



Pandemic Influenza Risk Management for Employers

A MILLIMAN GLOBAL FIRM



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This study was commissioned by GlaxoSmithKline.

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EXECUTIVE SUMMARY

Pandemic influenza has the potential of causing 30% or more of an employer's workforce to be absent from work for up to 3 weeks with an economic impact similar to a recession.¹ Pandemic influenza of this severity may infect 90 million Americans and could kill 2 million.¹ These grim human and economic forecasts are from a severe scenario published by US government agencies; even the moderate pandemic influenza scenario in these publications would disrupt many companies.^{1,2}

While the Congressional Budget Office (CBO) and many other studies on the effects of pandemic influenza focus on macro scale effects of a pandemic, our study focuses on individual employers. The CBO estimates that a severe pandemic influenza could cause a 4¼% reduction in US gross domestic product in the pandemic year.¹ Using assumptions very similar to those published by the CBO and by Health and Human Services (HHS) in its preparedness planning report, we estimate that a severe pandemic influenza will reduce a typical employer's revenue by 8% and its profit rate by 16 to 17 percentage points during the quarter of the pandemic. Even a moderate scenario would reduce a typical employer's revenue by 2% and profit rate by 3 to 4 points.

Several bird-to-human transmissions of new, highly virulent influenza strains have occurred in parts of the world over the past 10 years. Although the new strains have so far not mutated into a highly contagious human influenza that would unleash a pandemic, public health agencies and governments have recognized the threat and have established extensive surveillance, contingency plans and research aimed at managing, delaying or controlling pandemic influenza.

This report identifies the economic consequences of pandemic influenza for individual employers, and presents the potential value of antiviral prophylaxis. We estimate that timely use of prophylactic antivirals could reduce an employer's lost revenue and profit by about half. It should be noted that no clinical studies have been conducted to show whether antivirals are effective for the treatment or prophylaxis of patients with influenza strains with pandemic potential. And finally, no antiviral has been approved by the FDA for use with pandemic influenza.

Background

Concerns of pandemic influenza have heightened since 1997 when a novel avian influenza A virus (infecting domestic poultry) infected humans in Hong Kong and caused 18 hospitalizations and 6 deaths.¹ Since there is no general preexisting antibody protection to novel influenza A viruses, people are highly susceptible to infection, unlike seasonal influenza, which is caused by modified versions of influenza viruses that are already in widespread circulation. Several other outbreaks of avian influenza A virus have occurred with human infection since that time, but the responsible strains thus far have lacked the ability to spread easily from person to person and therefore have not led to a pandemic.

The H5N1 avian influenza A virus is now widespread in domestic and migratory fowl across Asia and Europe. As of February 19, 2007, WHO has reported that this strain has infected more than 274 humans killing 167 of those known to be infected.³ A pandemic could occur if this virus mutates so that it becomes easily contagious among people and spreads rapidly worldwide as in the 1918, 1957 and 1968 pandemics.

Extensive pandemic influenza preparedness plans have been developed by the Department of Health and Human Services and the Department of Homeland Security, and the Congressional Budget Office has developed estimates for the macroeconomic effect of pandemic influenza.^{1,2,4} The information and models in this report show ranges of potential impact on individual businesses in the US, using scenarios and assumptions published and widely disseminated by the US Government.

As in the official publications, we emphasize the extraordinary uncertainty concerning the “if, when, what, where and how” of pandemic influenza. The impact of pandemic influenza will depend on how severely a new strain sickens people and on society’s and businesses’ responses. In addition, businesses differ in their vulnerability to the effects of pandemic influenza. We have translated the available information and scenarios into financial structures that, we hope, many businesses will find useful as they plan how to manage this potential disaster.

This report was commissioned by GlaxoSmithKline, a pharmaceutical company. Milliman does not intend to endorse any product or approach through this report, which reflects the findings of the authors. The usual warning for any economic forecast is that it cannot capture all potentially relevant influences, and this caveat applies even more to forecasting the impact of pandemic influenza. Organizations should carefully consider how and whether to apply our findings to their situation. This report should be distributed only in its entirety, as pieces taken out of context could be misleading.

Our Approach and Findings

Most businesses depend on a constant, dependable supply of labor for meeting customer demands for their products and services. Pandemic influenza could temporarily disable 30% of an employer’s workforce.¹ Further, workers not infected by the influenza may miss work to care for sick family members. In a severe pandemic influenza, these work absences could last 3 weeks.¹ Under a moderate pandemic, the work absences are more likely to be approximately 4 days.¹ Even if it lasts only a few days, an unplanned absence for 30% of the workforce can disrupt many employers. For this reason, the Department of Homeland Security and the Centers for Disease Control and Prevention have identified steps employers can take to minimize or manage sickness and absences.^{4,5}

Our model estimates the potential effects of a severe and a moderate pandemic influenza on a single employer with and without the use of antiviral prophylactic treatment. Our application of published scenarios shows the impact that would occur in the quarter year of a pandemic influenza for a typical business with 10,000 employees. (See Table ES-1 on following page.)

Table ES-1
Results Without Prophylactic Treatment

	Severe Scenario	Moderate Scenario
Employee deaths caused by PanFlu	35 to 40	4 to 6
Reduction in Profit Rate (Earnings as a % Revenue assuming 10% pre-Pandemic)	Down 16-17 pts	Down 3-4 pts
Reduction in Revenue	8%	2%
Increase in Medical Expenses and Life Insurance Expenses	8%	1%
Percent of Lost Worktime During the Quarter of the PanFlu	8%	2%

We note that pandemic influenza may occur in waves separated by months. In this report, the financial estimates reflect an assumption that all waves occur within one fiscal quarter. If two waves occur, but in separate quarters, it would be reasonable to assume the same aggregate impact but less concentrated in time as the disruption would be spread over a longer time period. Other important assumptions, which generated these findings, are described in the body of the text.

Postexposure antiviral prophylaxis may be effective in preventing people from becoming sick. Assuming the effectiveness demonstrated in clinical trials, and that employees accessed and used such prophylaxis, our models produce the following results.^{6,7}

Table ES-2
Results with Prophylactic Treatment

	Severe Scenario	Moderate Scenario
Employee deaths caused by PanFlu	8 to 10	0 to 2
Reduction in Profit Rate (Earnings as a % Revenue assuming 10% pre-Pandemic)	Down 7-8 pts	Down 1-2 pts
Reduction in Revenue	3%	1%
Increase in Medical Expenses and Life Insurance Expenses	5%	1%
Percent of Lost Worktime During the Quarter of the PanFlu	3%	1%

Economic Context for Pandemic Influenza

Our report focuses on “microeconomic” business disruption, and we consider two broad categories:

1. Worker absence leading to reduced revenue. Workers may become ill or may miss work to care for family members who are ill.
2. Increased expenses. Medical and life insurance costs will increase during a pandemic.

These categories, while variable, are conceptually similar across employers. We do not consider “ripple effect” economics, as those vary enormously by business. For example, consumer demand for some products and services may decrease during a pandemic (such as attendance at public events), while others may increase (such as medical supplies or home entertainment). We also do not consider the likelihood that during pandemic influenza some workers may miss work to avoid contact with infected people.

Comparison of Pandemic Influenza to an Economic Recession

In its report on “Possible Macroeconomic Effects” of pandemic influenza, CBO concludes that a severe pandemic would cause economic disruption similar to a recession. CBO considers both “supply-side” and “demand-side” effects. The supply-side effects concern output losses from worker absences, such as those we consider in this paper. For a severe pandemic, the CBO found supply-side effects would cause a 2¼% reduction in the gross domestic product (GDP) for the year of the pandemic.¹ The demand-side effects of pandemic influenza would be the decline in demand for some products and services (such as restaurants and movie theaters).¹ CBO estimates demand-side effects would create a 2% reduction in GDP. Combining the supply-side and demand-side effects, the total reduction in GDP under the severe scenario is about 4¼%.¹

We believe the recession analogy for pandemic influenza is useful because businesses expect to manage their enterprises through economic cycles. Over the past 60 years, the US economy has gone through 10 periods of economic recession.⁸ On average, a postwar recession has lasted 10 months, only two recessions have lasted more than 11 months, and the two most recent recessions have lasted 8 months. As with economic cycles, we believe businesses can use planning to minimize the impact of potential pandemic influenza. The duration of pandemic influenza “waves” are relatively short, and the duration of an infected individual’s absence under the severe scenario averages about 3 weeks.¹ However, a pandemic’s duration is comparable to that of a recession.² Obviously, recessions have been much more common than pandemic influenza.

