Biosecurity and Bioterrorism: Biodefense Strategy, Practice, and Science
Volume 7, Number 3, 2009 © Mary Ann Liebert, Inc.
DOI: 10.1089/bsp.2009.0729

Public Health and Medical Responses to the 1957-58 Influenza Pandemic

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As the U.S. prepares to respond this fall and winter to pandemic (H1N1) 2009, a review of the 1957-58 pandemic of Asian influenza (H2N2) could be useful for planning purposes because of the many similarities between the 2 pandemics. Using historical surveillance reports, published literature, and media coverage, this article provides an overview of the epidemiology of and response to the 1957-58 influenza pandemic in the U.S., during which an estimated 25% of the population became infected with the new pandemic virus strain. While it cannot be predicted with absolute certainty how the H1N1 pandemic might play out in the U.S. this fall, lessons from the 1957-58 influenza pandemic provide useful and practical insights for current planning and response efforts.

> *The scientific watch on Asian influenza in the world this fall [1957] has provided no evidence of a world catastrophe like that of 1918 and 1919, when 20,000,000 people died of influenza and its complications.*[1(p29)]

In the spring of 2009, influenza cases caused by a new virus strain, pandemic (H1N1) 2009, were first identified in the U.S. and Mexico and soon spread throughout the world. As of the end of July, more than 134,000 cases and 800 deaths have been reported in more than 122 countries. In the U.S. alone, more than 43,000 cases and 300 deaths have been confirmed; more than 1 million cases are estimated to have occurred, and all states have had cases. Most H1N1 cases have been reported to be comparable in severity to seasonal influenza, although a small percentage has required hospitalization. Since April, a number of outbreaks with high attack rates have occurred in schools and summer camps, and some transmission has occurred in communities. However, with the onset of summer, influenza incidence has fallen sharply, as it customarily does. Speculation is now rife as to what might be expected over the coming months with the advent of autumn and the convening of schools. Might there be massive epidemics, or might the virus simply fade away? And when would epidemics begin—as early as September or not until the usual December-February influenza season? Might the severity of the disease increase such as to resemble the 1918 pandemic?

No one can predict with absolute certainty what future directions pandemic influenza might take, but we would be ill-served if we did not consider past experience. Interestingly, the 1957-58 Asian influenza (H2N2) pandemic bears many similarities to the 2009 pandemic in its epidemiologic behavior. Both arose early in the year and spread widely during the spring. While outbreaks substantially abated over the early summer months in the northern hemisphere, major epidemics developed in the southern hemisphere (the traditional seasonal pattern). To date, the reported clinical presentation of cases and transmission of disease appear to be similar to and be reminiscent of the 1957 pandemic outbreaks. Of the patients requiring hospitalization in 2009, many have been reported as having underlying medical conditions. Reported case-fatality rates have been low, similar to those observed during seasonal influenza epidemics.

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Thus, as the nation prepares to deal with the new pandemic strain this autumn and winter, we believe a review of the public health and medical experiences of the 1957-58 pandemic should be informative for current planning and response efforts. Such a consideration is also important because pandemic preparations since 2004 have largely focused on the threat of a pandemic of the highly virulent H5N1 "bird flu" virus. There has been appropriate concern that a bird flu pandemic might prove to be as devastating as the 1918 pandemic. While H5N1 continues to be a serious concern, the 2009 H1N1 strain currently appears to have similar case fatality rates as the 1957 Asian strain.

For this article, the authors reviewed 1957 pandemic data from the published sources cited in the references. We also reviewed mimeographed copies of surveillance reports from June to December 1957. These reports, which continued to appear at least into 1959, were published twice weekly by the Influenza Surveillance Unit of the Communicable Disease Center (CDC) during the 1957 pandemic;* these documents are part of author D. A. Henderson's personal library. Until November 1957, Dr. Henderson had major responsibility for establishing the CDC influenza surveillance program; data and analysis of events presented are also based on his direct experiences working with CDC during that time.

Additional information on the pandemic was obtained from a review of articles from the *New York Times* from September and October 1957 and of fall and winter 1957 records from the Johns Hopkins Hospital in Baltimore, Maryland; the University of Pittsburgh Medical Center in Pittsburgh, Pennsylvania; the Maryland State Department of Health; and the Baltimore City Health Department.

