Flu Symposium: Centenary of the 1918 Pandemic

Spanish Flu in Sydney, 1919

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Research Areas
Global health, health geography, population ageing, historical demography

Selected Publications


Outline

• Introduction
• Sydney, 1919
• Origins
• Control measures
• Temporal path
• Mortality patterns
  - age and sex
  - socio-economic
  - geographical
• Summary
  - uncertainties (origins? - waves? – govt. regulations? - differentials?)
Population size and mortality, Sydney, 1918-20


Table 1

<table>
<thead>
<tr>
<th>Year</th>
<th>Estimated mean population</th>
<th>Total deaths</th>
<th>Influenza deaths</th>
<th>Crude death rate (per 1,000 population)</th>
<th>Crude influenza death rate (per 1,000 population)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1918</td>
<td>785,000</td>
<td>7,862</td>
<td>134</td>
<td>10.02</td>
<td>0.17</td>
</tr>
<tr>
<td>1919</td>
<td>810,700</td>
<td>11,907</td>
<td>3,484</td>
<td>14.69</td>
<td>4.30</td>
</tr>
<tr>
<td>1920</td>
<td>884,790</td>
<td>9,429</td>
<td>118</td>
<td>10.66</td>
<td>0.13</td>
</tr>
</tbody>
</table>


**Global tolls** – most radical resculpturing of human populations since 14th century Black Death

**1918 influenza pandemic** – est. 50-100 million people died (cf. WW1 est. 17 million) – included Donald Trump’s grandfather; Lawrence of Arabia’s father; Arthur Conan Doyle’s son

**Simulation of similar highly contagious & lethal modern-day influenza outbreak**
(Institute for Disease Modelling/Bill Gates, *NEJM*, May 31, 2018
- After 3 months: 10.1 million deaths
- After 6 months: 32.9 million deaths

**Greatest health and social disaster in Sydney’s history**

**Morbidity**
- Estimated 300,000 Sydney residents went down with the flu
- 36-37% attack rate

**Mortality**
- Sydney’s flu death rate highest of Australia’s metropolitan areas
- many marriages ruptured – children orphaned

**Sydney 2018 (5.1 million population) equivalent**
- Flu cases: ≈1.8-1.9 million
- Flu Deaths: ≈22,000
Sydney, 1919

Area – approximately 480 sq km

Metropolitan boundaries
- North: Manly and Ku-ring-gai
- South: Botany Bay and Georges River
- West: Homebush, Strathfield, Enfield

Population – est. 810,700 persons (about twice size of today’s Canberra)
- around one third of population lived within 5 km of CBD
- well over half employment in city centre
- suburban residential development being stimulated by electric tramway and rail system

Health – in midst of demographic and epidemiological transition

Social topography – working class, industrial suburbs south of city centre
- north and east: more advantaged ocean and harbourside suburbs
The arrival of ‘Spanish’ flu in Sydney, January 1919

(Sydney Morning Herald, 28 January, 1919)


Epidemic initially seeded in Sydney by arrivals from Melbourne (soldiers then civilians) in late January 1919 – early clusters of cases (Randwick Military Hospital, Paddington, Darlinghurst, central Sydney)

Quickly developed into a general community outbreak, spreading from initial inner city concentration – Canterbury badly hit (21 hospitalised cases Feb 7-27) – also by 20 Feb had reached Willoughby, Ryde, Hunter’s Hill, Burwood Auburn, Bankstown, Lidcombe Hornsby)

Figure 1

Figure 1 'The arrival of ‘Spanish’ flu in Sydney, January 1919.
Figure 2

CABINET DECISIONS

Masking

To be closed down
Schools, theatres, music halls, libraries, billiard rooms, race meetings, church services, etc.

Space restrictions
Hotel bars, restaurants, tea houses – 250 cubic feet/person
Retail shops – space regulation to apply

GENERAL RECOMMENDATION
Take all possible advantage of fresh air
Avoid crowds

Proclamation of N.S.W. Government regulations to control the epidemic
(Sydney Morning Herald, 3 February 1919)

Weekly hospital admissions and deaths from influenza, Sydney, 1919 (a)


Number of deaths per week during the 1919 influenza epidemic, New South Wales

Daily hospital admissions and deaths from influenza, Sydney, 1919 (b)


Waxing and waning of epidemic
- Changing nature/virulence of virus?
- Introduction/lifting of restrictions?
- Build up of immunity?
- Weather?

Figure 2. (a) Epidemic curve for Sydney 1919 showing daily hospitalizations $h(t)$ (black bars) and deaths $d(t)$ (grey bars). Data on hospitalizations were not readily available after day 224. Periods A–F are labelled and characterized as follows: A, first cases, infection control measures; B, threat considered passed, lifting of control measures; C, reimposition of control measures, first wave; D, epidemic considered passed, lifting of control measures; E, second wave; F, epidemic passed.
Summary of epidemic incidence, policy and individual’s perceived risk factors influencing the degree of social distancing during different periods of the influenza epidemic in Sydney, 1919

Deaths often occurred rapidly
- newspapers fanned alarm – reports of people waking fine in morning and being dead by nightfall
- like media-induced panic in present day epidemics

Time from symptom onset to death for the cases of pandemic influenza in Sydney, 1919


Figure 3. Distribution of time from symptom onset to death for the cases of pandemic influenza in Sydney 1919 (after Armstrong 1920). Fitted curve is a gamma ($k=2.74$, $\theta=3.23$) distribution.
Uneven sweep across the city – age, sex, social, geographical differentials

Young adults ("prime of life" – 25-39yrs) - usual flu victims are the elderly and young

Higher male mortality (especially 1st wave) – why?
   - some greater male biological susceptibility to the particular viral strain? – 100 years on can only remain conjecture
   - differential socio-behavioural risk factors of males/females probably more a factor than biology – i.e. mobility and mixing by males? (employment?, hotels?, races?, football?)

