

Salmonellosis in Humans & Events in the Food Chain

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 - Basic epidemiology *Salmonella*
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- Conclusions



Acknowledgements

- ESR Disease Surveillance Groups, especially
 - Carolyn Nicol
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 - Gail Mustor
 - Donald Campbell
 - Roger Cook
- NIWA
 - Graham McBride



Codex Food Safety Metrics

- Human Population
 - ALOP “Acceptable Level of Protection”
- Food
 - FSO “Food Safety Objective”
- Processing
 - POs “Performance Objectives”
- Production
 - POs “Performance Objectives”



Codex Food Safety Metrics



PO₁

PO₂

PO₃

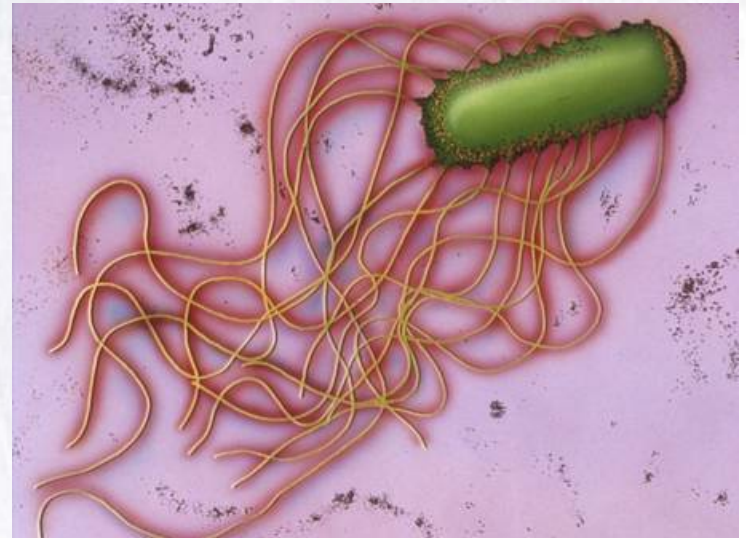
FSO

ALOP



The *Salmonella*

- Gram-negative rods
- Flagella – motile
- Growth with & without air
- Animal host – GIT
- Good environmental survival
- Enteric disease





S. Typhimurium invading human cells





Salmonella genotypes

- Serotypes
 - O and H agglutination antigen
 - Typhimurium, Brandenburg, Enteritidis, etc.
- Subtypes
 - Phage susceptibility
 - S. Typhimurium Definitive Types (DT) or Provisional Types (PT)
 - 1, 9, 23, 12a, 104, 135, 156, 160, etc
 - **2,300 genotypes**
 - DNA analysis
 - S. Brandenburg
 - 14 Pulsed-field Gel Electrophoresis (PFGE) strains



Host adaptation

- Variable host affinity
 - Human (Typhoidal salmonellosis)
 - *Typhi* & *Paratyphi*
 - Non-Human Animals hosts
 - *Strong*
 - *S. Enteritidis* DT 5 (Poultry)
 - *Weak*
 - *S. Typhimurium* DT 160

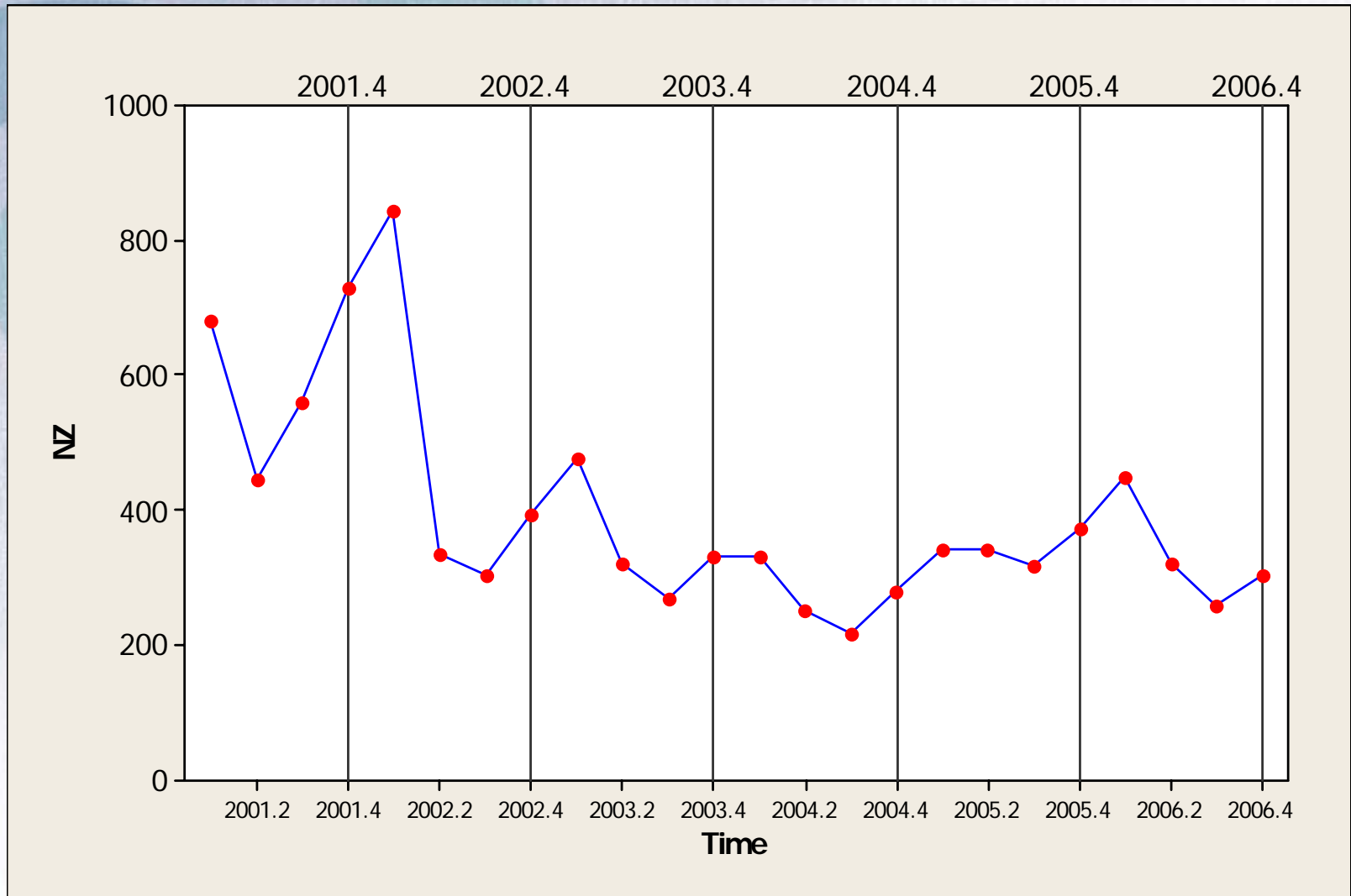


Method

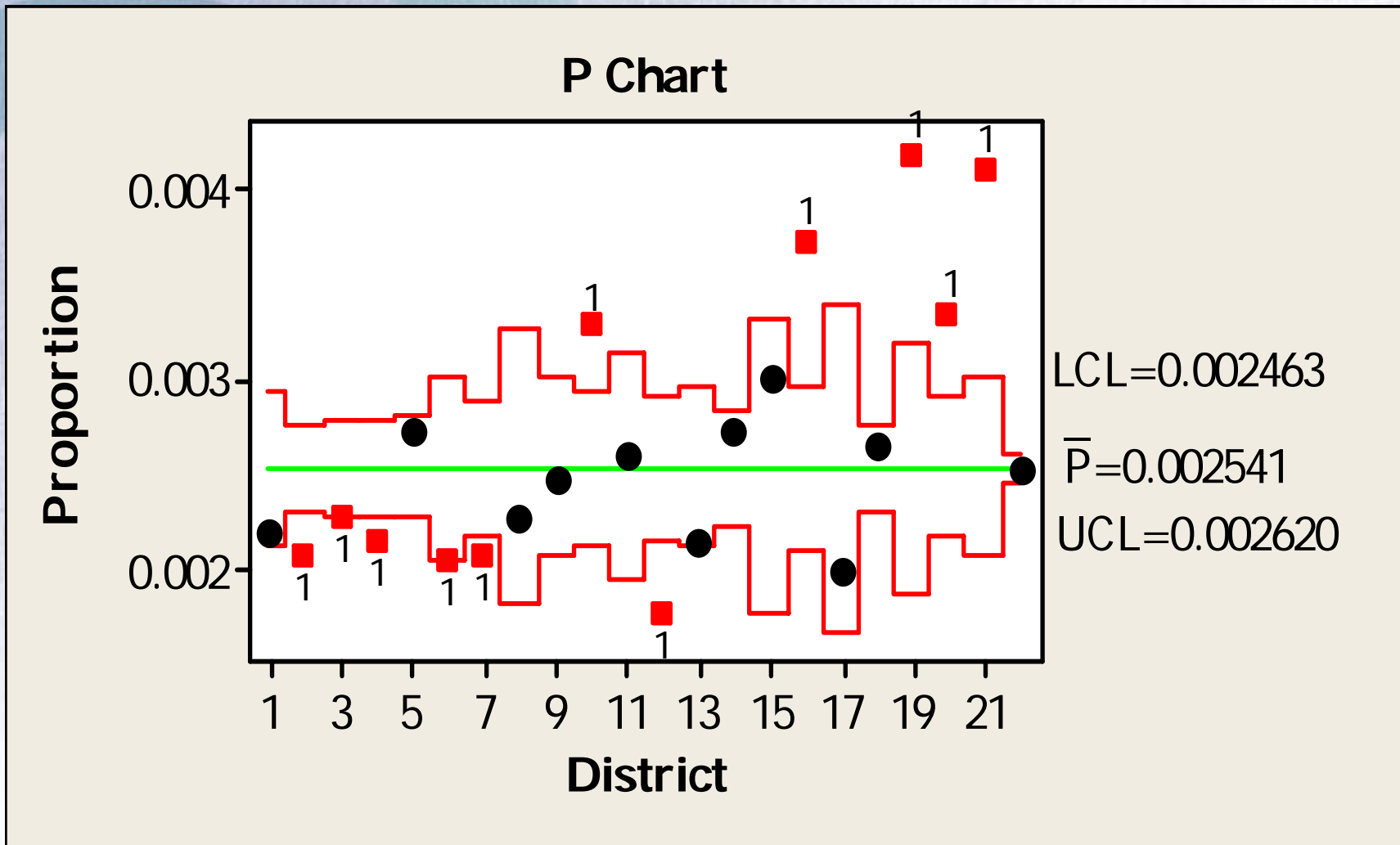
- Human salmonellosis
 - Notified diseases
 - *Time & district*
 - Subtype
 - *Time & district*
- Non-human *Salmonella*
 - Subtype
 - *District & slaughter-house*
 - National Microbiological Database
 - *Time & slaughter-house*
 - Surveys