Emergence of a New Influenza Virus Strain: 1957

In February 1957, a new influenza virus (H2N2), called the "Asian strain," emerged in China.[2] It subsequently spread to Hong Kong in April and through eastern Asia and the Middle East in April, May, and June.[2] By June, more than 20 countries, including the U.S., had experienced their first cases.[2] South American and African countries were afflicted in July and August. In September, widespread epidemics began in North America and Europe.[2]

The Initial Spread of Influenza in the U.S.: Summer of 1957

U.S. military bases in Korea and Japan experienced outbreaks of the Asian virus in April and May 1957, but the first cases in the U.S. were not reported until early June.[3,4] The cases were in military camps on the East and West Coasts, with some 10,000 cases reported from West Coast bases alone.[4] Naval ships reported attack rates of 18% to 45%.[5] Subsequently, numerous localized outbreaks began to occur in other closed, institutional-type settings (eg, conference centers, children's camps, migrant worker barracks). The outbreaks were characterized by attack rates as high as 30% to 50% or more, but the illnesses were mild. Some cases were reported from urban areas, but there was little communitywide transmission. Surprisingly, even family members of patients returning from infected camps or conference centers seldom were infected despite their close contact with the cases.[4] Such was the experience following outbreaks at a June conference of approximately 1,800 young people in Grinnell, Iowa, and a mid-July Boy Scout Jamboree of more than 53,000 in Valley Forge, Pennsylvania.[4] Some summer camps were closed because of epidemics, but most arranged for the care of patients in special cabins or tents.

During the summer of 1957, the virus seems to have seeded itself throughout the country, and in early August the first evidence of communitywide spread appeared.[3,6] A massive outbreak had developed in July in Tangipahoa Parish, Louisiana, and extended throughout this parish of 60,000 people.[3] The epidemic was intensively studied by CDC staff in an effort to gauge what might occur in the autumn. The triggering event appeared to be the opening of 20 of the parish schools in mid-July (the schools were opened early in the year so that students could take time off to work in the strawberry fields in the spring).[3] A few cases of febrile respiratory disease began occurring in early July, developing more or less simultaneously in most schools.[3] The peak of the outbreak was reached in late July; by mid-August, the influenza epidemic was over.[3] Only about 4 weeks had elapsed since it began. Attack rates in the schools ranged from 40% to 60%.[3] Serological surveys revealed that half of those reporting no influenza illness showed serological evidence of infection.[3] The illness was said to be "sudden in onset and marked by high fever, malaise, headache, generalized myalgia, sore throat, and cough . . . nausea and vomiting were not unusual among the younger children."[3(p1461)] Two deaths were associated with the epidemic, but no details were provided.[3] The outbreaks in this parish were soon followed by a series of outbreaks that involved entire communities throughout Louisiana and adjacent areas of Mississippi.[4]

National Policies for Addressing the Expected Pandemic

The looming pandemic and what to do about it was the subject of a special meeting of the Association of State and Territorial Health Officers (ASTHO) on August 27-28,

*In 1957 the CDC was called the Communicable Disease Center. In 1970, the name changed to the Center for Disease Control, and it was later changed to the current name, the Centers for Disease Control and Prevention.

1957, in Washington, DC.[†7,8] The health officials met to discuss the threat and to decide on strategies. At the time, there was uncertainty as to whether most epidemics would be delayed until the usual influenza season (perhaps December 1957-February 1958) or whether the virus might strike as it did once before (in 1918) in September.

ASTHO pointed out that "[p]revention, which in the absence of effective means to stop the spread of infection[,] resolves itself into an immunization program."[7(p1)] Accordingly, the association decided that the primary objective for the vaccine programs was "to prevent illness and death from epidemic influenza within the limits of available vaccine."[8(p2)] It was recognized, however, at the time of the meeting that vaccine production was just getting underway and that little vaccine would be available for at least 2 to 3 months.

