EXHIBITS

the general population. This effect is further exaggerated due to the fact that the average face amount varies by age.

The importance of the distribution of excess deaths by age in estimating the impact of pandemic influenza on an insured population should not be underestimated. Over 75 percent of the insured face amount in the model is distributed between ages 30-60. Thus, the virulence of the virus in these age ranges will have a great bearing on the overall impact of the event on the industry.

The distribution of excess deaths for seasonal influenza is typically shaped like a "U;" that is to say that excess deaths are heaped at age 0, quickly decrease to close to zero until they start to increase again at older ages (typically age 65) with a rapid rise at ages 85 and older.

However, the shape of the excess death curve usually changes in a pandemic. The 1957 pandemic attacked individuals primarily ages 65 and older; there were no excess deaths at age 0 versus the five-year period prior to the pandemic.[41] Compare this to the striking pattern in 1918, which showed a spike in excess deaths at all ages under age 65 but exhibited decreases in excess deaths for ages 65 and above. But the most disturbing characteristic in 1918 was the spike in excess deaths in the age groups from 20-40. This presentation was dubbed a "W" curve before it was realized that there were no excess deaths at the older ages—99 percent of the excess mortality occurred under age 65[42] and an estimated 50 percent between ages 20 to 40.[43] For the purposes of this paper, the 1918 distribution by age is termed a "V\" curve to visually cue the lack of deaths in the older ages and distinguish it from a hypothetical "W" curve which assigns deaths to older ages.

---

[41] Luk, Jeffrey et al, "Observations on Mortality during the 1918 Influenza Pandemic," Clinical Infectious Diseases 2001, Vol. 33, Table 1.
[42] Simonsen, Lone, et al, "Pandemic vs Epidemic Influenza Mortality: A Pattern of Changing Age Distribution," *Journal of Infections Diseases*, 1998, vol. 178, p. 55.
[43] Luk et. al. op cit.

There are different schools of thought as to why older ages were not affected in 1918. The traditional view is that older individuals were exposed to a variant of the virus in the 1889 pandemic, picking up some degree of immunity.[44] Drawing insight from experience with H5N1, others believe older individuals might have avoided the worst of the disease due to their lowered immune response and lack of cytokine storm.[45] As mentioned previously, the H5N1 virus must find receptors deep in the lungs of its victims, receptors which may seldom be accessed in even the healthy elderly. Of course, given that the demographics, living arrangements and sheer magnitude of the elderly population today is so different from 1918 it is difficult to extrapolate; other implications are clearly possible but beyond the scope of this paper.

It is not possible to predict the shape of the distribution of excess deaths. Based on past experience, a "U" shaped distribution of excess deaths was selected for the moderate pandemic scenario and a "V\" shaped distribution of excess deaths in the severe scenario. The "U" curve is based on information from 1957 and 1968 pandemics.[46] The "V\" curve was developed using information from the 1918 pandemic where additional deaths spike at the 20-40 age group and older ages are spared impact.[47]

For comparison purposes, deaths per thousand have been calculated for the general population and the insured population on page 3 of Exhibits 2-4 and 6-8. The results include statistics for percentage of deaths below age 20, 20-64 and 65-plus. This is useful for comparing the results utilizing these assumptions to actual results from previous pandemics.

[44] Willets, Richard, "The Facts Behind the Hype," *The Actuary* (UK), December, 2005, p. 29.
[45] McNeil, Donald G., "Immediate Treatment Needed for Bird Flu Cases, Study Says," *The New York Times*, 2006, September 11.
[46] Luk et. al. op cit.
[47] Luk et. al. op cit.

As stated previously, the 1918 pandemic had attributed 99 percent of its deaths to ages under 65. Compare this to the relatively mild pandemic in 1968 which caused 34,000 deaths and had a traditional "U" shaped distribution of excess deaths. Here, 50 percent of deaths were below 65 and 50 percent above 65. Finally, in the moderate 1957 pandemic, the proportion of deaths below 65 was closer to 35 percent because there were very few excess deaths at age 0; the majority of the excess deaths were found at ages 65 and above.

3.2.4 Insured vs General Population Mortality Ratio

The mortality rate of the individual insured population is significantly better than the general population due to the impact of underwriting and economic self-selection. While the ratio will vary by age, sex, smoking class, policy duration and underwriting type, the overall mortality for a block of individual underwritten business may be 60 percent of the general population mortality or less.[48] Even after 25 years, a seasoned block of individually underwritten business will exhibit significantly lower mortality than the general population, demonstrating the power of underwriting and economic self selection. Even group life certificate holders have better mortality than the general population due to selection afforded by the actively at work requirement needed to qualify for the benefit. The question is how much of this benefit might apply during an influenza pandemic.

