

The Age Pattern of Mortality in the 1918–19 Influenza Pandemic: An Attempted Explanation Based on Data for England and Wales

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Introduction

The worldwide influenza outbreak of 1918–19 had a number of features for which it has become notorious. The most obvious was its terrible virulence. Whereas, usually, influenza tends to be fairly benign (an old physicians' joke about the disease was "Quite a godsend! Everybody ill, nobody dying"¹) the 1918–19 variety showed a dreadful propensity to lead on to pneumonic complications and death. The bodies of the deceased, it might be added, were prone to a distressing darkening or even blackening.² Mortality among pregnant women seemed to be particularly high.³ Edwin Jordan, writing in the 1920s, put the global toll of the pandemic at, minimally, 21.6 million deaths; Kingsley Davis later estimated that there were about 20 million deaths in India alone; F Macfarlane Burnet suggested that influenza may have been responsible for 50–100 million deaths worldwide at this time.⁴ A recent textbook on influenza refers to an estimated 40–50 million deaths in the pandemic.⁵ Thus the 1918–19 influenza outbreak has tended to invite comparison with such other great historical pestilences as the Black Death of the fourteenth century and the plague of Justinian in the sixth century, many accounts ranking it third in mortality terms after these two but some even putting it in second place.⁶ Coming as it did towards the end of the First World War (and just afterwards), inevitably comparisons have

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¹ Alfred W Crosby, *Epidemic and peace, 1918*, Westport, Conn., Greenwood Press, 1976, p. 20. Reprinted with a new introduction as *America's forgotten pandemic: the influenza of 1918*, Cambridge University Press, 1989.

² Julius Burnford, 'Further notes on the epidemic (influenza), with special reference to pneumonia, in Macedonia', *Proc. R. Soc. Med.*, 1919, 12, Section of Medicine: 49–74, p. 53; Crosby, op. cit., note 1 above, p. 7; Geoffrey Rice, *Black November: the 1918 influenza epidemic in New Zealand*, Wellington, Allen and Unwin New Zealand, 1988, p. 2.

³ W I B Beveridge, *Influenza: the last great plague*, London, Heinemann, 1977, p. 15.

⁴ Edwin O Jordan, *Epidemic influenza: a survey*, Chicago, American Medical Association, 1927, pp. 227–9; Kingsley Davis, *The population of India and Pakistan*, Princeton University Press, 1951, p. 237; F Macfarlane Burnet, 'Portraits of viruses: influenza virus A', *Intervirology*, 1979, 11: 201–14, p. 203.

⁵ Karl G Nicholson, Robert G Webster and Alan J Hay (eds), *Textbook of influenza*, Oxford, Blackwell Science, 1998, p. 11.

⁶ Great Britain, Ministry of Health, *Report on the pandemic of influenza, 1918–19*, London, HMSO, 1920, p. 182; Andrew D Cliff, Peter Haggett and J Keith Ord, *Spatial aspects of influenza epidemics*, London, Pion, 1986, p. 1; K David Patterson, *Pandemic influenza 1700–1900: a study in historical epidemiology*, Totowa, NJ, Rowman and Littlefield, 1986, p. 1; Sandra M Tomkins, 'The failure of expertise: public health policy in Britain during the 1918–19 influenza epidemic', *Soc. Hist. Med.*, 1992, 5: 435–54, p. 435.

also been made between the pandemic and the war so far as mortality is concerned, it often being observed that influenza killed more people in a few months (worldwide) at this time than all the belligerent armies during 1914–18.⁷

Another feature for which the 1918–19 influenza pandemic is famous was its tendency to kill disproportionately those in the prime of life rather than, as is usually the case with this disease, the elderly or the very young. It was noted in an official British report on the outbreak that mortality seemed to be concentrated among those aged 20–40 and especially those aged 25–35.⁸ Alfred Crosby has reported much the same finding for the United States⁹ and indeed essentially the same feature has been noted in relation to many populations around the world. A 1998 *Textbook of influenza* simply reports that “Deaths were mainly seen in the 20–40-year age group”.¹⁰

A further aspect of the 1918–19 influenza outbreak that has attracted attention is the apparently almost simultaneous emergence of the especially lethal so-called “second wave” of the pandemic, which was responsible for most of the deaths, in a number of different and widely separated places round the world. Crosby reports that the “second wave” apparently began in the same week in the latter part of August 1918 in Freetown in Sierra Leone, in Brest in France, and in Boston, Massachusetts.¹¹ This puzzle has so far defeated both medical historians and epidemiologists. It is perhaps worth pointing out, though, that influenza, and not just the 1918–19 variety, often shows such mysterious features. As long ago as 1852, Theophilus Thompson, on the basis of the British record of influenza over the previous 300 years or so, had noted that influenza “outstrips in its course the speed of human intercourse”.¹² W H Clemow, writing in 1890, and basing himself on information about past influenza outbreaks as well as his own observation of the 1889–90 pandemic, noted that “The most striking feature of this fever, and the feature in which it differs most remarkably from other specific fevers, has ever been the fact that enormous numbers of people, spread over a vast extent of country, may be affected almost simultaneously”.¹³ In 1992, R Edgar Hope-Simpson, on the basis of a lifetime’s work and reflection on the disease, noted “the explosive nature of many influenza epidemics simultaneously attacking vast populations over wide areas”¹⁴ and observed that “some explode over a huge area ... [after] ... a long period in which no influenza virus has been isolated for many months and no communication can be traced between the earliest cases”.¹⁵

The main object in this paper will be to examine the impact of the 1918–19 influenza pandemic on mortality by age, using data for England and Wales, and then to attempt to account for the pattern observed. To this end, age-specific death

⁷ Nicholson, Webster and Hay (eds), op. cit., note 5 above, p. 9.

⁸ Great Britain, Ministry of Health, op. cit., note 6 above, pp. 90–1.

⁹ Crosby, op. cit., note 1 above, p. 215.

¹⁰ Nicholson, Webster and Hay (eds), op. cit., note 5 above, p. 11.

¹¹ Crosby, op. cit., note 1 above, p. 37.

¹² Theophilus Thompson, *Annals of influenza or epidemic catarrhal fever in Great Britain from*

1510 to 1837, London, The Sydenham Society, 1852, p. ix.

¹³ W H Clemow, ‘Epidemic influenza’, *Public Health: The Journal of the Society of Medical Officers of Health*, 1889–90, 2: 358–66, p. 362.

¹⁴ R Edgar Hope-Simpson, *The transmission of epidemic influenza*, New York, Plenum Press, 1992, p. 5.

¹⁵ *Ibid.*, p. 92.