Across the ten postwar recessions, real (inflation-adjusted) GDP declined by approximately 4.1% relative to its long-run trend.¹ Given the combined effect of a 4¼% drop in GDP from a severe influenza pandemic, the CBO found that a severe influenza pandemic would have a “slightly larger” impact on the US economy than the typical recession.¹

Microeconomics and Macroeconomics

This report presents microeconomic results from a Demonstration Case of the Milliman model. The hypothetical employer is from a large industry sector of the US economy and the assumptions are the industry-average characteristics for an employer in that sector. We also present sensitivity analyses where we vary employer characteristics. The microeconomic findings are, of course, of high interest to any employer.

For the Demonstration Case, we found a severe influenza outbreak could reduce the employer's output by about 7.5% in one quarter, which on an annual basis is somewhat less than the 2% supply-side effect presented by the CBO. However, our analysis, by design, estimates the supply-side effects for a single employer. In a ripple effect, the loss of products or services from one employer affected by an influenza outbreak will hurt other employers' ability to meet their customers' demands. For example, the decrease in output from the chemical industry would affect employers in the rubber and automobile industries. The supply-side effects in the CBO analysis would have included these inter-industry effects, which accounts for their somewhat higher macroeconomic figures.

“Input-output multipliers” capture inter-industry relationships. Each industry and employer has its own input-output multiplier, but we believe many if not most businesses have a multiplier between 1.0 and 2.0.⁹ This suggests an impact on an employer from pandemic influenza of up to 2-fold, or even higher. In the sensitivity analyses, we found that estimated decreases in an employer's output (revenue) vary by industry, but the decreases ranged from 5% to 15%. The variability by industry and input-out multiplier impact suggests that our findings are in line with the CBO results.

Impact of an Influenza Pandemic on Profit Rates

The model estimates the impact of an influenza pandemic on an employer's profit rate, defined as profits divided by total revenue. For the Demonstration Case we assumed a 10% profit rate pre-pandemic, higher than the national average profit rate of between 5.5% and 7.5%. We note that profit rates are slightly lower in the early periods of an economic contraction and later periods of an expansion and slightly higher in the later periods of an economic contraction and early periods of an expansion. We chose to use a 10% profit rate for the Demonstration Case to illustrate the possible effects of an influenza pandemic on an employer with above-average profits. We found that for the Demonstration Case, the employer experienced a loss for the quarter in which the pandemic occurs. If the illustration had been for an employer with average profits, the loss would have been larger.

The decreases in the profit rate shown by the Milliman model are consistent with the comparison of the effects of a severe influenza outbreak to a postwar economic recession. The most recent recession occurred from March 2001 through November 2001.⁸ On an annual basis, the aggregate profit rate in 2001 was approximately 25% below the profit rate for 2000. In the Demonstration Case, we found an employer's 10% profit rate decreased to a loss – effectively a 100% drop in profits. Noting that the Demonstration Case is for a single quarter, we can expect that on an annual basis the employer's profits

will decline by approximately 25%. As with the drop in output, the decline in profit rate due to a pandemic is about that of an economic recession.

BACKGROUND ON PANDEMIC INFLUENZA

A pandemic is a disease spread over a wide geographic area and affecting a large proportion of the population. Pandemic influenza occurs when a novel influenza virus emerges that can infect, and be efficiently transmitted among, individuals because of a lack of preexisting immunity in the community.² By contrast, seasonal influenza involves a virus against which many individuals will have some level of existing immunity.

There has been recent concern that pandemic influenza could occur if the highly pathogenic strain of H5N1 avian influenza A virus, an influenza subtype that is currently endemic in bird populations, mutates so that it becomes contagious among people and spreads rapidly worldwide. The H5N1 influenza, first identified in humans in 1997, has thus far lacked the ability to spread easily from person to person. The 1997 episode in Hong Kong resulted in 18 infections and 6 deaths.¹ Since that time there have been several outbreaks of the H5N1 influenza and the number of human cases has grown. As of February 19, 2007, this strain had infected more than 274 humans killing 167 of those known to be infected.³ Nearly all of the human cases were likely caused by contact with infected birds, although there have been several cases of probable human to human spread of the H5N1 virus.¹ The concern is also fueled by the fact that H5N1 avian influenza virus is spreading in fowl beyond Southeast Asia and China into Central Asia, Africa and Europe, is able to survive longer under a broad set of environmental conditions, and has increased the range of species it can infect.¹

Course of Infection

Due to its as yet unknown features, it is difficult to predict the course of infection for an influenza strain that might give rise to a pandemic. In particular, a pandemic influenza strain may be a new, exceptionally virulent strain. Nevertheless, for planning purposes, it is useful to set out a course of infection from which to consider the potential effects.

In its preparedness planning report, HHS sets out a course of infection and other assumptions when planning for the potential effects of pandemic influenza.²

- The typical incubation period (the time between acquiring the infection and becoming ill), for influenza averages 2 days. The HHS assumed this would be the same for a novel strain that is transmitted between people by respiratory secretions.
- The HHS expected that persons who became ill will shed virus and transmit infection for one-half to one day before the onset of illness. Viral shedding and the risk for transmission will be greatest during the first 2 days of illness. Children will shed the greatest amount of virus, and therefore are likely to pose the greatest risk for transmission.
- The HHS assumed that, on average, about 2 secondary infections will occur due to transmission from someone who is ill. The HHS also noted that some

estimates from past pandemics have been higher, with up to about 3 secondary infections per primary case.

Treatment

The treatment for pandemic influenza will range from symptomatic treatment to antivirals to outpatient medical care, hospitalization, ICU care, and mechanical ventilation. If a pandemic were to occur, an adequate supply of readily available antiviral drugs could limit the spread of the infection.² However, there are concerns whether the US government will have an adequate stockpile for the general population.

Because the characteristics of pandemic influenza are not known, we present treatment guidelines for seasonal influenza. We note that pandemic influenza could be different or much more severe than seasonal influenza.

Most people with seasonal influenza are treated symptomatically. Current guidelines include rest, hydration, and antipyretics as needed, but aspirin is avoided in children due to the risk of Reyes's syndrome. Fever and aches can be treated with acetaminophen or nonsteroidal anti-inflammatory drugs (NSAIDs, such as ibuprofen). Other measures, such as nasal decongestants and steam inhalation, also may help relieve symptoms.

Antiviral drugs may be helpful in the prophylaxis and treatment of seasonal influenza, as seen in studies where the duration of symptoms decreased if antivirals were given within 1 or 2 days of symptom onset.^{6,7} However, on November 16, 2006, the CDC recommended that "neither amantadine nor rimantadine be used for the treatment or chemoprophylaxis of influenza A in the United States until susceptibility to these antiviral medications has been re-established among circulating influenza A viruses."¹⁰

Most people with seasonal influenza will recover fully in approximately 1 or 2 weeks. However, if a secondary bacterial infection develops, antibiotics may be required and recovery time may lengthen. For institutionalized patients, young children, the elderly, those with chronic disease, and women in late pregnancy, seasonal influenza and influenza-related pneumonia are important causes of mortality. With appropriate antibacterial treatment the mortality rate due to secondary bacterial pneumonia is decreased.¹¹

In the event of pandemic influenza, antiviral drugs may reduce morbidity and mortality and may also limit viral spread. Therefore, the HHS Pandemic Influenza Plan has provided guidelines for the equitable allocation of antivirals, with the primary goal of decreasing mortality, morbidity and other health impacts, while preserving essential societal functions. During an actual pandemic, these guidelines may be modified based upon new knowledge of the causative virus, disease epidemiology, available drug supply, societal impacts, and other factors.² It should be noted that no clinical studies have been conducted to show whether antivirals are effective for the treatment or prophylaxis of patients with influenza strains with pandemic potential. And finally, no antiviral has been approved by the FDA for use with pandemic influenza.

In a pandemic influenza outbreak, drug companies could switch from producing seasonal flu vaccine to producing a vaccine effective against the pandemic influenza strain. However, this switch assumes that a vaccine against a newly developing strain could be quickly developed and that drug companies have the capacity to produce enough vaccine to control the pandemic – two assumptions for which the CBO raised serious concerns.¹

In a pandemic, the demands for medical services could strain the US healthcare system capacity. In a moderate pandemic (such as the 1957 and 1968 experiences), the HHS assumes that 50% of infected persons would receive outpatient medical care and approximately 1% of those infected would be hospitalized.² Among those hospitalized, approximately 15% will receive ICU care and 7.5% will need mechanical ventilation. Under the severe pandemic (such as 1918), the treatment demands are much greater. While HHS assumes the same 50% incidence for the use of outpatient care, 11% of these infected were expected to need hospitalization. Among those hospitalized, the same usage rates apply for ICU care and mechanical ventilation -- 15% and 7.5%, respectively. These figures would strain or possibly overwhelm healthcare system capacity.

