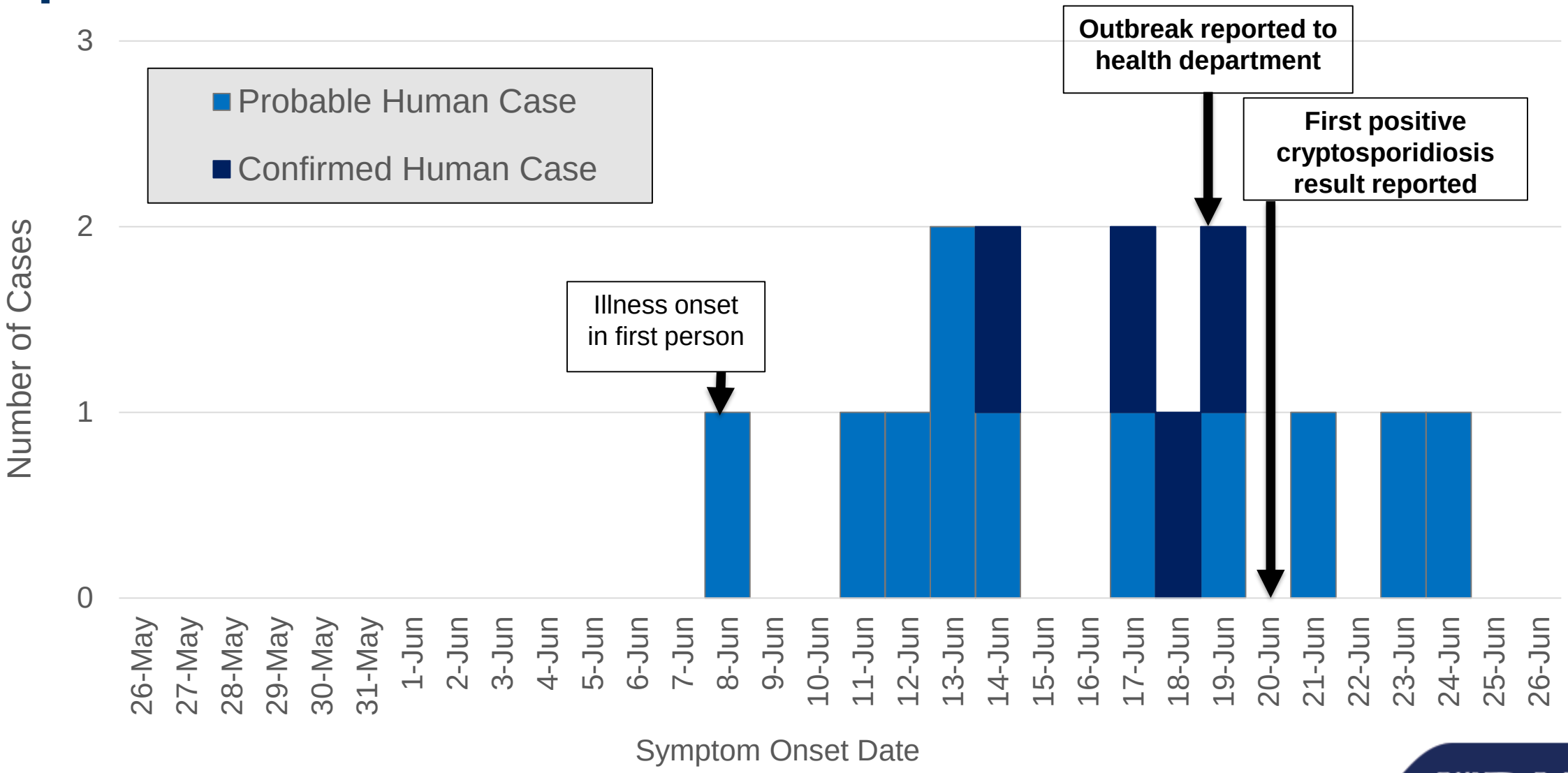
- 3.0, 10.9, and 13.5 MPN/100 mL
- One detected *E. coli* at 1 MPN/100 mL

VDH Office of Drinking Water advised water was an unlikely source of Cryptosporidium

