Changing patterns of epidemic polio mortality in New Zealand

Heather T. Battles

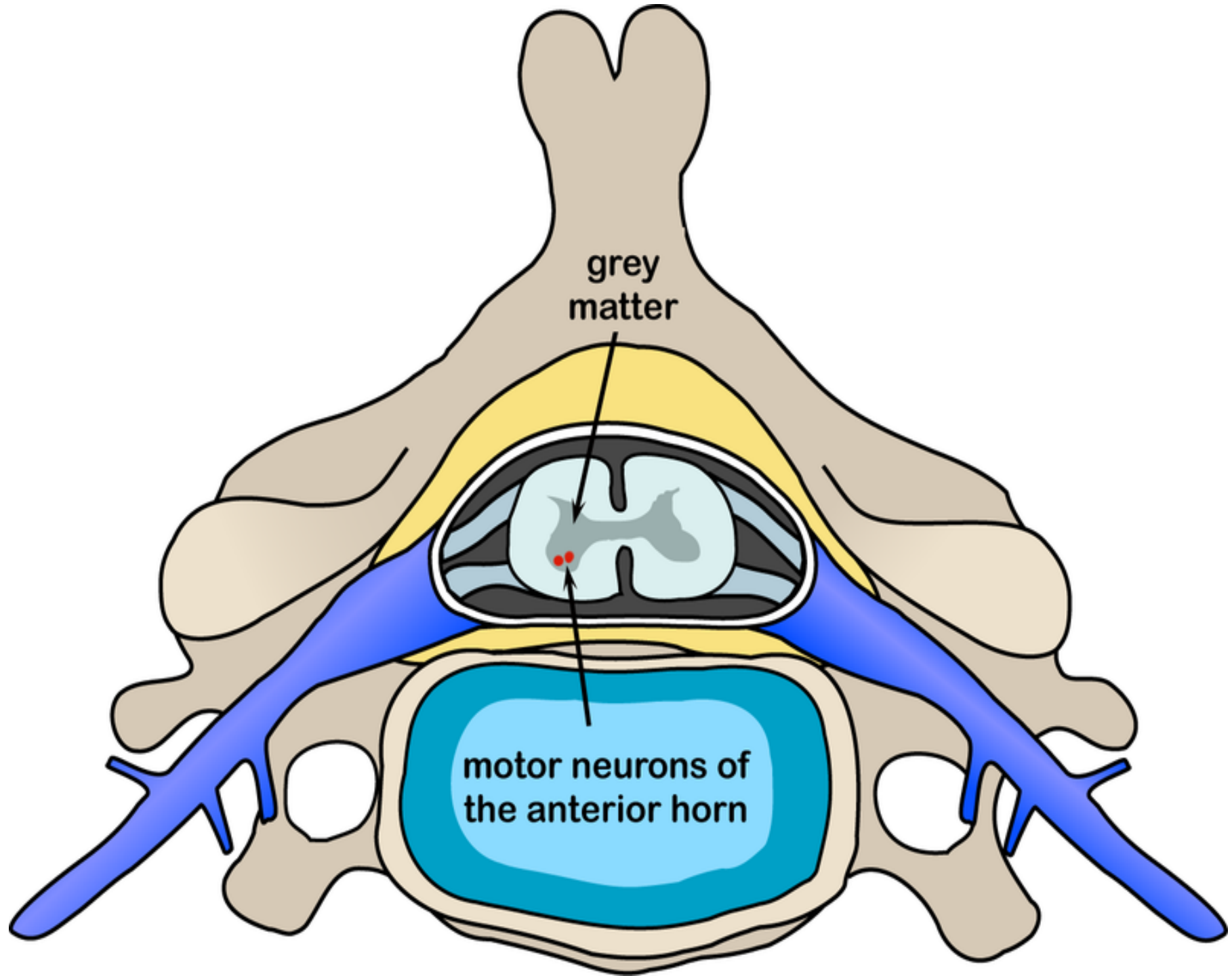Anthropology, University of Auckland
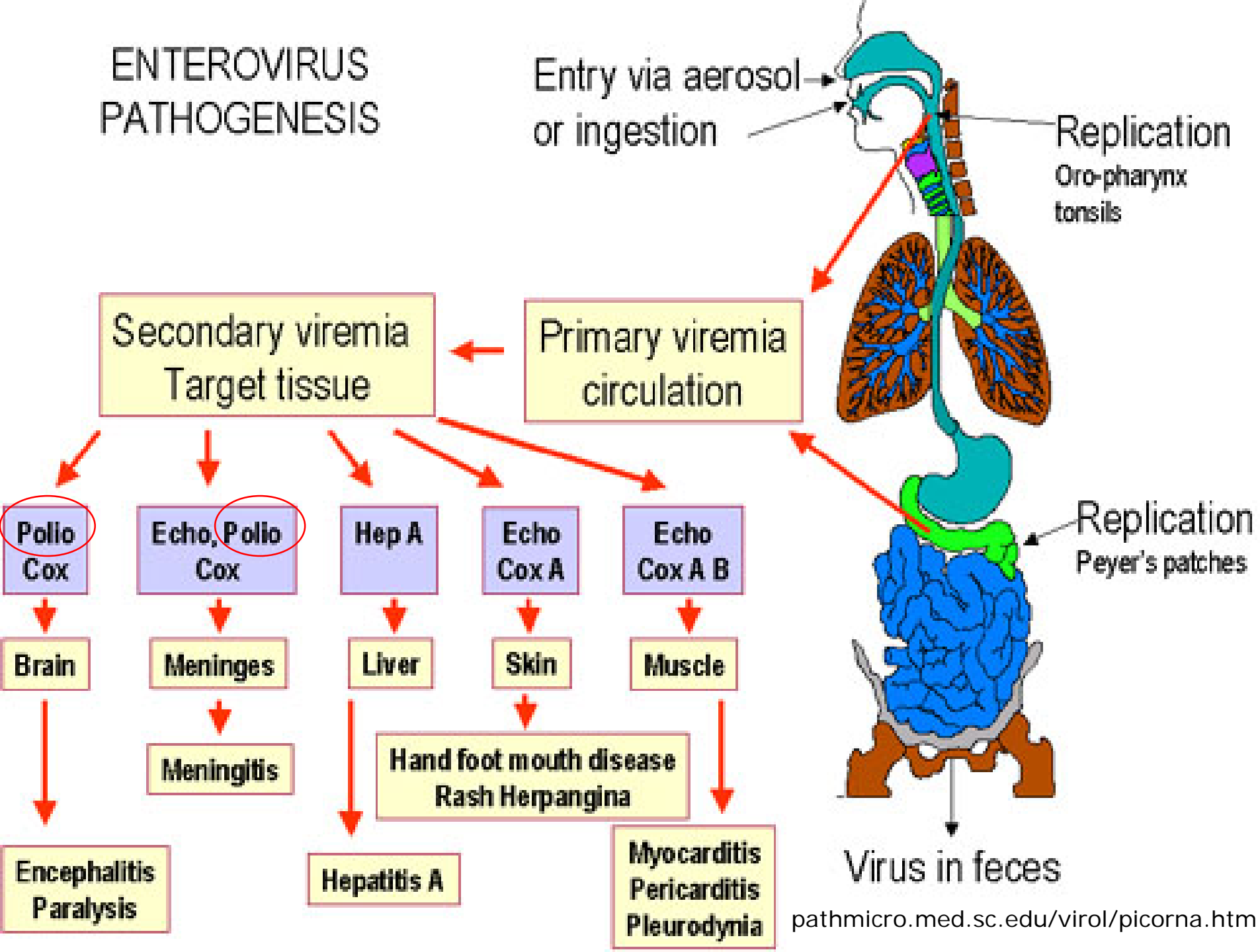
COMPASS seminar 18 July 2018