3.2.4.1 Underwriting

Underwriting serves the dual purpose of selection and classification of risks. The purpose of underwriting is to protect the company (selection) and place purchasers with similar expected costs into appropriate risk pools (classification). Individual underwriting classes include standard, substandard and a multiplicity of preferred classifications, as well as smoker/non-smoker and male/female classifications. More germane to this discussion is the selection aspect of the underwriting process

[48] Per discussions with reinsurers.

Underwriting standards for individual products differ by company and are proprietary in nature. Broad brush underwriting processes include guaranteed issue (none, but typically reduced benefits in the first two years), simplified issue (a simple form), paramedical (long form, nurse visit and blood draw) and full medical underwriting (full medical exam). Mortality on guaranteed and simplified issue products are closer to the general population or worse due to built-in anti-selection. These underwriting approaches are more often associated with niche products; the remainder of this discussion will presume issuance based upon medical and paramedical underwriting decisions.

In this process, chronic diseases such as heart disease, diabetes and renal problems are loaded with substandard rates if not eliminated from the risk pool. Companies will typically not insure individuals with any type of compromised immune systems, although a past history of cancer, once a certain rejection, is starting to be accepted at some companies. The underwriting process removes many of the at-risk subgroups, leaving an overall healthier population with lower baseline disease burden and lower mortality risk.

3.2.4.2 Economic Self Selection

Whether the sale is initiated by an agent or prospective client, the life insurance transaction starts with a significant amount of economic self-selection. The client needs discretionary income to buy the product and typically would only be interested in purchasing it if they had assets and/or a lifestyle to protect. According to LIMRA, the probability of life insurance ownership increases as income increases.[49] While there is potential for anti-selection against the company as the size increases, the company is typically protected from this sort of risk through the underwriting process and contract language.

[49] Retzloff, Cheryl D, op. cit., p. 28

LIMRA estimates that approximately 40 percent of Americans own individual life insurance and the same amount have group coverage; in total, 60 percent of Americans are covered by one or more life insurance policies. As of 2004, 17 percent of Americans lived at or below 125 percent of the poverty level.[50] Approximately 45 million people (16 percent of the U.S. population) were not covered by any type of health insurance at any point during the course of 2004.[51] While there is certainly some overlap between the population with life insurance and these sub-populations, it is reasonable to assume that the vast majority of the 60 percent of Americans with life insurance coverage and an even greater percentage of the 40 percent with individual insurance coverage live above 125 percent of the poverty level and have some form of employer based health insurance.

While having health insurance may not make a significant difference in access or quality of care during a severe pandemic if the health care system is overwhelmed, the overall health and existing disease burden of individuals with health insurance will be better coming into the event as they will have had access to needed preventative as well as emergent care. The treatment of chronic diseases among the medically insured population is also more consistent than for the uninsured population.

Thus, in addition to the underwriting process, part of the explanation for the significantly better mortality experience of the insured population is economic self selection. Individual insureds are in an economic class which is healthier than the general population and have better access to health care due to greater participation in the employer based health insurance system.

3.2.4.3 Society of Actuaries Delphi Study

The Project Oversight Group for the SOA's pandemic research project performed a two round Delphi study to provide guidance on how the excess death rate of the U.S.

[50] U.S. Bureau of the Census, Annual Social and Economic Supplements, 2005.
[51] Denavs-Walt, Carmen, et al, "Income, Poverty, and Health Insurance Coverage in the United States: 2005," U.S. Census Bureau, August 2006, p. 20.

insured population might differ from that of the U.S. general population during an influenza pandemic.[52] Assumed general population excess death rates from the selected pandemic scenarios were provided to participants, who were asked to estimate excess death rates for the insured population under these scenarios. Participants were asked to provide assumptions and reasoning behind their estimates. The results of the second round of the Delphi study are presented in Table 2.

Table 2

Ratio of U.S. Insured Population Excess Mortality vs U.S. General Population
Second Round Results of SOA Delphi Study

	Moderate Scenario		Severe Scenario	
	Delphi Results	*Ratio to Population (0.7 / 1000)*	*Delphi Results*	*Ratio to Population (6.5 / 1000)*
25th percentile	0.35	50.0%	3.39	52.1%
50th percentile (median)*	0.40	57.1%	5.00	76.9%
75th percentile	0.50	71.4%	5.50	84.6%
Mean	0.44	62.4%	4.64	71.4%

* *Selected*

The primary factors driving assumed reductions in the insured mortality rate versus the general population rate mentioned by participants corresponded to the prior discussion on underwriting and socioeconomic factors. In addition, study participants mentioned differences in exposure by age (captured in the model design), education level (captured through economic selection to a significant extent) and smoking status (the smoking rate among the individual insured population is less than one-half of the general population rate).

