Yersiniosis – a One Health approach for a growing problem in New Zealand.

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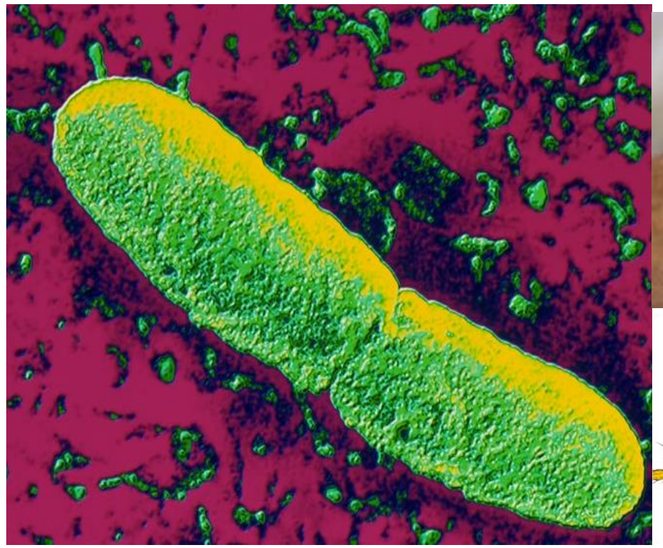
Yersiniosis

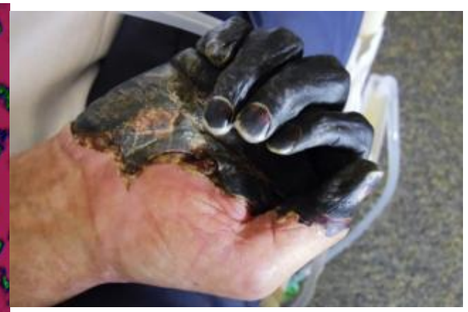
- A disease in mammals that is caused by the bacteria *Yersinia.*

Y. pestis

Plague “Black Death”

- 50 million deaths across Africa, Asia and Europe in the 14th Century. It wiped out up to half of Europe's population.
- Still exists today (not in NZ)





Y. enterocolitica* (YE) and *Y. pseudotuberculosis

Symptoms:

- Diarrhoea
- Stomach cramps (can be confused with appendicitis)
- Vomiting
- Fever
- Usually starts within a few days but generally <10 days after contact and usually lasts 2-3 days but can last as long as 3 weeks

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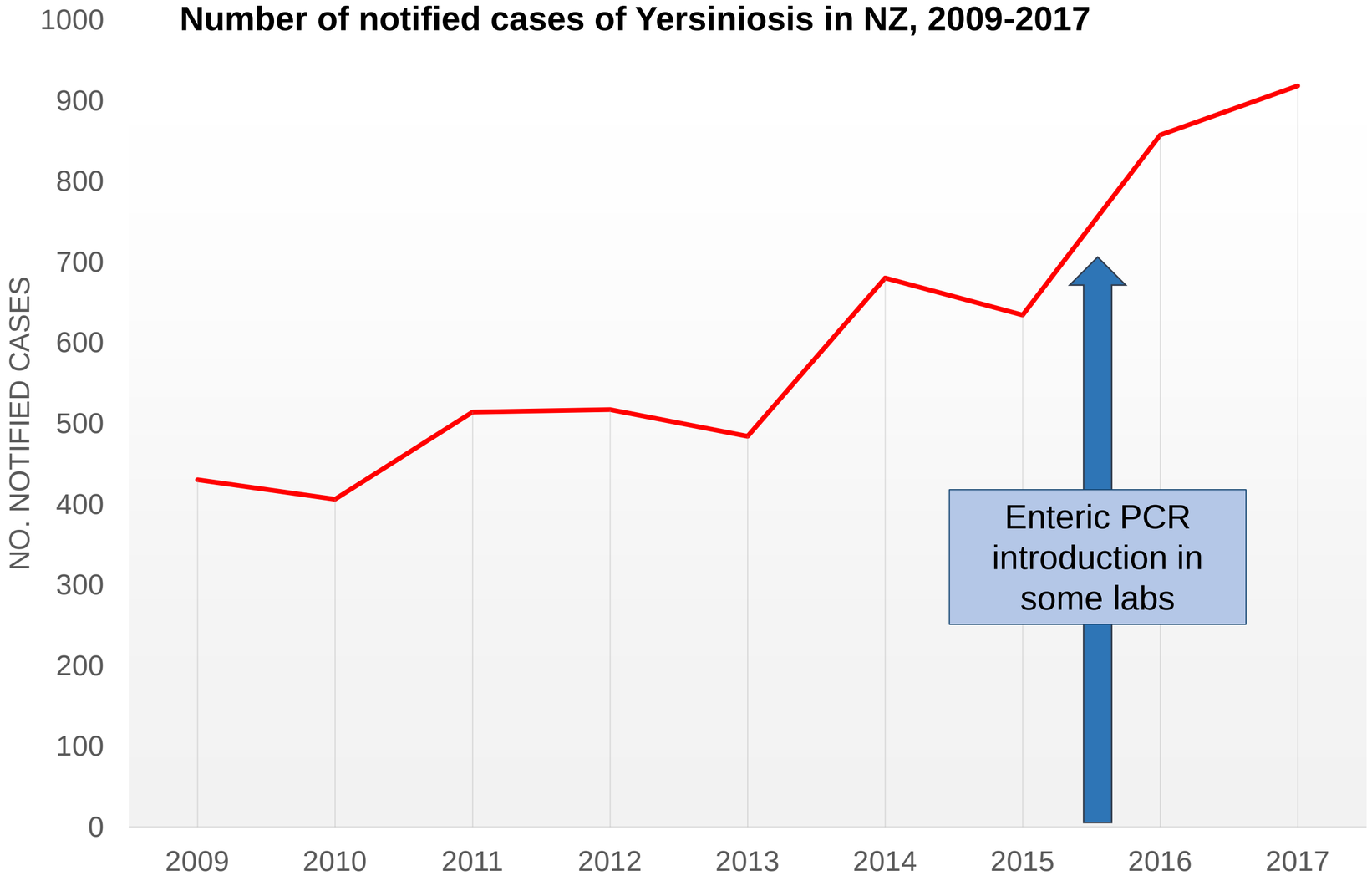
Yersiniosis is an emerging problem in NZ