Outline

1. Intro to polio and broad research questions
2. Summary of previous project (Ontario)
3. Overview of NZ project results to date (1916-1949)
   - Brief closer look at 1916 epidemic *(topic for tomorrow's seminar!)*
4. Next steps

grey matter

motor neurons of the anterior horn

ENTEROVIRUS PATHOGENESIS

Entry via aerosol or ingestion

Replication
Oro-pharynx
tonsils

Secondary viremia
Target tissue

Primary viremia
circulation

Replication
Peyer's patches

| Polio Cox | Echo, Polio Cox | Hep A | Echo Cox A | Echo Cox A B |

Brain → Encephalitis Paralysis

Meninges → Meningitis

Liver → Hepatitis A

Skin → Hand foot mouth disease Rash Herpangina

Muscle → Myocarditis Pericarditis Pleurodynia

Virus in feces

pathmicro.med.sc.edu/virol/picorna.htm

Paralysis: The New Epidemic

By Helen MacMurchy, M.D.

Infantile Paralysis is epidemic in some parts of Canada. The germ attacks rich as well as poor, adults as well as children. In Ontario last month half the cases were fatal. Dr. MacMurchy is able to give our readers the latest developments concerning this dread disease direct from the great specialists, having recently attended a medical congress where the question was discussed. It is now thought that the germ is carried mainly by the stable fly. Dr. MacMurchy says, Never let a fly rest on an infant.

Background

- Traditional model based on **hygiene hypothesis**
  - Higher SES, smaller families
- **Intensive Exposure (IE) hypothesis** (Nielsen et al.)
  - Crowding
- Use of mortality data for testing predictions of hypotheses, informing understanding of epidemiological transition


- Pre-20th C.
- Poor sanitation
- Endemic polio

- 20th C.
- Good sanitation
- Epidemic polio
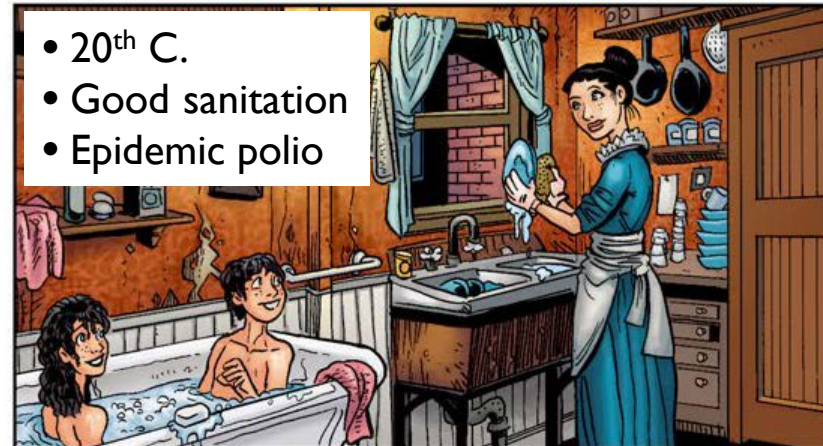
Questions

1) What groups were the most vulnerable?

2) Emergence of, or increase in, excess male mortality over time?

3) How were the epidemics shaped by their social, political, and economic structures and contexts – and vice versa?