[52] For a full report on the study as well as the completed questionnaires for each round, please see Stryker, Ronora et. al. "Study of the Effect of a Flu Pandemic on Insured Mortality Using the Delphi Method," http://www.soa.org/research/research-projects/life-insurance/default.aspx May 2007.

3.3 Life Insurance Industry Assumptions

The assumptions that were used to develop the excess claim estimates relate to the U.S. insurance industry. Individuals who work in the industry will be familiar with the primary sources: A. M. Best (Best's), the American Council of Life Insurers (ACLI), LIMRA International (LIMRA), the National Association of Insurance Commissioners (NAIC) and the Society of Actuaries (SOA). The potential impact of a pandemic on private sector self-insured plans was not addressed in this research.

3.3.1 Background

As might be expected, there are significant differences between the life insurance industry in 1918 and today. It seems worthwhile to review some of the differences to determine factors that put the industry more or less at risk. In 1918, there were fewer than 100 companies versus the more than 1,150 life insurance companies in existence today.[53] Of course, the regulatory environment was far different, but in general, statutory reserves were more conservative than they are today. However, there was no estimate of risk-based capital or asset adequacy testing in 1918 like there is now.

In terms of product types, there were no universal life or variable products. Most policies at the time were participating, meaning they paid optional dividends, providing additional conservatism. Group insurance had just gotten started at the beginning of the decade and in 1918 made up less than 2.5 percent of the total life insurance in force versus over 40 percent today.[54] This shift is material in the context of a pandemic as group insurance contracts are seldom reinsured and have low annual renewable term policy reserves. However, most of these contracts have a provision for annual repricing, reducing the pricing risk.

[53] American Council of Life Insurance. *Life Insurers Fact Book*, 2006, p. 2.
[54] Ibid, p. 92.

In 1918 the industry was still immature and the average policy size was much lower than today. According to the Spectator Year Book and Institute of Life Insurance, the average ordinary policy size in 1918 was $1,891 and the average industrial policy was $136.[55] At $839, group insurance certificates were quite a bit higher than industrial. But since the vast majority of policies inforce were industrial, the combined average policy size was only $543. Adjusted for inflation, in today's terms these policies range from a maximum of $25,000 for ordinary to only $2,000 for industrial.[56]

Average in force coverage today is approximately $140,000 per individual and one half that for group coverage.[57] With this five-fold increase in policy size since 1918 (even after adjusting for inflation), there has also been a marked increase in the reliance of direct writers on reinsurance, particularly on the individual side. The use of reinsurance in 1918 was not material, whereas 40 percent of individual life insurance inforce today is reinsured,[58] although this percentage varies greatly by product type.

3.3.2 Inforce Distribution

According to the 2000 census, the projected U.S. population in 2004 was 293.7 million.[59] The ownership distribution by age for individual and group insurance was estimated based on a 2004 LIMRA study.[60] The number of individual insureds/certificate holders is arrived at by multiplying the census population by the estimated insurance ownership percentages. The number of insureds thus estimated is approximately 108 million or 37 percent of the U.S. population, which is consistent with LIMRA and other sources.

---

[55] American Council of Life Insurance. *Life Insurers Fact Book,* 1953, p. 12.
[56] McCusker, John J., "Comparing the Purchasing Power of Money in the United States," Economic History Services, 2006, www.measuringworth.com/calculators/ppowerus.
[57] Note: Figures include multiple policies on one life.
[58] Bruggeman, David M., "Life Reinsurance Data from Munich American Survey," *Reinsurance News*, August 2005, No. 56, p. 8.
[59] U.S. Bureau of the Census, "National Population Estimates," www.census.gov/popest/national/asrh/NC-EST2005-sa.html.
[60] Retzloff, Cheryl D, op. cit.

To determine the total face amount in force, the number of insureds is multiplied by the assumed average face amount by age. The average face amount by age is also estimated from 2004 LIMRA research; the total amount in force thus calculated ties to LIMRA and other sources. The face amount by age is then multiplied by excess deaths per thousand to determine gross claims.

3.3.3 Reserves by Age

Traditional insurance products charge a level premium over the insured's lifetime to provide a level death benefit. Because mortality increases by age, part of the premium collected from a block of policies in the early years must be saved to pay for benefits in later years. The amount of the reserve is statutorily defined in the U.S. based on the year the product was issued, the type of product, mortality tables and formula based interest rates that discount expected cash flows to the current date.