- No additional testing conducted

Notably, the first raccoon became clinically ill only 2 days after intake

Epidemic Curve



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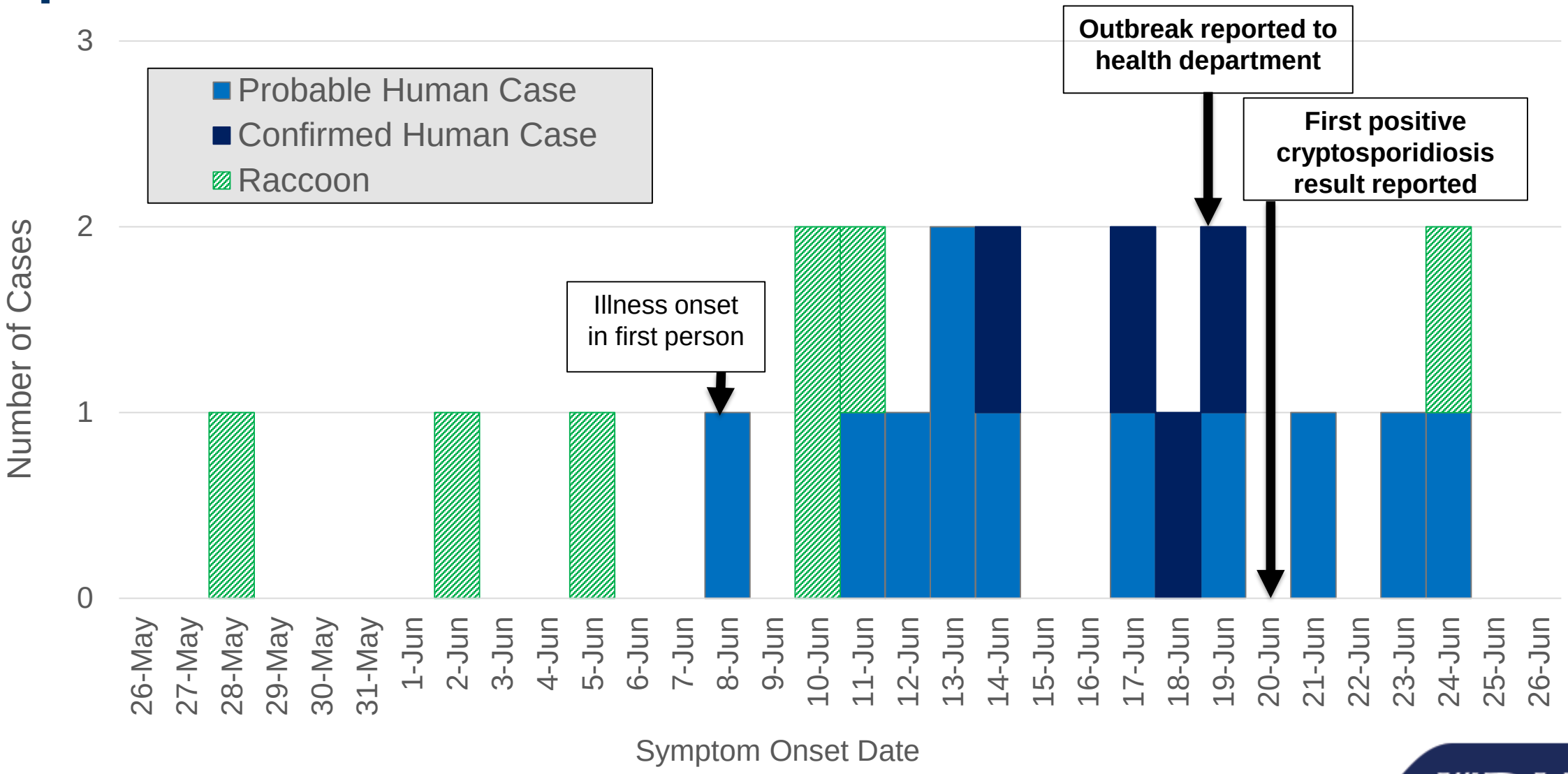