- The rate is higher in NZ than many other developed nations.
- E.g. In 2014, the European Union (EU; 25 countries) average rate was 1.8 per 100,000 population and Finland had the highest rate in the EU of 10.6 per 100,000*.
- For NZ in 2014, the rate was **15.1** per 100,000.
- The introduction of Enteric PCR in some NZ regions began from 2015. Increase in notified cases was observed prior to introduction of the PCR.

Data from annual surveillance summaries: https://surv.esr.cri.nz/surveillance/annual_surveillance.php and from Episurv Oct 2018
*ECDC, 2017. https://ecdc.europa.eu/en/publications-data/yersiniosis-annual-epidemiological-report-2016-2014-data

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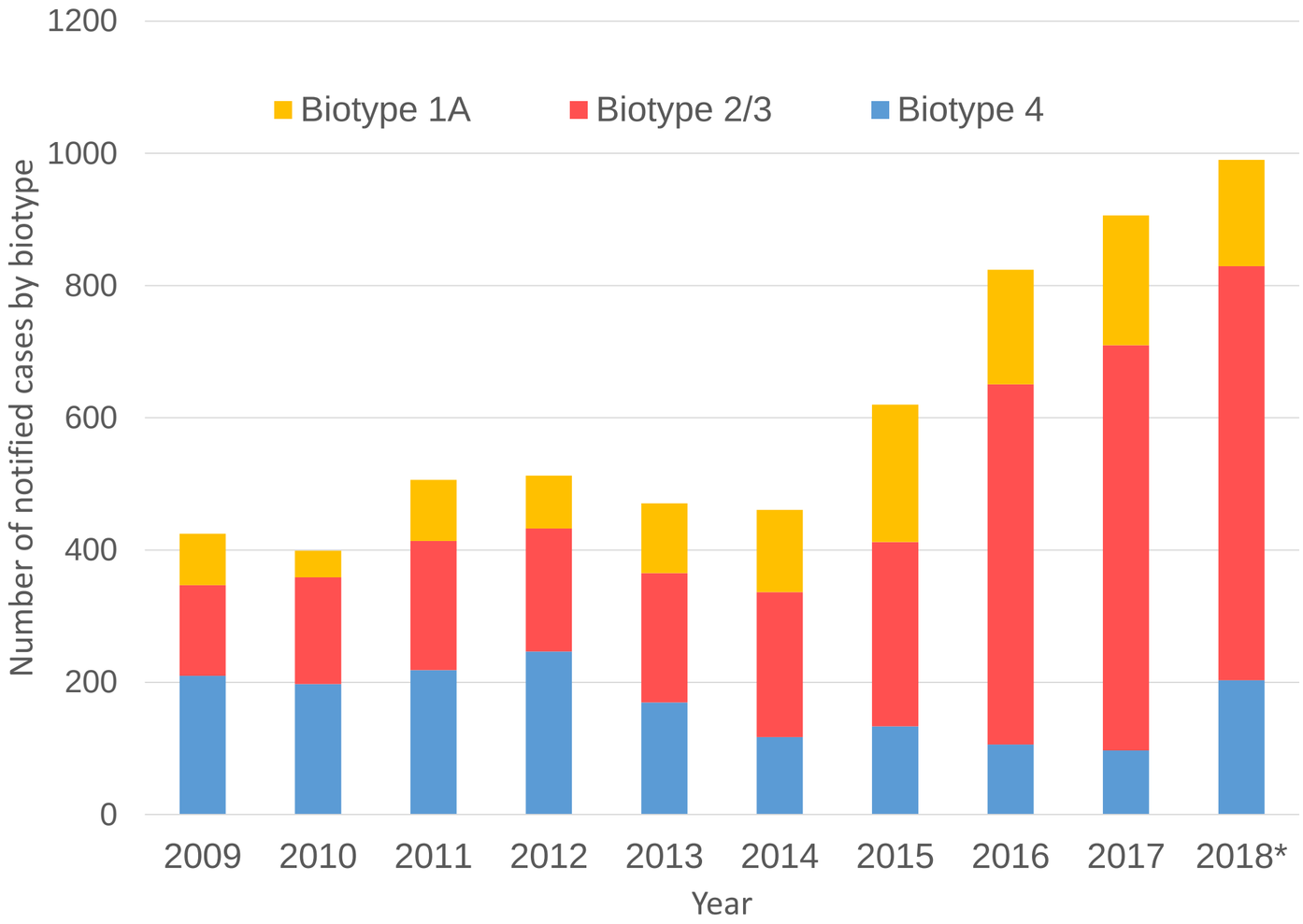
Y. enterocolitica - Biotyping