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rates (for all causes combined) for 1918 and for 1919, for males and females separately (though the data for males will not prove especially helpful), will be compared with earlier figures, and the implied age-specific changes calculated. An age-specific death rate is the ratio of the number of deaths to individuals in a particular age group in a year to the number of individuals in that age group. It might be objected that attempting to gauge the impact of the influenza pandemic on mortality by the analysis of changes in age-specific death rates for all causes combined was inappropriate since deaths from influenza itself were the real focus of interest. It is abundantly clear, however, that influenza exacerbates mortality from a very wide range of causes. The Registrar-General of England and Wales, in his account of the 1918–19 outbreak, explicitly regarded increases in mortality from pneumonia (all forms), bronchitis, organic heart disease and pulmonary tuberculosis, as well as influenza itself, as basically attributable to the influenza epidemic; he also observed that “Doubtless others might be added to this list”.¹⁶ William Farr, writing about an influenza outbreak in England and Wales in late 1847, concluded that increases in the recorded mortality from not only asthma, bronchitis and pneumonia but also whooping cough, measles and typhus were influenza-related.¹⁷ From this point of view, age-specific death rates for all causes combined have a very great deal to recommend them; some cause-specific data will also be considered but mainly to aid in the interpretation of the overall figures.

Much previous work in this area has not involved the analysis of age-specific death rates. The observation mentioned earlier, that the 1918–19 influenza outbreak tended disproportionately to kill young adults, was in most cases based upon an analysis of changes in the proportional distribution of deaths by age, whether all deaths or deaths from influenza or related causes, as the outbreak developed, compared with an earlier “normal” period (or sometimes an earlier influenza outbreak). The statistical account provided by the Registrar-General of the 1918–19 influenza epidemic in England and Wales does include some age-specific death rates (albeit for females only, and confined to the cause of death “influenza”) but much greater use was made of data showing the proportional distribution of deaths by age.¹⁸ The official British medical report on the epidemic, similarly, made only passing reference to age-specific rates.¹⁹ Crosby’s account of the outbreak in the United States refers only to data showing the proportional distribution of deaths by age.²⁰ H Phillips’ account of the 1918–19 influenza epidemic in South Africa does present some age-specific death rates, though confined to the causes of death “influenza”

¹⁶ England and Wales, Registrar-General, Supplement to the Eighty-first annual report of the Registrar-General of Births, Deaths and Marriages, *Report on the mortality from influenza in England and Wales during the epidemic of 1918–19*, London, HMSO, 1920, p. 3.

¹⁷ England and Wales, Registrar-General, *Tenth annual report*, London, HMSO, 1852, pp. xxviii–xxix. This report carried the formal signature of the Registrar-General of the time but was actually written by William Farr, the superintendent of the statistical department.

¹⁸ England and Wales, Registrar-General, op. cit., note 16 above, especially pp. 7–10. Data provided on p. 9 of this report showing the proportional distribution of female influenza deaths by age for quarterly periods during the epidemic have been mislabelled as age-specific death rates in Nicholson, Webster and Hay (eds), op. cit., note 5 above, p. 196.

¹⁹ Great Britain, Ministry of Health, op. cit., note 6 above.

²⁰ Crosby, op. cit., note 1 above, especially pp. 22–4 and ch. 11.

and “pneumonia”, and only for the period of the outbreak itself, without any earlier data for comparison.²¹ Geoffrey Rice, in his account of the epidemic in New Zealand, presents fully only data on the proportional distribution of influenza-related deaths by age at the time, though one or two of his comments indicate that he did also calculate some age-specific rates.²² Yet data on changes in the proportional distribution of deaths by age during the influenza outbreak do not provide a very satisfactory basis for detailed statements on changes in mortality, age group by age group. A decline in the proportion of all deaths contributed by a certain age group could occur, for example, though the rate of mortality in that age group actually rose. Perhaps for this reason, most investigators adopting this approach have contented themselves with the observation that young adults suffered more than others, and have said relatively little specific, or even nothing at all, about other age groups. It is hoped that the approach adopted here will allow a more detailed assessment to be made.

The next section of the paper will provide a brief account of the origins, spread and general nature of the 1918–19 influenza pandemic. Following that, the specific case of England and Wales will be considered in some detail, with some reference also to relevant comparative material for the United States.

The Origins and Course of the 1918–19 Pandemic

The earliest, well attested, cases of what was to become the 1918–19 influenza pandemic were reported in the United States among army recruits in military camps in March 1918.²³ There has been conjecture, though, that the pandemic may have originated elsewhere, for example, in China.²⁴ It has even been suggested that there may have been precursors of the 1918–19 outbreak, among military populations, in previous years: at an army camp in Etaples in northern France in 1916 and at Aldershot barracks in the south of England in 1917.²⁵ It has been suggested also that although these outbreaks apparently did not spread to the general population at the time they may have been associated with a “seeding” of the 1918–19 virus into the population at large before 1918, which facilitated its very rapid spread subsequently.²⁶ In any event, during the months that followed these early cases in the United States in 1918, the so-called “first wave” of the pandemic developed: initially, the United States’ population was affected, during March, April and May 1918; subsequently, influenza seemed to spread around the world, with many countries experiencing an epidemic during May, June or July.

This first wave was typically seen as fairly mild. It came to be referred to as “Spanish” influenza (a name which stayed with the pandemic throughout its course),

²¹ H Phillips, *‘Black October’: the impact of the Spanish influenza epidemic of 1918 on South Africa*, Pretoria, Government Printer, 1990, pp. 31, 169.

²² Rice, *op. cit.*, note 2 above, pp. 159–60.

²³ K David Patterson and Gerald F Pyle, ‘The geography and mortality of the 1918 influenza pandemic’, *Bull. Hist. Med.*, 1991, 65: 4–21, p. 5.

²⁴ Beveridge, *op. cit.*, note 3 above, p. 43.

²⁵ John S Oxford, A Sefton, R Jackson, N P A S Johnson and R S Daniels, ‘Who’s that lady?’, *Nature Medicine*, 1999, 5: 1351–2.

²⁶ *Ibid.*

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probably simply because neutral Spain, unlike those countries involved in the First World War, did not censor news of the epidemic there.²⁷ Notwithstanding the apparent relative mildness of the first wave, however, it seems to have shown at least early signs of that very feature so much remarked in relation to the second wave of the pandemic (and which some have regarded as virtually the defining characteristic of the 1918–19 influenza outbreak²⁸), a tendency for the mortality of young adults to rise more than that of other age groups. Crosby has noted this in relation to the United States²⁹ and the same feature has been reported for England and Wales.³⁰

The origins of the second, and virulent, wave of the pandemic have already been described. Having thus apparently first arisen in August 1918 this new wave then spread to (or at least appeared in) almost every part of the world. In most countries it began (effectively) in September or October of 1918 and reached a peak, in terms of mortality, in October or November, or sometimes December. In the case of Australia, though, the second wave is reported not to have begun until 1919.³¹ In quite a number of countries this second wave of the pandemic was then followed by a third wave, fairly early in 1919 in most cases. The third wave was typically much more serious than the first had been but was responsible for many fewer deaths than the second.