Surgeon General Leroy Burney announced on August 15 that vaccine was to be allocated to states according to population size, and it was to be distributed by the manufacturers through their customary commercial networks.[9] To address expected shortages, the Surgeon General recommended that physicians give priority to:

- Individuals whose services were necessary to maintain the health of the community;
- Individuals who were necessary to maintain other basic community services; and
- People with tuberculosis and others who, in the opinion of a physician, constituted a special medical risk.[8(p2)]

The importance of home care for patients was stressed. ASTHO recommended that "hospital admissions be limited as far as possible to those cases of influenza with complications, or to those with other diseases which might be aggravated by influenza."[7(p3)]

At the meeting, ASTHO also stated that *"there is no practical advantage in the closing of schools or the curtailment of public gatherings as it relates to the spread of this disease* [emphasis added]."[7(p2)] This was in recognition that they saw no practical means for limiting the spread of infection.[7]

Surveillance

As of June 1957, CDC's only available measure for assessing epidemiologic trends in the U.S. was through routine weekly telegraphic reports of deaths coded as "pneumonia" or "influenza." The data were regularly reported to the National Office of Vital Statistics (NOVS). These reports, which were received from 108 large cities (50 million persons—about 30% of the population), were found to lag the actual date of death by about 10 days and the date of onset of illness by about 3 weeks.[4]

An Influenza Surveillance Unit was established at CDC in July and the following 3 additional surveillance systems were added:[4]

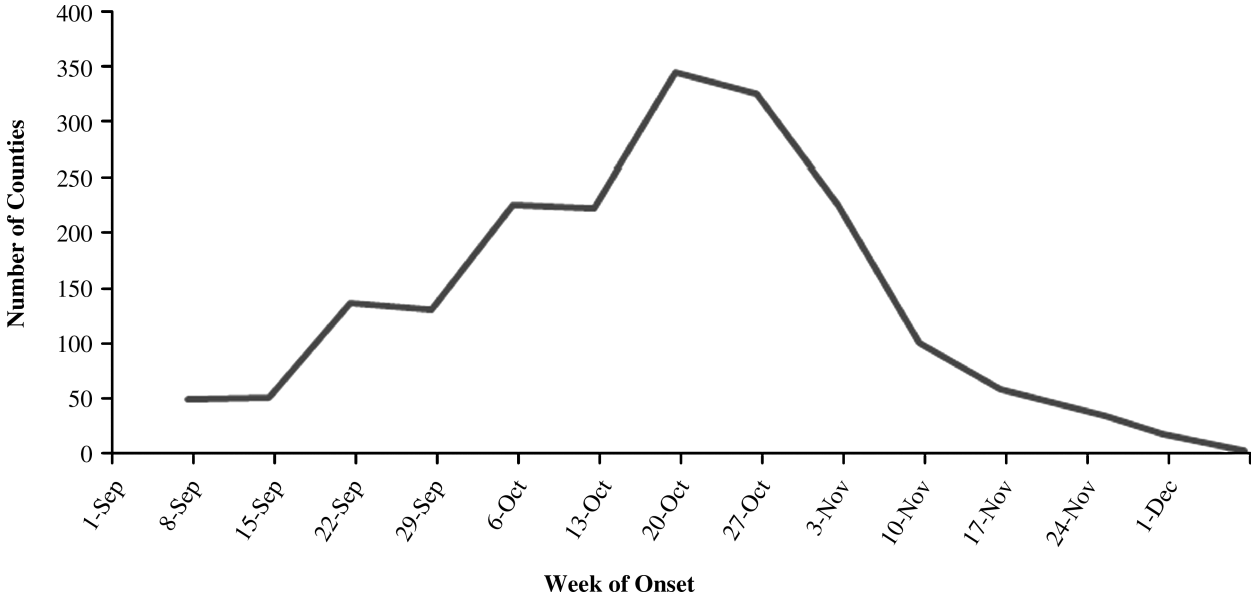
- *County Reports*. Each state was asked to identify a responsible observer in each county to provide information about cases and other details about the outbreak in his or her county. These data were to be reported to the state epidemiologist, who would send a weekly state summary to the Influenza Surveillance Unit. It was soon apparent that, except for the date of onset of a county outbreak, more detailed data were not likely to be provided. The outbreaks were so explosive that the evidence of an epidemic in progress in a county was quickly apparent by school absenteeism, clinic visits, and local gossip. Thus, dates of onset of epidemics in counties were tracked. Reports were received from two-thirds of the counties, comprising 85% of the U.S. population (Figure 1).
- *National Health Survey*. In 1957, a national survey (which is now called the National Health Interview Survey) was established to provide for ongoing monitoring of the health of the American people. Weekly interviews were conducted of 2,000 persons in 700 households, which were selected to provide a representative geographic and socioeconomic sample. On special request, the survey director provided weekly tabulations to CDC on the numbers of people with 1 or more days in bed because of an upper respiratory infection (Figure 2). It seemed doubtful that a sample so small would provide productive information, but, in fact, it tracked reasonably closely the trends of pneumonia and influenza mortality. Undoubtedly, this reflected the rapidity of influenza spread across the country and the development of what was almost a simultaneously occurring national epidemic.
- *Absenteeism*. The American Telephone and Telegraph Company provided daily absentee records for 60,000 telephone workers in 36 cities. It was a small, unrepresentative sample but an indicator of the impact of influenza.