Children from the Wilson Home for crippled children, about to go to hospital by ambulance, for special treatment, Takapuna, Auckland. Pascoe, John Dobree, 1908-1972 :Photographic albums, prints and negatives. Ref: 1/4-000651-F. Alexander Turnbull Library, Wellington, New Zealand. /records/22846507

Ontario Project Overview
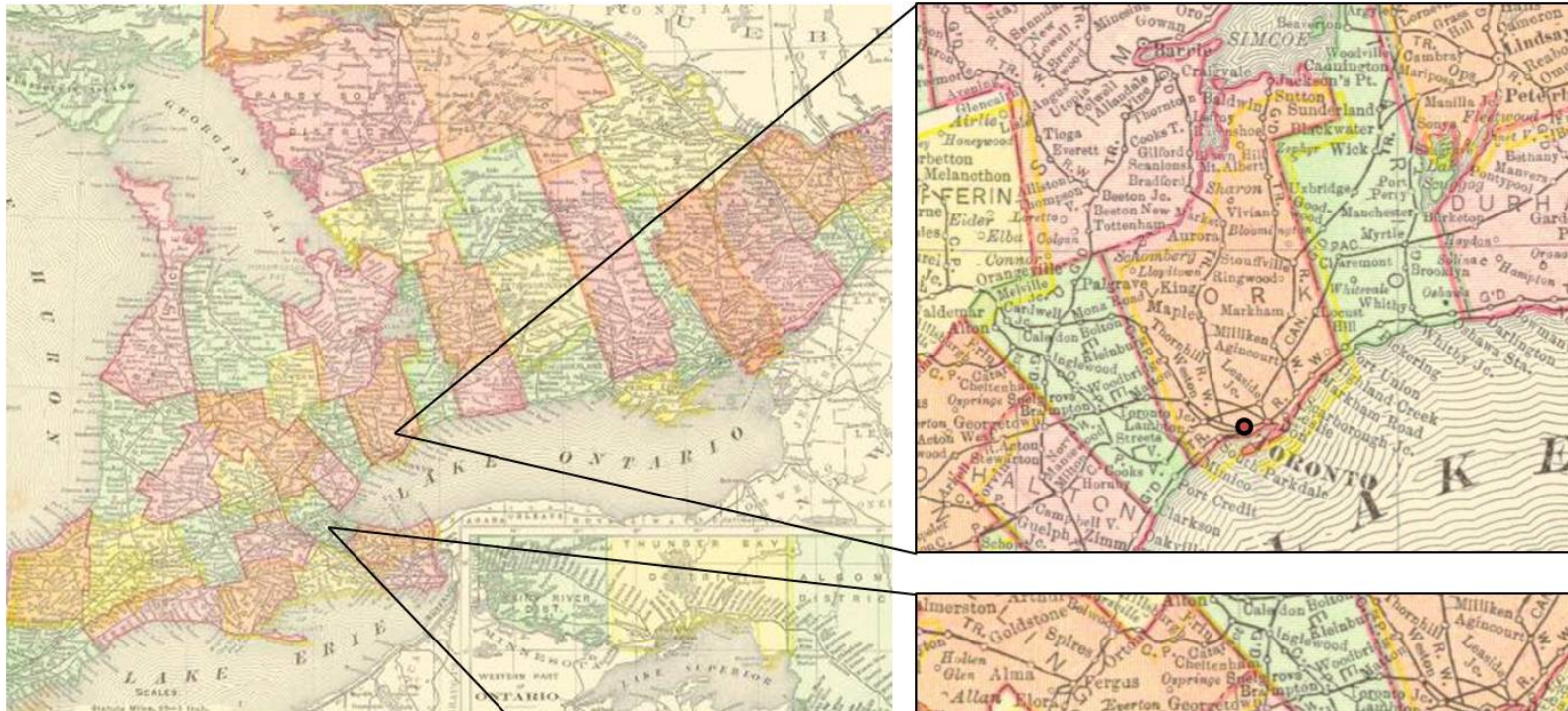
- Wentworth and York Counties
- Major epidemics in 1910, 1922, 1929/30, 1937
- 337 deaths (1900-1937)
- Mapping with ArcGIS

Data

- Age
- Sex
- Illness duration
- Seasonality
- Nativity
- Birthplace
- Ethnicity
- Religion
- Family size
- Birth order
- Occupation (SES)
- Residence

Challenges

- Data availability
  - Birth records only to 1914
  - Absence of 1921 Census data (until 2013)
- Mobility of population
  - Multiple moves between countries, cities
  - Migration from rural farms to cities
  - Frequent change of residence within city

Predictions of Nielsen et al.

- Intensive-exposure:
  - Polio deaths will increase with family size
  - U-shaped age curve in polio deaths
- Cross-sex transmission:
  - Higher sex ratio in smaller families