Influenza in England and Wales in 1918–19

According to the Registrar-General,³² the influenza outbreak in England and Wales began at the end of June 1918. His account speaks of the first wave of the epidemic running from 23 June to 14 September 1918, with mortality reaching a peak in the week ending 13 July, the second wave lasting from 15 September 1918 to 25 January 1919, with a peak of mortality in the week ending 9 November, and a third wave between 26 January and 10 May 1919, with a mortality peak in the week ending 1 March. He reported that during the entire forty-six weeks of the epidemic there were 151,446 deaths from influenza itself in England and Wales, including about 10,500 deaths to non-civilians, but estimated that the total excess mortality attributable to the influenza outbreak in this period, including deaths recorded as due to other causes, was about 198,000; this total included some 14,000 deaths of non-civilians. These latter estimates imply an increase in the crude death rate (ratio of deaths to population) for civilians, as a result of the influenza outbreak, during the twelve months including the forty-six weeks of the epidemic, of about five and a

²⁷ Patterson and Pyle, *op. cit.*, note 23 above, p. 7.

²⁸ F Macfarlane Burnet and Ellen Clark, *Influenza: a survey of the last 50 years in the light of modern work on the virus of epidemic influenza*, Melbourne, Macmillan, 1942, p. 69.

²⁹ Crosby, *op. cit.*, note 1 above, p. 21.

³⁰ England and Wales, Registrar-General, *op. cit.*, note 16 above, pp. 7–11.

³¹ Rice, *op. cit.*, note 2 above, p. 138.

³² England and Wales, Registrar-General, *op. cit.*, note 16 above.

half deaths per 1000 population per year.³³ The Registrar-General's estimates show very clearly that the second wave of the epidemic in England and Wales was indeed, as elsewhere, by far the most serious and that the third wave was next in importance so far as mortality was concerned, with the first wave much less serious than the other two. Of the 184,000 civilian deaths attributed by the Registrar-General to the influenza outbreak, about 10 per cent occurred before the end of September 1918, 63 per cent between 1 October and 31 December 1918, and 28 per cent in the period, from 1 January to 10 May 1919.³⁴ Sandra Tomkins has argued that, despite having one of the most highly developed public health establishments of the period (and even bearing in mind that this was wartime), Britain mounted a rather poor response to the 1918–19 influenza outbreak. There was, she believes, far too much emphasis on measures to prevent the spread of the disease, such as ventilation of cinemas, or to treat it, which did not work, and far too little emphasis on measures which might help avert secondary complications in victims. Better provision of emergency hospitals and home nursing care, and efforts to support victims and their families, such as home help programmes, might well have reduced mortality.³⁵

As indicated previously, the Registrar-General's report on the influenza outbreak in England and Wales did not consider changes in age-specific death rates (except in the case of females, and confined to the cause of death "influenza" as such). In the case of males of military age he would have found it extremely difficult to do so in any case. During the First World War there were of course very large numbers indeed of men normally resident in England and Wales who were absent overseas for military reasons; on the other hand, at any one time, quite large numbers of military personnel would have been present in England and Wales itself. Estimates of the civilian population of males by age group in England and Wales are available for each year, but the numbers of non-civilian males by age in the country are unknown. The data on numbers of male deaths by age from registration, on the other hand, refer to all deaths within the country, whether of civilians or non-civilians. Thus, regrettably, reasonably reliable age-specific death rates for males of military age in England and Wales at this time cannot be obtained.³⁶

³³ This figure has been obtained by multiplying the estimated increase in annual death rate during the forty-six weeks of the epidemic produced by influenza deaths as such, provided by the Registrar-General, by the ratio of all deaths caused by the epidemic to influenza deaths, and then multiplying the result by 46/52. See England and Wales, Registrar-General, *op. cit.*, note 16 above, p. 3.

³⁴ Calculated from England and Wales, Registrar-General, *op. cit.*, note 16 above, p. 7.

³⁵ Tomkins, *op. cit.*, note 6 above.

³⁶ The Registrar-General has, on the face of it, provided annual age-specific death rates for males in every age group in England and Wales during this time. See England and Wales, *The Registrar-General's decennial supplement 1921, part III*,

London, HMSO, 1933, p. xlvii. However, attempting to reproduce these rates from basic data makes clear that whereas the numerators used were all deaths occurring in England and Wales, the denominators included those overseas on military service. A series of age-standardized, age-specific death rates for males for single calendar years from 1912 to 1920 published recently by Britain's Office for National Statistics was based upon denominators which included only civilians in the country but numerators which included deaths within the country of both civilians and non-civilians (though the accompanying text might be read as suggesting otherwise). See Office for National Statistics, *The health of adult Britain 1841–1994, volume 1*, London, The Stationery Office, 1997, p. 40.

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Table 1 presents age-specific death rates for females, and for males of non-military age, for England and Wales in each of the years 1913 to 1919. The impact of the influenza outbreak is clearly discernible: age-specific mortality rates for females in 1918 were markedly higher than in any of the previous five calendar years for all age groups between the ages of 5 and 45. That this upsurge in mortality was associated with the influenza outbreak is clear from the data shown in Table 2. The death rate from influenza as such was very much higher in 1918 than in any of the previous five years in all age groups up to 65, and higher also among those aged over 65, though less markedly so. Much the same can be said of 1919 (*vis-à-vis* the five years before 1918), though influenza mortality was quite a lot lower in 1919 than in 1918. It may be seen also from the age-specific death rates from influenza that, in the period leading up to 1918–19, there had been an earlier influenza outbreak (or outbreaks), in 1915 and 1916; though in general very much less serious than the 1918–19 outbreak, this (or these) had made quite an impact on the mortality of the elderly.

The data indicating age-specific mortality in different years from influenza, pneumonia and bronchitis combined, also shown in Table 2 (increases in mortality from all three of these causes might be anticipated during an influenza epidemic), tell essentially the same story. Mortality generally rose in 1918–19. These data show, however, that, among those aged 65 or over, the mortality rate from these causes arising from the 1918–19 influenza outbreak was actually lower than in the earlier outbreak (or outbreaks) in 1915–16.

Data indicating age-specific mortality from tuberculosis in England and Wales in different years have been presented in Table 2 mainly as a precaution. As noted recently by Jay Winter and Jean-Louis Robert, mortality from tuberculosis (after declining for many years) increased during the First World War, especially among young adults.³⁷ Thus the question might be raised whether some part of the apparent increase in mortality at the time of the 1918–19 influenza outbreak might not truly be attributable to tuberculosis rather than to influenza. It is clear from the material presented in Table 2, however, that any such effect could only have been slight, since increases in tuberculosis mortality in 1918 were very minor compared with increases in mortality from influenza. Moreover, since, according to the Registrar-General, tuberculosis mortality in the first six months of 1918 was actually considerably lower than in the corresponding period in 1917, suggesting that the wartime rising trend may well have ended by then,³⁸ the implication is that the 1918 increase in tuberculosis mortality was provoked by, and should be seen as part of the mortality associated with, the influenza outbreak. It is worth noting that the great majority of tuberculosis deaths (about three-quarters over the period 1911–20³⁹) were from pulmonary tuberculosis, already mentioned as liable to exacerbation by influenza.