Number of notified cases of *Y. enterocolitica* by biotype, 2009 – Oct 2018



Data presented in the figure was extracted from EpiSurv (October 2018).
*2018 only up to the end of October.

- In NZ, >99% of cases are due to *Y. enterocolitica.*
- *Y. pseudotuberculosis* usually very few cases (2014 outbreak. 220 cases, 72 hospitalisations).
  - https://www.esr.cri.nz/home/about-esr/our-science-in-action/esrs-response-to-the-yersinia-pseudotuberculosis-outbreak/
  - https://www.mpi.govt.nz/dmsdocument/11030/loggedIn
- **Biotyping** based on biochemical characteristics.
- **Biotype 2/3 and 4** = pathogenic (presence of plasmid and chromosomal virulence genes).
- Shift from biotype 4 to biotype 2/3 over the years. NZ is different to other countries where biotype 4 predominates in clinical cases.
- **WHY THE SHIFT AND DIFFERENCE?**
- **Biotype 1A** are classically considered as non-pathogenic in many countries.
- **WHY IS IT APPEARING IN CLINICAL CASES?**

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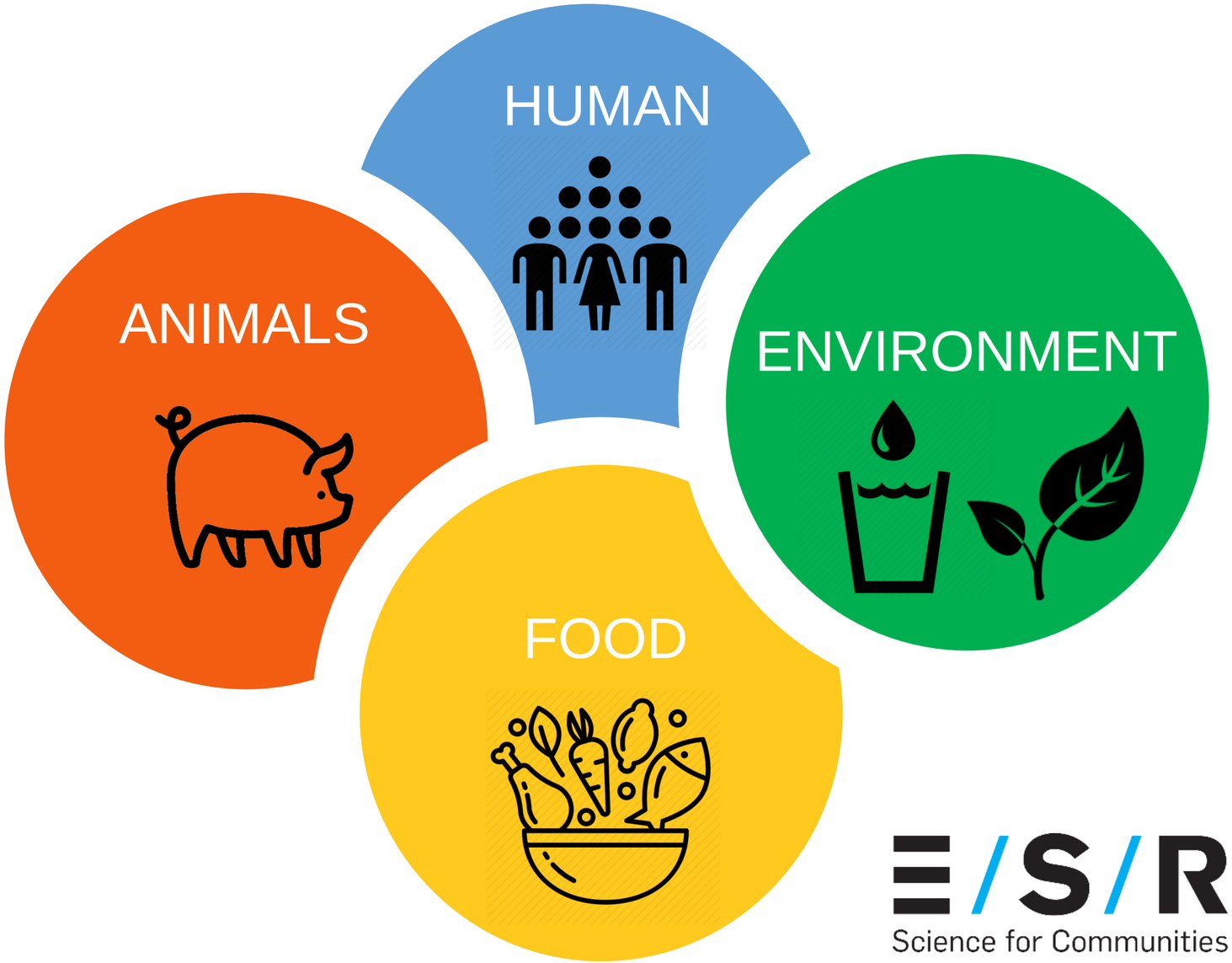
What is the cause of all the yersiniosis?

To discuss:

- The challenges that we are facing

- What information can we gain using a One Health approach?



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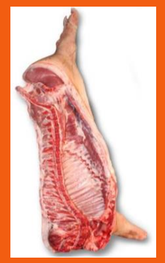
ANIMALS



FOOD

Some species of animals can get Yersiniosis as well.

Does that contribute to human disease?

- **Estimated that the majority of cases of Yersiniosis is foodborne.**
- ***Y. enterocolitica:*** Pigs are an important reservoir (YE biotype 4 predominates - also reported for NZ).
- Consumption of undercooked pork or cross contamination of other foods during handling and preparation of raw pork.
- Cross contamination of carcasses during slaughter.
- Interventions during slaughter can help.
- But YE has been isolated from cattle, deer, goats, dogs, cats, rodents and birds etc.
    - Are these sources contributing to human disease?