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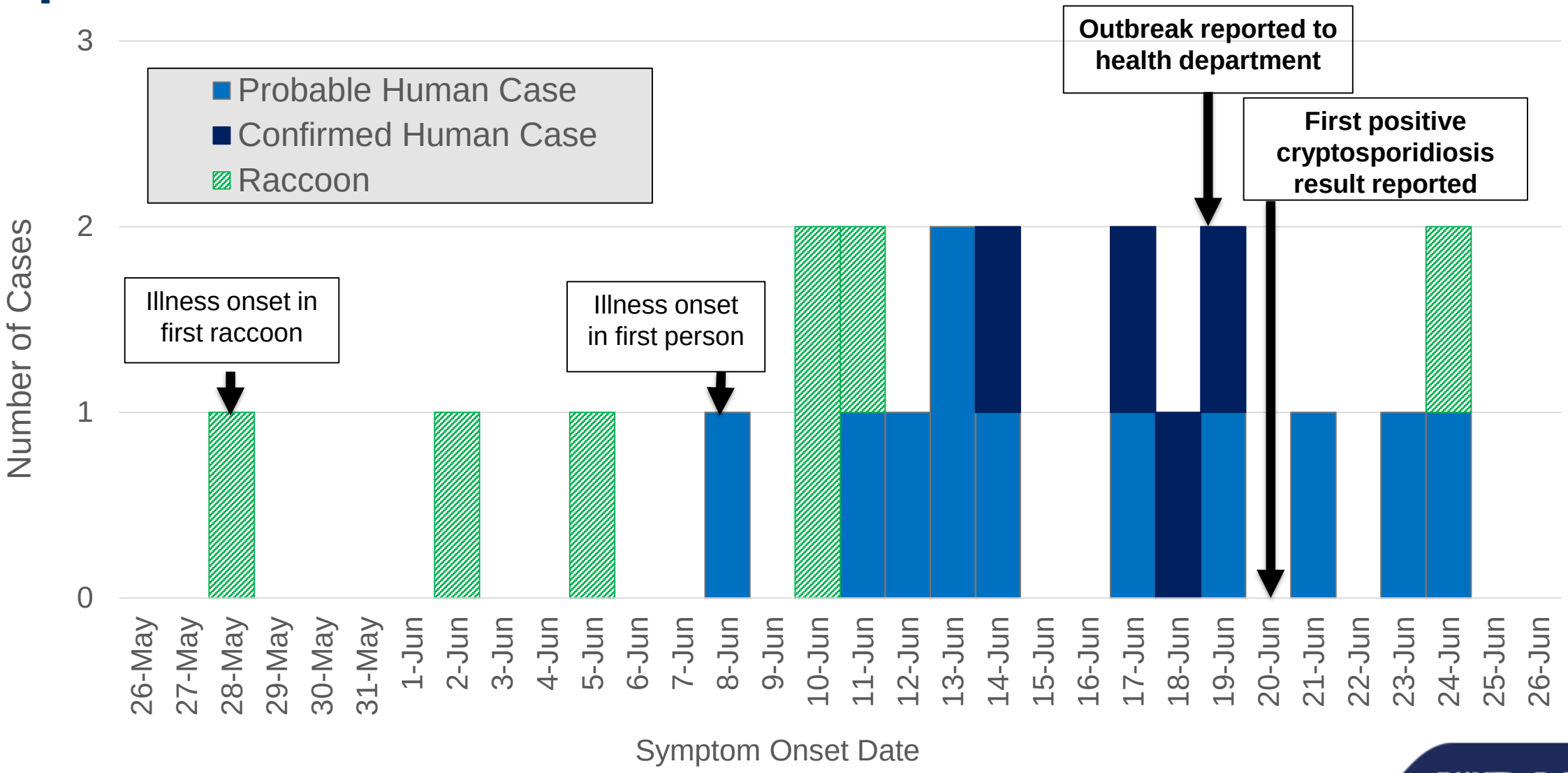