20th Century Pandemics

Over the past four centuries, there have been between 10 and 13 probable influenza pandemics – a rate of approximately three pandemics per century.¹ There were three pandemics during the past century. During the 1918-1919 outbreak, widely referred to as the “Spanish Flu” pandemic, an estimated 25-30% of the world’s population became ill; as many as 11% of those infected died.¹ The mortality rate was particularly high among individuals between 15 and 35 years old.¹

Although the infection rates during the 1957 and 1968 outbreaks were not significantly different from the 1918 outbreak, the mortality rates were much lower. During the 1918 outbreak, the case fatality rate was estimated to be about 2.5%, and during the 1957 and 1968 outbreaks the case fatality rates were estimated between 0.1% and 0.2%.¹

Key Assumptions

Recently, the US Department of Health and Human Services (HHS) and the Congressional Budget Office (CBO) published seminal reports on the effects of a pandemic influenza outbreak.^{1,2} The HHS report focuses on steps the federal, state, and local governments, as well as private industry, should take to prepare for a widespread pandemic influenza outbreak. The CBO report focuses on the estimated effects on the US economy. Both reports use similar assumptions concerning the infection and fatality rates that might occur under “severe” and “moderate” influenza outbreaks.^{1,2} Because only three widespread influenza outbreaks occurred during the 20th century, modelers have scant information to develop infection and fatality rates. The approach used for the HHS and CBO reports is to use the experience from the 1918 outbreak to develop infection and fatality rates for a “severe” outbreak and to use the experience from the 1957 and 1968 outbreaks for a “moderate” outbreak.

The HHS assumes a 30% infection rate across all individuals, with school-age children experiencing a 40% infection rate and working adults experiencing a 20% infection rate.² The HHS assumes the same infection rates under its severe and moderate scenarios.² The CBO assumes that under a severe outbreak 30% of workers would be infected and that among individuals who were infected 2.5% of the cases would be fatal. Survivors would miss 3 weeks of work due to sickness, fear of becoming sick, or caring for family or friends.¹ The CBO assumes that under a moderate outbreak 25% of all individuals would be infected and the case fatality rate would be between just over 0.1%. Survivors would miss one-quarter of the amount of time lost under a severe outbreak.¹

Worker productivity lost due to absences from the workplace and fatalities would give rise to supply-side consequences for employers. For some sectors of the economy, there would also be “demand-side” consequences due to a falloff in the demand for certain products and services (such as restaurants and movie theaters).¹

The CBO estimates that a severe pandemic would cause 90 million people in the US to become sick and 2 million fatalities. Real GDP would drop by 4.25% over the following year, with approximately one-half of the drop due to workers unable to work (supply side effects) and one-half due to decreases in consumer demand (demand-side effects).¹ Under the moderate pandemic scenario, the CBO estimates that 75 million people in the US would become infected and generate 100,000 deaths. The drop in economic activity under a moderate pandemic scenario was considered less than the drop for a typical recession. Economic effects for the moderate scenario might be masked by normal variation in economic activity.¹

FINDINGS

Our modeling shows estimates for an employer -- a Demonstration Case -- for the following effects of pandemic influenza:

1. Supply-side: Reduced revenue caused by absent workers
2. Expenses: Increased medical and life insurance costs

Each of these hurts the profit rate –profit defined as a percent of total revenue. The potential variability around our estimates is large. Important elements of that variability are the following:

- The severity of pandemic influenza will likely vary by locale, and even by employer within locale.
- Input-output multipliers can cause additional economic disruption. Industries and companies within industries vary in how disruption among suppliers or customers can cause additional effects on a company.

For these reasons, our findings should be viewed as a framework for customization by businesses, rather than as particular results applicable to any particular organization.

The Demonstration Case

For the model's Demonstration Case, we developed the following characteristics for a hypothetical employer:

- 10,000 employees with an occupational distribution reflecting that of the US all-industry average.
- Average annual wage of \$40,910.
- Pre-pandemic profit rate: 10%.
- Generous medical and employee life insurance benefits (3 times salary).

Other assumptions are described in the Technical Appendix. Because our model measures the impact of labor absence, an important factor is the ratio of corporate revenue to wages. The Demonstration Case assumes revenue is twice wages, as shown in Table 1.

Table 1
Workforce and Business Operations Assumptions
for the Demonstration Case

Consideration	Assumption
Number of workers	10,000
Total Annual Wages	\$409 million
Ratio of Revenue to Wages	2.00
Total Annual Revenue	\$818 million

For the hypothetical employer, the distribution of workers across occupational groups and the average salary for each group are based on the US, all-industry average, as shown in Table 2. From a survey conducted between mid-April and mid-May 2006, The Conference Board found that 44% of employers with sales between \$500 million and \$1 billion did not have any plans in place to address the impact of a pandemic influenza.¹²

Table 2
Distribution of Total Employment and Average Annual Salary
for the Demonstration Case

Occupational Group	Percent of Total Employment	Average Annual Salary
Management occupations	4.6%	\$95,526
Professional	23.7%	59,000
Sales and related occupations	10.7%	35,424
Administrative	17.5%	32,087
Production occupations	43.5%	30,200
Total	100.0%	40,910

We applied the moderate and severe pandemic influenza scenarios described in the Appendices.

Revenue Impact

We developed the revenue impact on the Demonstration Case by estimating, for the moderate and severe scenarios, the impact of the pandemic on worker absence, including estimating infection rates, duration of infection, and workers who stay home to care for

family members. The resulting days of absence generates lost wages and lost revenue. This is described in further detail in the Technical Appendix.

For the Demonstration Case, the moderate and severe scenarios generate the revenue reductions shown in Table 3.

Table 3
Revenue Reductions Under the Demonstration Case

	Severe	Moderate
Revenue in One Quarter	\$205 million	\$205 million
Portion of Workers Who Lose Some Time	33%	33%
Number of Weeks Out of Work	3.00	0.75
Total Wages Lost Due to Pandemic	\$7.8 million	\$2.0 million
Revenue Lost in One Quarter	\$15.6 million	\$3.9 million
Impact on Revenue in One Quarter	7.6%	1.9%

Health Benefits and Mortality Expenses

Pandemic influenza will cause an increase in medical expenses provided by employers through employee benefits programs. The mortality associated with pandemic influenza will generate additional employer costs through employer provided life insurance. Large corporations generally self-insurance health benefits and life insurance benefits are often experience rated, so we show these costs as employer costs. In addition, deaths among employees are associated with replacement costs. Our Demonstration Case shows the results in Table 4.

Table 4
Additional Healthcare, Life Insurance, and Worker Replacement Costs Under the Demonstration Case

	Severe	Moderate
Additional Healthcare Costs	\$11.1 million	\$1.4 million
Number of Deaths	39	4
Life Insurance Costs	\$4.8 million	\$0.5 million
Worker Replacement Costs	\$1.2 million	\$0.1 million
Total Additional Expenses	\$17.1 million	\$2.0 million

Impact on Profit

We used additional assumptions to estimate the impact of reduced revenue and increased expense on profit. We note that companies vary enormously in profit rates and their ability to quickly vary expenses. For the Demonstration Case, we assumed a relatively high profit ratio – 10% of pre-pandemic revenue. The results of the moderate and severe scenarios are shown in Table 5.

Table 5
Estimated Profit Rates Under the Demonstration Case
Without Prophylactic Treatment

	Severe	Moderate
Profit rate	10%	
Salaries	\$102 million	
Revenues	\$205 million	
Profit	\$20 million	
Non-Wage Expenses	\$82 million	
Total Additional Expenses	\$17 million	\$2 million
Adjusted Expenses	\$201 million	\$186 million
Adjusted Revenues	\$189 million	\$201 million
Estimated Profit rate	-6.5%	7.2%

The above analysis assumes that the Demonstration Case will continue to pay wages through the absence of workers. Mechanisms for this to occur include paid time off, sick leave, short-term disability, vacation time, allowing workers to borrow against future paid time off accruals, or generosity on the part of the employer. Obviously, an employer that reduces wages will reduce its expenses during a pandemic.