Reserves by age in the model are different for group products (which hold an annual renewable term reserve) and individual products, which are a blend of whole life, term, universal life and variable life products. Estimating the group life reserve was relatively straightforward as a reserve mortality table was applied to the in force by age and the result validated against the total NAIC group life reserve.

Validating the individual reserve estimate to aggregate industry data is more challenging, as it is a blend of different product types, all of which have different reserve patterns. Reserves per thousand for various blocks of in force business were requested from members of the Project Oversight Group. From this data a curve of reserves by age was developed. The curve was then fitted to the in force and compared to the aggregate NAIC ordinary life reserve. Thus, the estimated reserves by age is not reflective of any one company, nor is it a strict representation of the reserve distribution of the entire industry. Instead, it is a reasonable estimate of a curve which, while likely to be off at any given age, ties in aggregate to the NAIC reserve data. Companies can easily (and more accurately) extend this methodology to their own specific exposures.

3.3.4 Impact of Taxes

Claims are deductible from insurer income. To the extent operating losses due to a pandemic claim surge exceed current income, the impact will be ameliorated by the tax treatment of the resulting net operating losses (NOL). The 2006 ACLI Life Insurance Fact Book shows 2005 net operating income for the life industry of $22.2 billion after taxes and policyholder dividends. Net operating losses from even a severe pandemic could presumably be utilized in three years or less.

A corporate tax rate of 35 percent has been assumed in this analysis; the tax positions of individual companies will be different. The NOL adjustment assumes a going concern (tax deductions are of less value in bankruptcy); NOL are also of value in a sale or merger. Although there may be companies that are not able to make use of their NOLs, the paper assumes that the industry as a whole will be able to do so. The value of the NOL is calculated on an undiscounted basis. Individual companies using this methodology would need to make an appropriate adjustment for the time value of money.

3.4 Reinsurance Industry Assumptions

In contrast to the direct side, reinsurance in the United States, like the world at large, is very concentrated. Nine companies control 90 percent of the U.S. reinsurance market, with 75 percent concentrated in the top five players: Munich American Re, RGA Re, Scottish Re, Swiss Re and Transamerica Re.[61] To a much greater extent than the direct side, the results of the U.S. reinsurance industry are tied to the fortunes of these five companies. The reinsurers considered in the determination of the reinsurance credit percent are shown in Table 3.

[61] Bruggeman, David M., op. cit.

Table 3

Reinsurers Included in Reinsurance Analysis

Employers Reassur Corp	RGA Reins Co
General Re Life Corp	SCOR Life US Re Ins Co
Generali USA Life Reassurance Co	Scottish Re Life Corp
Munich American Reassur Co	Scottish Re Us Inc
Optimum Re Ins Co	Swiss Re Life & Health Amer Inc
Reassure America Life Ins Co *	Transamerica Financial Life Ins Co
Revios Reins Canada Ltd	Transamerica Occidental Life Ins Co *
Revios Reins US Inc	

** Adjusted for direct business written*

As a caveat, note that each direct writer's reinsurance program is tailored for its individual needs and risk tolerances. Thus, while understanding the capacity of the reinsurance industry as a whole is important to understanding the net impact of a pandemic, it **will not** provide accurate insight into the effect on an individual company. It must be noted that each individual reinsurance carrier has very different risk exposures, statutory surplus, retrocession programs and capital available from other sources. Thus, depending both on an insurer's reinsurance program and the reinsurance carriers selected to implement it, similarly situated direct writers may fare differently during a particular pandemic scenario.

3.4.1 Background

There are two main types of reinsurance products: proportional and non-proportional. The vast majority of life products are proportional (YRT, co-insurance or some variant of these), where the reinsurance risk is in proportion to the face amount of the individual policy.

Non-proportional reinsurance is primarily the bailiwick of P&C companies, although there are some non-proportional life products available. Non-proportional life coverages include catastrophe (Cat) coverage and stop loss coverage, typically sold to groups. Cat cover is provided for a single event, typically defined as a fire, earthquake or terrorist attack. Although it would certainly be tried in court, most reinsurers would argue that Cat cover is not meant to cover a pandemic as it is not a defined "event."[62] It is safe to assume that, barring surprise judicial action, Cat cover would not provide coverage for a pandemic.