Predictions of traditional hygiene model

- Mortality by SES:
  - Greater mortality at higher SES
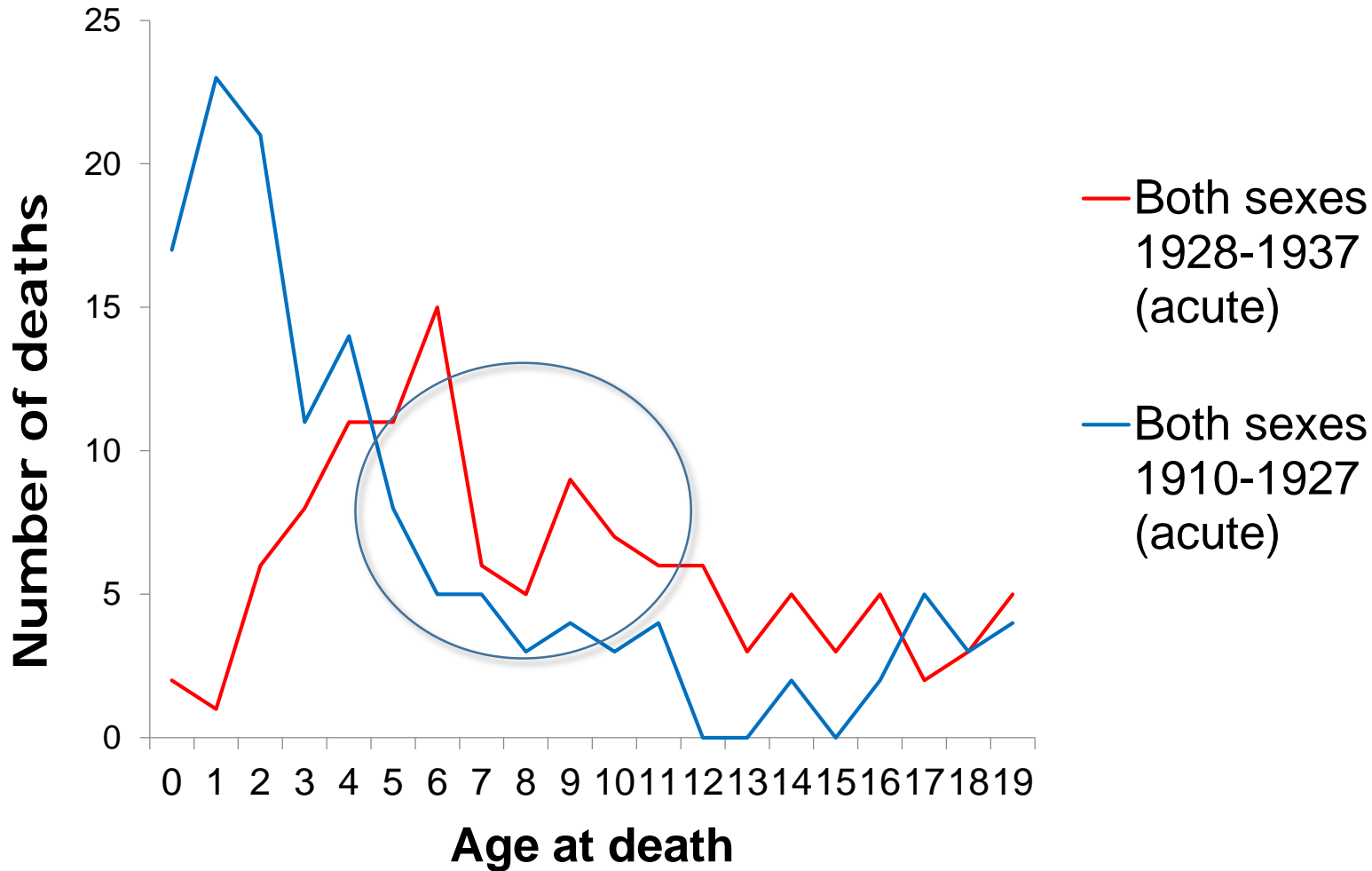
Figure. Number of acute polio deaths by age in Wentworth and York Counties, ages 0-19.

SES by status scores

Status score	Category	Example occupations
1	Professional	Dentist, Lawyer
2	Entrepreneurial/Clerical	Clerk, Farmer, Sales manager
3	Skilled labour	Carpenter, Stonemason
4	Semi-skilled labour	Porkpacker, Teamster
5	Unskilled labour	Farm labourer, Travellers

Based on Hauser, R. M. 1982. Occupational status in the nineteenth and twentieth centuries. *Historical Methods* 15:111-26.

Polio deaths by status score

TABLE 5. *Proportions of acute polio deaths by status score over time*

| | 1900–29 | | 1930–37 [a] | | 1900–37 | | | |
| | Acute only | | Acute only | | Acute only | | Chronic and acute | |
Status score	n	%	n	%	n	%	n	%
1	3	2.54	5	6.76	8	4.17	8	3.74
2	39	33.05	28	37.84	67	34.90	76	35.51
3	51	43.22	29	39.19	80	41.67	87	40.65
4	17	14.41	9	12.16	26	13.54	29	13.55
5	8	6.78	3	4.05	11	5.73	14	6.54
Total	118	100.0	74	100.0	192	100.0	214	100.0

[a] A chi-square test found no evidence of a real difference between the proportions of deaths by status score for the 1930–37 period compared to those of the 1900–29 period (χ^2 (4, $n = 74$) = 7.04, $p = .13$, $V = .15$).

(Battles 2017)

Proportion of population vs polio deaths by status score

Table 8 Proportion of population in each status score according to the 1921 Census (Toronto and Hamilt[on] proportions of polio deaths in Toronto and Hamilton combined, 1900–1937

Status score	Census %[a]	Polio %[b]	Polio n expected[c]	Polio n observed[b, d]
1	1.46	3.33	2.18	5
2	28.08	23.33	42.13	35
3	40.77	52.00	61.15	78
4	10.98	14.00	16.47	21
5	18.71	7.33	28.06	11

Source: Census of Canada 1921 (Canada, Dominion Bureau of Statistics 1925, Table 41).

[d] A chi square test found evidence of a real difference between the observed polio deaths versus the expected number of deaths based on the Census distribution for status scores two through five, $\chi^2(3, n = 145) = 17.75$, $p < .001$, $V = .22$.

[e] This status score versus sum of remaining status scores. Two-tailed p values reported. Status score one not tested itself due to its small sample size.