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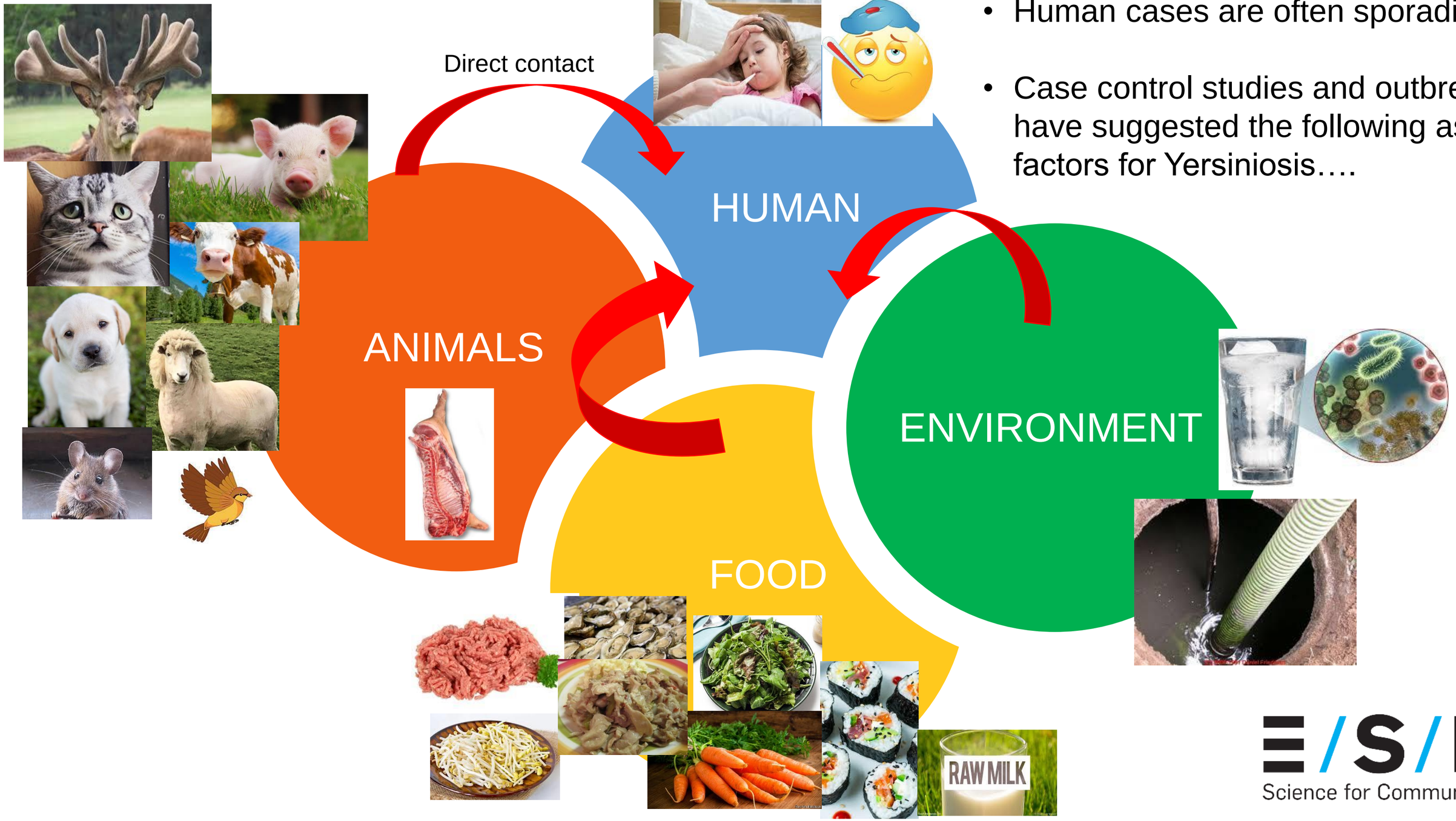

- Human cases are often sporadic.
- Case control studies and outbreaks