Potential Value of Post-Exposure Viral Prophylaxis

If pandemic influenza occurs, antiviral drugs may be able to reduce infection in people exposed to the virus as well as treat those infected.

A limited number of drugs have shown promise in treating the types of influenza that could create a pandemic and in the prophylactic treatment of people exposed to others with active infection. Depending on the drug, antiviral drugs can be stored for several years, and consequently developing a stockpile has advantages for controlling the effects of a pandemic. Several countries, including Japan, the United Kingdom, France, Norway,

the Netherlands, New Zealand, and the United States, have taken steps to stockpile antiviral drugs.¹ In the event of a pandemic in the US, the HHS would lead the public health and medical response. In May 2006, the HHS set a goal to stockpile enough antiviral treatments for at least 25% of the US population. In a January 2007 report to Congress, the HHS reported that by Fiscal Year 2008 the US federal government will have completed the purchase of 50 million antiviral treatment courses and subsidized the states and other entities with the purchase of another 31 million treatment courses.^{13, 14}

Table 6 presents the results where the employer has provided appropriate antiviral prophylactic treatment to the employees. The results find a much smaller drop in revenue. The employer remains profitable under both the severe and moderate influenza pandemic scenarios.

Table 6
Estimated Profit Rates Under the Demonstration Case
with Prophylactic Treatment

	Severe	Moderate
Profit rate	10%	
Salaries	\$102 million	
Revenues	\$205 million	
Profit	\$20 million	
Non-Wage Expenses	\$82 million	
Total Additional Expenses	\$10 million	\$2 million
Adjusted Expenses	\$194 million	\$186 million
Adjusted Revenues	\$198 million	\$203 million
Estimated Profit rate	2.1%	8.5%

The above scenario assumes the employer purchases sufficient antivirals at AWP prices to provide prophylactic treatment to all employees. It also assumes that all employees use the treatment appropriately. Other important assumptions are described in the Appendix.

Results for a Fortune 500 Company

The model was used to calculate the estimated economic impact of an influenza outbreak on a typical Fortune 500 company in the hotel industry. It is important to keep in mind that these estimates are for the loss of revenue and increased healthcare, life insurance costs, and worker replacement costs because employees will not be able to work due to

the influenza disease. These estimates do not include the impact that might arise from a decrease in the demand for hotel services.

Table 7 presents the results with and without employees using an appropriate antiviral prophylactic treatment. For this illustration, there was a workforce of 110,000 employees, the revenues/wage multiplier was 2.35, and the starting profit rate was 12%. Table 7 presents the results with and without prophylactic treatments. The results are similar to the Demonstration Case, with and without prophylactic treatment. Without prophylactic treatment, the expectation is that the company would incur a loss during a severe influenza outbreak. With prophylactic treatment, the results find that the company would remain profitable during such an outbreak.

Table 7
Estimated Profit Rates for a Fortune 500 Company
with and Without Prophylactic Treatment
(All figures are for one financial quarter)

	Severe	Moderate
Profit rate	12%	
Salaries	\$800 million	
Revenues	\$1,880 million	
Profit	\$226 million	
Non-Wage Expenses	\$854 million	
	Without Prophylactic Treatment	
Total Additional Expenses	\$169 million	\$20 million
Adjusted Expenses	\$1,824 million	\$1,675 million
Adjusted Revenues	\$1,737 million	\$1,845 million
Estimated Profit rate	-5.0 %	9.2 %
	With Prophylactic Treatment	
Total Additional Expenses	\$104 million	\$18 million
Adjusted Expenses	\$1,759 million	\$1,673 million
Adjusted Revenues	\$1,821 million	\$1,866 million
Estimated Profit rate	3.4 %	10.3 %

Results for Individual Industries

The assumptions for the Demonstration Case were for an “average” employer in the US with a workforce of 10,000 employees. The Demonstration case relied on the US averages for the occupational distribution, average annual salaries, workplace injury rates, healthcare costs, and other workforce characteristics and employee-benefit provisions.

Assumptions specific to an employer or developed from industry averages can be used for the model. Table 8 presents the results when the model was executed using the occupational distributions and average annual salaries for five industries. (The occupational distributions and average annual salaries for these five industries are presented in Tables 1 and 2 in the Technical Appendix to this report.) Assumptions

concerning injury rates, healthcare costs, the 2.0 revenue/wage multiplier, and a starting profit rate of 10% were the same as in the Demonstration Case.

Table 8
Estimated Profit Rates for Employers in Five Industries Without Prophylaxis
Under the Severe and Moderate Pandemic Scenarios (Starting profit rate 10%)

	Severe	Moderate
All Industries	-6.5%	7.3%
Chemical Manufacturing	-5.4%	7.4%
Transportation Equipment Manufacturing	-5.5%	7.4%
General Merchandise Stores	-11.3%	6.7%
Truck Transportation	-6.7%	7.2%
Securities, Commodity Contracts and Other Financial Investments and Related Activities	-3.8%	7.6%

WHAT EMPLOYERS CAN DO

This section describes the issues employers face in preparing for pandemic influenza. Our main message is that pandemic influenza planning requires consideration across the entire enterprise.

As others have indicated, pandemic influenza should be an important part of an organization's disaster recovery plan and risk management plan. The Business Roundtable, an association of CEOs of America's leading companies, has made explicit the connection between pandemic influenza and homeland security: "Should a pandemic influenza outbreak occur, chief executive officers would play a key role in protecting their employees' health and safety as well as mitigating the impact on business. As with all homeland security preparations, the key task is planning."¹⁵

The HHS guidelines offer employers more detailed recommendations for the development of their pandemic influenza plans. These recommendations include ensuring the availability of materials for respiratory infection control (e.g., tissues, receptacle for their disposal) and hand hygiene. Regarding antiviral drugs, HHS discourages healthcare providers from writing prescriptions for certain antivirals in advance of pandemic influenza because public buying after a public announcement of pandemic influenza could deplete drug store supplies. Employers who choose to stockpile may find valuable guidance about dissemination in the information provided by HHS for critical organizations.²

Even though pandemic influenza directly affects employees' health, we believe it would be a mistake to consider the response the sole responsibility of a company's benefits or human resource department. Pandemic influenza is an example of why enterprise risk management has emerged as a powerful management tool. One seminal document defines enterprise risk management as,

Enterprise risk management is a process, effected by an entity's board of directors, management and other personnel, applied in strategy setting and across the enterprise, designed to identify potential events that may affect the entity, and manage risk to be within its risk appetite, to provide reasonable assurance regarding the achievement of entity objectives.¹⁶

Because all employees could be affected by pandemic influenza, all departments play an important role.

How to Use This Paper in the Corporation

We and others have compared the business impact of severe pandemic influenza to that of a recession. Of course, some companies do not survive recessions while others demonstrate leadership and innovation and gain competitive advantage. We believe the same enterprise-wide challenges would apply during pandemic influenza.

Our model produces what might be considered "base cases" for companies -- challenges that organizations can beat. The model establishes rough magnitudes of the problem and

identifies key elements that can be managed. While a comprehensive discussion is outside the scope of this report, we offer the following challenges companies may have to manage through pandemic influenza:

- To what extent can non-absent workers compensate for absent workers through increased productivity or overtime?
- Can the company bring back retirees, workers on vacation or temporary workers to fill in for missing workers?
- Will the company's infrastructure support working at home? For which workers?
- To what extent can production be temporarily shifted to regions that, at that time, are less affected by pandemic influenza?
- Can management take steps to minimize disruptions among customers, stockholders, creditors, workers, suppliers and vendors?

Sources that address numerous additional considerations, such as reducing transmission in the workplace, are shown at the end of this section.

Value of Non-Pharmaceutical Measures

The Department of Homeland Security identifies key disease confinement measures in its document on critical infrastructure and key resources.⁴ These are:

- **Isolation:** Separation of persons with specific infectious illnesses in their homes, in hospitals, or in designated healthcare facilities.
- **Quarantine:** Separation and restriction of the movement, usually of a group of people, who, while not yet ill, have potentially been exposed to an infectious agent.
- **Social Distancing:** Within the workplace, social distancing measures could take the form of: modifying the frequency and type of face-to-face employee encounters (e.g., placing moratoriums on hand-shaking, substituting teleconferences for face-to-face meetings, staggering breaks, posting infection control guidelines); establishing flexible work hours or worksite, (e.g., telecommuting); promoting social distancing between employees and customers to maintain three-foot spatial separation between individuals; and implementing strategies that request and enable employees with influenza to stay home at the first sign of symptoms.
- **Closing Places of Assembly:** Voluntary or mandatory closure of public places, including churches, schools, and theaters.

