Another factor that increased the deadly effects of the 1918 pandemic was World War I. Living in close quarters under wartime conditions increased the spread of influenza, and the limited supportive health care available at the time was diverted to the war effort. Finally, many countries censored news reports about the pandemic to keep up morale as WWI drew to a close; unfortunately, this censorship prevented people from knowing the severity and extent of the pandemic so they could take precautions to mitigate the infection.

Unique among historical influenza pandemics, the 1918 event caused high excess mortality in younger adults, especially those aged 25–34. Typically, influenza strikes the very young and very old, resulting in a “U”-shaped CFR profile, such as that shown in Figure 1 for the 1928–1929 flu season. However, the 1918 virus exhibited a unique “W”-shaped profile (Figure 1), indicating increased mortality among young to middle-aged adults.
THE ROLE OF TECHNOLOGICAL AND MEDICAL ADVANCES

Many treatments are now available for influenza that were unknown in 1918. The discovery of the influenza virus in 1931 made it possible to develop vaccines that prevent infections. (Figure 2 is a timeline showing the discovery of the virus and other relevant scientific advances, along with past pandemics.) Today, antiviral drugs are available to treat influenza infection. In addition, the use of antibiotics and vaccines has reduced the rate of bacterial co-infections such as tuberculosis and pneumococcal disease, which cause complications in influenza patients. Furthermore, greater supportive care measures are now available, including state-of-the-art hospitals and intensive care units; in fact, studies suggest that many patients who died of influenza in 1918 might have survived if modern medicine had been available. Heightened national and international planning and preparedness efforts have also improved the ability for the world to respond to an imminent influenza pandemic threat.

ESTIMATING THE EFFECTS OF A MODERN-DAY “SPANISH FLU” PANDEMIC

To estimate the effects of a modern-day “1918 pandemic,” AIR’s epidemiologic model was run for a range of events using initial parameters consistent with the historical pandemic. These parameters included $R_0$ values of 1.80–2.48, and a range of CFRs (0.90%–1.25%) that have been adjusted to account for medical and scientific advances since 1918. Other initial parameters included when and where the pandemic originated. The pandemic was then propagated through the AIR model to estimate mortality and life insurance losses.

It is important to note that the model explicitly incorporates the application of mitigation measures such as antivirals, vaccines, and travel restrictions, and makes realistic assumptions for each. For example, the model assumes that vaccine production and deployment takes about six months; in contrast, antivirals are assumed to be available immediately. In the model, the availability

Pandemics are low frequency events with a potentially high impact for which there is a limited historical record. For these reasons, assessing pandemic risk can be challenging.

Probabilistic modeling enables a more robust understanding and management of pandemic risk than relying on the historical record alone. The AIR Pandemic Flu Model supplements traditional epidemiologic modeling with explicit modeling of population movement to yield a complete catastrophe modeling solution, allowing risk managers to fill in the gaps in the historical data.

The AIR Pandemic Flu Model also accounts for medical and technological advancements, incorporates the very latest in influenza research, and has been externally peer-reviewed by leading experts.
of both vaccines and antivirals varies according to each modeled country’s stockpile size, resource levels, and distribution capabilities. The model also accounts for variation in the efficacy of these pharmaceutical interventions by patient age, with an average efficacy of 40%–60%. Finally, the model accounts for worldwide population movements through air travel and local commuting. Global air travel will likely decrease as the pandemic becomes more widespread because of government-mandated restrictions and because people are likely to avoid traveling due to concerns over contracting the virus.

The AIR Pandemic Flu Model estimates that a modern day “Spanish flu” would result in between 21 and 33 million deaths globally. Developed countries would experience the lowest mortality rates, with population-level mortality rates in the range of 0.08%–0.09%, as shown in Figure 3. In fact, the AIR model suggests that, due to medical and technological advancements, case fatality rates would be almost 90% less than what was experienced during the actual 1918 Spanish flu. However, the AIR model also finds that increased global travel and an aging population would raise the death rate of a modern day “Spanish flu” pandemic by 30% and 8%, respectively, compared to the actual mortality rates in 1918. Taken together, these modeling results suggest that dramatically fewer excess deaths—nearly 70% fewer than actually occurred in 1918—would result from a “Spanish flu” event today.

The stochastic “modern day Spanish flu” event generated for the AIR model produces an age CFR profile similar to that of the actual 1918 pandemic. Specifically, the stochastic pandemic event exhibits increased mortality rates among young- to middle-aged adults (25–34 years of age), yielding a “W”-shaped mortality profile very similar to the mortality profile of the actual 1918 pandemic. This “W”-shaped profile can be attributed to the ability of the simulated virus to cause a cytokine storm, demonstrating the model’s ability to capture the effects of this complex syndrome.