The other non-proportional life reinsurance product is stop loss. This is more often provided to group life contracts (particularly large employer contracts which self insure) but it may also be negotiated by direct writers that wish to put an aggregate limit on their overall claims for a year. In the past, there has not been much interest in this product, although it was available. Currently there is more interest in the product due to the heightened awareness of pandemic exposure, but availability has decreased and the cost is greater. While this coverage would specifically include losses due to a pandemic, it is an annual renewable product and, were a multi-wave pandemic to occur, prices and availability would likely be modified to take events into account.

While non-proportional reinsurance is of interest to the companies that have purchased it, for the purposes of this exercise, the paper assumes only proportional coverage.

3.4.2 Assumptions

The total amount of reinsurance in force is $5.6 trillion based on 2005 One Source Data. Reinsurance exposure is distributed by age using information provided by members of the Project Oversight Group. Thus, the effect of the distribution of excess deaths by age is captured in the same manner as on the direct basis.

[62] It would be difficult to determine whether or not a death were due to the pandemic or some other cause.

Normally, reinsurance payable would be subtracted from direct claims to arrive at the net. However, this assumes that the reinsurer has adequate reserves and surplus to cover claims. For an extreme shock to the system like a pandemic, it must be established whether there are enough funds to pay the claims and, if not, adjust the payout accordingly. This is the function of the reinsurance credit percent in the model.

The reinsurance credit percent is simply the claims surge capacity divided by claims. If claims are less than surge capacity, the reinsurance credit is 100 percent. If claims are greater than surge capacity, the reinsurance credit is less than 100 percent. The implication is that not all reinsurer claims are paid in full and the direct writer is responsible for making up the difference.

The claims surge capacity consists of:

- Statutory surplus
- Assets backing offshore retroceded amounts (letters of credit, trust agreements, funds deposited)
- Other capital and surplus (reserve redundancies, securitized mortality risks, capital market funding, infusion from parent or U.S. P&C affiliates)

This report develops an estimate for a reinsurance credit for the U. S. reinsurance industry in aggregate under different pandemic scenarios. Reinsurance is a dynamic marketplace, very responsive to capital requirements and its attendant costs. Individual reinsurers have widely differing exposures and positions with regard to reserves and capital and surplus, as well as access to capital from a parent and other sources.

The reinsurance figures used in this report are in constant flux and the results should be considered a guide, not a definitive answer. Reinsurance programs for direct writers differ significantly and individual treaties can be complex. Results developed for the purpose of this report are not indicative of the potential experience of individual reinsurers nor appropriate for use with specific insurance portfolios.

3.5 Results

Based on the methodology and assumptions described previously, Table 4 quantifies the potential impact of a moderate pandemic scenario. Full details of the calculation are shown in Exhibits 2 through 5 in the EXHIBITS section of this paper.

Table 4

Estimated Impact of a Moderate Pandemic Scenario on Direct Writers
0.7 deaths per 1000, "U" excess mortality distribution; billions of dollars

	Gross Claims	Reserve Release	Reinsurance Credit	Tax offset	Net Claims After Taxes
Individual	4.5	0.9	1.8	0.7	1.3
Group	2.3	0.0	0.0	0.8	1.5
Total	6.8	0.9	1.8	1.5	2.8
% of Gross Total		*13.2%*	*26.5%*	*22.1%*	*41.2%*

Based on the methodology and assumptions described previously, Table 5 quantifies the impact of a severe pandemic scenario. Full details of the calculation are shown in Exhibits 6 through 9 in the EXHIBITS section of this paper.

Table 5

Estimated Impact of a Severe Pandemic Scenario on Direct Writers
6.5 deaths per 1000, 1918 "V\ " excess mortality distribution; billions of dollars

	Gross Claims	Reserve Release	Reinsurance Credit	Tax offset	Net Claims After Taxes
Individual	78.6	2.7	23.2	18.4	34.3
Group	47.1	0.1	0.8	16.1	30.0
Total	125.7	2.8	24.0	34.5	64.3
% of Gross Total		*2.2%*	*19.1%*	*27.4%*	*51.2%*

Note the focus of companies on certain markets may lead to greater risk in the event of a pandemic. Older companies with large blocks of in force business that have aged significantly will find themselves more exposed in a scenario with a "U" excess death curve (a moderate pandemic). However, as the older policies at the older ages tend to have higher reserves and lower face amounts, this will have the effect of ameliorating the already softer blow of a moderate pandemic scenario.

Large face amount level premium term policies carry lower reserves than whole life and are often highly leveraged with reinsurance. Companies which focus on writing this business typically target a younger demographic that is more vulnerable to a "V\" distribution of excess deaths. Companies struggling under a severe scenario may be stressed to a greater degree if they are focusing in markets vulnerable to the "V\" mortality distribution.