Table 3 presents measures comparing age-specific death rates for females, and for

³⁷ Jay Winter and Jean-Louis Robert, *Capital cities at war: Paris, London, Berlin 1914–1919*, Cambridge University Press, 1997, pp. 468–70, 480, 508–10, 520–2. See also England and Wales, *op. cit.*, note 36 above, pp. xci–cii.

³⁸ England and Wales, *op. cit.*, note 36 above, p. xcvi.

³⁹ *Ibid.*, p. cii.

Table 1
Age-specific death rates per 1000 for males and females in England and Wales for the years 1913 to 1919

Age Group	Males									Females								
	1913	1914	1915	1916	1917	1918	1919	1913	1914	1915	1916	1917	1918	1919				
0-4	40	39	42	33	32	39	33	33	33	34	27	26	34	26				
5-9	3	3	4	3	3	6	4	3	3	4	3	3	6	4				
10-14	2	2	2	2	2	3	2	2	2	2	2	2	4	2				
15-19	—	—	—	—	—	—	—	3	3	3	3	3	6	3				
20-24	—	—	—	—	—	—	—	3	3	3	3	3	8	4				
25-29	—	—	—	—	—	—	—	4	4	4	4	4	10	5				
30-34	—	—	—	—	—	—	—	4	4	5	4	4	9	6				
35-39	—	—	—	—	—	—	—	6	6	6	5	5	8	6				
40-44	—	—	—	—	—	—	—	7	7	7	7	7	9	7				
45-49	—	—	—	—	—	—	—	10	10	10	9	9	11	9				
50-54	17	18	19	18	17	19	16	13	14	14	13	12	14	12				
55-59	25	25	26	24	24	25	23	19	18	19	18	17	18	17				
60-64	37	37	40	37	36	36	34	27	28	29	27	25	26	25				
65-69	51	51	55	54	54	54	52	39	39	43	41	39	40	39				
70-74	81	82	91	87	87	82	80	66	67	74	68	63	60	62				
75+	151	148	171	164	162	143	160	128	131	149	142	137	123	138				

Note: rates rounded to nearest whole number.

Source: England and Wales, *The Registrar-General's decennial supplement 1921, part III*, London, HMSO, 1933, p. xlvii.

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Table 2

Age-specific death rates per 1000 from influenza, pneumonia or bronchitis, and from tuberculosis, for females in England and Wales, for the years 1913 to 1919

Cause of Death and Year	Age Group (Females)									
	0–4	5–9	10–14	15–19	20–24	25–34	35–44	45–54	55–64	65+
<i>Influenza</i>										
1913	0.09	0.02	0.02	0.03	0.05	0.05	0.09	0.16	0.37	1.30
1914	0.10	0.01	0.03	0.03	0.04	0.05	0.08	0.14	0.35	1.21
1915	0.19	0.03	0.03	0.06	0.06	0.08	0.12	0.23	0.53	2.46
1916	0.10	0.02	0.03	0.04	0.05	0.06	0.10	0.19	0.49	2.19
1917	0.11	0.03	0.02	0.04	0.05	0.05	0.07	0.15	0.37	1.64
1918	4.12	1.88	1.42	2.41	3.64	4.83	2.46	2.28	2.34	3.80
1919	1.44	0.41	0.28	0.60	0.97	1.50	0.87	1.08	1.49	2.94
<i>Influenza, Pneumonia (all forms) or Bronchitis</i>										
1913	6.8	0.4	0.1	0.2	0.2	0.3	0.6	1.2	3.2	13.7
1914	7.0	0.4	0.2	0.2	0.2	0.3	0.6	1.3	3.3	14.4
1915	8.2	0.5	0.2	0.3	0.3	0.4	0.7	1.6	4.1	19.5
1916	6.0	0.4	0.2	0.2	0.2	0.3	0.6	1.3	3.4	16.8
1917	6.2	0.4	0.2	0.2	0.2	0.3	0.6	1.2	3.2	15.2
1918	12.8	2.8	1.9	2.9	4.4	5.8	3.3	3.6	5.2	15.9
1919	8.2	0.9	0.5	0.8	1.3	2.0	1.4	2.1	4.4	17.0
<i>Tuberculosis (all forms)</i>										
1913	1.8	0.6	0.7	1.2	1.3	1.4	1.3	1.1	0.9	0.6
1914	1.6	0.6	0.7	1.2	1.4	1.4	1.4	1.2	1.0	0.6
1915	1.8	0.6	0.8	1.4	1.5	1.5	1.5	1.2	1.0	0.7
1916	1.6	0.7	0.8	1.5	1.6	1.5	1.5	1.2	1.0	0.7
1917	1.6	0.7	0.9	1.7	1.7	1.6	1.5	1.2	0.9	0.7
1918	1.4	0.7	0.9	1.8	1.9	1.8	1.6	1.3	1.0	0.7
1919	1.2	0.5	0.7	1.5	1.6	1.4	1.3	1.0	0.9	0.6

Source: the rates shown in the top two panels of the table have been calculated from data provided in the annual reports of the Registrar-General of England and Wales for the years 1918 and 1919, in Great Britain, Ministry of Health, *Report on the pandemic of influenza, 1918–19*, London, HMSO, 1920, pp. 33–4, and in England and Wales, *The Registrar-General's decennial supplement 1921, part III*, London, HMSO, 1933, Table 1; this latter publication (p. xciv) also provided the rates shown in the bottom panel of the table.

males of non-military age, in England and Wales in 1918 and in 1919 with the average of the corresponding rates for the three years 1915–17. Relative changes are indicated by the ratios of 1918 and 1919 rates to the earlier rates, and actual increases or decreases, by the differences between the 1918 and 1919 rates and the earlier ones. Since Table 3 has been constructed from more detailed data than those shown in Table 1 there may seem to be small inconsistencies between the two tables because of rounding.

Table 3

Age-sex-specific death rates for England and Wales in 1918 and 1919 compared with the average annual rates for 1915–17

Age Group	ASDR ÷ AV1915–17				ASDR less AV1915–17			
	1918		1919		1918		1919	
	M	F	M	F	M	F	M	F
0–4	1.10	1.17	0.93	0.91	3.5	5.0	–2.6	–2.7
5–9	1.58	1.72	1.01	1.05	2.0	2.5	0.0	0.2
10–14	1.55	1.76	1.00	1.03	1.2	1.7	0.0	0.1
15–19		1.98		1.12		3.0		0.4
20–24		2.31		1.25		4.5		0.8
25–29		2.66		1.40		6.3		1.5
30–34		2.19		1.28		5.1		1.2
35–39		1.51		1.04		2.8		0.2
40–44		1.25		0.95		1.7		–0.4
45–49		1.17		0.95		1.5		–0.5
50–54	1.05	1.10	0.88	0.92	0.8	1.3	–2.1	–1.1
55–59	0.99	0.99	0.91	0.94	–0.3	–0.1	–2.3	–1.0
60–64	0.95	0.95	0.90	0.92	–1.9	–1.3	–3.9	–2.1
65–69	0.98	0.97	0.95	0.95	–0.8	–1.0	–2.6	–1.9
70–74	0.93	0.87	0.91	0.91	–5.9	–8.8	–7.8	–6.2
75+	0.86	0.86	0.97	0.97	–22.7	–19.7	–5.7	–4.7

Note: ASDR = age-specific death rate; AV1915–17 = average of rates over 1915–17; rates expressed per 1000 in age group.