- **“Snow Days/Weeks” and/or Furloughing Non-Essential Workers:** Voluntary or mandatory closure of all non-essential businesses and/or furloughing all non-essential workers. Of course the employer should consider extending paid time off.
- **Changes in Movement Patterns:** Restricting movement at the border, instituting reductions in the transportation sector, and applying quarantine protocols.

Each of these measures is applicable to most businesses, and will have their own impact on business. In addition, pharmaceutical prophylaxis can reduce the infection rate of seasonal influenza and may be useful for pandemic influenza.

Web Sites for More Information

The Center for Disease Control (CDC) and the US Department of Health and Human Services (HHS) provide web sites with very comprehensive information on pandemic and seasonal influenza. Much of this information is directed to employers, and some documents include checklists and processes for avoiding influenza and managing business in a pandemic.¹⁷

- To help employers and their employees on strategies for preventing flu, the CDC web site www.cdc.gov/flu/workplace provides flyers, posters, and other materials that can be posted and distributed in the workplace. This web site also includes information for employers and employees concerning the symptoms associated with the flu and steps for preventing the flu.
- The HHS web site www.pandemicflu.gov/plan/business includes a checklist for business pandemic planning, a “critical infrastructure guide” that provides a contingency planning process for an influenza pandemic and information for employees on how to protect against influenza.
- The HHS web site www.pandemicflu.gov/plan/businesschecklist.html provides a checklist developed by the CDC and HHS that identifies specific activities for businesses to prepare for an influenza pandemic.¹⁸ This checklist includes tasks to plan for the impacts on the business, its employees and customers, a process for establishing policies to be implemented during a pandemic, allocating resources to protect employees and customers during a pandemic, and communicating to and educating employees.
- The National Business Group on Health, a national non-profit organization focused on the health and wellness challenges of large employers, has a practical material and examples from large employers on its web site:
<http://www.businessgrouphealth.org/globalhealth/avianflu.cfm>.

In addition to these two federal government agencies, two major national business organizations have produced information that employers can use to protect against and

prepare for an influenza pandemic. Although the web site for each business group includes links to the CDC and HHS sites, each group also provides additional resources for employers to consider.

- The Business Roundtable has published a comprehensive report that provides strategic considerations and options for managing a wide range of homeland security risks, available at www.businessroundtable.org/pdf/20050503003CEORiskMgmtGuideFINAL. In many respects, the report serves as a blueprint for an all-hazards private sector response. Among other issues, the report addresses CEO and board involvement, capital planning, assets, human resources, crisis planning and legal considerations
- The US Chamber of Commerce web site www.uschamber.com/issues/index/defense/pandemic_influenza provides information on how businesses can prepare for pandemic influenza to maintain business continuity, help protect employees' health, and work with health officials to minimize disruption. This web site also provides information on the key differences between seasonal influenza and pandemic influenza. The Chamber and the Trust for America's Health have developed a brochure to help businesses with preparations for an influenza pandemic. The brochure identifies 10 steps an employer can take to maintain business continuity.

We expect that these sources and others will produce additional materials as the knowledge of and concern over pandemic influenza develops.

TECHNICAL APPENDIX

General Considerations

The Milliman model estimates the economic effects of pandemic influenza on a single employer. There are three major components to the financial costs of an influenza pandemic: (1) revenue lost because workers are unable to work, (2) healthcare costs for covered infected persons who receive healthcare, and (3) life insurance costs and replacement costs for covered persons who die from the illness.

This model produces an estimate for the supply-side financial effects on an employer caused by workers who are unable to work due to illness or caring for ill family members. Supply-side disruption causes revenue and profit loss because workers cannot produce the products and services purchased by the employer's customers.¹ Demand-side effects, caused by a decrease in the demand for the employer's products or services, vary greatly by industry and are not estimated in this present model. During a pandemic, demand will increase for certain industries and decrease for others.¹

The relative importance and even the direction of supply-side and demand-side effects will vary by employer. Supply-side effects may be relatively higher for manufacturing employers with large numbers of employees but with little consumer contact. By contrast, demand-side effects may be relatively higher for businesses with high contact between employees and customers or with a large amount of contact among customers, such as restaurants and movie theaters. Because of this variability, employers using this model should adapt the structure we provide here to add estimates of demand supply effects.

Estimation

The model can be executed using some or all of the characteristics of an employer's workforce. If employer-specific information is not available, the model will estimate the effects using averages for the employer's industry.

Model Design – Components of Lost Revenue

The model uses important characteristics of an employer's workforce, benefits, and financial structure to estimate the effects for pandemics of differing severity. For many components, the employer's specific information can be used. However, we provide a set of industry-average characteristics in case the specific information on the employer is not readily available.

Four Major Demographic / Epidemiologic Components

Four demographic / epidemiologic components drive revenue loss, as follows:

- Occupational distribution. Occupation is an important factor in an enterprise's human capital and financial results. We consider the impact of pandemic influenza by occupational class to help employers consider this factor. Workers who can work at home or other isolated locations can reduce their exposure to

pandemic influenza. While management, professionals, and sales workers may be able to shift work sites, administrative, production, and service workers are less likely to do so. Family composition varies by occupation; for this reason the risk of an employee missing work to care for an ill family member varies. In addition, employers should evaluate the relative impact of different occupational classes, given their own business characteristics.

In the model, the employer's occupational distribution can be used or an occupational distribution can be selected from the 89 North American Industry Classification System (NAICS) industry groups.¹⁹

- Worker wage and salary levels. Absence from work, whether due to illness, injury, or for other reasons, reduces output, and reduced output generally leads to economic loss for the employer. Wages (here used to include salary) are correlated with the output value generated by workers, and consequently a good measure of lost output caused by worker absences.²⁰ For assumed infection incidence rates and expected days away from work, the model estimates the value of lost output. In the model, either the wages for the specific employer or data for standard NAICS industry groups can be used.
- Pandemic severity. For its analyses, the CBO assumed a 30% infection rate for its severe scenario and a 25% infection rate for its mild scenario.¹ By contrast, the HHS assumed a 30% infection rate for both its severe and moderate scenarios.² We assumed 30% of all individuals become infected. For seasonal influenza, infection rates are higher among children, but, with the uncertainties surrounding a pandemic influenza we applied the 30% infection rate to all ages. However, morbidity and mortality rates in our sources vary with the pandemic's severity. The severity of past pandemics and even seasonal influenza vary by locale. For purposes of our model, we use assumptions from two scenarios CBO and HHS have each used. These assumptions generate our "severe" scenario and a "moderate" scenario.
 - For the severe scenario, infected workers and not-infected workers caring for others would miss 3 weeks of work.
 - For the moderate scenario, infected and not-infected workers caring for others are expected to miss one-quarter of the time assumed under the severe scenario (that is, 0.75 of a work week).
- Family composition. An infected spouse or underage child(ren) in the family may cause a worker to be absent from work. We split the workforce into four groups based on family status: (1) single worker with no children, (2) single worker with underage children, (3) married worker with no children, and (4) married worker with children.²¹

Normal workplace and non-workplace injuries, illnesses, and vacations cause workers to be absent. Our model nets out the effects of normal "background" absences not

associated with the pandemic. We did not consider that workers absent on vacation may be available to offset workers who are sick.

Occupational Distribution

Wage and salary levels, non-influenza injury and illness rates, and family composition differ across occupational groups, which is why the model identifies the occupational distribution of an employer's workforce. The model allows the employer's specific occupational distribution and also provides the average distribution for the employer's industry.

For 89 industry groups, employment data are available from the U.S. Bureau of Labor Statistics for 22 Standard Occupational Classification (SOC) groups. The model contains distributions for the 89 industry groups, and the 22 SOC groups are aggregated to 5 occupation groups.^{19, 22}

Table 1 presents the occupational distributions for all industries and for 5 industry groups.

- Chemical Manufacturing (NAICS 325)
- Transportation Equipment Manufacturing (NAICS 336)
- General Merchandise Stores (NAICS 452)
- Truck Transportation (NAICS 484)
- Securities, Commodity Contracts, and Other Financial Investments and Related Activities (NAICS 523)

Table 1 highlights the importance of categorizing employer's workforce by occupation. The occupational distribution varies a lot by industry. For example, management and professional workers account for approximately 5% of all workers in the general merchandise stores and truck transportation industries, approximately 25% in the chemical manufacturing and transportation equipment manufacturing industries, and over 40% in the securities industry. Workers in sales positions, who account for approximately 10% of workers in all industries, account for almost 60% in the general merchandise stores industry, approximately one-quarter in the securities industry, but less than 5% in the other three industries. These differences are important when injury/illness rates and family composition are considered in the model. They are also important components in an employer's disaster recovery plan.