Human cases by quarter – 2001 to 2006

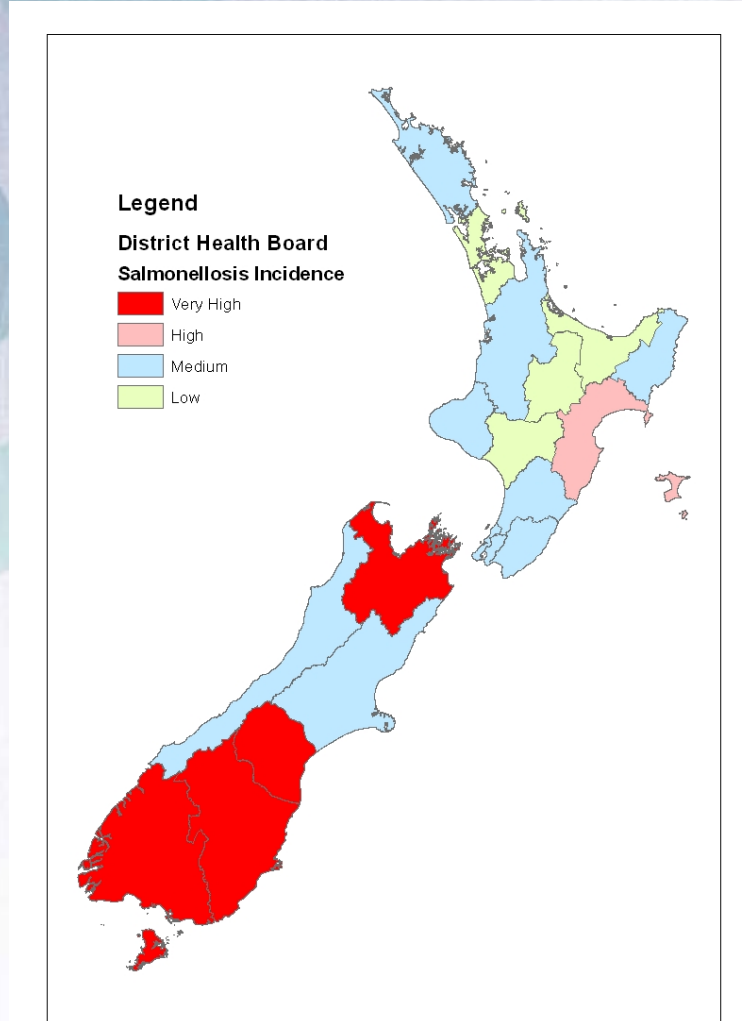


Human Salmonellosis Incidence by District



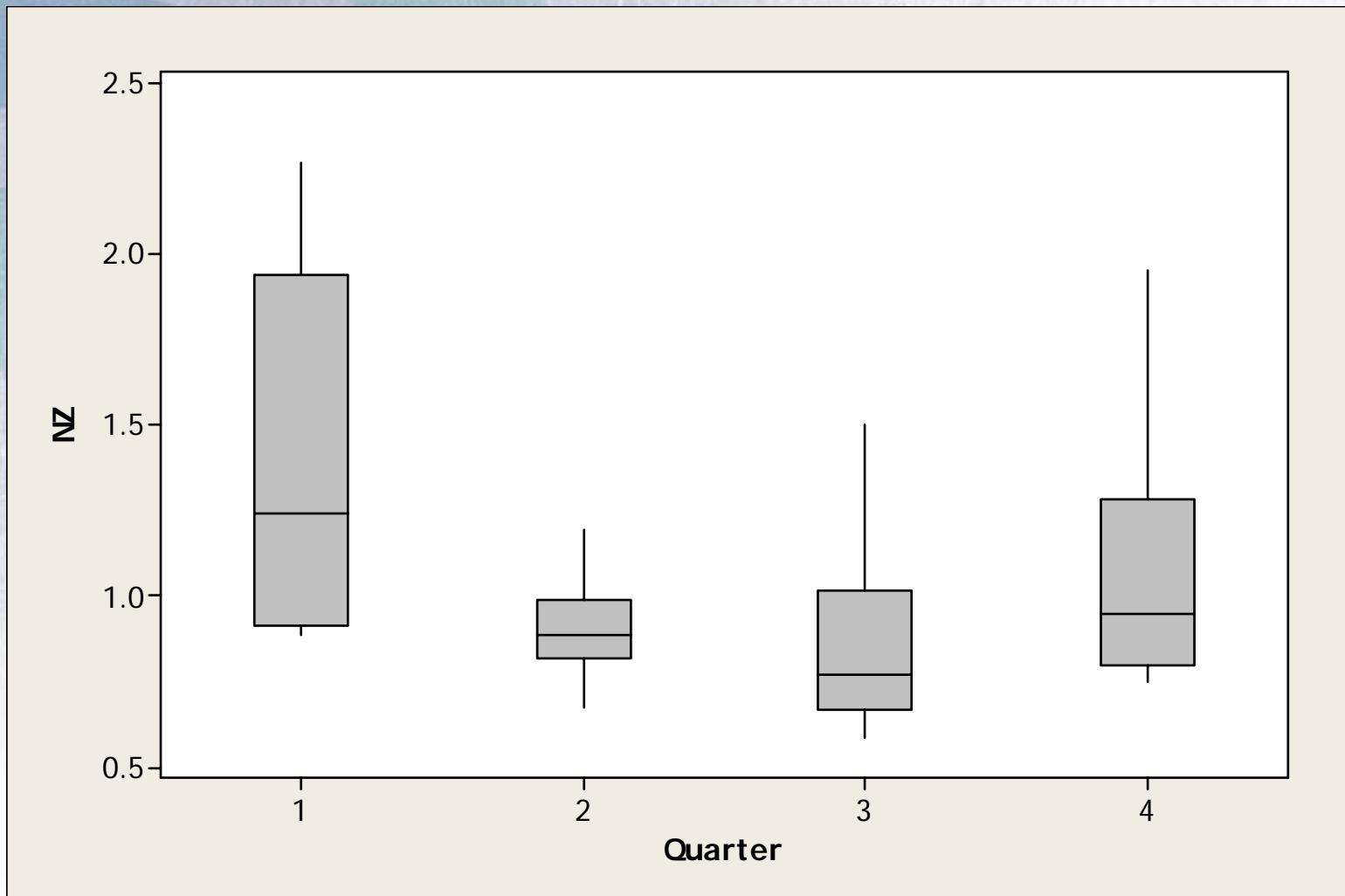


Human Salmonellosis Incidence



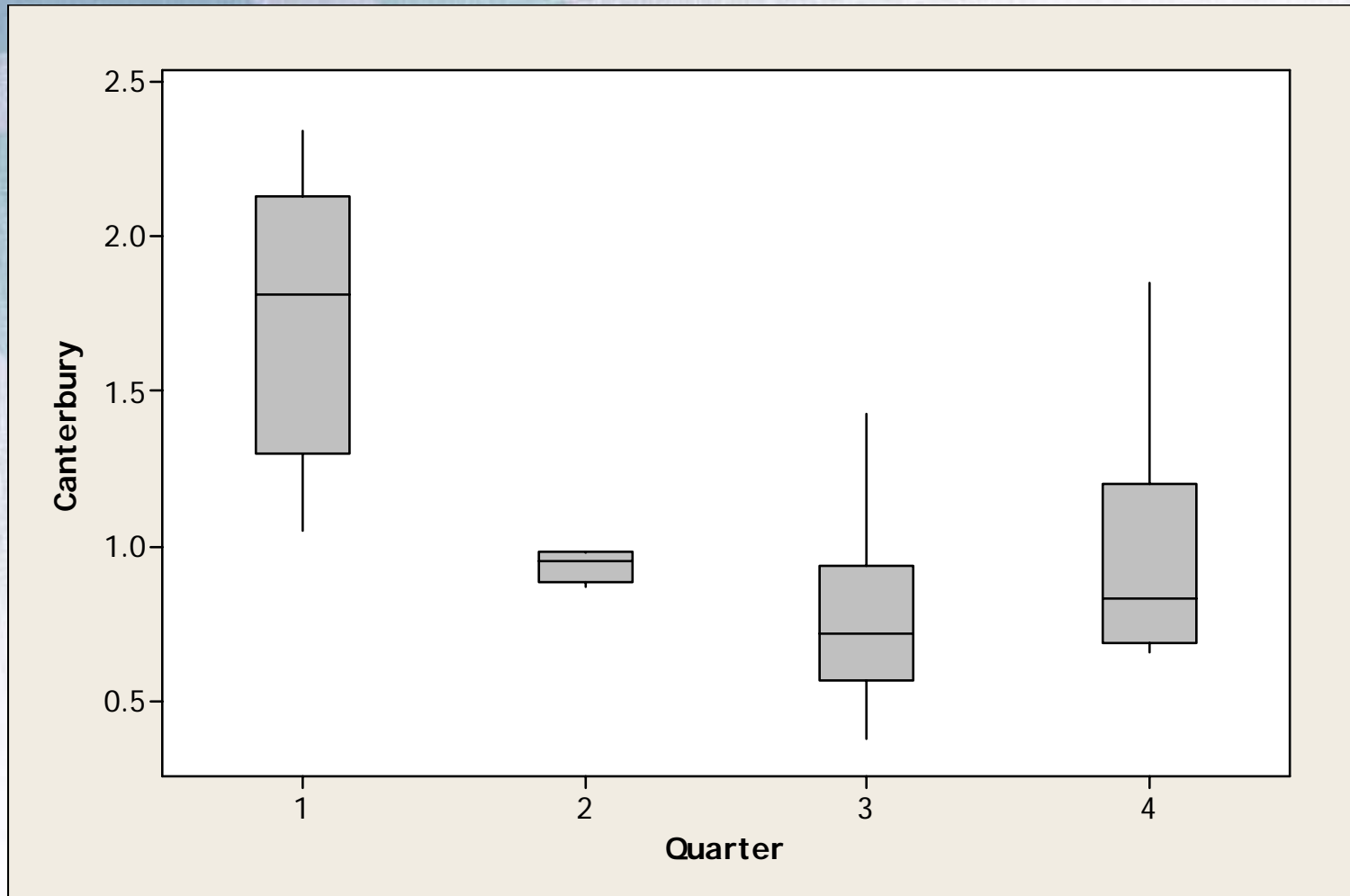


Human salmonellosis per 10,000 by quarter



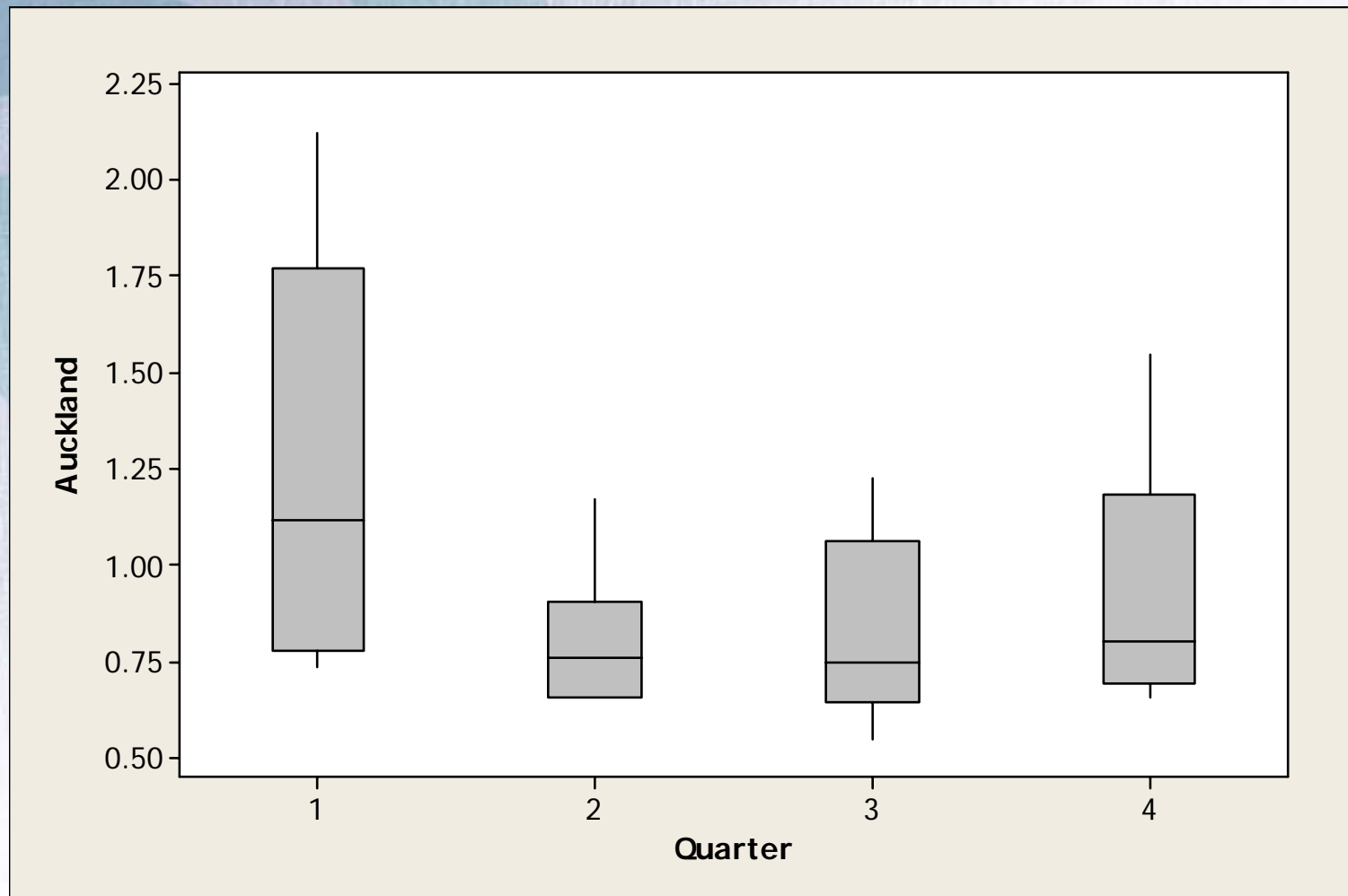


Canterbury District



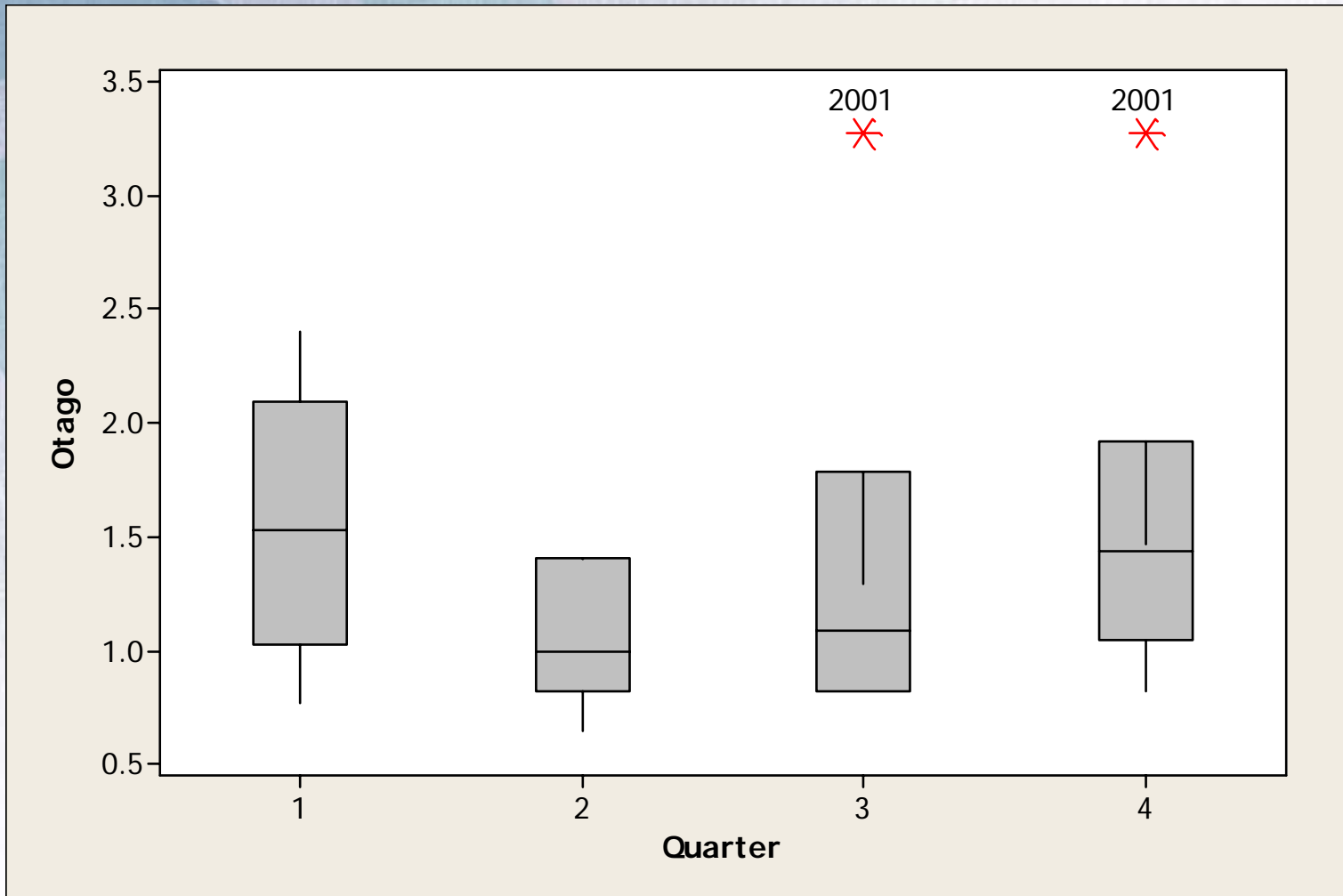


Auckland district



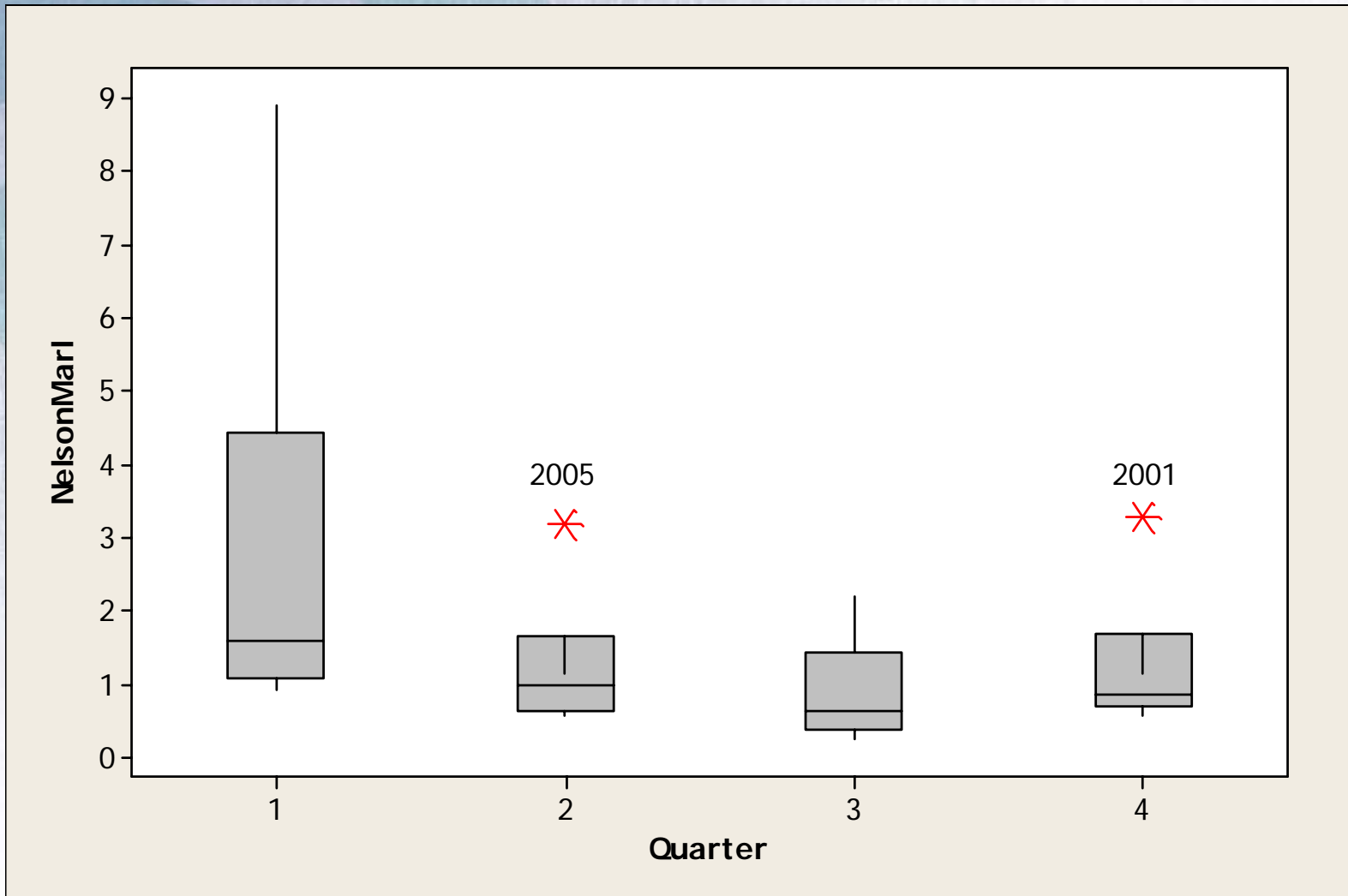


Otago



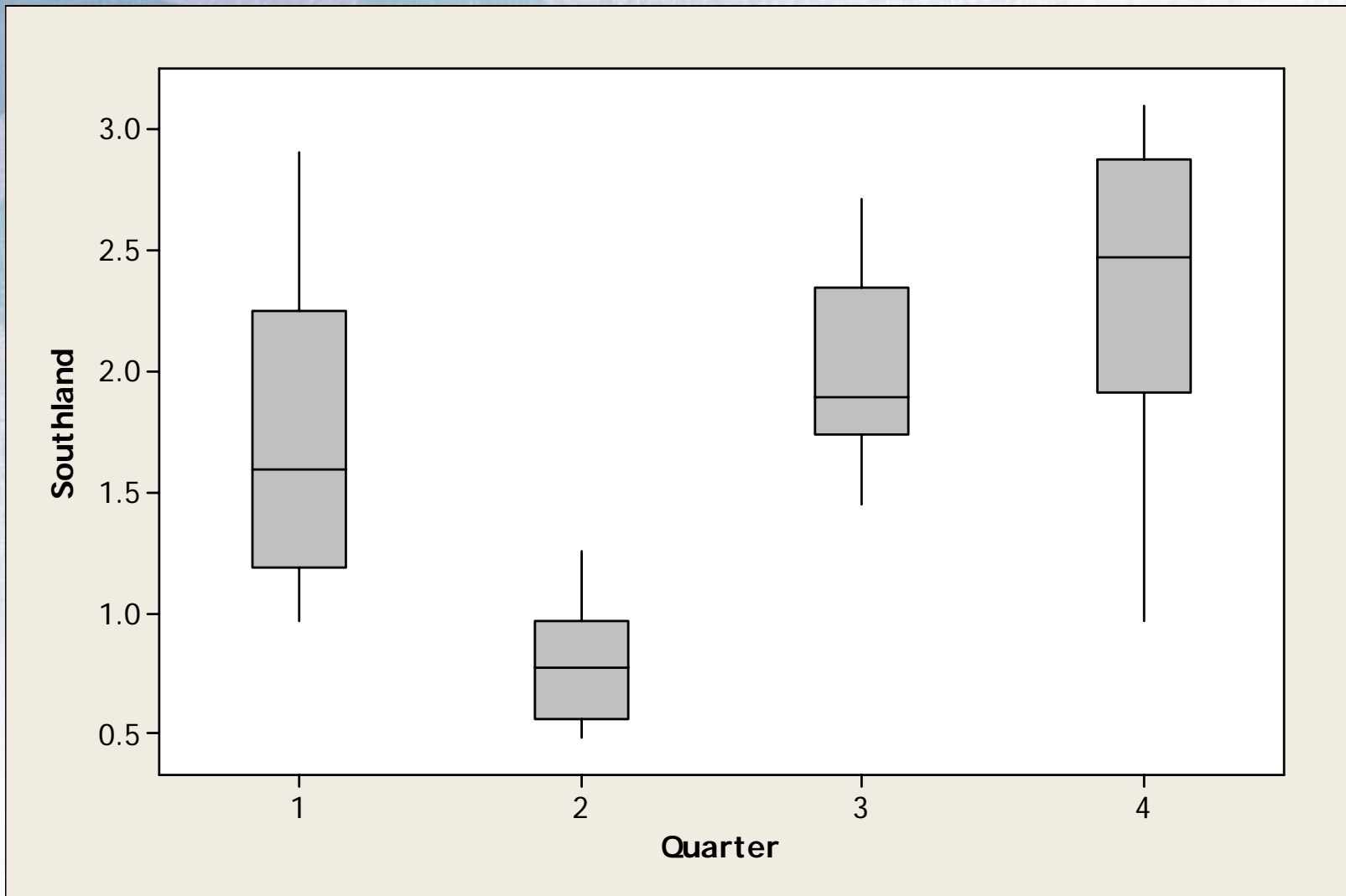


Nelson Marlborough