Fall 1957: Epidemic Influenza Sweeps the Country

The opening of schools in September appeared to be "a major factor in initiating community epidemics."[4(p40)] By the middle of the month, most counties on the West Coast were experiencing major epidemics, with particularly extensive outbreaks in California and Arizona. By the end of September, states along the eastern seaboard were similarly affected, and, by the end of October, more than half of the

[†]ASTHO is now called the Association of State and Territorial Health Officials.

Figure 1. Number of Counties Reporting New Influenza Outbreaks by Week of Onset, United States, September-December 1957[a]



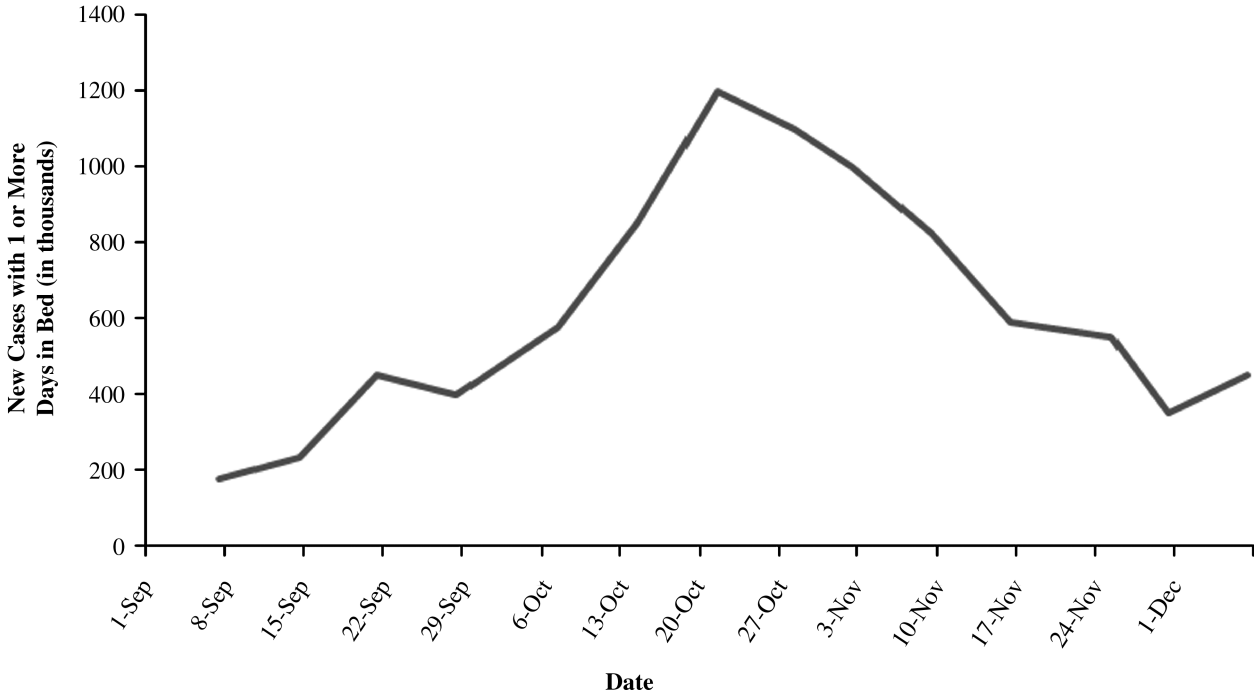
[a]Adapted from data in Reference 4.

counties throughout the country were experiencing epidemics (Figure 1).[4]

Little more than 2 months had been necessary for influenza to sweep the country. By mid-November, spread of the disease throughout the country was effectively complete, and by the end of November the numbers of new cases of respiratory disease being recorded by the National Health Survey began to level off (Figure 2).[4]

A decrease in the number of registered influenza and pneumonia deaths began in mid-November, and by the

Figure 2. New Respiratory Disease Cases as Reported through the National Health Survey, United States, September-December 1957[a]



[a]Adapted from data in Reference 4.