Table 1
Occupational Distributions for All Industries and 5 Industry Groups

Occupational Group	All Industry Groups	Chemical Manufacturing	Transportation Equipment Manufacturing	General Merchandise Stores	Truck Transportation	Securities, Commodity Contracts, and Other Financial
Management	4.6	7.3	4.1	1.2	2.7	9.8
Professional	23.7	21.7	18.2	3.9	1.6	31.2
Sales	10.7	3.3	1.0	58.3	1.6	23.5
Administrative	17.5	11.2	6.3	24.5	12.5	34.6
Production	43.5	56.6	70.3	12.2	81.6	0.9
Total	100.0	100.0	100.0	100.0	100.0	100.0

Average Annual Salary

The average salaries for the employer can be used in the model or the average salaries from the US Bureau of Labor Statistics for the employer's industry group can be used.

Table 2 presents the average annual wages for the same industries in Table 1. There are large wage differences across industries. For example, the average annual wage for workers in the securities industry are more than three times higher than for the general merchandising. More important, however, are the differences across occupational groups within industries. The average salary for workers in professional occupations in the securities industry is approximately 120% higher than the average salary for administrative workers. For the other three industries, the average salary for professional workers is between 65% and 90% higher than the average salary for administrative workers.

Table 2
Average Annual Salaries for All Industries and for 5 Industry Groups

Occupational Group	All Industry Groups	Chemical Manufacturing	Transportation Equipment Manufacturing	General Merchandise Stores	Truck Transportation	Securities, Commodity Contracts, and Other Financial
All Workers	\$40,910	\$50,518	\$48,591	\$23,112	\$38,777	\$79,257
Management	95,526	110,915	104,862	73,154	87,185	140,323
Professional	59,000	65,920	71,338	43,591	53,470	87,956
Sales	35,424	70,804	59,971	20,935	56,732	102,647
Administrative	32,087	37,212	37,797	22,802	32,266	39,379
Production	30,200	38,348	40,211	22,575	37,550	32,255

Routine Reasons for Absence from Work

Without the effects of an influenza outbreak, workers will be away from work for work-related and nonwork-related injuries and illnesses. The model nets these absences by using the number of workers on the job as a starting point.

Data from the US Bureau of Labor Statistics are used to estimate the number of workers away from work due to work-related and nonwork-related injuries and illnesses. From its Current Population Survey, the USBLS compiles the incidence of lost worktime due to work-related injuries and illness from the Current Population Survey, a national survey conducted monthly on approximately 50,000 households.²³

We assumed that, on average, workers are provided 8 paid holidays and 10 vacation days per year, and that there are 260 days in a year available for work.²⁴ The implication is that over the course of a year 6.9% of worktime is spent on holidays and vacations.

Taken together, these assumptions imply that, on average, 1% of worktime lost is due to injuries and illnesses and 7% is lost due to paid holidays and vacations. In the Demonstration Case for the model, there are slight differences across occupational groups in the number of workers on the job because of differences in lost worktime due to injuries and illnesses.

Table 3
Time Away from Work Due to Injuries and Illnesses
and Due to Paid Holidays and Vacations

Occupational Group	Lost Worktime Rate due to Illness/Injury	Paid Holidays and Vacation
Management	0.8%	6.9%
Professional	1.1%	6.9%
Sales	1.0%	6.9%
Administrative	1.6%	6.9%
Production	1.6%	6.9%

Infection Rates

In the CBO and HHS reports, each agency presents two scenarios that differ according to the severity of an influenza pandemic. The two agencies generally relied on the experience from the 1918 pandemic to develop infection and fatality rates for a “severe” scenario, and the experience from the 1957 and 1968 outbreaks for a “moderate” scenario. Table 4 summarizes key assumptions from those reports that are relevant to this report.

- Severe scenario: In both reports 30% of the US population become infected, and slightly more than 2% of those infected die. The 30% infection rate in the CBO report is for all individuals, including workers in all sectors (except the farm sector).¹ In the HHS report, the 30% overall infection rate was separated into a 40% infection rate among school-aged children and a 20% infection rate among working adults.²
- For the moderate scenario, the HHS assumed a 30% infection rate across all individuals, while the CBO report used a 25% infection rate.

We do not attempt to quantify the number of absent workers who miss work because they fear becoming infected during work or commuting. For this reason, our absence figures may be lower than other estimates.

Previous pandemics have had two waves of infection,¹ and the CBO and HHS assumptions are the totals for the pandemic across waves.

Table 4
Assumptions for Severe and Moderate Scenarios

	Severe		Moderate	
	(1) CBO	(2) HHS	(3) CBO	(4) HHS
Illness				
Number of persons infected	90 million	90 million	75 million	90 million
Percent of US population	30%	30%	25%	30%
Deaths				
Number of deaths	2,000,000	1,903,000	100,000	209,000
Percent of infected persons	2.2%	2.1%	0.13%	0.23%
Percent of US population	0.67%	0.63%	0.03%	0.07%

Sources:

- (1) CBO report, page 1, paragraph 5, lines 6-9.
- (2) HHS report, page 18, Table 1.
- (3) CBO report, page 2, top, lines 2-4.
- (4) HHS report, page 18, Table 1.

The CBO presents estimates for worker lost time. Under the severe scenario workers are away from work for three weeks, and under the moderate scenario workers are away for one-quarter the absence under the severe scenario (that is, three-quarters of a week). The exception is the farm sector, where the CBO assumes absence rates one-third of other industries. Table 5 presents the absence rates in the CBO report and used for the present model.

Table 5
Weeks Out of Work

Economic Sector	Severe	Moderate
Nonfarm Business	3	0.75
Farm	1	0.25
Household	3	0.75
Nonprofit Institutions	3	0.75
Government	3	0.75

Source: CBO report, page 42, Table A-1.

For the Milliman model, we assumed that infected workers would be away from work – even if able to work, they would be away to avoid infecting others. While infection rates might differ across occupations, we found little rationale to support such assumptions.

The Milliman model produces estimates for two levels of an influenza outbreak. In a severe outbreak, 30% of the population is assumed to be infected and an infected worker

is expected to be away from work for three weeks. In a moderate scenario, 30% of the population is assumed to be infected and an infected worker is expected to be absent from work for four days. The infection rate assumptions are from HHS report. The time-away-from-work assumptions are from the CBO report.¹

Family Composition

We divided the labor force into the following family configurations: (1) single worker with no children, (2) single worker with underage children, (3) married worker with no children, and (4) married workers with children. We applied the following assumptions for the “family effect:”

- Single workers have no care-giver responsibilities and have no family effect.
- Workers in single-parent families with underage children would be the care-giver for infected children.
- Workers in Husband/Wife families but no children would be the care-giver if the spouse becomes infected.
- Workers in traditional families (husband, wife, children) may be the care-giver for an infected spouse or children when the spouse works outside the home.

Table 6 presents the distribution of family composition, by occupation, developed by Milliman. Workers in management positions tend to be older and therefore more likely to have a spouse but no dependent children. By contrast, workers in administrative positions tend to be younger and therefore single.

Table 6
Distribution of Family Composition, by Occupation

Occupational Group	Total	Single Worker Only	Single-Parent Worker + Underage Children	Worker + Spouse	Worker + Spouse + Underage Children
Management	100	10	10	50	30
Professional	100	20	10	10	60
Sales	100	5	20	15	60
Administrative	100	25	20	10	45
Production	100	20	15	5	60

Table 7 presents the estimated number of workers absent due to family effects. We provide separate estimates for workers in single-parent with children, spouse only, and spouse with children families.

Given the present assumptions, for this employer, 7.6 out of 100 management workers would be absent from work to care for other family members who are infected. By contrast, only 4.6 out of 100 professional workers would be absent because they will be caring for other family members. The difference is due to the high percentage of management workers in worker+spouse families. In these families, if the spouse becomes infected, the worker will bear the burden of care-giving.