(Battles 2017)

Pre-Depression (1900-29) vs Depression (1930-37)

Table 10 Median and untransformed mean ages by status score for acute polio deaths in the pre-Depression (1900–1929) and Depression (1930–1937) periods

| Status score | Age at death, in years | | | | | |
| | Median | | Mean (SD) | | n | |
	1900-29[a]	1930-37[b]	1900-29	1930-37	1900-29	1930-37
1	18.66	16.50	18.23 (0.79)	13.97 (8.15)	3	5
2	14.21	11.22	16.65 (14.40)	14.11 (8.88)	39	28
3	4.95	10.89	8.60 (9.70)	12.60 (6.23)	51	29
4	2.44	11.04	5.26 (7.39)	12.59 (9.12)	17	9
5	3.05	18.26	7.62 (9.78)	14.38 (10.13)	8	3
All status scores	5.87	10.97	10.95 (11.87)	13.14 (7.88)	118	74

[a] A Kruskal-Wallis test rejected the null hypothesis that age at death was the same across the status scores for the 1900–1929 period, $H(4) = 19.89$, $p < .001$. Jonckheere's test demonstrated a trend of decreasing median age over the status scores, $J = 1498$, $z = -4.28$, $p = .000$, $r = -.39$.
[b] A Kruskal-Wallis test found no difference in age at death across the status scores for the 1930-1937 period, $H(4) = .30$, $p = .99$.

(Battles 2017)

Working class plague

- Working classes (skilled/semi-skilled labourers) hardest hit
- Fits with findings of the *Report on Poliomyelitis in Ontario, 1937*
  - Households with epidemic polio cases had more persons per household and fewer rooms per person
- Mixed high and low risk?
  - *"In poor and unhygienic households you were more likely to be protected against the virus but you were also more likely to meet it"* (Cockburn 2005)

Battles, H.T. (2017) Differences in polio mortality by socioeconomic status in two southern Ontario counties, 1900–1937. *Social Science History* 41(2): 305–332.

Overview of Findings

- 2-stage pattern for Wentworth/York:
  - 1910-1927 vs. 1928-1937
- Changes in polio deaths, socio-ecology
- Consistent with predictions of Nielsen *et al.*

	Stage 1 (1910-1927)	Stage 2 (1928-1937)
Age at death	Majority <5	Majority >5
U-shaped age curve	Absent	Present (dip at ages 7-8)
Sex ratio (ages 0-19)	1.0 (equal)	1.5 (excess males)
Family size	Median = 4	Median = 2
Age gradient by SES	Present	Absent

Conclusions

Quantitative results   **+**   Social/economic context of southern Ontario pre-SWW (esp. during Depression)

=   polio more accurately characterized as a 'working-class plague'

**Polio's patterns were not static —
they changed as the environment changed.**

Bio-eco-cultural approach to the study of emerging disease
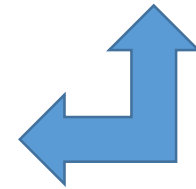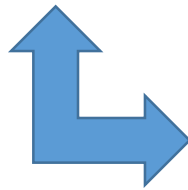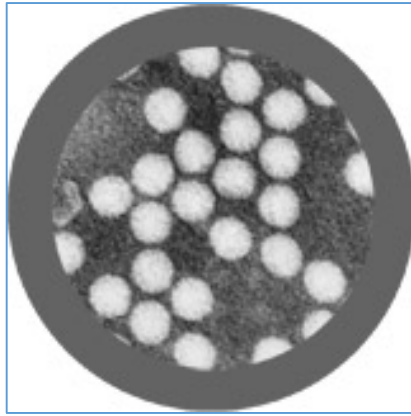
NZ Project Overview

- Non-Māori death registrations
- Four major epidemics:
  - 1916
  - 1924/25
  - 1936/37
  - 1947-49

Children and nurses from the Wilson Home for crippled children in Takapuna, Auckland, at the home's private beach. Pascoe, John Dobree, 1908-1972 : Photographic albums, prints and negatives. Ref: 1/4-000654-F. Alexander Turnbull Library, Wellington, New Zealand. /records/23194193

Materials and Methods

- Death registrations – infantile paralysis/ poliomyelitis
- 20th C. reports and research papers (e.g. in *NZMJ*)
- Census (esp. 1916)
- Newspapers (via Papers Past)
- Autobiographic accounts (published and unpublished)

Results

- 415 deaths identified
  - 1916: 125 deaths
  - 1924/25: 181 deaths
  - 1936/37: 44 deaths
  - 1947-49: 65 deaths
- December – April (i.e., summer/early autumn)