Figure 3. Weekly Pneumonia and Influenza Deaths in 108 Cities, United States, September 1957-April 1958[a]

[a]Adapted from data in Reference 10.

end of December the numbers had returned to normal (Figure 3).[10] In Figure 3, the upper solid line represents the number of pneumonia and influenza deaths reported from 108 cities weekly from September 1957 to April 1958; the lower solid line is the number of such deaths that would be expected based on previous years' experience with pneumonia and influenza deaths. The dashed line ("epidemic threshold") in Figure 3 is almost never exceeded except during influenza epidemics.

Absenteeism

Schools

High rates of absenteeism were recorded in schools across the country. It was estimated that over 60% of students had clinical illnesses during the autumn.[4] Data from 28 U.S. school systems showed increases of 20% to 30% absenteeism above the usual 5% average.[4] Junior high and high school student absenteeism was typically about 5% to 10% greater than among elementary school students.[4] On October 25, the Surgeon General estimated that 1 million Americans had developed influenza during the preceding week.[11] He added, however, that the epidemic was "not alarming" and estimated that the overall death rate was no more than two-thirds of 1% "of those contracting Asian influenza."[11]

In New York City, the outbreak began in early to mid-September 1957. From September 27, citywide data on influenza were recorded.[12] School absenteeism reached its maximum with 280,000 absences on October 7.[13] This amounted to 29% of all school attendees.[13] The highest rate was registered for Manhattan schools, which had an overall 43% absentee rate.[13] That day, 4,642 teachers (11%) did not report to work due to being sick.[13] Business establishments, however, reported no significant increase in absenteeism.[14] Within 2 weeks after the peak, school absentee rates were almost back to normal—around 7%.[15,16]

Industry

There was no evidence to suggest that industrial absenteeism was a significant problem except among teachers and healthcare workers. For example, data on telephone workers in 36 cities showed that the epidemic peaked during the week ending October 19 with an excess absenteeism rate of only 2.7%.[4] In the cities tracked, excess absenteeism during each city's peak week varied from 3.0% to 8.0%.[4]

Hospitals and Clinics

As mentioned, ASTHO encouraged home care for uncomplicated influenza cases to reduce the hospital burden and recommended limitations on hospital admissions to the

sickest patients.[7] Although the influenza incidence reached high levels during the course of the epidemic and physicians' offices and clinics were crowded to overflowing, most patients were not severely ill and did not require special medical care. Accordingly, most were advised simply to stay home, rest, and drink plenty of water and fruit juices.

Hospital admissions did increase, but in the 3 cities that we reviewed—Pittsburgh, Baltimore, and New York—hospitals had a surge capacity sufficient to handle the patient load. In Pittsburgh, for example, the pandemic had no significant impact on hospital practice and did not require the canceling of elective surgeries or discharging of patients.[17] There was a report of mothers with children "flocking into" the outpatient department of the Children's Hospital of Pittsburgh in early October, but few patients were admitted.[17] At Johns Hopkins Hospital in Baltimore, the pandemic appears to have been a non-event, and the hospital leadership expressed concern only about experiencing lower than usual "utilization and occupancy" in December and January.[18] The Maryland State Department of Health, which appointed an Influenza Advisory Committee in June 1957, referred to pandemic cases as being "mild diseases," noting that the virus "does not cause more serious illness than other types of flu—it simply affects more people."[19]

New York City seems to have experienced higher attack rates than most cities, but the vast majority of cases in the city were mild.[20] In early October, the *New York Times* reported that "extra beds were being prepared" at one hospital, and at Bellevue Hospital extra physicians were assigned to cope with the "upper respiratory epidemic" and elective surgeries were suspended.[21,22] Some hospital clinics were "jammed to overflowing . . . with suspected Asian influenza victims."[23(p12)] Private physicians reported seeing 4 to 5 times the number of influenza cases that were usually seen at that time of year; the city's public clinics were similarly crowded.[14] However, a physician at Bellevue referred to the pandemic as a "newspaper epidemic," and "the Hospitals Department . . . [saw] it as only a large number of cases."[21(p16)]

Disease Mitigation Efforts

Efforts to prevent morbidity and mortality associated with the pandemic focused on having supplies of vaccine. Measures were generally not taken to close schools, restrict travel, close borders, or recommend wearing masks. Quarantine was not considered to be an effective mitigation strategy and was "obviously useless because of the large number of travelers and the frequency of mild or inapparent cases."[4(p36)]