Southland





Human salmonellosis subtypes

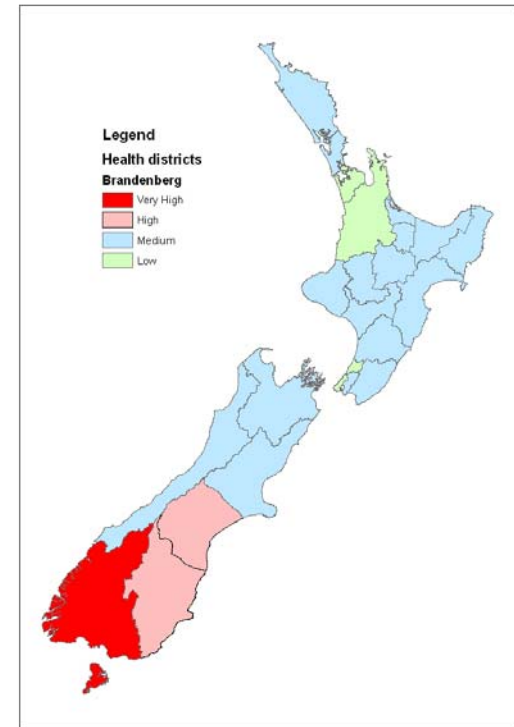
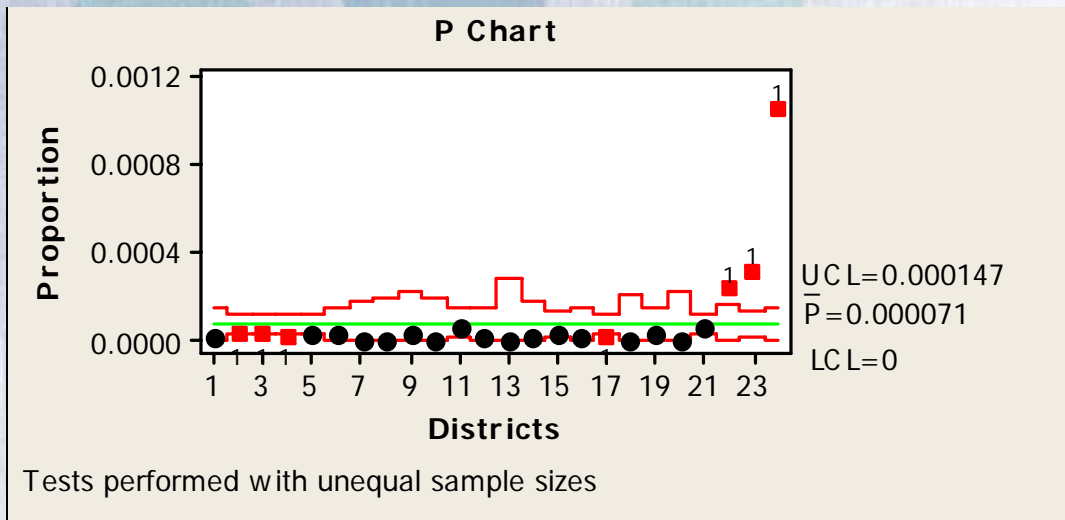
- 2003 to 2006
 - 222 total subtypes
 - 11 subtypes 60% of total
 - 31 subtypes 80% of total

Human salmonellosis subtypes

2003	2004	2005	2006
Typhimurium 160	Typhimurium 160	Typhimurium 160	Typhimurium 160
Typhimurium 1	Brandenburg	Typhimurium 1	Typhimurium 156
Typhimurium 74	Typhimurium 1	Typhimurium 156	Typhimurium 1
Typhimurium 156	Infantis	Enteritidis 9a	Typhimurium 101