Deaths by age: *Which groups were most vulnerable?*

Polio and war

'The Homecoming from Gallipoli' (Wellington, NZ, 15 July 1915) by Walter Armiger Bowring
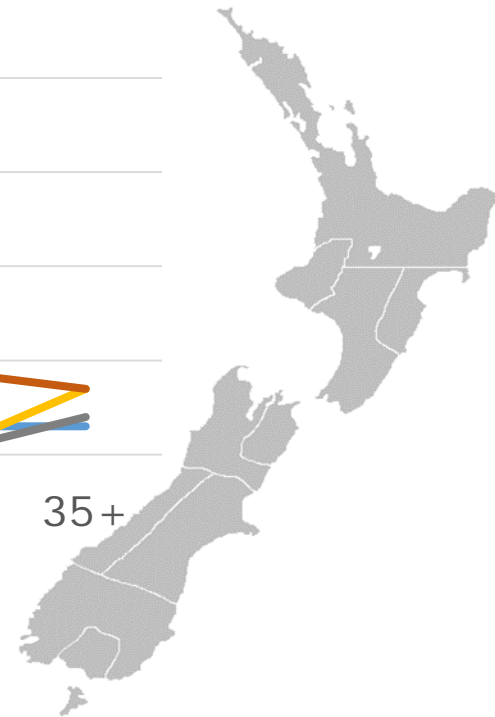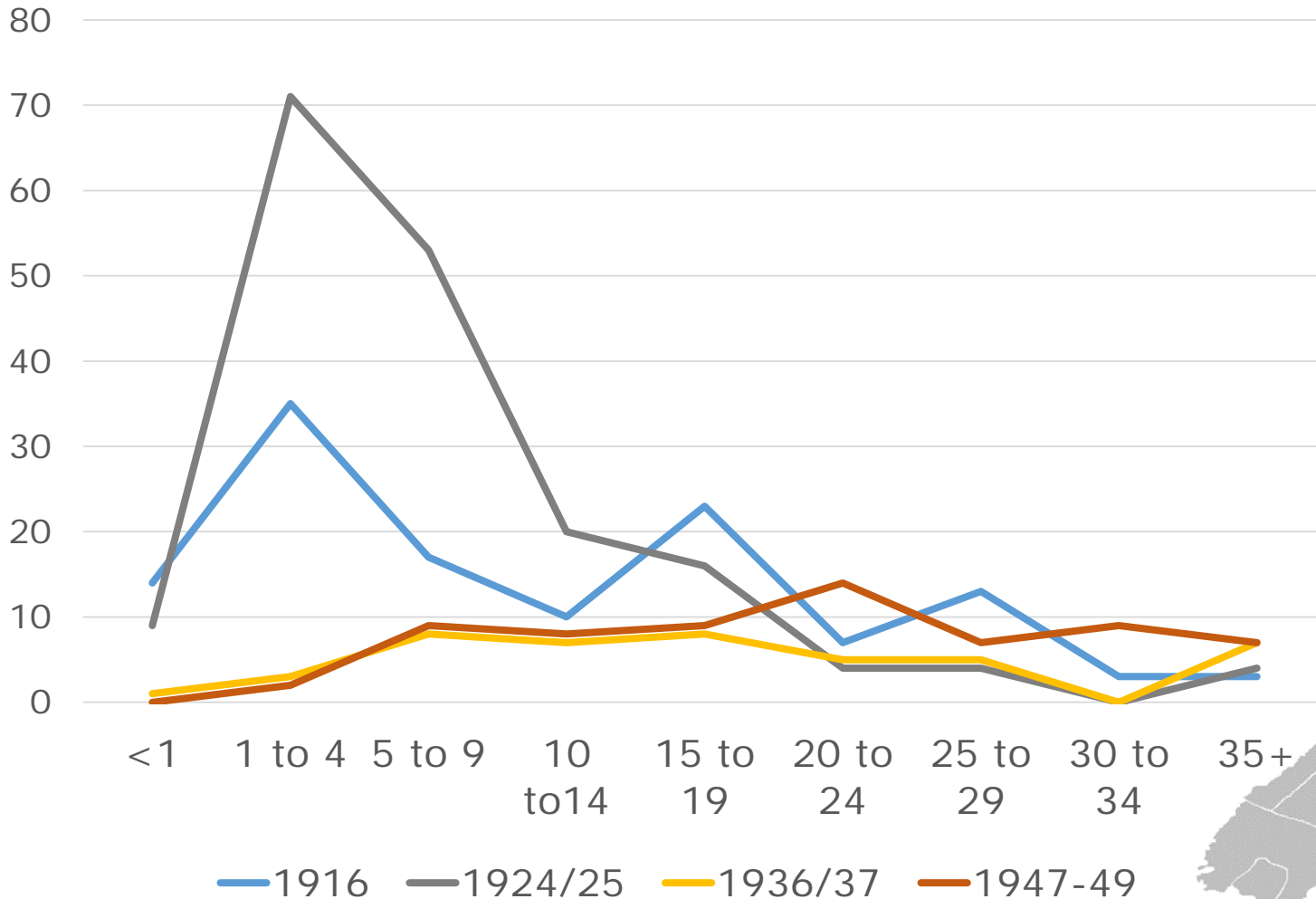
- Gear (1952:6): *"In the second world war, as in the first, poliomyelitis was more prevalent than in more normal times."*

- Blamed the South African epidemics of 1918 and 1944/45 on troops returning from Middle East

Country	Region	Death Rate (per 100,000)
US (regions)	New England (6 states)	11.3
	Middle Atlantic (3 states)	24.1
	South Atlantic (4 states)	3.4
	Atlantic regions combined	*17.3*
NZ (Prov. Districts)	Auckland	20.1
	Taranaki	21.5
	Hawke's Bay	18.4
	Wellington	9.9
	Marlborough	24.1
	Nelson	4.6
	Westland	0.0
	Canterbury	2.7
	Otago – Otago Portion	0.0
	Otago – Southland Portion	11.7
	North Island	*16.4*
	South Island	*4.0*

New York City,
July 1916
(Credit Bettmann/Corbis)