Source: calculated from data provided in England and Wales, *The Registrar-General's decennial supplement 1921, part III*, London, HMSO, 1933, p. xlvii.

The data showing the relative changes in mortality rates for females in 1918 and 1919, compared with 1915–17, immediately draw attention to what has already been noted as a much remarked feature of the 1918–19 influenza outbreak, a tendency for young adults to suffer more than others. In both 1918 and 1919 the highest proportional increases in female mortality rates, compared with former times, were for women in their late twenties; age-specific mortality for women aged 25–29 in 1918 was more than two and a half times the 1915–17 level; and indeed women aged 20–34, in general, suffered proportionately more than other age groups. In 1918, female mortality rates rose at all ages up to about age 55, with especially marked proportional increases (at least 50 per cent and often much higher than this) between the ages of 5 and 40; at ages over 60, on the other hand, female mortality rates in 1918 were actually somewhat lower than previously. In 1919, the picture seems to have been generally a rather subdued version of 1918. Mortality rates were higher in 1919 than in 1915–17 at all ages between 5 and 40 but the proportional increases were much smaller than had been the case in 1918; and death rates at all other ages were actually somewhat lower in 1919 than in 1915–17.

The Age Pattern of Mortality in the 1918–19 Influenza Pandemic

The data showing actual changes in age-specific mortality rates for females between 1915–17 and 1918 and 1919, also presented in Table 3, allow another quite important element to be added to this account. It may be seen that, in 1918, although females aged 25–29 suffered the greatest actual increase in their mortality rate over 1915–17 compared with other age groups, and women aged 20–24 and 30–34 also suffered severely, females under the age of five experienced a substantial increase in their mortality rate as well, although in relative terms they had appeared to be not much affected. The explanation, of course, is that the mortality of females under five was usually fairly high in any case, so that even a modest proportional increase amounted to a noticeable actual increase in the rate. A corollary is that the number of excess deaths among female under-fives in 1918 as a result of the influenza epidemic was also quite substantial. An analogous finding was reported by Christopher Langford and Pamela Storey in their account of the 1918–19 influenza outbreak in Sri Lanka: in that case they concluded that, whilst the largest proportional increases in age-specific mortality rates during the epidemic were indeed for young adults, it was children under the age of five who actually suffered the greatest absolute increases in mortality rates.⁴⁰

The data of Table 3 only permit comparisons between the sexes for those under the age of 15 or over the age of 50. In 1918, females under 15 seem to have suffered rather more than males in the influenza epidemic, as did those in their early fifties; however, the differences were small (albeit quite systematic). Over the age of 55, where mortality rates tended to be somewhat lower in 1918 than in 1915–17, there is no evidence of any real differences between the sexes. For 1919, the data might possibly be thought to “hint” that females suffered slightly more than males in a number of age groups, but there is no unmistakable evidence of any sex-related differences. In what follows, the age pattern of mortality for females in the 1918–19 influenza outbreak in England and Wales will be assumed to provide a reasonable indication of the age pattern of mortality for the population as a whole. Further support for this supposition is provided by the data for the white population of the United States presented in Table 4. These data refer to males, including those of military age, as well as to females, actually present in the United States (or, strictly, in the United States “death registration area”, comprising those States judged to have reliable registration⁴¹); those overseas on military service, and any mortality they might have suffered, are excluded. It may be seen, firstly, that the age pattern of mortality among white females in the United States during the 1918–19 influenza outbreak was similar to that found in England and Wales; and, secondly, that the age pattern of mortality for white males in the United States was much the same as for females.

⁴⁰ Christopher M Langford and Pamela Storey, ‘Influenza in Sri Lanka, 1918–1919: the impact of a new disease in a pre-modern third world setting’, *Health Transition Review*, 1993, supplement to volume 2, 1992: 97–123, pp. 112–13.

⁴¹ Strictly, the data on which Table 4 is based are not comparable from year to year, since the United States death registration area continued to be enlarged over the period from 1915 to 1919. However, the main features shown by the data of Table 4 should still be genuine.

Table 4

Age-sex-specific death rates for the white population of the United States (death registration States only) in 1918 and 1919 compared with the average annual rates for 1915–17

Age Group	ASDR ÷ AV1915–17				ASDR less AV1915–17			
	1918		1919		1918		1919	
	M	F	M	F	M	F	M	F
Under 1	1.06	1.06	0.86	0.86	6.8	5.7	–15.6	–12.3
1–4	1.45	1.56	0.89	0.89	4.6	5.2	–1.2	–1.0
5–14	1.56	1.78	1.08	1.08	1.4	1.7	0.2	0.2
15–24	2.69	2.35	1.11	1.24	7.2	5.0	0.5	0.9
25–34	3.00	2.58	1.11	1.33	12.4	8.2	0.7	1.7
35–44	1.62	1.49	0.93	1.04	5.6	3.5	–0.6	0.3
45–54	1.11	1.13	0.85	0.95	1.5	1.5	–2.2	–0.5
55–64	1.00	1.01	0.85	0.91	–0.1	0.2	–4.2	–2.1
65–74	0.97	0.96	0.87	0.90	–1.7	–1.9	–8.0	–5.2
75–84	0.93	0.92	0.87	0.89	–9.5	–9.9	–16.3	–13.0
85+	0.91	0.90	0.92	0.91	–23.8	–23.7	–19.9	–23.0

Note: ASDR = age-specific death rate; AV1915–17 = average of rates over 1915–17; rates expressed per 1000 in age group.

Source: calculated from Robert D Grove and Alice M Hetzel, *Vital Statistics Rates in the United States 1940-1960*, Washington, DC, National Center for Health Statistics, 1968, pp. 329–33.

In the next section of the paper, an account will be given of the extent to which England and Wales suffered outbreaks of influenza during the eighty or so years before the epidemic of 1918–19. There will also be some discussion of influenza viruses (strictly, influenza A viruses) and the way they operate. (Influenza A viruses are those which cause pandemics; the B and C viruses are much less important epidemiologically.) It will be argued that the age pattern of mortality in England and Wales in 1918–19 makes sense if it is supposed that an earlier influenza outbreak, in 1847–48, was itself caused by a virus which was related to that responsible for 1918–19, so that those exposed to the earlier virus had some immunity to the later one.