Infantis	Typhimurium 156	Brandenburg	Infantis
Typhimurium 135	Typhimurium 74	Infantis	Brandenburg
Typhimurium 101	Enteritidis 9a	Typhimurium 101	Enteritidis 9a
Enteritidis 9a	Typhi	Saintpaul	Typhimurium 12a
Brandenburg	Saintpaul	Typhimurium 135	Typhimurium 74
Typhimurium 8 variant	Typhimurium 101	Typhimurium 12a	Typhimurium RDNC
Montevideo	Typhimurium 135	Typhimurium 74	Typhi
Typhimurium 12a	Virchow	Typhi	Saintpaul
Saintpaul	Typhimurium RDNC	Typhimurium 42	Thompson

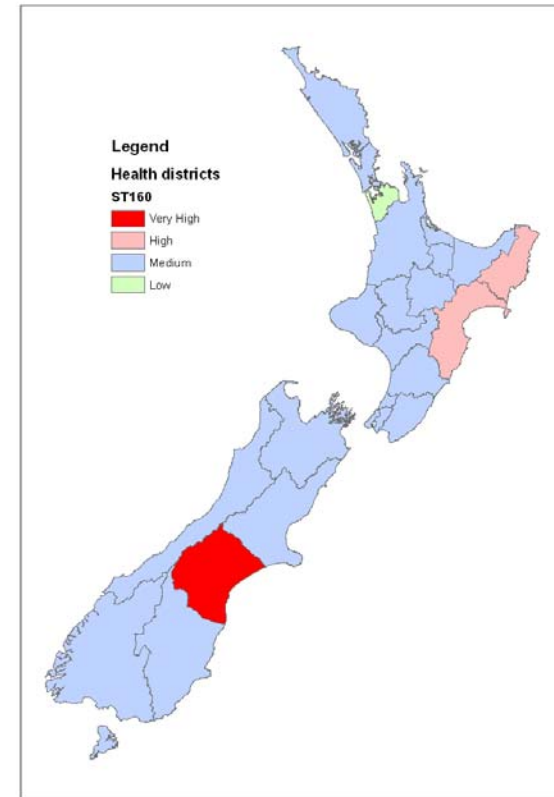
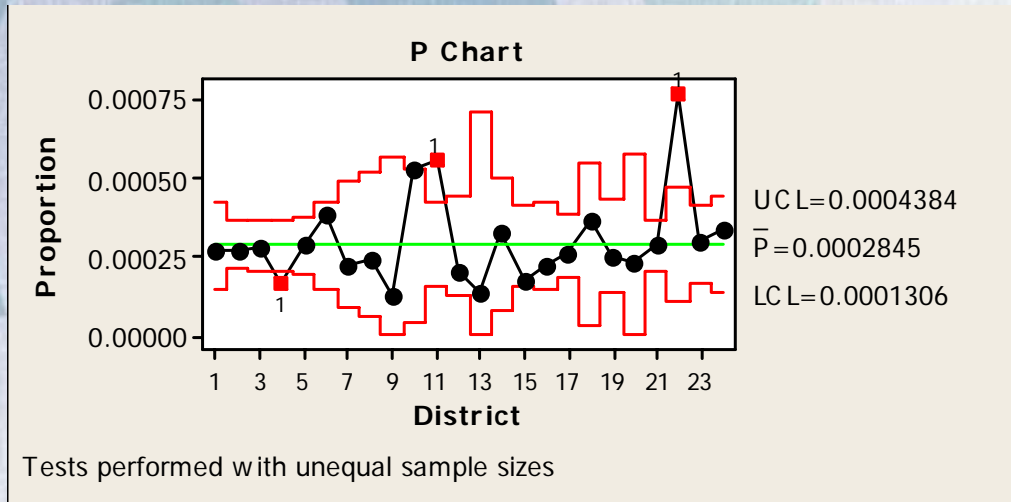