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1916 Results: Age and sex

1916 death rate per 10,000
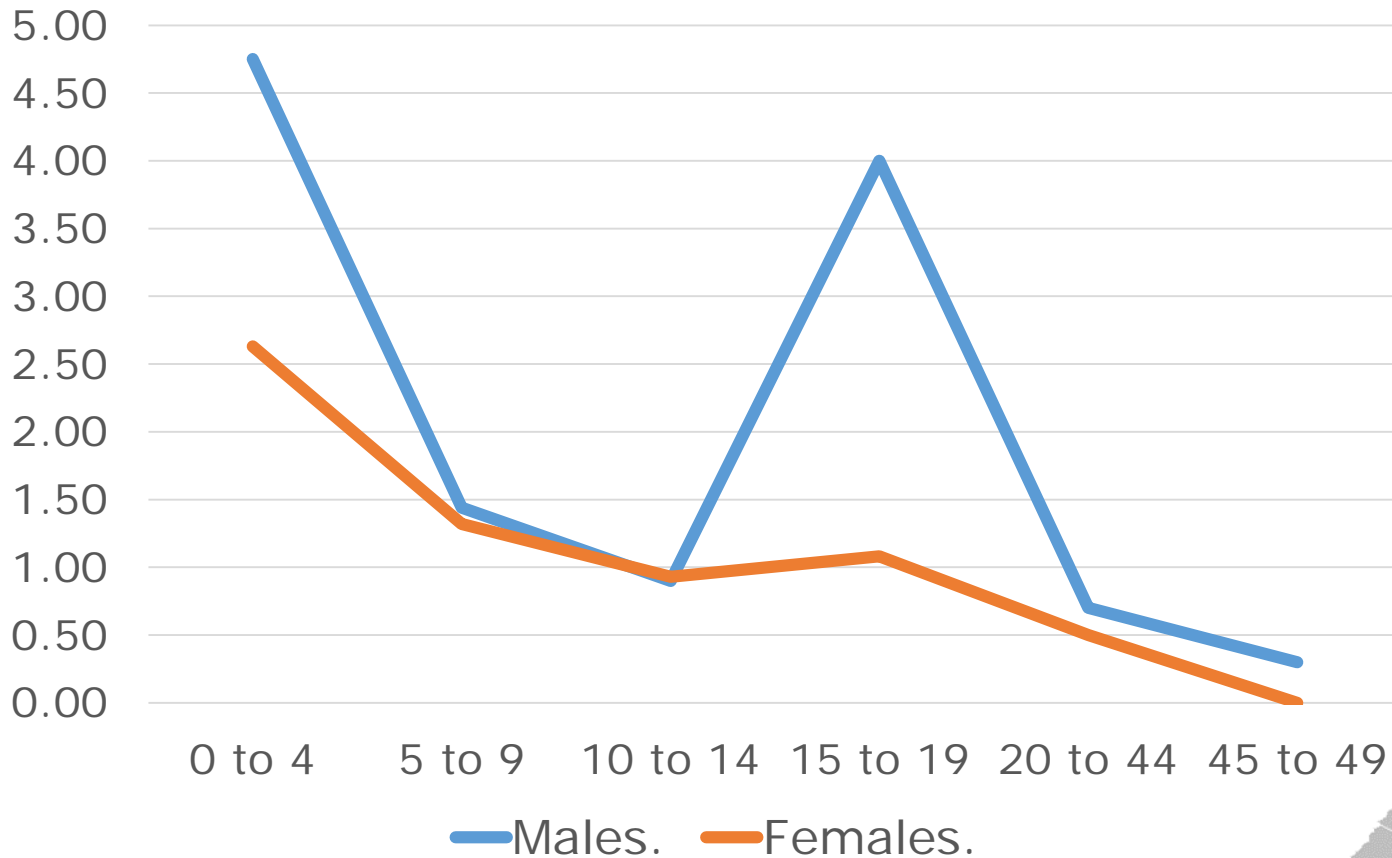
$x^2 = 4.393$, df = 4, $p = 0.36$

Did the sex ratio in polio mortality increase over time?