3.6 Other Considerations Impacting Value

While the results described here and presented in the exhibits are robust, they are not comprehensive. Because a pandemic is so broad in scope, there are a number of cascading issues which might further impact a company's solvency or ability to pay claims in a timely fashion. However, many of these issues reveal themselves only at an individual company level, as the data needed to quantify them at the industry level are not available from public sources. A few of these issues include changes in asset values, liquidity and disintermediation risks, the duration of the claims surge, gains on release of payout annuity reserves, the cost of guarantees on variable products and post-pandemic mortality levels.

3.6.1 Asset Values

It is widely believed that asset values will suffer during a pandemic. The Congressional Budget Office estimates that a severe pandemic will cause a 5 percent drop in overall economic output similar in depth and duration to that of an average post war recession

in the United States.[63] While this may be true, the impact on the stock and bond markets is less certain; results of the SOA Delphi Study were inconclusive.[64] While lower interest rates driven by the economic slowdown might increase the value of bonds, the decrease in credit worthiness due to the recession might offset this effect as defaults increase.

In 1918 and 1919 the stock market responded with gains, but its composition was significantly different than it is today. Likewise, the availability of information and the real time response of institutional and day traders might have an unpredictable short term effect on asset values; although, mid term one would expect the market to find appropriate levels. It is likely that uncertainty surrounding the event will increase spreads on bonds while equities will have their value reduced until scientists and politicians get their arms around the issues and the population feels the end of the event is near.

3.6.2 Disintermediation

An insurance company will need to be able to pay out a significant amount of claims in a short period of time in an efficient manner. It needs to be able to have liquidity to accomplish this during a period when markets may well be down. Thus, it will be prudent to build up short-term cash positions as evidence of sustained H2H transmissibility builds.

Another item to be aware of is disintermediation in the form of demand for loans or cash surrender values. While possible, it is unclear what the economic drivers might be for these scenarios. However, any added demands for cash flow in addition to claims will put additional stress on potentially reduced asset values.

---

[63] Holtz-Eakin, Douglas, "A Potential Influenza Pandemic: Possible Macroeconomic Effects and Policy Issues," Congressional Budget Office, December 8, 2005, p. 1.
[64] Stryker, Ronora, et. al. "Study of the Effect of a Flu Pandemic on Economic Values Using the Delphi Method," www.soa.org/research/research-life.aspx, May 2007.

3.6.3 Duration of the Claims Surge

Unlike seasonal influenza, there is no seasonal pattern as to when pandemic influenza occurs and no way of knowing in advance how long the pandemic might last. The characteristics of the 1918 pandemic varied by location but it is generally agreed to have occurred in the United States in three waves over a period of 18 to 24 months, although two thirds of the deaths occurred in a six month period.[65]

The excess deaths in this report were modeled as though they all occurred within one accounting period. However, it is possible (some would argue likely) that the impact of a severe pandemic would be felt over multiple accounting periods. During this period, there could be market responses, both in terms of demand for insurance and in the risk mitigation tactics insurers might implement, that might ameliorate the financial effects of the pandemic as it plays out. However, the effect of such measures are uncertain, and from a solvency standpoint it was deemed appropriate to consider the excess deaths as occurring in one accounting period. This assumption is offset somewhat by accounting for the Net Operating Losses on an undiscounted basis, and the net impact is considered to be immaterial for the purpose of this report.

3.6.4 Gains on Payout Annuities

There is no way to identify reserves held for contingent payout annuities on the annual statement. Some payout annuities are structured settlements which have guaranteed payouts (are not life contingent). Even if information on reserves were available, the attained age distribution for this business is not available, although the majority of the business would likely be in the over 65 age group.

The consensus is the bulk of the annuity assets on the annual statement are not life contingent, but are instead either still in the accumulation stage or are not life contingent. Thus, it appears that the amount of savings due to the release of annuity reserves from excess mortality would be small by comparison to the overall losses.

[65] Barry, op. cit., p. 5.

However, companies that have significant annuity holdings are encouraged to go through the exercise of quantifying the potential impact of a pandemic on their annuity portfolio.

3.6.5 Guaranteed Minimum Death Benefit

A guaranteed minimum death benefit (GMDB) feature is generally available with variable universal life and variable annuity products to help maintain the death benefit coverage despite drops in equity markets. Some products ensure that the death benefit will not lapse even if the cash surrender value or account value is insufficient to cover monthly charges. In short, GMDB ensures the policy death benefit is guaranteed for a life policy or annuity in the accumulation phase no matter how the underlying funds are performing.