Closing schools and limiting public gatherings were not recommended as strategies to mitigate the pandemic's impact, except for administrative reasons due to high levels of absenteeism.[7] For example, ASTHO noted that "in some instances there may be administrative reasons for closing schools due to illness of teachers, bus drivers, large absentee rates, etc."[7(p2)] In early October, the Nassau County Health Commissioner in New York stated that "public schools should stay open even in an epidemic" and that "children would get sick just as easily out of school."[24(p22)] Many high school and college football games across the country were canceled or postponed because players were sick with influenza.[25-27]

Vaccine—Too Little and Too Late

Vaccine production efforts were greatly accelerated. The U.S. received its first influenza specimens from Hong Kong on May 13 and definitively identified the new strain on May 22. Special efforts were made to rapidly adapt the virus for use in vaccine production, and trials were conducted in early July with 700 subjects. The vaccine was to be packaged as a single 1.0-ml dose. Eventually, vaccine effectiveness was found to range from 53% to 60% in studies conducted during the outbreak.[28]

The 6 domestic vaccine manufacturers gave the production of vaccine high priority. Approximately 4 million doses were released in August, 9 million in September, and 17 million in October.[28] This amounted to enough vaccine for 17% of the population. However, the epidemic had peaked in late October 1957. New outbreaks declined sharply in November, and most terminated by the end of that month. Given the limited amount of vaccine available and the fact that it was not more than 60% effective, it is apparent that vaccine had no appreciable effect on the trend of the pandemic.[28]

Economic Impact

Despite the large numbers of cases, the 1957 outbreak did not appear to have a significant impact on the U.S. economy. For example, a Congressional Budget Office estimate found that a pandemic the scale of which occurred in 1957 would reduce real GDP by approximately 1% "but probably would not cause a recession and might not be distinguishable from the normal variation in economic activity."[29(p2)] As a comparison, industrial production in Canada was 1.2% below trend during the peak of the pandemic in October and at trend in November of 1957.[30] According to the Canadian Department of Finance, "[o]verall, the picture that emerges from the 1957 and 1968 pandemics is of possible very small direct economic impacts and no indirect impacts."[30(p16)]

January-March 1958: An Unexpected Increase in Excess Deaths

Unexpectedly, a second, 3-month-long wave of excess influenza and pneumonia deaths began in January 1958[4] and

peaked in late February (Figure 3).[10] This increase in excess mortality was puzzling. It occurred during the usual months of seasonal influenza. However, there were no communitywide epidemics being reported, the National Health Survey revealed a normal winter occurrence of febrile respiratory illness, schools were not closing, and industrial absenteeism was not elevated. Alexander Langmuir, who was then Chief of the CDC Epidemiology Branch, speculated that the deaths must have resulted from small and sporadic outbreaks too inconspicuous to attract public attention.[31]

Morbidity and Mortality

CDC estimated that approximately 45 million people—equivalent to about 25% of the population—had become infected with the new virus in October and November 1957.[4] County-level data showed attack rates ranging from 20% to 40%. The peak morbidity for the nation occurred in week 42;[4] the peak in influenza and pneumonia deaths occurred some 3 to 4 weeks later (Figure 3).[10]

In the 1957 pandemic, a similar age distribution of cases was noted in a number of different studies.[32] The highest attack rates were in school-age children through young adults up to 35 or 40 years of age.[32] Older adults, including those over the age of 60, had significantly lower attack rates. This was a very different age distribution pattern from that seen during nonpandemic years. It was attributed to the complete absence of protective antibody among children and young and middle-aged adults. In 1957-58, adults over 65 years of age accounted for 60% of deaths, but in 1960 they represented fully 80% of all excess pneumonia and influenza deaths.[33] This was attributed to the epidemics occurring during the winter months when indoor crowding was greater.

It has been observed that during an influenza epidemic, the effect of the epidemic extends well beyond deaths attributed solely to pneumonia and influenza. During the 6-month pandemic of October 1957 to March 1958, the National Office of Vital Statistics expected to receive and record 830,000 death certificates—a figure based on longer-term trends in mortality.[33] In fact, there were 62,000 more deaths than this, of which 19,000 represented excess deaths due to pneumonia and influenza.[31] To put this in perspective, there had been a total of 13 Type A epidemics between 1934 and 1963 (Table 1).[31] All except the 1957-58 pandemic would now be characterized as being due to "seasonal influenza" resulting from a genetic "drift" of the virus. The 1957-58 epidemic was different in that the genetic character of the virus "shifted" significantly, so that few in the population had residual immunity. The Type A viruses (H1N1) were supplanted by the H2N2 strain. It should be noted, however, that in 3 of the epidemics (1937, 1943-44, and 1963) the number of both excess deaths and excess pneumonia and influenza deaths approached or exceeded those of 1957-58.[31]