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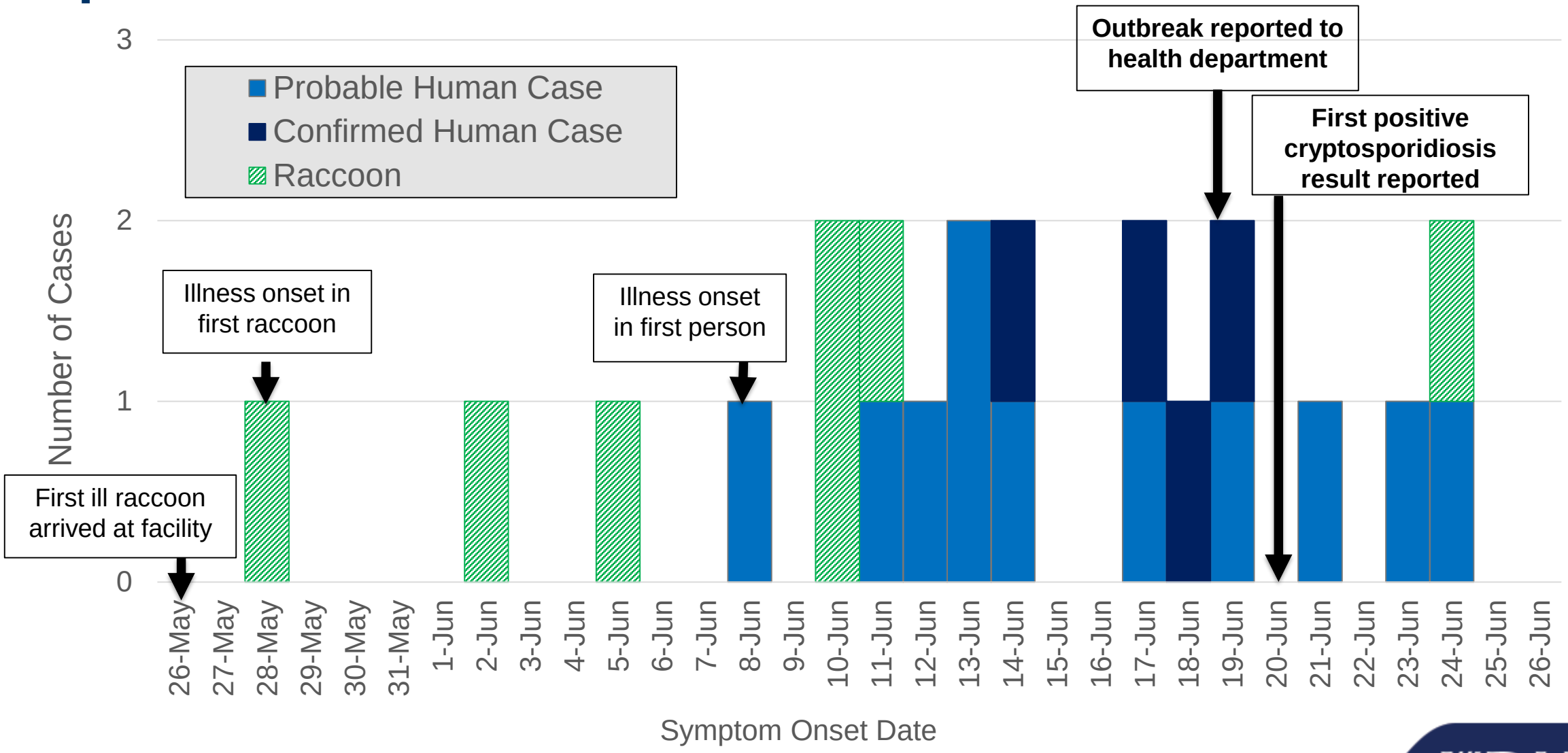
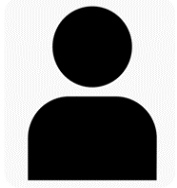


Laboratory Investigation Findings



1 Antigen +
Cryptosporidium

3 PCR +
Cryptosporidium

6 ELISA +
Cryptosporidium

1 *Cryptosporidium* +

***Cryptosporidium parvum* subtype IIaA16G3R2**

2 **7**

Outbreak in Context

Racoon infections with *Cryptosporidium* species and genotypes are known to occur

Raccoons infections have not previously been reported in association with human illness

While outbreaks of cryptosporidiosis have been reported in association with animal contact, wild animals have not been identified as a source of exposure in previous outbreaks

Evidence for Raccoons as the Exposure Source

Raccoon illness preceded human illness by 11 days

Molecular typing identified *C. parvum* IIaA16G3R2 in ill raccoons and humans

The first raccoon became ill only 2 days after arriving at the wildlife facility, making raccoon exposure at the facility less likely

Of the four exposures shared by a majority of ill people, contact with raccoons had the highest attack rate (73.3%) and risk ratio (4.4; CI = 1.7-11.3) and was significantly associated (<.01) with illness in multivariable modelling

Limitations

Foxes and cottontails, while clinically healthy, were not tested for *Cryptosporidium* as part of this outbreak investigation

While tap water was tested for total coliforms and E. coli, it was not specifically tested for *Cryptosporidium*

Significance and Implications

This outbreak is the first report of human illness after exposure to raccoons infected with *C. parvum*

Raccoons and other wildlife species capable of infection with *C. parvum* might be an under-recognized source of human infection

- Routine testing of wildlife for *C. parvum* is not always performed
- Human healthcare providers should consider C. parvum as a differential diagnosis in persons who have contact with raccoons and present with gastrointestinal illness

The outbreak subtype IIaA16G3R2 has not previously been reported in raccoons

Acknowledgements

Wildlife facility staff, interns, and volunteers

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Questions???

References

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3. Hattori K, Donomoto T, Manchanayake T, Shibahra T, Sasai K, Matsubayashi M. First surveillance and molecular identification of the *Cryptosporidium* skunk genotype and *Cryptosporidium parvum* in wild raccoons (*Procyon lotor*) in Osaka, Japan. *Parasitology Research* 2018; 117:3669–3674. https://doi.org/10.1007/s00436-018-6089-y