Brandenburg



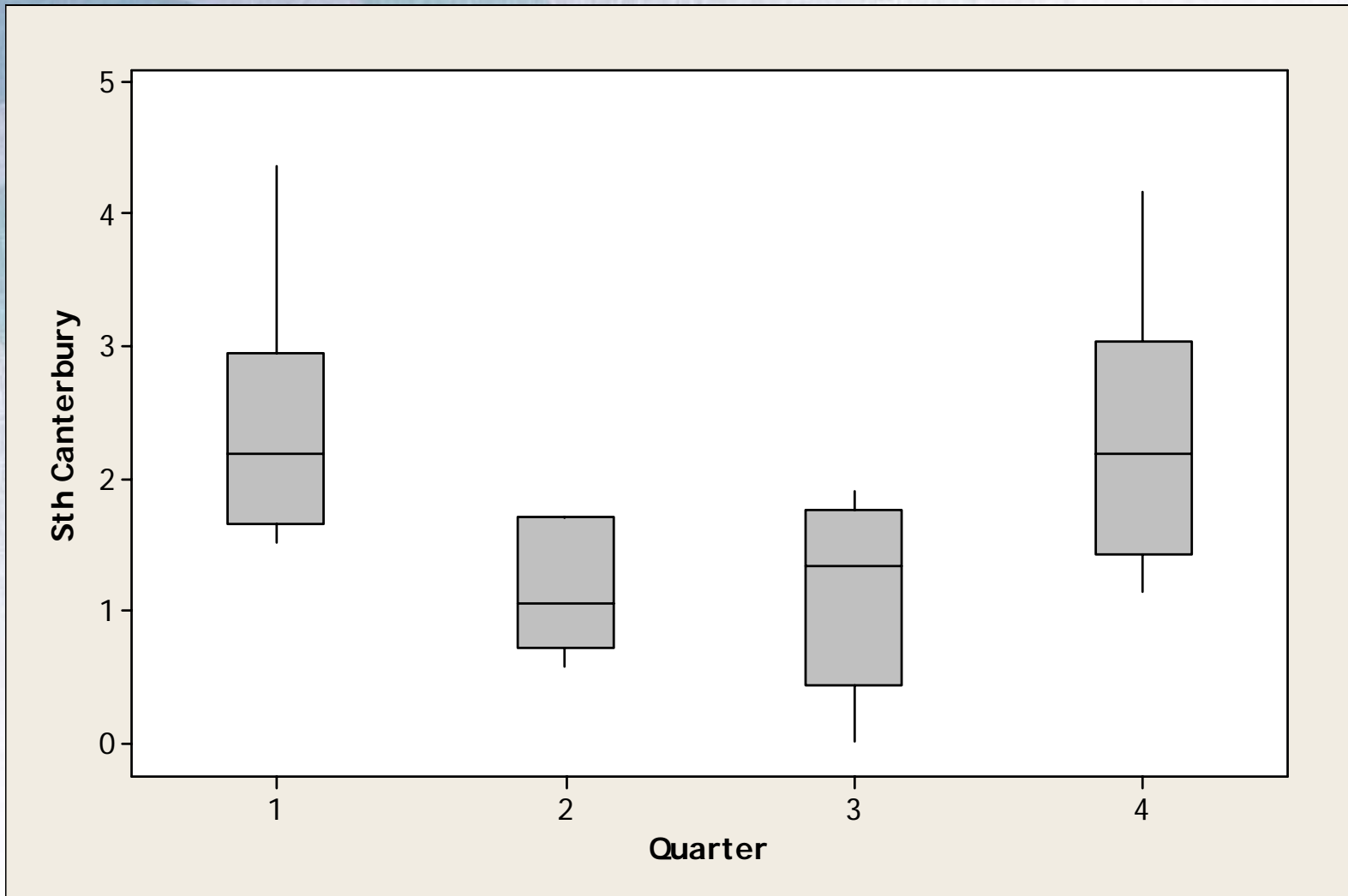


Typhimurium DT 160



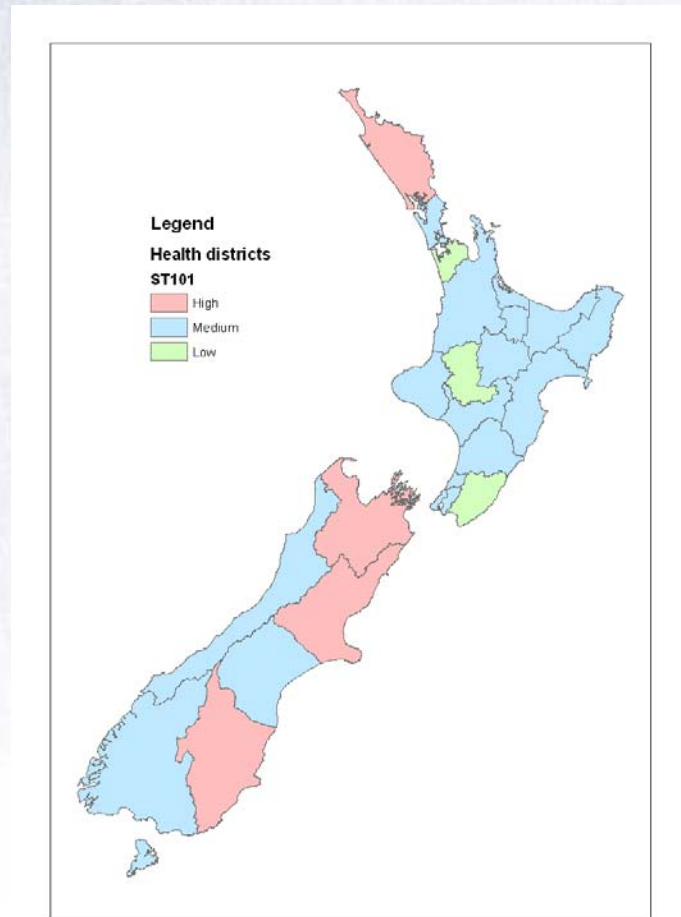
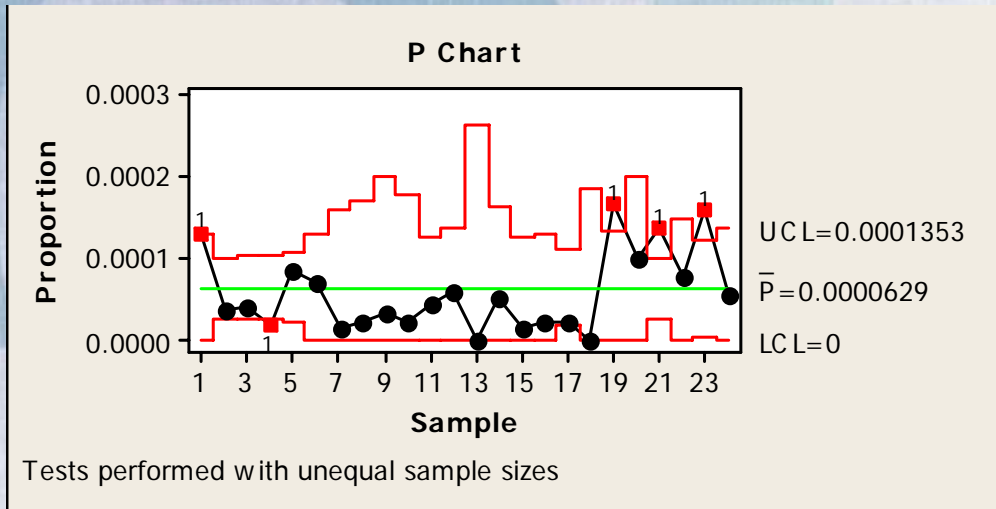


Human Incidence by Quarter: Sth Canterbury



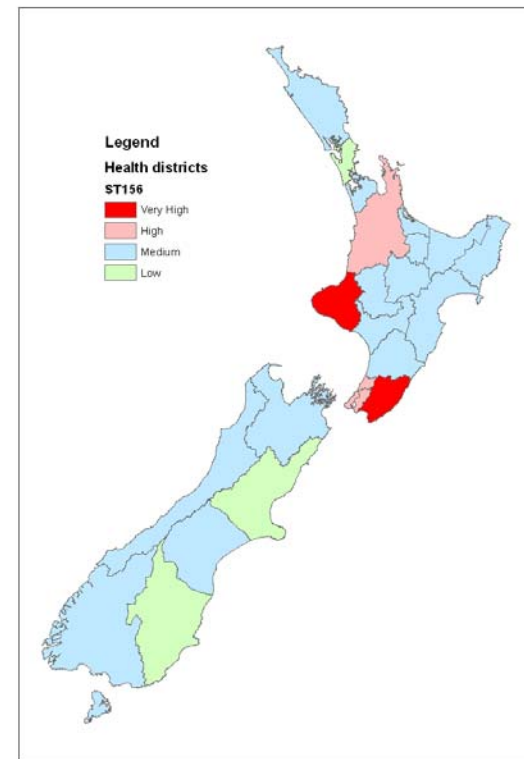
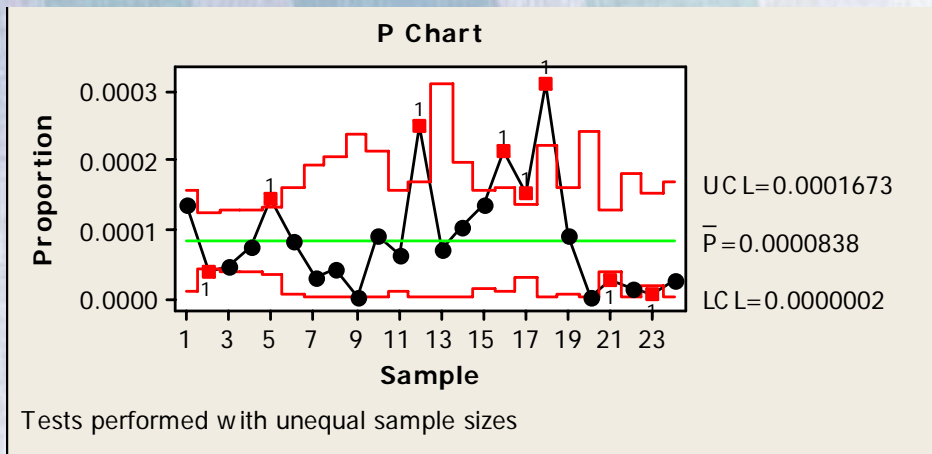