Table 1. Mortality Characteristics of Type A Influenza Epidemics, United States, 1937-1963[a]

	Number of Excess Deaths	
Period of Excess Mortality	*Pneumonia and Influenza*	*All Causes*
Dec 1934-Jan 1935	5,800	11,000
Jan-Mar 1937	29,000	46,000
Mar 1939	3,100	6,100
Dec 1940-Feb 1941	7,200	16,000
Dec 1943-Jan 1944	21,000	53,000
Mar-Apr 1947	4,800	13,000
Mar-Apr 1950	3,200	11,000
Feb-Apr 1951	4,000	15,000
Jan-Mar 1953	10,000	30,000
Oct 1957-Mar 1958	**19,000**	**62,000**
Mar-Apr 1959	1,500	4,100
Jan-Mar 1960	12,000	27,000
Feb-Apr 1963	12,100	57,000

[a]Adapted from data in Reference 31.

Antibiotics, as well as improved medical care, became increasingly available after 1945, but what impact they have had on deaths associated with influenza is not apparent from the excess mortality data.

Summary

The 1957-58 pandemic was such a rapidly spreading disease that it became quickly apparent to U.S. health officials that efforts to stop or slow its spread were futile. Thus, no efforts were made to quarantine individuals or groups, and a deliberate decision was made not to cancel or postpone large meetings such as conferences, church gatherings, or athletic events for the purpose of reducing transmission. No attempt was made to limit travel or to otherwise screen travelers. Emphasis was placed on providing medical care to those who were afflicted and on sustaining the continued functioning of community and health services. The febrile, respiratory illness brought large numbers of patients to clinics, doctors' offices, and emergency rooms, but a relatively small percentage of those infected required hospitalization.

School absenteeism due to influenza was high, but schools were not closed unless the number of students or teachers fell to sufficiently low numbers to warrant closure.

However, the course of the outbreak in schools was relatively brief, and many could readily return to activities within 3 to 5 days. A significant number of healthcare workers were said to have been afflicted with influenza, but reports indicate that hospitals were able to adjust appropriately to cope with the patient loads. Based on our *New York Times* review, there were no reports that major events were canceled or postponed except for high school and college football games, which were often delayed because of the number of players afflicted.

Available data on industrial absenteeism indicate that the rates were low and that there was no interruption of essential services or production. The overall impact on GDP was negligible and likely within the range of normal economic variation.[29]

Health officers had hopes that significant supplies of vaccine might become available in due time, and special efforts were made to speed the production of vaccine, but the quantities that became available were too late to affect the impact of the epidemic. The national spread of the disease was so rapid that within 3 months it had swept throughout the country and had largely disappeared. It was reported that with the end of the fall epidemic, demands for vaccine declined sharply. Whether a renewed effort was made to encourage vaccination before the spring of 1958 is not known, but many believe it was not.

During the 1957 pandemic, 25% of the U.S. population became ill with influenza, and excess mortality due to pneumonia and influenza occurred. From one watching the pandemic from very close range, though, it was a transiently disturbing event for the population, albeit stressful for schools and health clinics and disruptive to school football schedules.

Acknowledgments

Special thanks for assistance provided by Nancy McCall, Archivist with the Alan Mason Chesney Medical Archives of Johns Hopkins, and thanks to Christine SooHoo, MS; Jason Matheny, MPH, MBA; Amesh Adalja, MD; Kunal Rambhia; Lauren Smith; and other staff at the Center for Biosecurity for their valuable research contribution.