have suggested the following as risk factors for Yersiniosis….

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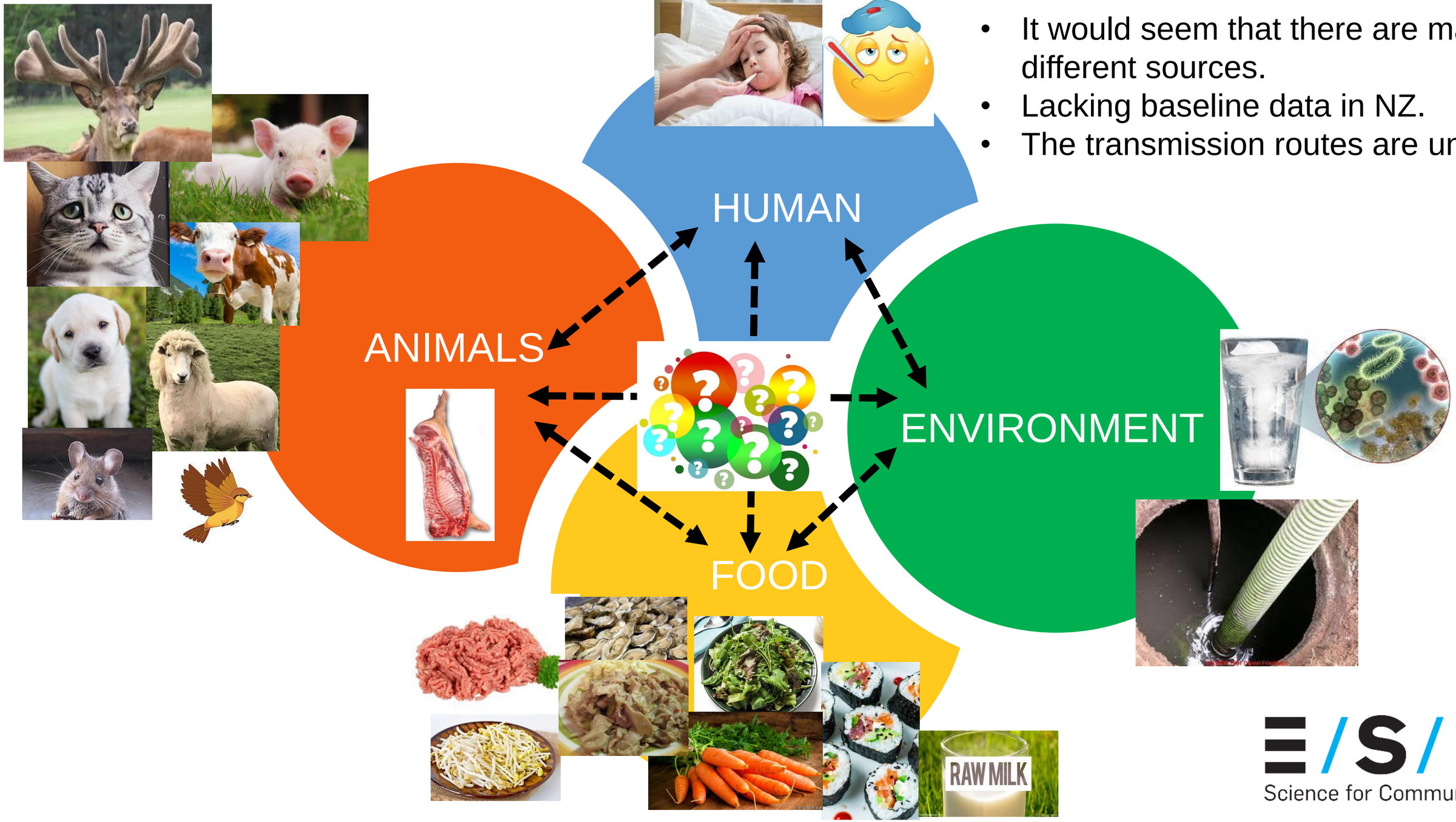