Epidemic	Median age at death (years)		Sex ratio (M:F)	Chi square test results
	M	F		
1916	8	7.5	1.7 (79:46)	χ2 (1,125) = 8.712, **p = .003**, **φ = .26**
1924/25	6	5	1.1 (95:86)	χ2 (1, 306) = .448, p = .50
1936/37	19	16	2.4 (31:13)	χ2 (1,44) = 7.364, **p = .007**, **φ = .41**
1947-49	21	21	1.0 (33:32)	n/a
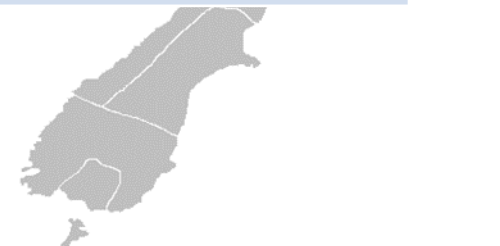
Age at death by sex
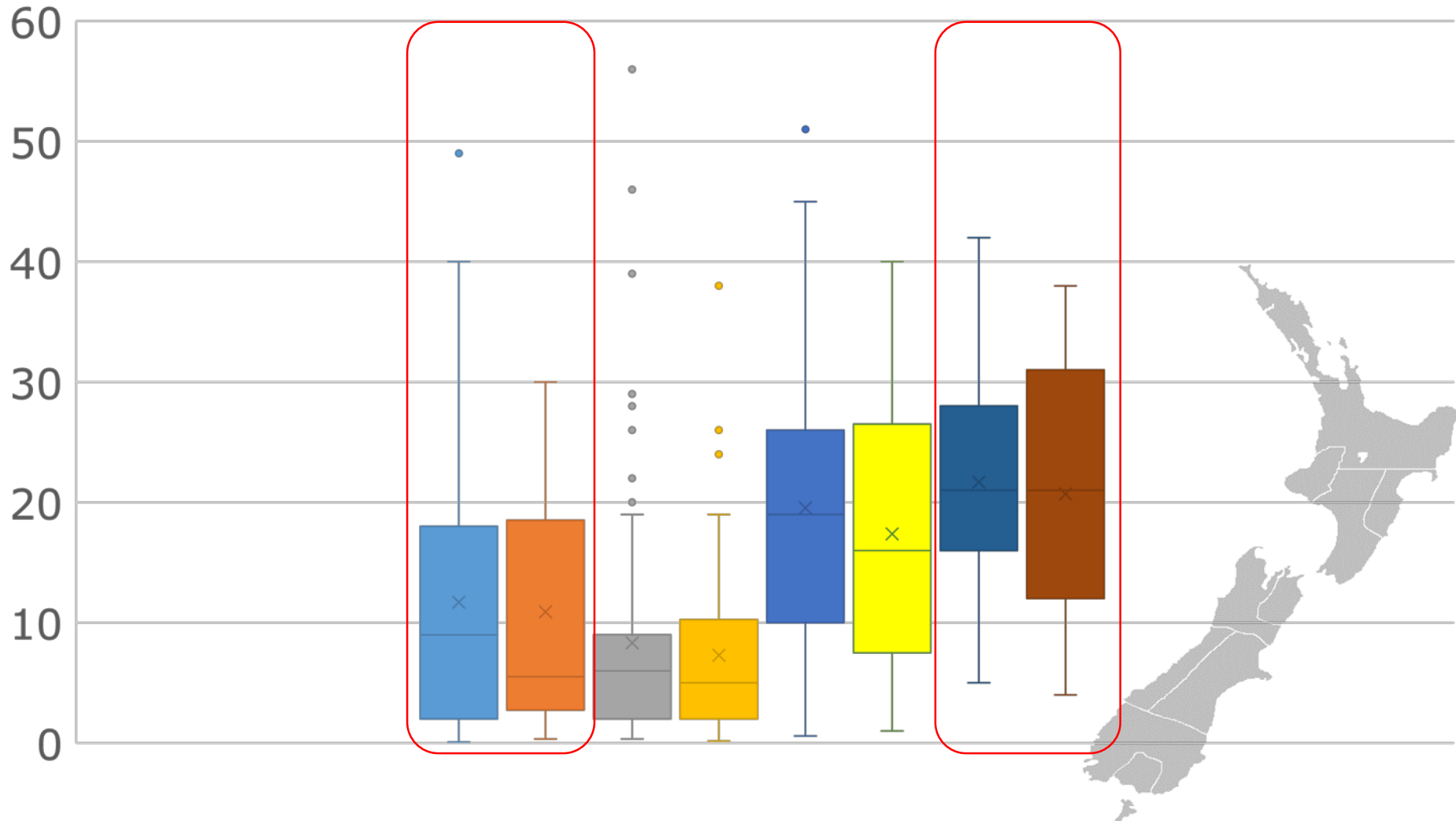
Questions from first results

- Can we say there are general patterns for polio?
  - How variable?
  - Did they vary according to certain rules/conditions, as Nielsen et al. suggest?
- How to address the problem of small sample sizes?

Results so far

- **Preliminary** results show partial fit with expectations of traditional model

- No evidence of polio among NZ troops in FWW

- Excess male mortality - but sex ratio fluctuates

- Polio pandemics? (1916? 1937?)

Next steps

- SES analysis - *Was there differential mortality during New Zealand's polio epidemics?*
  - Status scores and/or HISCLASS
  - Compare to Ontario pattern
  - Compare to Rice and Bryder's finding re: 1918 influenza in NZ

- The 1916 epidemic and the First World War
  - How they were linked biologically and socially
  - Why was this epidemic 'forgotten'?
  - How was the epidemic linked to imperialist anxiety (including fears of disability/impairment)?

ANTHROPOLOGY SEMINAR

To be held on Thursday, 19th July 2018

4.00 to 5.30 pm in Room HSB 802 (Social Sciences Staff Room)

Heather Battles
(University of Auckland)

The First World War and the 'forgotten' 1916 polio epidemic in New Zealand

This presentation examines New Zealand's 1916 polio epidemic, which resulted in over 1,000 notified cases and 125 deaths among Pākehā alone, in addition to an unknown number cases and deaths among Māori. Despite the proportionately heavy toll of this epidemic, it has been largely forgotten', subsumed in historical and public memory by the upheaval and impact of the Great War as well as the subsequent mass mortality of the 1918 Flu.

Scholarship on the once-forgotten 1918 influenza pandemic has illuminated not only many factors which contributed to this 'forgetting' but also how intimately linked that disease was to the War – both biologically and socially. Are similar links to be found in the case of polio in 1916?

I present the results of quantitative and qualitative research of the non-Māori death registrations, contemporary newspapers, and other historical sources. I find little evidence of a direct biological link between wartime conditions and the spread and severity of the disease. Much clearer are the ways in which the epidemic articulated socially and politically with the War. I examine the negative and positive repercussions of these connections for the treatment of polio patients and how these connections to the War contribute to our understanding of collective forgetting versus remembering.

Dr. Heather Battles completed her BA in Anthropology and History at the University of Victoria in BC, Canada, in 2005, before moving to Ontario for graduate studies. She completed her Masters in the Anthropology of Health and her PhD in Biological Anthropology, both at McMaster University. Her doctoral dissertation used historical records to examine the shifting social, geographical, and demographic patterns of polio mortality in southern Ontario in the early 20th century. She took up her current position in Biological Anthropology at the University of Auckland in 2014, beginning her ongoing research into polio mortality in New Zealand. She takes an inter-/multi-disciplinary approach to the study of epidemics, combining historical demography, infectious disease ecology, medical anthropology, and social history..

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NEW ZEALAND

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- University of Auckland Faculty of Arts New Staff FRDF grant

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- Previous research on polio in NZ by Jean Ross and Deborah Simpson

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ARTS

Family photo with military action figure/doll c1915.
Archives New Zealand Reference: BBAE 4984/127/D978

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