References

1. Plumb R. Toll of Asian flu nothing like 1918. *New York Times* November 15, 1957:29.
2. Dunn FL. Pandemic influenza in 1957: review of international spread of new Asian strain. *JAMA* 1958;166(10): 1140-1148.
3. Carey DE, Dunn FL, Robinson RQ, et al. Community-wide epidemic of Asian strain influenza: clinical and subclinical illnesses among school children. *JAMA* 1958;167(12):1459-1463.
4. Trotter Y, Dunn FL, Drachman RH, et al. Asian influenza in the United States, 1957-1958. *Am J Hyg* 1959;70(1):34-50.
5. U.S. Department of Health, Education, and Welfare. Communicable Disease Center (CDC). *CDC Influenza Report No. 9.* August 5, 1957.
6. Dunn FL, Carey DE, Cohen A, Martin JD. Epidemiologic studies of Asian influenza in a Louisiana parish. *Am J Hyg* 1959;70(3):351-371.
7. Association of State and Territorial Health Officers. Resolution Adopted by Association of State and Territorial Health Officers at Special Meeting on Influenza, Washington, DC. Appendix A. *CDC Influenza Report No. 15* (September 5, 1957). August 27-28, 1957.
8. Association of State and Territorial Health Officers. Resolutions Adopted by Association of State and Territorial Health Officers at Special Meeting on Influenza, Washington, DC. *Appendix to CDC Influenza Report No. 14* (August 29, 1957). August 27-28, 1957.
9. U.S. Department of Health, Education, and Welfare. Communicable Disease Center (CDC). *CDC Influenza Report No. 12.* August 16, 1957.
10. Langmuir AD. Asian influenza in the United States. *Ann Intern Med* 1958;49(3):483-492.
11. UP. Flu toll reaches 300 as cases rise. *New York Times* October 25, 1957:17.
12. Flu cases in city show sharp rise. *New York Times* October 16, 1957:37.
13. Alden R. Flu up in schools; state aid imperiled. *New York Times* October 8, 1957:1, 20.
14. Robinson L. Is it a real epidemic? A study of dispute on disease here. *New York Times* October 10, 1957:24.
15. Health officials optimistic on flu. *New York Times* October 22, 1957:68.
16. Weaver W. Flu epidemic cuts state school aid. *New York Times* October 29, 1957:1.
17. Based on discussions with UPMC staff and on a review of September and October 1957 news articles from the *Pittsburgh Post-Gazette*.
18. Based on a review of Johns Hopkins Medical Board Minutes and Johns Hopkins Hospital Board of Trustees Minutes from October 1957 through May 1958. The Alan Mason Chesney Medical Archives, Johns Hopkins Medical Institutions. Baltimore, Maryland. June 2009.
19. Maryland State Department of Health. *Monthly Bulletin* October 1957;29(10).
20. 500,000 here hit by the Asian flu. *New York Times* November 10, 1957:64.
21. Benjamin P. Asian flu in city called epidemic; 150,000 pupils ill. *New York Times* October 3, 1957:16.
22. Flu rate triples in city hospitals. *New York Times* October 1, 1957:30.
23. Alden R. Flu victims jam hospital clinics. *New York Times* October 4, 1957:12.
24. Flu cases in city continue to rise. *New York Times* October 2, 1957:22.
25. Flu throws football for loss as many games are called off. *New York Times* October 19, 1957:14.
26. Flu is still tackling college elevens but some teams find new opponents. *New York Times* October 25, 1957:32.
27. Flu sidelines ten on Clemson team. *New York Times* October 31, 1957:45.

28. Jensen KE, Dunn FL, Robinson RQ. Influenza, 1957: a variant and the pandemic. *Progress in Medical Virology* 1958; 1:165-209.
29. U.S. Congressional Budget Office. *A Potential Influenza Pandemic: Possible Macroeconomic Effects and Policy Issues*. December 8, 2005 (revised July 27, 2006). http://www.cbo.gov/ftpdocs/69xx/doc6946/12-08-BirdFlu.pdf. Accessed July 21, 2009.
30. Department of Finance, Canada. *The Economic Impact of an Influenza Pandemic*. Working Paper 2007-04. December 12, 2006. http://dsp-psd.pwgsc.gc.ca/collection_2008/fin/F21-8-2007-4E.pdf. Accessed July 21, 2009.
31. Langmuir AD, Henderson DA, Serfling RE. The epidemiological basis for the control of influenza. *Am J Pub Health* 1964;54(4):563-571.
32. Serfling RE, Sherman IL, Houseworth WJ. Excess pneumonia-influenza mortality by age and sex in three major influenza A2 epidemics, United States, 1957-58, 1960 and 1963. *Am J Epidemiology* 1967;86(2):433-441.
33. Eickhoff TC, Sherman IL, Serfling RE. Observations on excess mortality associated with epidemic influenza. *JAMA* 1961;176(9):776-782.

Manuscript submitted July 21, 2009;
accepted for publication July 28, 2009.

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