No age-sex tabulations of attacks available – so whether deaths reflected attack rates unknown

Age-sex-specific death rates from influenza, Sydney, 1919

Table 3

<table>
<thead>
<tr>
<th>Occupational group</th>
<th>Rate per 1,000</th>
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<tbody>
<tr>
<td>Professional</td>
<td>4.3</td>
</tr>
<tr>
<td>Commercial</td>
<td>4.8</td>
</tr>
<tr>
<td>Domestic</td>
<td>6.0</td>
</tr>
<tr>
<td>Industrial</td>
<td>6.2</td>
</tr>
<tr>
<td>– Labourer</td>
<td>12.0+</td>
</tr>
<tr>
<td>Transport and communication</td>
<td></td>
</tr>
<tr>
<td>– Railways and tramways</td>
<td>6.5</td>
</tr>
<tr>
<td>– Roads</td>
<td>5.9</td>
</tr>
<tr>
<td>– Seas, rivers, harbours</td>
<td>6.4</td>
</tr>
<tr>
<td>– Postal and telegraph services</td>
<td>7.8</td>
</tr>
<tr>
<td>Primary producers</td>
<td>5.5</td>
</tr>
<tr>
<td>All occupations</td>
<td></td>
</tr>
</tbody>
</table>

Source: Deaths by occupations data: NSW Statistical Register 1919-20.

Note
The rates are based on the assumption that the Statistical Register and Census allocations of individuals to occupational groups were identical. The open-ended value for labourers is due to the census tabulations buying labourers within the 'undefined industrial' class.

Occupational differentials – 2 sets of possible mechanisms?
– direct on-the-job risk factors?
  and/or
– life style and socio-economic factors?

Jobs involving close contact with public (e.g. tramways, postal, road carters/carriers)

LS and SES
Workers on low incomes, living in sub-standard houses, poor nutrition

Death rates from influenza per 1,000 males aged 15+, by occupational group, New South Wales, 1919

Index case – soldier from Melbourne 21/1 – admitted RMH 23/1
- pneumonic influenza suspected in Melbourne but not officially declared
- flu spread quickly to others within RMH isolation ward

Other military cases arrived in city – inner city stays – infection clusters emerged

City residents with no Melbourne contact soon started falling ill from flu – initial inner city focus, but soon spread out to more distant areas – cases data poor

Final pattern – spatial core of epidemic (deaths) 13 inner city LGAs plus 5 other above average mortality areas (Eastwood, Homebush, Hunter’s Hill, Botany, Hurstville)

Lowest mortality LGAs were Ryde, Lane Cove, Ku-ring-gai, Willoughby, Manly, plus Vaucluse

Some puzzles

Age-sex standardised influenza mortality ratios, Sydney, 1919

Table 4

Table 8.3 Correlations (r) between 1919 standardised influenza mortality ratios and selected 1921 Census demographic and socio-economic indicators, Metropolitan Sydney

<table>
<thead>
<tr>
<th>Constructs/Variables</th>
<th>r</th>
</tr>
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<tbody>
<tr>
<td><strong>Population density/crowding</strong></td>
<td></td>
</tr>
<tr>
<td>Persons per square kilometre</td>
<td>0.25</td>
</tr>
<tr>
<td>Occupied dwellings per square kilometre</td>
<td>0.23</td>
</tr>
<tr>
<td>Average number of persons per occupied private dwelling</td>
<td>0.47</td>
</tr>
<tr>
<td>Average number of persons per room (occupied private dwellings)</td>
<td>0.53</td>
</tr>
<tr>
<td><strong>Population mixing</strong></td>
<td></td>
</tr>
<tr>
<td>Male population – per cent breadwiners</td>
<td>0.02</td>
</tr>
<tr>
<td>Female population – per cent breadwiners</td>
<td>0.01</td>
</tr>
<tr>
<td>Total population – per cent breadwiners</td>
<td>0.20</td>
</tr>
<tr>
<td><strong>Socio-economic status</strong></td>
<td></td>
</tr>
<tr>
<td>Male breadwinners – per cent in professional occupations</td>
<td>−0.60</td>
</tr>
<tr>
<td>Male breadwinners – per cent in manufacturing occupations</td>
<td>0.99</td>
</tr>
<tr>
<td>Male breadwinners – per cent employers</td>
<td>−0.60</td>
</tr>
<tr>
<td>Male breadwinners – per cent unemployed</td>
<td>0.51</td>
</tr>
<tr>
<td>Occupied private dwellings – average weekly rent</td>
<td>−0.57</td>
</tr>
<tr>
<td>Occupied private dwellings – per cent owner occupied</td>
<td>−0.46</td>
</tr>
</tbody>
</table>

Explaining the geography ...

Can only study deaths – case numbers x area initially reported by metropolitan newspapers – but dropped after a few weeks

Patterning of mortality (Fig. 7) suggests some “urban regularity” is at work – i.e. - population density/crowding?
- population mixing?
- SES?

Simple and multiple correlation and regression analysis – interpretation
- r values over/under 0.30 rate as statistically significant
- SES and density/crowding significant
- No mixing association found? – concept poorly measured?

Multiple regression/correlation models lift statistical explanation, but not real world explanation

Simple correlations between 1919 standardised influenza mortality ratios and selected 1921 Census demographic and socioeconomic indicators, Metropolitan Sydney LGAs