Typhimurium DT 101





Typhimurium DT 156





Top 20 : Human, Non-human & Abattoir

Human Reported

Typhimurium 160
 Typhimurium 156
 Typhimurium 1
 Typhimurium 101
 Infantis
 Brandenburg
 Enteritidis 9a
 Typhimurium 12a
 Typhimurium 74
 Typhimurium RDNC
 Saintpaul
 Thompson
 Typhimurium 42
 Agona
 Mbandaka
 Corvallis
 Weltevreden
 Typhimurium 23
 Typhimurium 135
 Group B 4,5,12 : d : -

Non-human

Brandenburg
 Hindmarsh
 Typhimurium 101
 Typhimurium 160
 Typhimurium 1
 Infantis
 Typhimurium 156
 Derby
 Tennessee
 Urbana
 Typhimurium 135
 Typhimurium 42
 Anatum
 Agona
 Senftenberg
 Typhimurium 12a
 Typhimurium 9
 Typhimurium RDNC
 Montevideo
 Typhimurium Untypable

Abattoir Survey

Brandenburg
 Typhimurium 101
 Typhimurium 1
 Infantis
 Agona
 Tennessee
 Typhimurium 135
 Typhimurium 160
 Hindmarsh
 Typhimurium 156
 Typhimurium 12a
 Saintpaul
 Typhimurium 42
 Typhimurium 9
 Typhimurium 23
 Kiambu
 Senftenberg
 Typhimurium RDNC
 Enteritidis
 Enteritidis 9a



Common human genotypes – other isolations

- **Typhimurium 160**
 - Wild birds, poultry feed, + many low level
- **Typhimurium 156**
 - Calves
- **Brandenberg**
 - Sheep, cattle
- **Infantis**
 - Poultry (meat & farms), meat meal, + many low level
- **Typhimurium 74**
 - Calves
- **Enteritidis 9a**
 - Many low level



Common unique non-human genotypes

- **Hindmarsh**
 - Sheep
- **Tennessee**
 - Poultry (meat, feed & environment), meat meal
- **Derby, Anatum & Senftenberg**
 - Meat meal, poultry (feed & farm environment)
- **Urbana**
 - Environment
- **Typhimurium DT 9**
 - Calves



Abattoir surveillance – genotypes & species

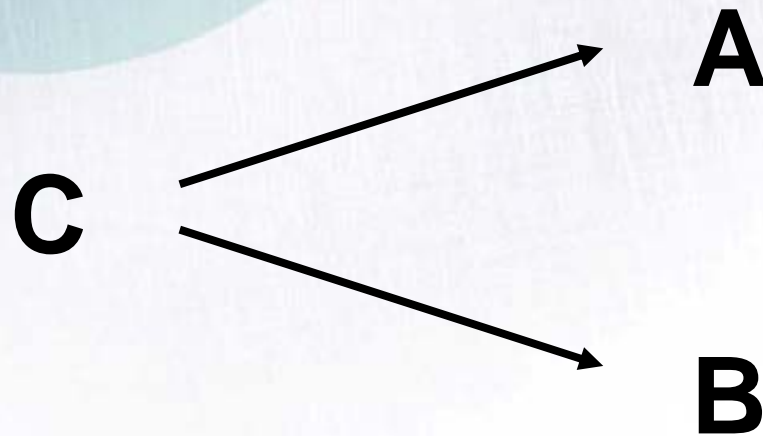
Subtype	Calf	Bovine	Ovine	Porcine	Poultry	Total
Brandenburg	45	0	23	0	0	69
Typhimurium 101	4	0	0	0	36	40
Typhimurium not typed	3	0	0	0	35	38
Typhimurium 1	10	0	1	0	11	22
Infantis	0	0	7	0	14	21
Agona	0	0	0	0	18	18
Tennessee	0	0	0	0	17	17
Typhimurium 135	6	0	1	0	9	16
Typhimurium 160	5	0	1	0	9	15
Hindmarsh	3	1	5	0	0	9
Typhimurium 156	6	0	2	0	0	8
Unknown	1	1	1	0	4	7
Typhimurium 12a	1	0	0	0	4	5
Saintpaul	0	0	3	0	0	4
Typhimurium 42	2	0	0	0	2	4
Typhimurium 9	2	0	1	0	0	3
Typhimurium 23	3	0	0	0	0	3

Abattoir surveillance - location

Subtype	Upper NI	Lower NI	Upper SI	Lower SI
Brandenburg	2	12	2	53
Typhimurium 101	2	0	36	2
Typhimurium (not typed ST101?)	2	2	33	1
Typhimurium 1	2	6	11	3
Infantis	7	2	3	9
Agona	15	2	1	0
Tennessee	0	0	17	0
Typhimurium 135	13	3	0	0
Typhimurium 160	2	1	7	5
Hindmarsh	3	3	2	1
Typhimurium 156	2	5	0	1
Unknown	2	0	3	2
Typhimurium 12a	0	1	4	0
Saintpaul	0	1	1	2
Typhimurium 42	1	1	2	0
Typhimurium 9	0	0	1	2
Typhimurium 23	2	1	0	0



Causality ?



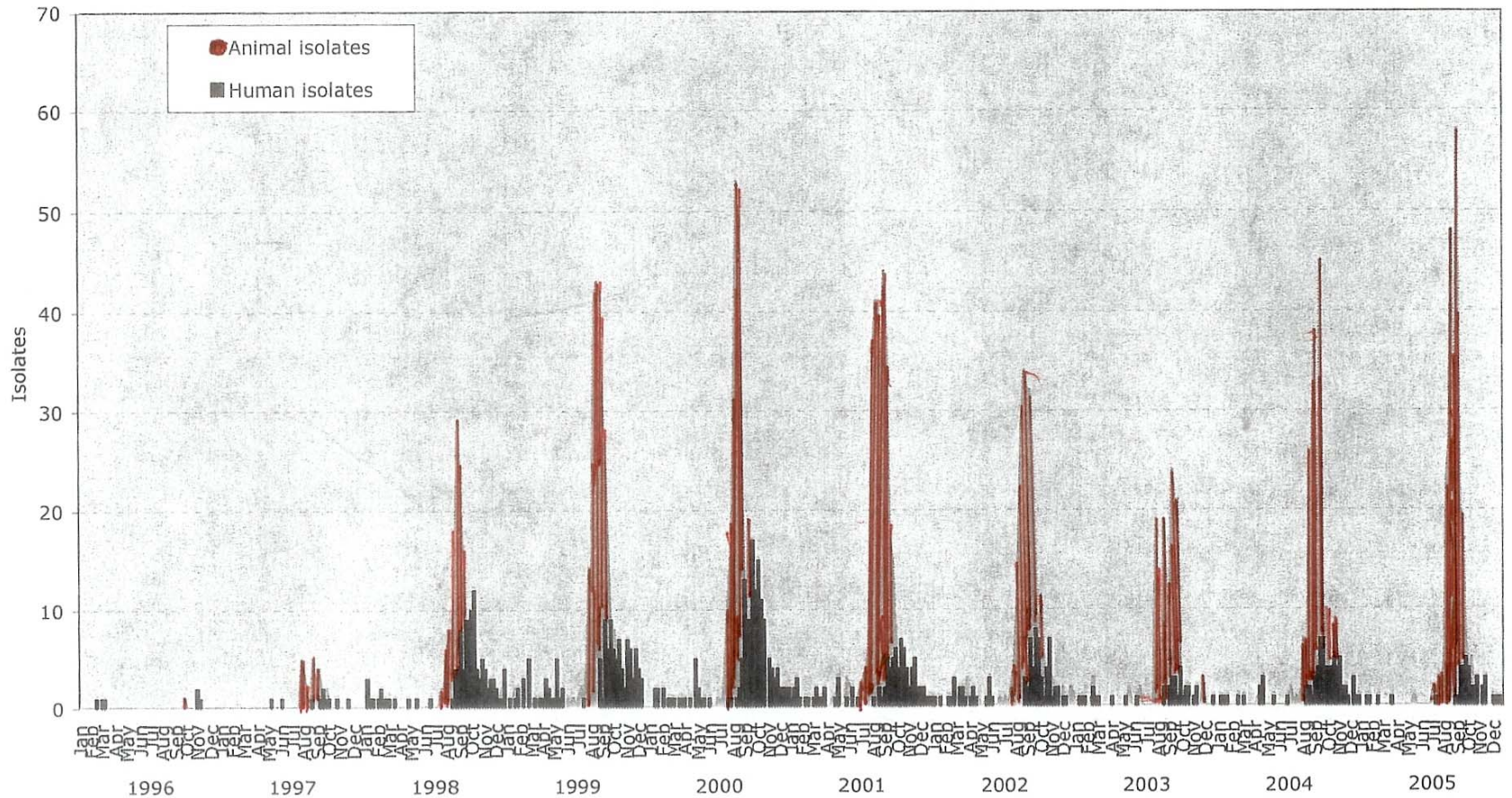


Causality ?

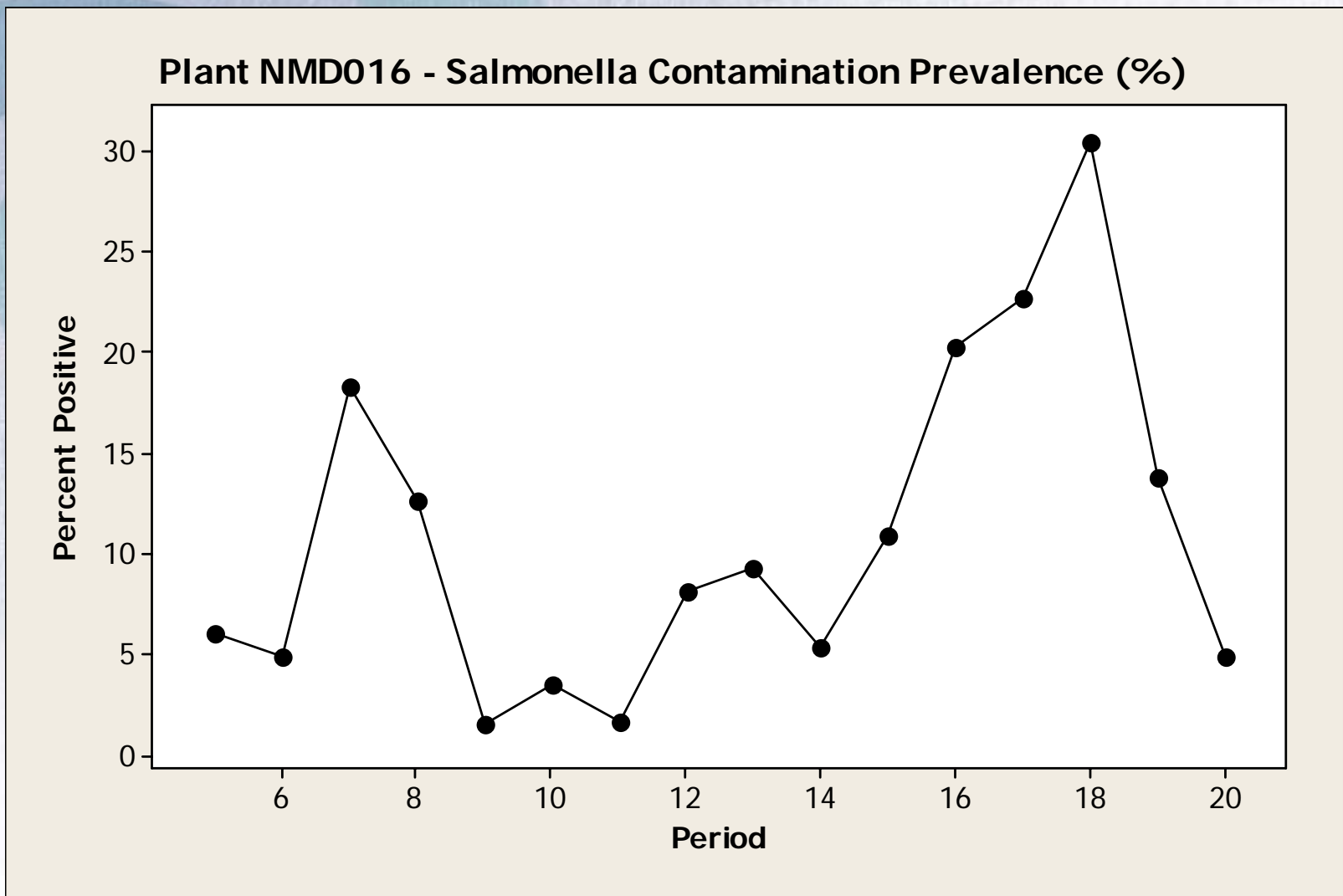
- **Evidence of association**
- **Strength of association**
- **Biologic gradient**
- **Consistency**
- **Biological plausibility**
- **Coherence**
- **Temporality**