Table 1. Mortality and life insurance losses estimated by AIR for seven countries due to a modern-day recurrence of the 1918 influenza pandemic (Source: AIR)

<table>
<thead>
<tr>
<th>COUNTRY</th>
<th>NUMBER OF DEATHS</th>
<th>INDUSTRY LIFE INSURANCE LOSSES (USD BILLIONS*)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>15,000 – 26,000</td>
<td>0.8 – 1.4</td>
</tr>
<tr>
<td>Canada</td>
<td>20,000 – 37,000</td>
<td>2.1 – 3.8</td>
</tr>
<tr>
<td>France</td>
<td>36,000 – 62,000</td>
<td>2.1 – 3.7</td>
</tr>
<tr>
<td>Germany</td>
<td>48,000 – 85,000</td>
<td>1.8 – 3.3</td>
</tr>
<tr>
<td>Japan</td>
<td>83,000 – 145,000</td>
<td>8.9 – 15.2</td>
</tr>
<tr>
<td>UK</td>
<td>36,000 – 64,000</td>
<td>3.1 – 5.5</td>
</tr>
<tr>
<td>U.S.</td>
<td>188,000 – 337,000</td>
<td>15.3 – 27.8</td>
</tr>
</tbody>
</table>

*All losses converted from local currency to USD using exchange rates as of 12/31/2012.

The AIR model estimates that a modern day “Spanish flu” event would result in additional life insurance losses of between USD 15.3–27.8 billion in the United States alone. According to the American Council of Life Insurers, benefits paid to beneficiaries in 2010 amounted to more than USD 58 billion (ACLI, 2011). Therefore, losses from a modern day “Spanish flu” would represent close to a 48% increase in the total benefits paid by the life insurance industry.

PUTTING THE SIMULATED PANDEMIC IN CONTEXT

The AIR Pandemic Flu Model features a 500,000-year stochastic catalog of more than 18,000 simulated pandemics. Based on this stochastic catalog, AIR can estimate exceedance probabilities for a modern-day recurrence of the 1918 pandemic from various perspectives. Exceedance probabilities vary by country and, within those countries, the probabilities also vary by age group. The AIR Pandemic Flu Model shows that, for the U.S. and UK, the observed population-level mortality from a recurrence would have an exceedance probability between 0.5%–1.0%, corresponding to a 100–200-year return period. This return period holds true for most age categories, with a few exceptions. For example, the mortality level for the 25 to 34-year-old age category is associated with a return period of around 200–400 years, which arises from the pandemic’s atypical “W”-shaped mortality profile. Conversely, for the 65+ age category, the estimated level of mortality would have a return period around 50–100 years.
Insurance and reinsurance companies should, however, realize that a modern day “Spanish flu” pandemic does not represent a worst-case scenario in terms of pandemic risk. For example, an emergent pandemic strain could be resistant to antiviral drugs; in addition, it may prove impossible to manufacture a vaccine in a timely fashion due to production difficulties. Hospitals may also be overwhelmed by the influx of the sick and the “worried well” and may be unable to provide care to everyone who needs treatment. For these reasons, and due to the threat of highly pathogenic avian influenza, the AIR stochastic catalog also includes extreme events with CFRs as high as 25%–30% in developed countries. Events this severe have the potential to cause hundreds of millions of deaths globally, including millions of deaths in the United States alone.

REFERENCES

AMERICAN COUNCIL OF LIFE INSURERS. 2011. 2011 LIFE INSURERS FACT BOOK, PAGE XIII.


1AIR TRENDS HISTORICAL LIFE INSURANCE LOSSES TO MODERN-DAY DOLLARS USING THE SHARE OF GDP METHOD (THE SHARE OF GDP REPRESENTED BY A HISTORICAL LOSS VALUE IS CALCULATED, AND THIS PROPORTION IS APPLIED TO THE CURRENT GDP).

2WHILE ALL OF THESE TREATMENTS ARE AVAILABLE IN DEVELOPED COUNTRIES, THEIR AVAILABILITY IN OTHER PARTS OF THE WORLD VARIES.

ABOUT AIR WORLDWIDE

AIR Worldwide (AIR) is the scientific leader and most respected provider of risk modeling software and consulting services. AIR founded the catastrophe modeling industry in 1987 and today models the risk from natural catastrophes and terrorism in more than 90 countries. More than 400 insurance, reinsurance, financial, corporate, and government clients rely on AIR software and services for catastrophe risk management, insurance-linked securities, detailed site-specific wind and seismic engineering analyses, agricultural risk management, and property replacement-cost valuation. AIR is a member of the Verisk Insurance Solutions group at Verisk Analytics (Nasdaq:VRSK) and is headquartered in Boston with additional offices in North America, Europe, and Asia. For more information, please visit www.air-worldwide.com.