Influenza in England and Wales during the Nineteenth Century and the Age Pattern of Mortality in 1918–19

Table 5 shows annual crude death rates from influenza for England and Wales between 1838 and 1920. Crude death rates are ratios of the deaths in a year (in this case, deaths where the cause has been reported as influenza) to total population; here these rates have been expressed per million; for the years 1911 to 1920 the rates refer to females only. 1838 was the first full calendar year for which information became available (including deaths by cause) from the then new system of civil vital registration in England and Wales. Many of the rates depicted in Table 5 have been taken directly from official publications; some have been calculated from data

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Table 5
Death rate (DR) from influenza per million population for
England and Wales, 1838–1920

Year	DR	Year	DR	Year	DR	Year	DR
1838	53	1859	57	1880	7	1901	174
1839	57	1860	58	1881	4	1902	224
1840	66	1861	38	1882	3	1903	190
1841	104	1862	45	1883	4	1904	169
1842	55	1863	45	1884	3	1905	205
1843	63	1864	39	1885	5	1906	184
1844	77	1865	29	1886	3	1907	267
1845	42	1866	31	1887	3	1908	288
1846	65	1867	29	1888	3	1909	254
1847	285	1868	14	1889	2	1910	182
1848	459	1869	32	1890	157	1911	113
1849	92	1870	28	1891	574	1912	143
1850	78	1871	15	1892	533	1913	160
1851	120	1872	12	1893	325	1914	150
1852	75	1873	11	1894	220	1915	273
1853	99	1874	10	1895	423	1916	232
1854	58	1875	19	1896	122	1917	182
1855	193	1876	8	1897	195	1918	2984
1856	55	1877	8	1898	330	1919	1105
1857	73	1878	8	1899	389	1920	256
1858	93	1879	11	1900	504		

Note: rates for 1911–1920 refer to females only; sources of data specified in text.

provided in official publications; and those for the years 1843 to 1846, inclusive, have been estimated on the basis of London data, assuming that the ratio of national influenza deaths to London influenza deaths observed during 1840–42 continued to apply.⁴² The rates shown in Table 5 will not indicate the full impact of mortality from influenza on the English population since some mortality assigned to other

⁴² The death rates shown in Table 5 have been obtained as follows: for the years 1911 to 1920, calculated from data provided in Great Britain, Ministry of Health, *op. cit.*, note 6 above, pp. 33–4, the annual reports of the Registrar-General for the years 1918, 1919 and 1920, and England and Wales, *op. cit.*, note 36 above, Table 1; for 1891 to 1910, England and Wales, Registrar-General, *Seventy-third annual report (1910)*, London, HMSO, 1912, p. 23; for 1881 to 1890, England and Wales, Registrar-General, *Sixty-third annual report (1900)*, London, HMSO, 1902, p. lxxvii; for 1865 to 1880, England and Wales, Registrar-General, *Forty-third annual report (1880)*, London, HMSO, 1882, p. lxxv; for

1853 to 1864, England and Wales, Registrar-General, *Thirty-third annual report (1870)*, London, HMSO, 1872, p. 427; for 1838 to 1842 and 1847 to 1852, calculated from data provided in the annual reports of the Registrar-General for the years 1860 (Table I) and 1870 (p. 422); for 1843 to 1846, estimated from data provided in England and Wales, Registrar-General, *Ninth annual report*, London, HMSO, 1849, pp. 146–52 and the annual reports of the Registrar-General for the years 1860 (Table I) and 1870 (p. 422), on the assumption that the ratio of national influenza deaths to London influenza deaths observed during the period 1840–42 also applied in each year 1843 to 1846.

causes of death will in fact also be influenza-related; however, these data should at least give a reasonable indication of the major shifts in influenza prevalence over time.

It may be seen from Table 5 that there was quite a serious outbreak of influenza in England and Wales in 1847–48, with further upsurges in influenza deaths, though not as serious as the earlier one, in 1851 and in 1855. Thereafter, the registered death rate from influenza tended to fall, apparently reaching very low levels indeed in the 1880s (it will be suggested subsequently that there may well have been an element of under-reporting in this), but there was a dramatic reversal of this tendency in 1890, leading on to an extremely high influenzal death rate in 1891 and in 1892. After this (but prior to 1918–19), the death rate from influenza fluctuated, with noticeable peaks in 1895 and 1900, though quite generally, apparently, influenza mortality tended to stay at much higher levels than had typically been observed in the years before 1890.

New influenza viruses appear as a result of “antigenic drift” or “antigenic shift”. “Drift” results from mutation and in most cases the new variants produced are similar enough to pre-existing viruses that any immunity already established (infection with a particular influenza virus tends to confer protection against it in the future) continues to have relevance; “shift” results from a re-assortment of viral components, such that a radically different virus is much more likely to be produced. Influenza pandemics, at least in the common-man sense of worldwide outbreaks of influenza, occur when a new virus appears that is different enough from any circulating previously that the population has no immunity to it. This is usually the result of antigenic shift, though sometimes the process of antigenic drift can produce a virus novel enough to provoke such a worldwide outbreak. It should be noted, though, that many experts in this field want to reserve the term “pandemic” for only those worldwide outbreaks of influenza that result from antigenic shift. Rather mysteriously, when a new viral variant appears, whether only slightly or very different from that circulating previously, a so-called “vanishing trick” often takes place, whereby the new form seems entirely to displace the old within a short period of time.⁴³

Sometimes what seems to be a “new” virus, causing a pandemic, is found to be the same as, or fairly closely related to, the virus responsible for an earlier pandemic. The evidence for this is that people over a certain age at the time of a modern-day outbreak have been discovered, using laboratory tests, already to be showing some resistance to the virus responsible for it, indicating previous exposure. Thus, even though direct laboratory assessment of viruses has been possible only since the 1930s, it is believed that the influenza pandemic of 1889–92 was caused by a virus identical or similar to that which later caused a pandemic in 1957–58, and that the influenza pandemic of 1898–1900 was similarly related to one in 1968–69. By such indirect means, or by direct means, the viruses believed to have been responsible for each of the influenza pandemics since that of 1889–92 have been established, albeit in the

⁴³ The account provided in this paragraph is based upon a reading of three texts: C H Stuart-Harris, G C Schild and J S Oxford, *Influenza: the viruses and the disease*, 2nd ed., London, Edward

Arnold, 1985; Hope-Simpson, *op. cit.*, note 14 above; and Nicholson, Webster and Hay (eds), *op. cit.*, note 5 above, chs 1 and 17.

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earlier cases without every detail of the virus structure being known. Unfortunately, as yet, there is no information of this kind for any earlier period.⁴⁴

Suppose that the influenza outbreak in England and Wales in 1847–48 had been caused by a virus related to that responsible for the 1918–19 outbreak. Then it seems overwhelmingly likely that post 1847–48 cases of influenza, before 1890, when it is clear from Table 5 the 1889–92 pandemic actually arrived in this country, would have been caused by the same virus or a close variant. It seems unlikely that a radically new influenza virus could have appeared, yet left so little mark on the mortality figures; the relatively minor 1851 and 1855 upswings in mortality probably represented simply further waves associated with the 1847–48 outbreak, a fairly common phenomenon where influenza is concerned. That is not to say, it should be noted, that influenza mortality in England and Wales and/or influenza had truly declined by the 1880s to the extent that Table 5 might be thought to suggest: influenza may well have become less fully reported as a cause of death as its importance really did decline; and the fatality of influenza may well have fallen as a consequence of the progressive immunization of the population to the disease (the usually-vulnerable elderly would have been especially important in this).