Table 7
Number of Workers Absent from Work
Due to the Family Effects of a Severe Influenza Outbreak

Occupational Group	(1) Single-Parent Workers Absent to Care for Infected Children	(2) Workers Absent to Care for Spouse	(3) Workers Absent to Care for Spouse/Children	(4) Total
Management	1.9	4.8	0.9	7.6
Professional	1.9	1.0	1.7	4.6
Sales	3.9	1.5	1.7	7.1
Administrative	3.8	1.0	1.3	6.1
Production	2.9	0.5	1.7	5.1

Model Design – Healthcare Costs

An influenza outbreak will increase healthcare costs borne directly by the employer (if self-insured) or passed to the employer in the form of higher insurance premiums for experience rated healthcare coverage. The Milliman model estimates the additional healthcare costs for both severe and moderate scenarios.

Covered Lives

We assumed all workers in a company are covered by the employers’ health benefits program. We used the 2006 *Milliman Health Cost Guidelines* “Standard Demographics” to estimate the number of covered spouses and child dependents, as well as to distribute those members into single, husband/wife, single parent family and traditional family tiers. This distribution reflects the demographic composition of a typical large employer group. Under these assumptions, a typical employer with 10,000 employees will have 4,721 covered spouses and 7,844 covered children, for a total covered population of 22,565. Employers with significantly different demographics should consider adjusting our model results to better reflect their situation.

Infection Rates

We applied the 30% infection rate described above. We note that infection rates for particular locales could be much higher or lower.

Use of Healthcare Services

Not all infected persons will seek healthcare, and the intensity of healthcare will differ among those who seek care. We relied on the HHS report for our assumptions concerning the use of medical services.² We adjusted the HHS figures, which did not differentiate between the elderly and working age adults. Our analysis of claims data shows that the elderly are about 6 times more likely to use inpatient services, and we adjusted the HHS figures accordingly.

Table 8 presents the adjusted HHS assumptions for outpatient and inpatient healthcare use. The mortality rates shown are based on historical information and do not reflect potential reductions due to a healthier population or better medical care.

Table 8
Incidence Rates for Outpatient and Inpatient Healthcare Services

	Severe	Moderate
Given infection, incidence of outpatient healthcare (OP)	50%	50%
Given OP, incidence of inpatient healthcare (IP)	13.9%	1.2%
Given IP, incidence of ICU care	14.9%	14.9%
Given IP, incidence of mechanical ventilation	7.5%	7.5%
Given IP, incidence of death	19%	24%

Given a workforce of 10,000 workers, Table 9 presents the results applying the infection rate and healthcare utilization rates to the default assumptions for the number of adult dependents and covered children.

We did not consider potential capacity limitations that could occur during a severe pandemic. Costs may be limited by the availability of services if healthcare resources are overwhelmed. Such capacity limits could occur as a result of shortages of healthcare workers who may be infected or otherwise absent, or through demand exceeding physical capacity.

Table 9
Number of Covered Lives, Infected Persons,
and Infected Persons Using Healthcare Services

	Severe	Moderate
Number of Covered Lives and Infected Persons		
Number of workers	10,000	10,000
Number of adult dependents	4,721	4,721
Number of covered children	7,844	7,844
Total number of covered lives	22,565	22,565
Number infected	6,770	6,770
Number of Infected Persons Using Medical Services		
Outpatient healthcare	3,385	3,385
Inpatient healthcare	455	40
ICU care	68	6
Mechanical ventilation	34	3
Deaths	87	10

Incremental Cost of Healthcare

We used information from the MedStat MarketScan database, trended to 2007, to calculate the per-patient costs for infected persons. These per-patient costs do not vary by scenario. Table 10 presents the per-patient costs.

Table 10
Per-Patient Cost of Healthcare for Infected Persons Seeking Care

Type of Healthcare	Cost per Patient
Outpatient healthcare	\$ 113
Inpatient healthcare	17,019
ICU care	42,643
Mechanical ventilation	73,845
Post Hospital Discharge	419

The figures in Table 10 reflect employer costs for relatively generous programs (low cost sharing) with relatively loosely managed networks. Employers with restrictive networks or whose costs are significantly different from national average figures should consider adjusting these figures for their circumstances.

Our estimates for cost were developed by examining historical data for seasonal influenza. Outpatient costs were developed by comparing individuals' costs during an episode of seasonal influenza to their costs before and after the episode. We note that some routine medical care and elective care will likely be suspended during an outbreak of pandemic influenza, and this may remove or delay some of the on-going healthcare system costs borne by employers. We have assumed that usual costs will apply during pandemic influenza, and utilization will not be limited by capacity.

Estimation

Additional healthcare costs are calculated as the product of per-patient costs in Table 10 and the number of infected persons in Table 9.

Model Design – Mortality Costs and Worker Replacement Costs

Most employers provide death insurance to their workers, adult dependents, and covered children. We assumed a face value of 3 times the annual salary of a worker. Consequently, in the model the estimate for the life insurance costs is 3 times the annual salary for the number of workers whose deaths are attributable to the influenza pandemic.²⁴

Pandemic influenza will impose the additional burden on an employer in that workers who die will need to be replaced. Replacement costs include recruiting, relocation, training, the temporary inefficiency of new hires and vacant positions. The Conference Board has estimated these costs to be equal to 75% of a worker's annual salary.²⁵ We assumed that the employer would replace each worker who dies because of the influenza pandemic and that the replacement costs would be 75% of the worker's salary.

Model Design – Antiviral Prophylactic Treatment

Antiviral prophylactic treatment for influenza can be an important preventive action taken by an employer. We assumed that workers would receive one course of treatment – costing either \$60 or \$80 per treatment. Lower or higher cost per treatment would produce different outcomes.²⁶

Currently, there are two influenza prophylactic treatment recommendations^{6,7}:

- “Household/Close Contact Prophylactic Treatment” –Indicated when a person is exposed to a flu-infected family member or close contact.
- “Community Outbreak Prophylactic Treatment” – This treatment is indicated for a person who is exposed to a flu-infected community.

We assumed the antiviral prophylactic therapy would reduce the infection rate by approximately 77% throughout the course of the pandemic, which implies no significant development of resistance.^{6,27} Finally, we assumed that spouses and dependent children will not receive any prophylactic treatment.

Results – Demonstration Case

This section shows the development of key intermediaries in the model.

Lost Revenue Due to an Influenza Pandemic

Number of Workers Away from the Job Under a Pandemic

Table 11 shows, for each job classification, the number of workers away from the job due to pandemic influenza and the number expected to remain on the job. This is presented on the basis of 100 workers in each occupation.

Table 11
Number of Workers Away from the Job Due to a Severe Influenza Outbreak and
Number of Workers Remaining on the Job

Occupational Group	(1) Number of Workers	(2) Number of Workers on the Job if No Pandemic	(3) Number Working Who Become Infected	(4) Number Absent Due to Family Effects	(5) Number Away from the Job Due to Influenza Outbreak	(6) Number of Workers Remaining on the Job
Management	100	92.3	27.7	7.6	35.3	57.0
Professional	100	92.0	27.6	4.6	32.2	59.8
Sales	100	92.1	27.6	7.1	34.7	57.4
Administrative	100	91.5	27.5	6.1	33.6	57.9
Production	100	91.5	27.5	5.1	32.6	58.9

Lost Wages for One Week of Pandemic

Table 12 presents the amount of one week’s wages lost due to an influenza pandemic for our Demonstration Case, which assumes industry average wages and occupation distribution from the US Bureau of Labor Statistics.²² While these provide a baseline for the hypothetical employer, employer-specific information can be substituted in the execution of the model.

Table 12
One Week of Lost Wages for Workers Absent Due to an Influenza Pandemic

Occupational Group	(1) Percent of Workers	(2) Average Annual Salary	(3) Number of Employees	(4) Percent of Employees Absent Due to Pandemic	(5) Number of Workers Absent to Pandemic	(6) One Week of Wages Lost for Workers Absent Due to Pandemic
Management	4.6%	95,526	460	35.3%	162	\$ 297,600
Professional	23.7%	59,000	2,370	32.2%	763	865,717
Sales	10.7%	35,424	1,070	34.7%	371	252,737
Administrative	17.5%	32,087	1,750	33.6%	588	362,828
Production	43.5%	30,200	4,350	32.6%	1,418	823,532
	100.0%		10,000	33.0%	3,302	2,602,414

Estimated Total Value Lost Due to a Pandemic

Table 13 presents the estimated value lost under the severe and moderate pandemic scenarios. The severe scenario assumes the infection lasts for three weeks, and therefore the result in this illustration is three times the weekly amount at the bottom of Column (6) in Table 12. The moderate scenario assumes the infection lasts for four days -- the result in this illustration is three-quarters the amount at the bottom of Column (6) in Table 12.