Human & Animal Brandenburg isolates



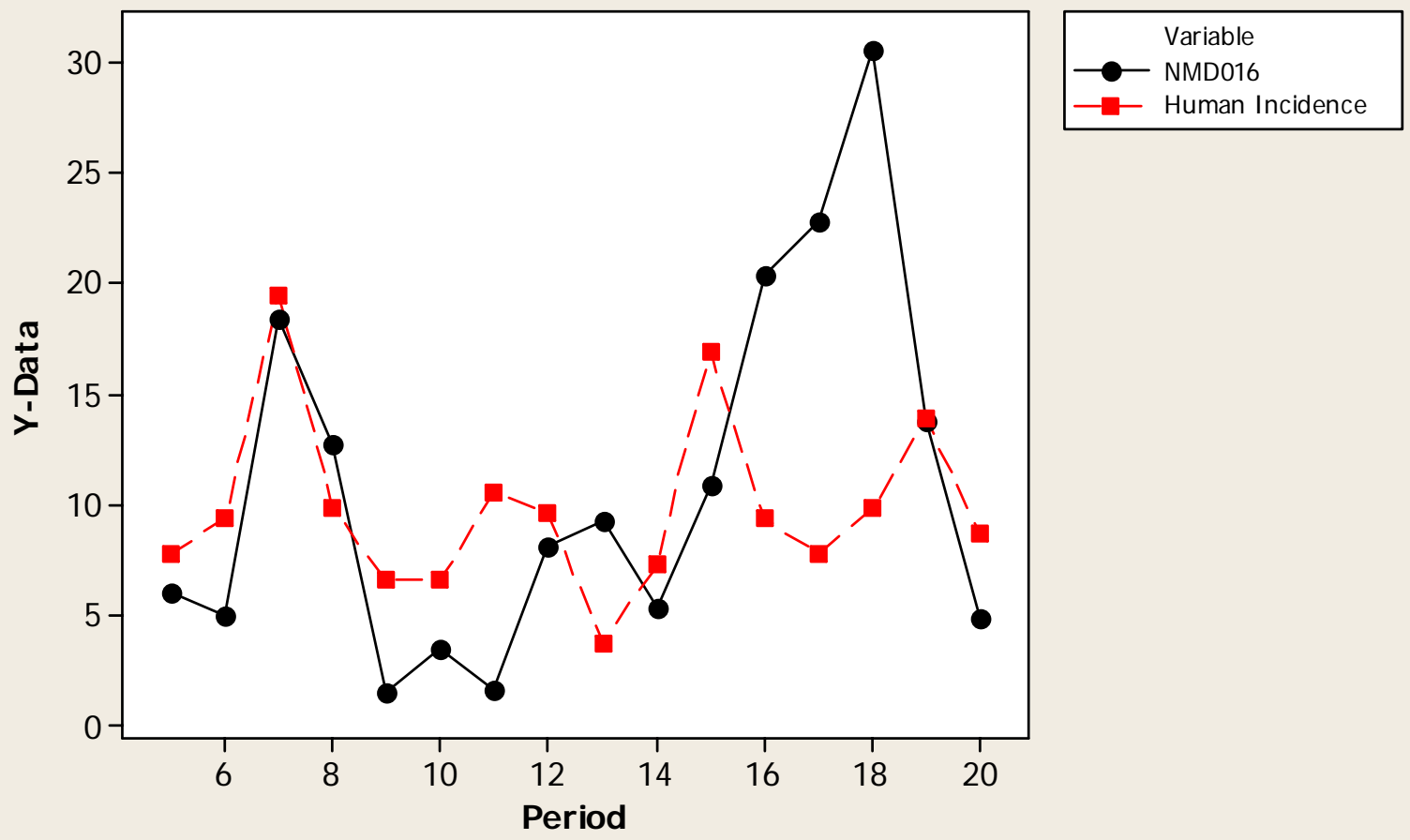
Plant NMD016 *Salmonella* monitor





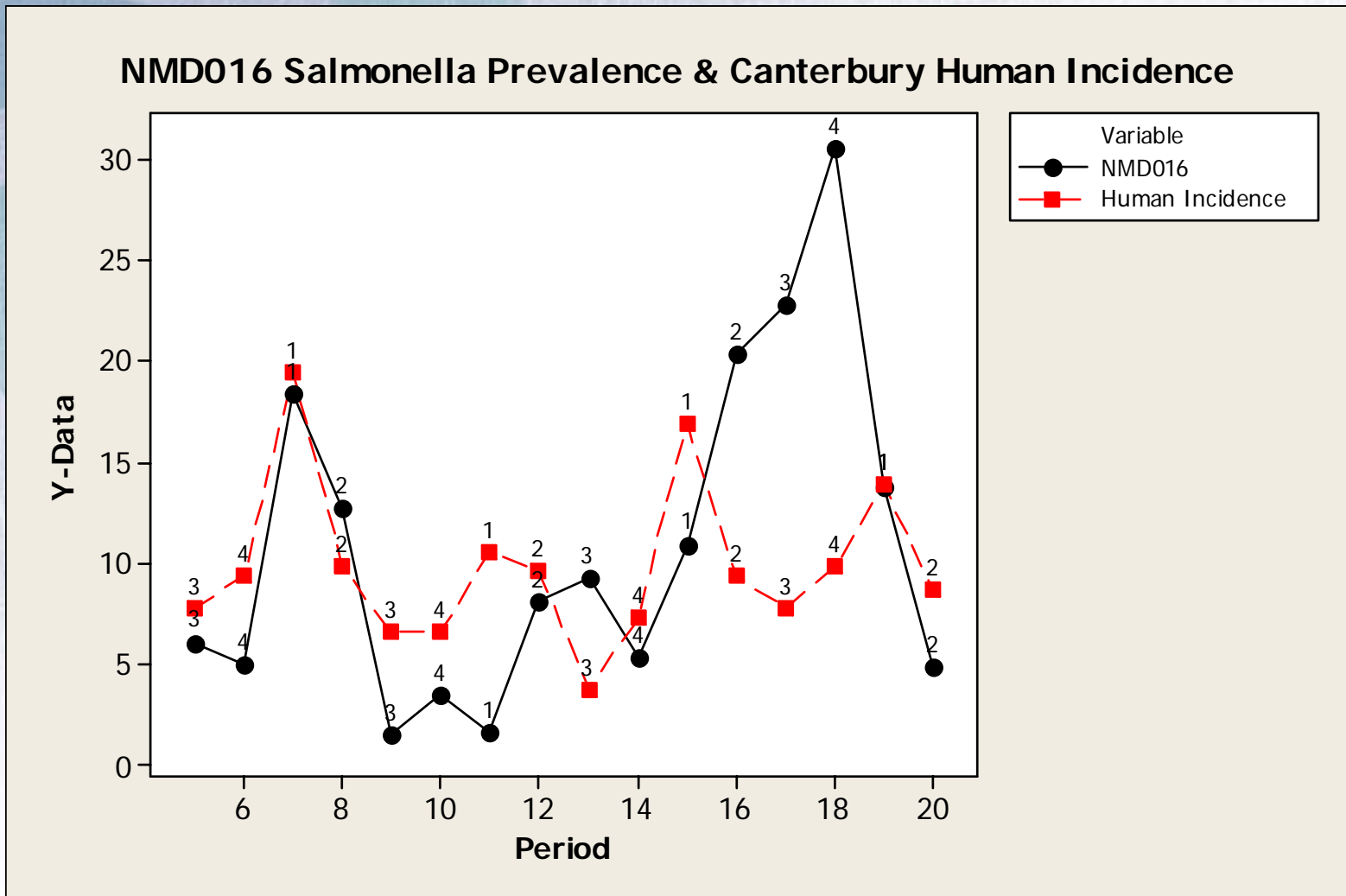
Contamination Prev. & Human Incidence

NMD016 Salmonella Prevalence & Canterbury Human Incidence





With Quarter Label



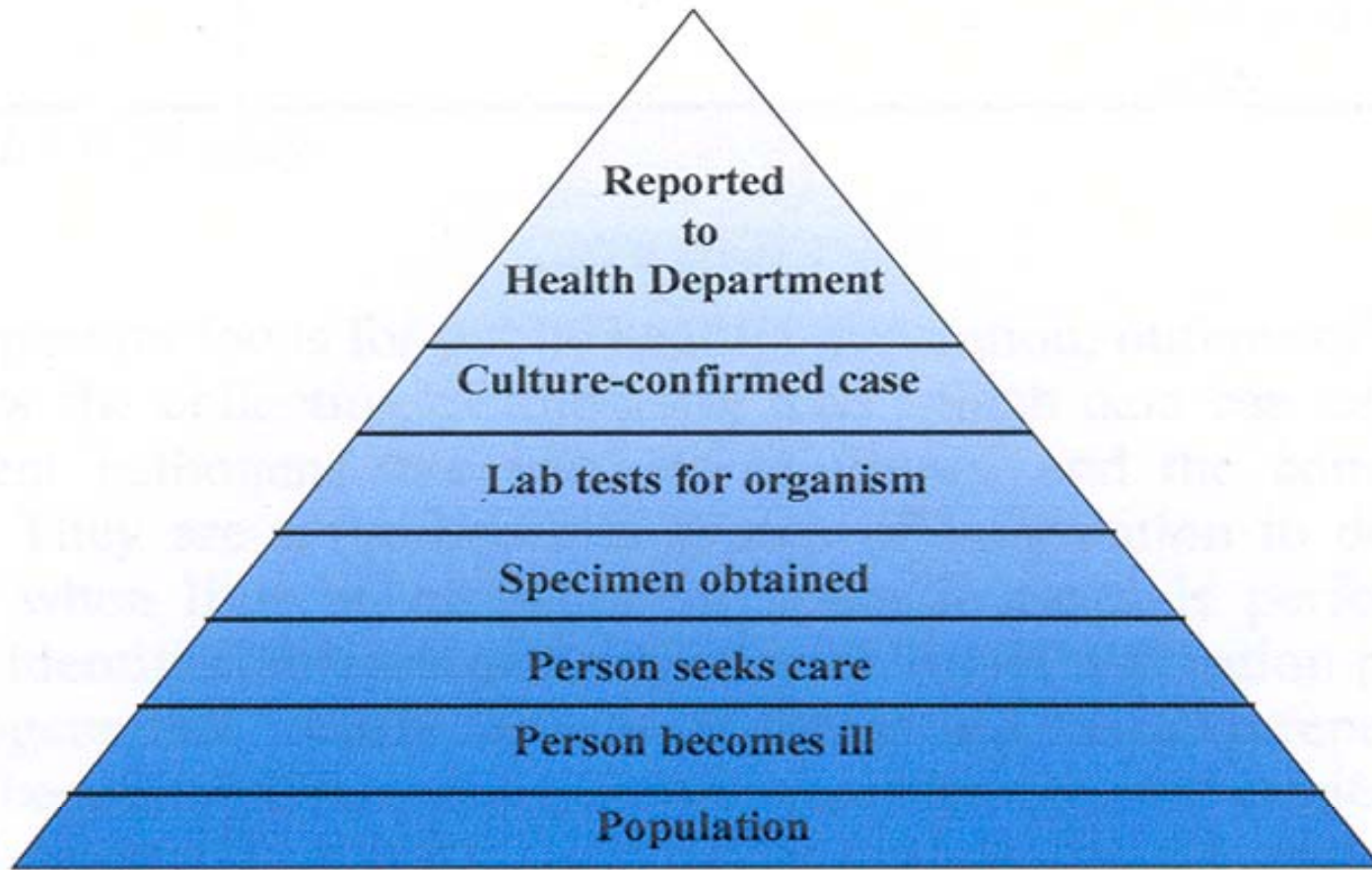


Conclusions

- Data quality
 - Humans
 - *Legislated reporting system*
 - *But what is really happening?*



Burden of acute gastro-intestinal disease pyramid





Conclusions

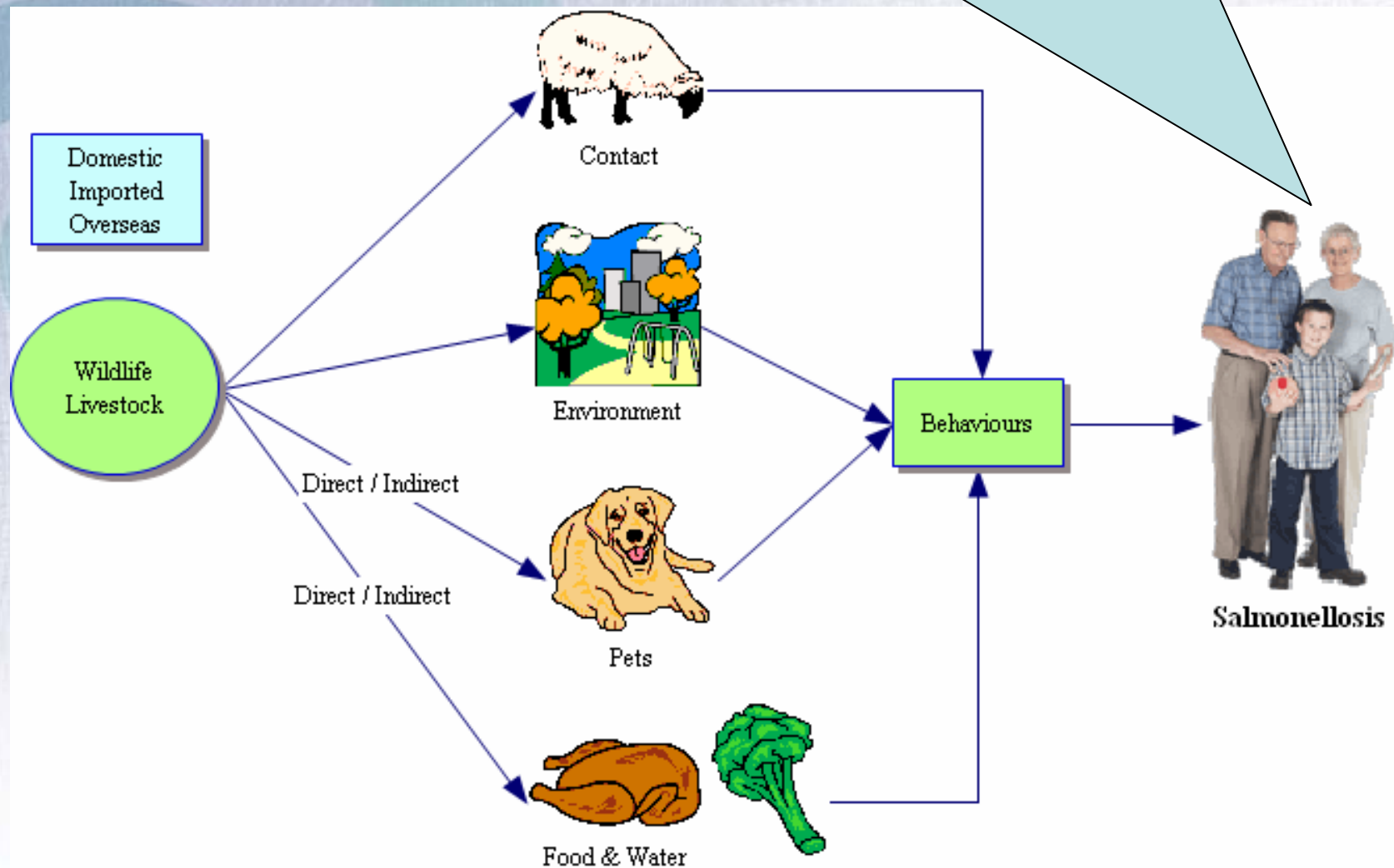
- Data quality
 - Animals
 - *Clinical reports*
 - *National Microbiological Database*
 - *Projects*



Clustering in time & space