What, in this case, would have been the expected age pattern of mortality in the 1918–19 influenza outbreak in England and Wales? The 1890 epidemic had begun in January,⁴⁵ meaning that only those who were aged at least 28 and a half at the onset of the 1918–19 outbreak (in late June) would have spent some time alive prior to the 1890 epidemic and thus possibly have been exposed to the 1847–48 virus (this supposes that the latter would have been completely displaced by the 1890 virus as a result of the so-called “vanishing trick”); the influenza mortality in England and Wales in 1915–16, it should be noted, is believed to have been associated with the virus that was in circulation before that which caused the 1918–19 outbreak. Those older than 28 and a half in 1918–19 would have been more and more likely, with increasing age, to have been exposed to the 1847–48 virus, partly because, simply, there had been more time in which this could happen, and partly because, at least as indicated by the mortality figures (Table 5), influenza seems to have been more prevalent the further back in time one moves (back to 1847–48). Those who had actually lived through the 1847–48 outbreak, it may be noted, would have been aged 70 or older in 1918–19. Thus the expectation would be, if the virus responsible for the 1918–19 outbreak was indeed related to the 1847–48 virus, that the mortality figures for 1918–19 would show increasing signs, after about the age of 29, of some prior resistance to the disease; those over 70 would be expected to show an especially high degree of immunity, having lived through 1847–48, and so would those in their sixties, though to a lesser extent, since influenza continued at relatively high levels for some years after 1847–48 and was especially marked in 1851 and in 1855. It might be added that there is reason to believe that the first influenza virus encountered in childhood conditions a person’s immune system in such a way that they are especially likely to maintain a strong resistance

⁴⁴ Ibid.

⁴⁵ Clemow, *op. cit.*, note 13 above, p. 359.

to that virus later in life (this has been dubbed “the doctrine of original antigenic sin”).⁴⁶

It may be seen in Table 3, from the data for females aged 25–29 and older, that the age pattern of mortality in the 1918–19 influenza outbreak in England and Wales did indeed essentially conform to this expectation. These data look, in other words, much as one would anticipate if the 1847–48 and 1918–19 viruses had been related to each other. At first sight, it might be thought strange that the mortality of those over age 60 was actually somewhat lower in 1918 than “usual” (i.e. during 1915–17), and indeed that in 1919 an even wider range of age groups (under 5 and over 40) apparently experienced lower than “usual” mortality. However, this could well be partly a reflection of the fact that the period 1915–17 was itself relatively badly affected by influenza; it has already been noted that the death rate among the elderly from influenza, pneumonia and bronchitis combined was actually lower in 1918–19 than it had been in 1915–16. A more general factor would have been that, before the onset of the influenza outbreak, the year 1918 apparently did have lower mortality than usual,⁴⁷ and that, after the first, influenza-affected, quarter, the remainder of the year 1919 was also generally a rather healthy one.⁴⁸ The fact that young adults tended to suffer worse mortality than most children in the 1918–19 influenza outbreak is not particularly surprising. According to William Farr in the *Tenth annual report* of the Registrar-General of England and Wales, for example, the 1847–48 influenza outbreak was most fatal to adults and to the aged: on the basis of data for particular weeks in London during the last quarter of 1847 he concluded that “The mortality in childhood [by which he meant under the age of 15] was raised 83 per cent., in manhood 104 per cent., in old age [60 and over] 247 per cent.”⁴⁹

In the following conclusion the argument will be summarized and the important question of its applicability, not just to England and Wales, but to the world at large, will be considered. In the postscript there will be some mention of recent attempts to establish in detail the precise structure of the 1918–19 virus, still not known in its entirety with certainty, obviously motivated, at least in part, by the fear of its possible return.

Conclusion

A much remarked feature of the 1918–19 influenza pandemic was that young adults seemed to suffer worse mortality than older adults and, most surprising

⁴⁶ Stuart-Harris, Schild and Oxford, *op. cit.*, note 43 above, pp. 47, 133, 174; Hope-Simpson, *op. cit.*, note 14 above, p. 55.

⁴⁷ England and Wales, Registrar-General, *op. cit.*, note 16 above, p. 4.

⁴⁸ Whereas the crude death rate for females for the first quarter of 1919 was much higher than the corresponding average rate for the first quarters during 1915–17, the crude death rates

for females for the second, third and fourth quarters of 1919 were all substantially lower than the corresponding 1915–17 figures. (Calculated from the annual reports of the Registrar-General for the years 1915 to 1920 and England and Wales, *op. cit.*, note 36 above).

⁴⁹ England and Wales, Registrar-General, *op. cit.*, note 17 above, p. xxviii.

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of all, given the usually greater vulnerability of old people to influenza, considerably worse mortality than the elderly. No explanation of this mystery has previously been offered, though Crosby (citing F Macfarlane Burnet) has suggested that it might have to do with the different ways the human immune system responds, at different ages, to a completely new infection.⁵⁰ It has been argued above that the age pattern of mortality in the 1918–19 influenza outbreak in England and Wales makes sense if it is supposed that the virus which caused it was related to the one responsible for an earlier influenza outbreak, in 1847–48, since this would mean that those exposed to the earlier virus would have enjoyed some immunity to the later one. However, since essentially the same age pattern of mortality as observed in England and Wales in 1918–19 has been reported quite generally for countries around the world during the pandemic, this then raises the question of whether the England and Wales experience of influenza during the nineteenth century was duplicated elsewhere, since, if not, the argument that previous exposure explained the age pattern of mortality might be difficult to sustain.

Regrettably, data on cause of death of the type that have been considered here for England and Wales since 1838 are not available for this period for other countries. Hence, assessment of the impact of influenza during the nineteenth century must depend on the reports of doctors and others at the time. This implies, as K David Patterson tells us, that, even if a particular influenza virus did spread around the world (which he certainly does not see as an inevitability given nineteenth-century transport speeds), “the patchy nature of surviving records might not reveal it”; he also notes that, since information is lacking on the viruses responsible for influenza outbreaks prior to 1889, “The definition of a pandemic presents major difficulties in the pre-1889 period”.⁵¹ It is not particularly surprising, then, that opinions vary on whether the 1847–48 influenza outbreak was part of a pandemic or not. Patterson himself believes not: even though it was “considered a true pandemic by many authors” his own assessment is that the 1847–48 outbreak primarily affected western Europe and the Mediterranean; “East and South Asia were not involved, nor were the Americas”; (he does go on to add, however, “with the possible exception of a minor late outbreak in the West Indies in October and November 1848”⁵²). By contrast, though, the 1998 *Textbook of influenza*, after a review of all the evidence (including Patterson’s), concludes that 1847–48 was the period of a “probable pandemic”.⁵³

Clearly, if the 1847–48 influenza epidemic in England and Wales was part of a worldwide outbreak, as many believe, then in principle the explanation that has been suggested for the age pattern of mortality in the 1918–19 influenza pandemic might be valid. But what if Patterson is right and 1847–48 was not the period of a pandemic? The virus responsible for the 1847–48 outbreak was either a “new” one, in the sense of being radically different from that circulating in the period leading

⁵⁰ Crosby, *op. cit.*, note 1 above, pp. 220–2.