- It would seem that there are many different sources.
- Lacking baseline data in NZ.
- The transmission routes are unclear.

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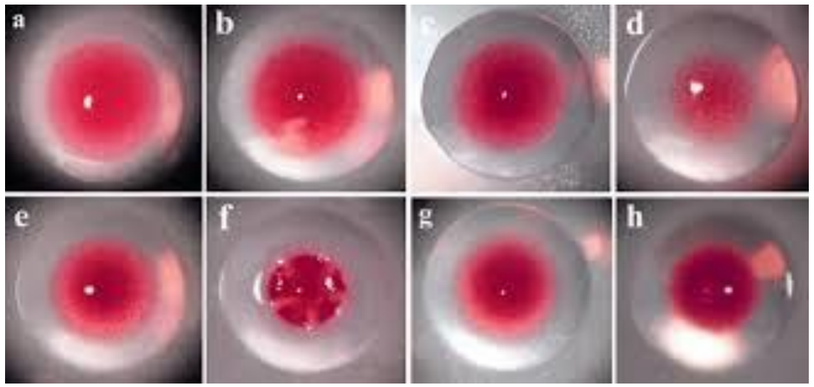
The challenges…

Firstly….

Isolating *Y. enterocolitica* from foods is not easy.

- Standard international methods are insensitive and not very robust.
- Yersinia is present in foods in low numbers and it grows poorly amongst a high background flora.
- Cold enrichment usually needs a long time for incubation. Not practical for outbreaks.
- Recovery can depend on the biotype and matrix type (not one enrichment can be used)
- Molecular detection methods often do not detect YE biotype 1A (due to lack of common virulence genes used in these methods).
- ESR is working with MPI to make improvements in this area.



Different colony morphologies on CIN agar

ChromAgar Yersinia
(www.chromagar.com)

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The challenges…

Secondly….

- Extended questionnaires administered by the District Health Board Public Health Units to notified cases are often by post, which results in a poor response rate (20%).
- In the few cases received, a potential source is rarely identified and the increasing number of cases, the turn-around-time and lack of sufficient resourcing prevents follow up and proper investigation.
- Can surveillance data help us?

Notification rate per 100,000 population of selected enteric disease by ethnic group, 2017*

Rate per 100,000	Māori	Pacific peoples	Asian	MELAA[a]	European or other	Total rate[b]
Campylobacteriosis	74.1	48	62.8	117.7	158.1	135.2
Yersiniosis	14.2	11.2	29.7	33.6	18	19.2
Cryptosporidiosis	19.3	15.6	8.5	22.4	28.2	24.9
Salmonellosis	15.6	16.7	16.5	24.3	25.9	23.3
VTEC/STEC infection	9.9	5.8	5.1	22.4	12.6	11.4

[a]MELAA = Middle Eastern/Latin American/African, [b]Total rate includes cases where ethnicity was unknown.
*Pattis *et al.* (2018). Annual report concerning foodborne disease in New Zealand 2017. Draft report.