This is another area where the annual statement does not provide sufficient information to adequately quantify the potential risks for the industry. Based on deterministic estimates of drops in asset values, a company should be able to quantify a range of potential losses for their company. Although exposure will vary by company based on their product distribution, it is unlikely that this exposure will be a material factor in overall solvency and pandemic preparedness.

3.6.6 Post-pandemic Mortality Levels

There are different schools of thought as to how a pandemic might affect mortality levels subsequent to the event.

The survivorship echo theory suggests that there would be measurable improvement in mortality after a pandemic. The argument is that pandemic influenza targets the weak and infirm, thus a portion of the excess deaths from the pandemic would have died shortly thereafter anyway. One could test this theory through examining the post pandemic death rates in populations, specific demographics (e.g., the elderly) or

disease states. However, care must be taken not to include items from secular trend and attribute them to a survivorship echo.

This theory may be reasonable in mild or moderate scenarios, particularly at the older ages. There are some contra indications to a survivorship echo theory in the 1918 pandemic. As noted by all observers, this pandemic targeted young and healthy individuals who would not otherwise have been at risk during a normal seasonal flu. While certainly unhealthy individuals died, it was not a culling of the weak and infirm.

Another contraindication to this theory in 1918 is that individuals aged 65 and over did not experience excess mortality from the flu. Thus, it seems more likely that rather than an echo, this is an example of an overall improvement in mortality at the older ages that was already in progress at the time the pandemic occurred. This improvement at the older ages continued for several years and is not consistent with the echo theory.

An alternative theory holds that heavier mortality is experienced in the period immediately following the pandemic due to weakening of those who were stricken but survived the illness. The author could find no controlled longitudinal studies analyzing the issue or a generally accepted hypothesis other than the null hypothesis. While it may well be the case that it is the frail that are primarily impacted during the seasonal flu, it seems that as pandemics increase in virulence the healthy population as a percentage of the total impacted grows. At the same time, it may well be that in absolute terms the number of deaths of the frail grows, even while deaths as a percentage of the total excess deaths is falling. Whether and how this impacts the mortality rate subsequent to a pandemic is unclear, and may well be a function of factors specific to a given pandemic.

4. CONCLUSION

This research has attempted to quantify the impact of pandemic influenza on the direct life insurance industry while providing companies, regulators and guaranty associations with tools to help them plan for this eventuality. Critical areas for additional research have been cited, including identifying appropriate ranges for stress testing, further quantifying the difference in excess death rates between individual insured versus population mortality and estimating the potential impact of a pandemic on different asset classes.

But research is only a start. Concern about the current H5N1 influenza subtype should be leveraged to push the development of infrastructure and processes needed to mitigate the impact of a pandemic event. Insurers should take steps to expand their business continuity efforts to include pandemic planning and discuss tactical responses to pre-pandemic, pandemic and recovery event stages.

Businesses do not operate in closed systems; the best continuity plans can be derailed by lack of integration with local planning efforts. Actuaries and their employers should be proactive in reaching out to local officials and take leadership roles in community planning efforts.

Finally, stakeholders need to consider how the industry as a whole will respond under the stress of a pandemic. The industry image and 100 years of brand equity will rest to some degree on the ability of all insurers, regulators and guaranty associations to respond effectively to the many challenges a severe pandemic poses. It is my hope that this exercise has educated interested parties about the financial risks a pandemic poses, stimulated them to consider the consequences of those risks and motivated them to take steps to mitigate those risks.

Exhibits

Moderate Pandemic Scenario Assumptions

Morbidity (1)	30.0%			
Excess Curve (2)	U	*Flat, "U", 1918 "V\ ", or "W" shaped distribution of excess deaths*		
Population XS Deaths per 1000 (3)	0.70	Moderate 0.70	Severe 6.50	
Mortality Ratio of Insured vs Gen Pop (4)	57.1%	Moderate 57.1%	Severe 76.9%	*Relative impact of pandemic on insured vs general population mortality*