⁵¹ Patterson, *op. cit.*, note 6 above, p. 3.

⁵² *Ibid.*, p. 43.

⁵³ Nicholson, Webster and Hay (eds), *op. cit.*, note 5 above, p. 7.

up to 1847–48, or it was a variant of, or even the same as, the virus already in circulation. If the latter, then the 1847–48 virus was very probably related to one which had spread throughout the world already. There is strong evidence that there was an influenza pandemic during the period 1830–33, and there were further substantial outbreaks in some parts of the world during 1836–37, presumably caused by the same or a related virus.⁵⁴ If, on the other hand, the 1847–48 virus was “new”, but did not, for some reason, spread everywhere at that time, it seems extremely unlikely that it would not have spread throughout the world subsequently. It is worth remembering that there were further upsurges of influenza in England and Wales in 1851 and 1855, which were probably related to the same virus as produced the 1847–48 outbreak, so that further opportunities for worldwide transmission would have arisen. Moreover, Patterson tells us that influenza was reported in the West Indies and in South America in late 1850 and in Germany in early 1851; and that outbreaks were recorded both in Europe and in the western hemisphere in 1857–58.⁵⁵ All observers agree that, as in England and Wales, there were no further substantial outbreaks of influenza anywhere during the nineteenth century until the 1889–92 pandemic arrived.⁵⁶

All things considered, the argument that has been put forward, on the basis of data for England and Wales, might well, in principle, apply also to the rest of the world. Fundamentally, the argument is that the age pattern of mortality in the 1918–19 influenza pandemic reflected previous exposure to a related virus over a period of time prior to 1889 or 1890. Even if the 1847–48 influenza outbreak was not worldwide, there seems every reason to believe that all populations would have been visited by this or a related virus not many years later, if not actually at that time; if the 1847–48 virus was itself related to that responsible for the 1830–33 pandemic, such a virus may already have established itself worldwide in any case. Hence it is indeed likely that, for at least thirty years, in many cases for forty years, and perhaps for an even longer period before the pandemic of 1889–92, populations around the world would have harboured the 1847–48 virus or one related to it. Moreover, populations generally would also have had the shared experience of an upsurge in exposure to influenza in 1847–48 or some time during the ensuing ten years.

A further potential difficulty remains: if the 1918–19 influenza outbreak was so lethal, and if 1847–48 was caused by a related virus, why was the mortality associated with 1847–48 clearly so much lower than in 1918–19? It is effectively being supposed that the 1918–19 influenza outbreak was caused by a virus similar enough to that

⁵⁴ See Nicholson, Webster and Hay (eds), *op. cit.*, note 5 above, pp. 5–6, who report that (p. 6) “No disagreement exists among commentators for the pandemic of 1830–33”. This is not strictly true since Patterson argues that there were separate pandemics in 1830–31 and 1833 as well as a further “probable pandemic” in 1836–37 (see Patterson, *op. cit.*, note 6 above, pp. 32–41, 47, 83). However, he is rather unconvincing on this: neither the 1833 outbreak nor that of 1836–37

seems to have been worldwide; and Patterson himself observes that the 1833 outbreak in some ways “behaved like a second wave of a modern pandemic” (*ibid.*, p. 38) and that (p. 40) the 1836–37 virus could have been a drifted variant of the earlier strain.

⁵⁵ Patterson, *op. cit.*, note 6 above, p. 47.

⁵⁶ *Ibid.*; see also Nicholson, Webster and Hay (eds), *op. cit.*, note 5 above, p. 7.

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responsible for 1847–48 that exposure to the earlier outbreak conferred some protection against the later one but at the same time different enough from the earlier virus to have taken on a considerably enhanced virulence. All that can really be said on this is that it is not known, as yet, exactly why the 1918–19 virus was so lethal but that it might indeed prove that this lethality arose from a structural feature which represented only a very small change to an earlier virus (or a change, at least, which did not negate the value of previously-acquired immunity). It is worth noting, moreover, that even different waves of the same influenza pandemic often show noticeably different degrees of severity.⁵⁷

Postscript

It has been believed for some time that the virus responsible for the 1918–19 influenza pandemic was closely related to one later identified as the cause of a swine influenza, which remains an infection of pigs to the present day.⁵⁸ Given the dreadful history of this virus (not to mention the suggestion that viruses may sometimes be recycled), it is obviously of considerable interest and importance that the precise structure of the 1918–19 influenza virus be established. In recent years there have been a whole series of attempts to achieve this. These have ranged from investigations of tissue, deliberately stored at the time, from individuals dying from influenza in 1918–19, to studies based on victims' remains recently exhumed from permafrost in Spitsbergen and in Alaska.⁵⁹ A great deal of progress has been made; however, as one commentator noted recently, "Even after the latest round of . . . analysis of the flu genome, it remains a mystery why the flu virus of 1918 was so deadly".⁶⁰

It is fair to say that the medical world is still haunted by the memory of 1918–19. It should be remembered that, even today, there are no effective drug cures for viral conditions like influenza (though, hopefully, pneumonic complications of bacterial origin could be treated with antibiotics). There was great alarm in the United States in 1976 when there was apparently direct transmission of a strain of swine influenza to humans, which was then followed by further cases resulting from human-to-human transmission, at Fort Dix, a military camp; however, fortunately (and against expectation at the time), this did not spread to the general population; in the meantime, though, an appropriate vaccine had been produced and more than 40 million Americans vaccinated.⁶¹ The world held its breath in 1997 when a number of deaths occurred in Hong Kong as a result

⁵⁷ Nicholson, Webster and Hay (eds), op. cit., note 5 above, p. 16.

⁵⁸ Ibid., pp. 11–12.

⁵⁹ Ibid.; see also Jeffery K Taubenberger, Ann H Reid, Amy E Krafft, Karen E Bijwaard and Thomas G Fanning, 'Initial genetic characterization of the 1918 "Spanish" influenza virus', *Science*, 1997, 275: 1793–6; and John S Oxford and Rod S Daniels, 'The Holy Grail of

influenza virologists', *Nature Medicine*, 1999, 5: 484–5.

⁶⁰ Nicholas P Restifo, 'Flu: the story of the great influenza pandemic of 1918 and the search for the virus that caused it', *Nature Medicine*, 2000, 6: 12–13, p. 13.

⁶¹ Ibid.; see also Nicholson, Webster and Hay (eds), op. cit., note 5 above, p. 198.

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of infection with an influenza virus emanating from chickens, which appears to be highly pathogenic (though possibly not transmitted from human to human); it remains to be seen whether the mass slaughter of chickens at that time will prove to be the end of the matter or not.⁶²

⁶² Nicholson, Webster and Hay (eds), *op. cit.*, note 5 above, pp. 561–5.