- People of Asian and MELAA ethnicity had higher notification rates for yersiniosis compared to other ethnic groups.
- Food sources that are more popular in these groups, food/cultural practices and preparation?

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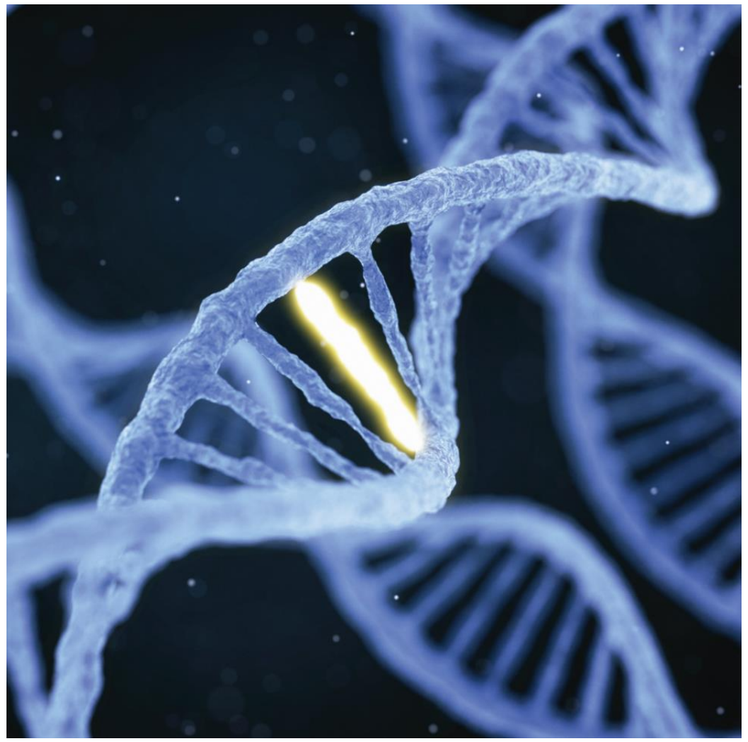
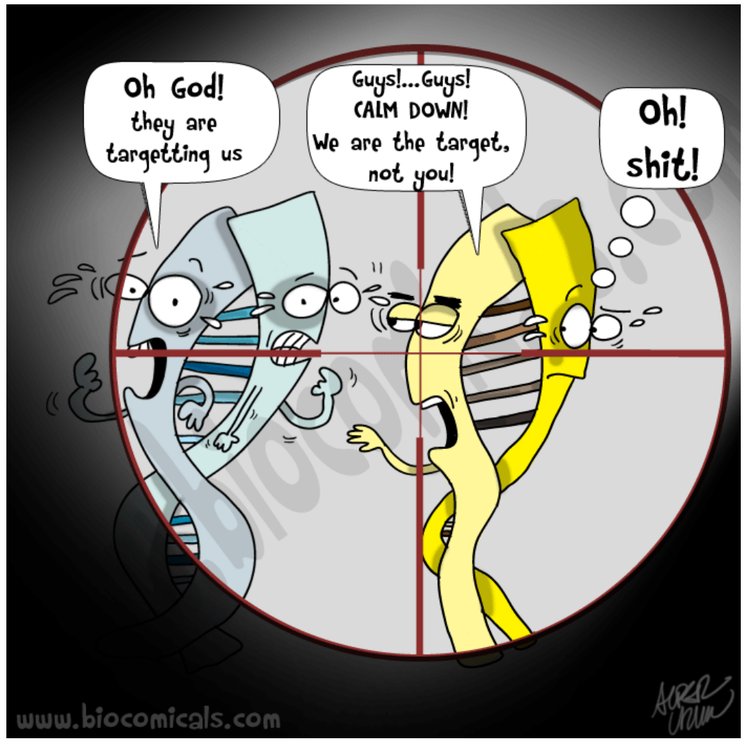
The challenges…

Thirdly…

- Traditional typing for *Y. enterocolitica* including biotyping lacks discriminatory power.
- Whole genome sequencing now offers sufficient resolution for more detailed and targeted characterisation of *Y. enterocolitica* .