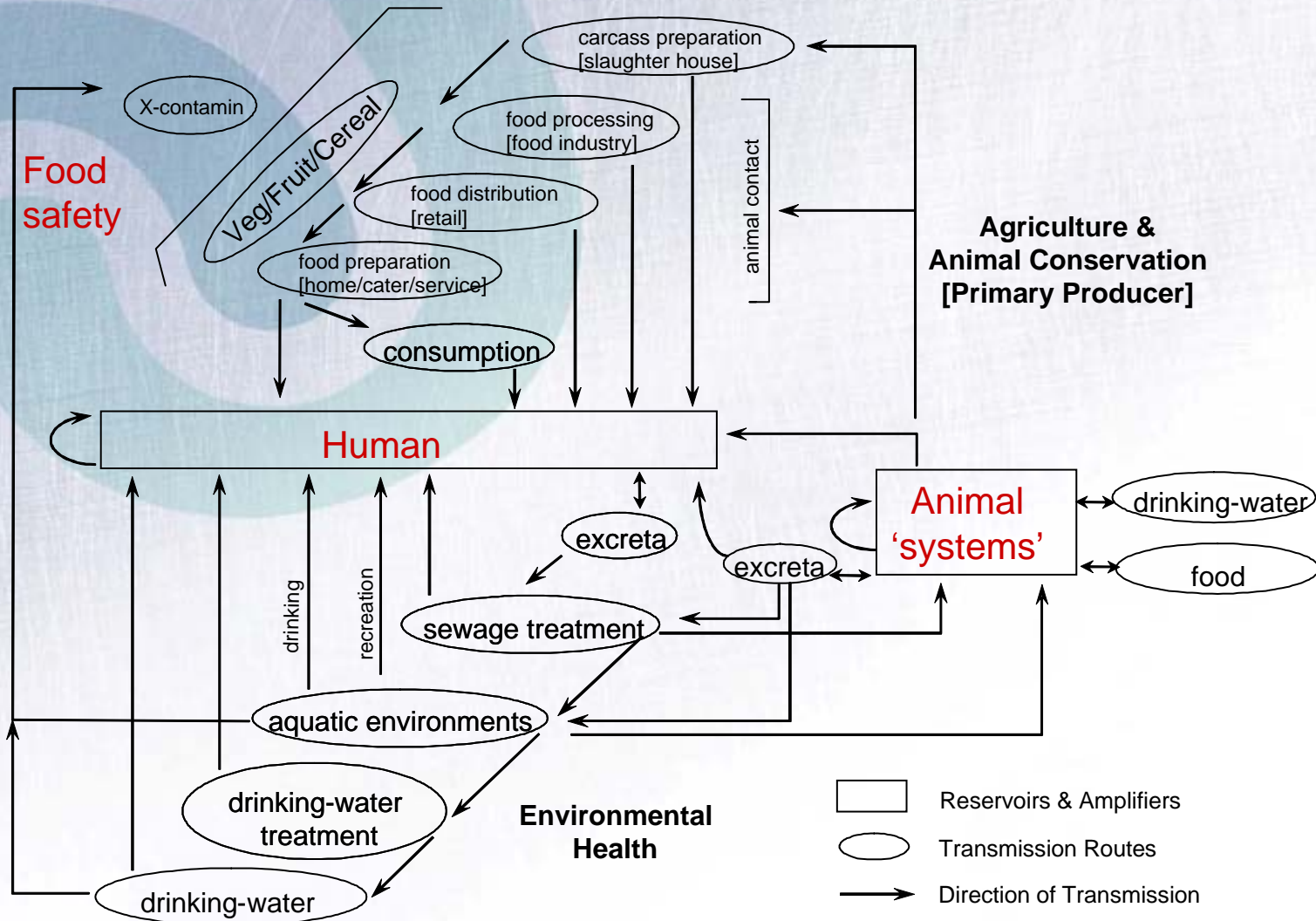
- Humans
 - Location & seasonal patterns
- Non-humans
 - Species differences
 - Location
 - Changes over time
- Environment (feeds, farms, waterways)
 - Some unique differences

YOPIs (The young, old, pregnant or immuno-compromised)





A “more complex” model





Codex Food Safety Metrics

- Food Safety Objective
 - Realistic to set ?
 - *Complex epidemiology*
 - *Human issues (YOPIs)*
 - *Social and cultural issues*
 - *Travel*
 - *Food contamination prevalence not critical unless very high?*
 - *Imported foods*
 - *Genotype variation*
 - ST 160 versus Brandenburg



Codex Food Safety Metrics

We really need to know what's going on !!