Row (4) is the assumed revenue/wage multiplier, which accounts for the fact that revenue is typically significantly larger than wages.

In viewing these results, we would like to emphasize some important considerations:

- The estimated effects are for an “average” employer: we used national averages for the occupational distribution, average annual wages and other assumptions from US Bureau of Labor Statistics and other Milliman analyses.
- Second, the results are for a severe or moderate pandemic, assuming a 30% infection rate, and the out-of-work periods stated above.

Table 13
Revenue Lost Due to Influenza Outbreak

Consideration	Severe	Moderate
Total salary	\$102,276,000	\$102,276,000
Salary lost due to employee illness	7,807,241	1,951,810
Percent of salary lost due to employee illness	7.6%	1.9%
Total output/wage multiplier	2.0	2.0
Value Lost During Period Due to Pandemic (\$)	15,614,483	3,903,621

Estimated Financial Impact

Demonstration Case without Prophylactic Treatments

The model's financial impact is generated by the decrease in revenues due to worker absences, increases in healthcare costs, payout of life insurance benefits, and the cost of replacing workers who die. These components affect different parts of an employer's profit rate – the decrease in revenues reduces profits because receipts are down, while the increase in expenses reduces profits because expenditures are up. We assumed that an employer's other on-going expenses do not change during pandemic influenza. Particular employers who can take steps to reduce their costs should consider adjusting our results accordingly to reflect their situation.

Table 14 presents the results for the Demonstration Case, which assumes that \$1 of wages and salaries produces \$2 of revenue and the employer's profits are 10% of revenue. After accounting for the 7.6% reduction in revenue because workers will be away from work and the 20.9% increase in expenses (8.3% as a percent of revenue) for healthcare costs, life insurance benefits, and worker-replacement costs, the employer's financial result for the quarter in which the pandemic occurs moves from a 10% gain to a 6.5% loss (as a percent of revenue). Under the moderate scenario, the lost revenue reduction is 1.9% and the profit for the quarter moves from 10% to 7.2%.

Table 14
Assumptions and Results for Calculating Estimated Financial Impact:
Demonstration Case

Consideration	Severe	Moderate
Assumptions		
Total Output/Wage Multiplier	2.0	2.0
Profit Rate	10.0%	10.0%
Results		
Lost Revenue	7.6%	1.9%
Increase in Expenses (% of non-pandemic expenses)	20.9%	2.5%
Increase in Expenses (% of non-pandemic revenue)	8.3%	1.0%
Estimated Profit Rate	-6.5%	7.2%

Demonstration Case with Prophylactic Treatments

Table 15 presents the results where the employer has provided the prophylactic treatment to the employees. As described earlier, there are two types of treatment – one costing \$60 per worker and a second costing \$80 per worker. Furthermore, the treatment reduces the infection rate by approximately 77% among workers (with no change to the infection rate for spouses and dependent children).

The results find a much smaller drop in revenue. Under the severe scenario, instead of a 7.6% drop with the prophylactic treatment, the decrease is only 3.2%. Under the moderate scenario, the decrease in revenue with the prophylactic treatment is only 0.8% rather than the 1.9% drop without the treatment. Because fewer workers are getting sick and there are fewer deaths, there also are substantial decreases in the healthcare expenses, life insurance benefits, and worker replacement costs.

The employer remains profitable under both treatment-cost scenarios and for both the severe and moderate influenza pandemic scenarios. Without the prophylactic treatment, the estimate was for a 6.5% loss under the severe pandemic scenario. With prophylactic treatment, the estimates are a profit of approximately 2.0%. For the moderate influenza scenario, the drop from a 10% profit to a 7.2% profit without prophylactic treatment is reduced by approximately one-third to a profit of approximately 8.5%.

Table 15
Estimated Financial Impact with Prophylactic Treatment:
Demonstration Case

Consideration	Prophylactic Treatment = \$60 per Treatment		Prophylactic Treatment = \$80 per Treatment	
	Severe	Moderate	Severe	Moderate
Assumptions				
Total Output/Wage Multiplier	2.0	2.0	2.0	2.0
Profit Rate	10.0%	10.0%	10.0%	10.0%
Results				
Lost Revenue	3.2%	0.8%	3.2%	0.8%
Increase in Expenses (% of non-pandemic expenses)	12.0%	2.0%	12.2%	2.3%
Increase in Expenses (% of non-pandemic revenue)	4.8%	0.8%	4.9%	0.9%
Estimated Profit Rate	2.1%	8.5%	2.0%	8.4%

Results – Sensitivity Analyses

Different Revenue/Wage Multipliers and Pre-Influenza Outbreak Profit Rates

For sensitivity analyses, we varied the output/wage multiplier and the pre-pandemic profit rates. The results from these analyses are presented in Table 16.

- The financial impacts are larger for labor-intensive employers. All other assumptions held constant, the result for an employer with a 3.0 output/wage ratio is a 3.4% loss, and for an employer with a 1.25 output/wage ratio the loss is 11.8%.
- The Demonstration Case finds that an employer’s profit rate will fall by approximately 15 percentage points. All other assumptions being the same, an employer with a 15% pre-pandemic profit rate can expect the profit rate to fall to a 1% loss if a pandemic occurs. If the pre-pandemic profit rate had been 5%, the profits during the pandemic are expected to drop to a 12% loss.

Table 16
Assumptions and Results for Calculating Estimated Financial Impact:
Sensitivity Analyses for Alternative Revenue/Wage Factors and Profit Rates

Consideration	Demonstration Case	Higher Multiplier	Lower Multiplier	Higher Profit Rate	Lower Profit Rate
Assumptions					
Total Output/Wage Multiplier	2.0	3.0	1.25	2.0	2.0
Profit Rate	10.0%	10.0%	10.0%	15.0%	5.0%
Results					
Lost Revenue	7.6%	7.6%	7.6%	7.6%	7.6%
Increase in Expenses (% of non-pandemic expenses)	20.7%	9.8%	133.6%	23.8%	18.5%
Increase in Expenses (% of non-pandemic revenue)	8.3%	5.6%	13.4%	8.3%	8.3%
Estimated Profit Rate	-6.4%	-3.5%	-11.9%	-1.1%	-11.9%

Different Infection Rates

For a second sensitivity analysis, we assumed a 50% infection rate to estimate the impact of an influenza outbreak that hits an employer particularly hard.

- Without prophylactic treatment, the declines in estimated profits are quite substantial from the non-pandemic 10% profit rate and the results from the 30%-infection rate scenario. Under the severe scenario, we found that the employer's profit rate falls from a 10% gain to a 19% loss (see Table 17), compared to the 4.8% loss when the infection rate was 30%. Under the moderate scenario, the profit rate falls from 10% to 5.5%, compared to the 7.2% loss when the infection rate was 30%.
- With prophylactic treatment, the decrease in estimated profits are much smaller. Under the severe scenario, the employer's estimated profit rate is slightly more than a 3% loss (see Table 18), compared to the 19% estimated loss without prophylactic treatment. Under the moderate scenario, the estimated profit rate is approximately 7.5%, compared to the 5.5% profit rate without prophylactic treatment.

Table 17
Results Assuming a 50% Infection Rate
Without Prophylactic Treatment

Consideration	Severe	Severe
Assumptions		
Total Output/Wage Multiplier	2.0	2.0
Profit Rate	10.0%	10.0%
Results		
Lost Revenue	12.1%	3.0%
Increase in Expenses (% of non-pandemic expenses)	36.4%	4.2%
Increase in Expenses (% of non-pandemic revenue)	14.6%	1.7%
Estimated Profit Rate	-19.0%	5.5%

Table 18
Results Assuming a 50% Infection Rate
With Prophylactic Treatment

Consideration	Prophylactic Treatment = \$60 per Treatment		Prophylactic Treatment = \$80 per Treatment	
	Severe	Moderate	Severe	Moderate
Assumptions				
Total Output/Wage Multiplier	2.0	2.0	2.0	2.0
Profit Rate	10.0%	10.0%	10.0%	10.0%
Results				
Lost Revenue	5.1%	1.3%	5.1%	1.3%
Increase in Expenses (% of non-pandemic expenses)	19.5%	3.0%	19.8%	3.2%
Increase in Expenses (% of non-pandemic revenue)	7.8%	1.2%	7.9%	1.3%
Estimated Profit Rate	-3.1%	7.6%	-3.2%	7.5%

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