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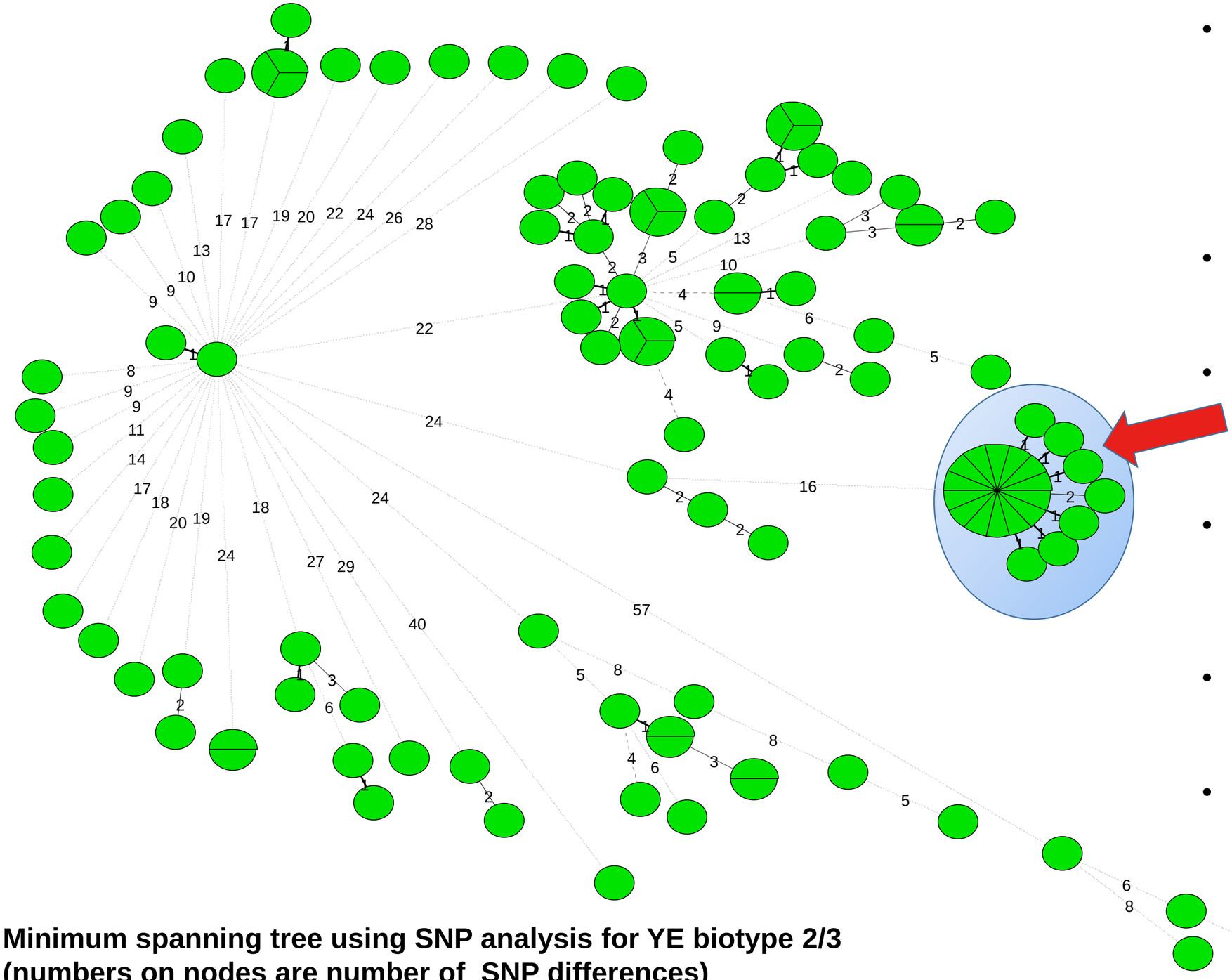

Minimum spanning tree using SNP analysis for YE biotype 2/3 (numbers on nodes are number of SNP differences)

- Example of using whole genome single nucleotide polymorphism (SNP) analysis on a **selection of YE isolates** (2014-2017, clinical, biotype 2/3)
- Genetic diversity within the same biotype(s)
- Identify outbreak isolates that are the same genotype (0-2 SNP differences between them).
- Greater potential to link human cases that can be investigated further.
- More animal/food/environmental testing.
- Smoking gun: same genotypes between human cases and other sources.

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Conclusions

- Increasing number of human yersiniosis in NZ.
- Epidemiology for *Yersinia* remains unclear in NZ.
- Lots of challenges in finding the sources and transmission routes.
- BUT there is a lot of potential to improve isolation methods and use better technologies to compare isolates from many sources.

- Collaboration helps!
- Are you working on *Yersinia*?
  - Workshop to be held as a part of the NZ Food Safety and Science Centre (March 2019).

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