Distribution of Excess Deaths by Age

Age Range	US Census Population (5)	Flat Extra Percentage (6)	Flat Extra Excess qx (7)	"U" Curve (Seasonal) Percentage (8)	"U" Curve (Seasonal) Excess qx (9)	1918 "V\ " Curve Percentage (10)	1918 "V\ " Curve Excess qx (11)	Hypothetical "W" Curve Percentage (12)	Hypothetical "W" Curve Excess qx (13)
0 - 4	20,071,268	100%	0.70	250%	1.75	177%	1.24	105%	0.74
5 - 9	19,605,572	100%	0.70	15%	0.11	35%	0.25	19%	0.13
10 - 14	21,145,156	100%	0.70	15%	0.11	35%	0.25	38%	0.27
15 - 19	20,729,802	100%	0.70	15%	0.11	106%	0.74	86%	0.60
20 - 24	20,971,302	100%	0.70	15%	0.11	153%	1.07	124%	0.87
25 - 29	19,560,906	100%	0.70	30%	0.21	224%	1.57	181%	1.27
30 - 34	20,471,032	100%	0.70	30%	0.21	224%	1.57	181%	1.27
35 - 39	21,052,318	100%	0.70	30%	0.21	130%	0.91	105%	0.73
40 - 44	23,056,334	100%	0.70	30%	0.21	106%	0.74	76%	0.53
45 - 49	22,122,629	100%	0.70	60%	0.42	82%	0.58	38%	0.27
50 - 54	19,496,176	100%	0.70	90%	0.63	59%	0.41	38%	0.27
55 - 59	16,489,501	100%	0.70	120%	0.84	47%	0.33	57%	0.40
60 - 64	12,589,423	100%	0.70	160%	1.12	35%	0.25	76%	0.53
65 - 69	9,956,467	100%	0.70	200%	1.40	24%	0.17	95%	0.67
70 - 74	8,507,005	100%	0.70	250%	1.75	24%	0.17	141%	0.99
75 - 79	7,410,757	100%	0.70	320%	2.24	12%	0.08	191%	1.33
80 - 84	5,560,125	100%	0.70	390%	2.73	12%	0.08	286%	2.00
85+	4,859,631	100%	0.70	1000%	7.00	12%	0.08	381%	2.67
Total	293,655,404		**0.70**		**0.70**		**0.70**		**0.70**

Column Notes:

(1) Implementation Plan for the National Strategy for Pandemic Influenza
(2) Selected excess death curve, based on historical data
(3) Based on HHS figures
(4) SOA Pandemic Mortality Delphi Study
(5) 2000 US Census projected to 2004
(6) Flat extra mortality %
(7) (6) x (3)
(8) Hypothetical distribution based on data from 1957 and 1968
(9) (8) x (3)
(10) Hypothetical distribution based on data from 1918
(11) (10) x (3)
(12) Hypothetical distribution extrapolating historic data
(13) (12) x (3)

Severe Pandemic Scenario Assumptions

Morbidity (1)	30.0%			
Excess Curve (2)	V\	*Flat, "U", 1918 "V\ ", or "W" shaped distribution of excess deaths*		
Population XS Deaths per 1000 (3)	6.50	Moderate 0.70	Severe 6.50	
Mortality Ratio of Insured vs Gen Pop (4)	76.9%	Moderate 57.1%	Severe 76.9%	*Relative impact of pandemic on insured vs general population mortality*

Distribution of Excess Deaths by Age

Age Range	US Census Population (5)	Flat Extra Percentage (6)	Flat Extra Excess qx (7)	"U" Curve (Seasonal) Percentage (8)	"U" Curve (Seasonal) Excess qx (9)	1918 "V\ " Curve Percentage (10)	1918 "V\ " Curve Excess qx (11)	Hypothetical "W" Curve Percentage (12)	Hypothetical "W" Curve Excess qx (13)
0 - 4	20,071,268	100%	6.50	250%	16.25	177%	11.49	105%	6.83
5 - 9	19,605,572	100%	6.50	15%	0.98	35%	2.30	19%	1.24
10 - 14	21,145,156	100%	6.50	15%	0.98	35%	2.30	38%	2.48
15 - 19	20,729,802	100%	6.50	15%	0.98	106%	6.89	86%	5.57
20 - 24	20,971,302	100%	6.50	15%	0.98	153%	9.95	124%	8.05
25 - 29	19,560,906	100%	6.50	30%	1.95	224%	14.55	181%	11.77
30 - 34	20,471,032	100%	6.50	30%	1.95	224%	14.55	181%	11.77
35 - 39	21,052,318	100%	6.50	30%	1.95	130%	8.42	105%	6.81
40 - 44	23,056,334	100%	6.50	30%	1.95	106%	6.89	76%	4.96
45 - 49	22,122,629	100%	6.50	60%	3.90	82%	5.36	38%	2.48
50 - 54	19,496,176	100%	6.50	90%	5.85	59%	3.83	38%	2.48
55 - 59	16,489,501	100%	6.50	120%	7.80	47%	3.06	57%	3.72
60 - 64	12,589,423	100%	6.50	160%	10.40	35%	2.30	76%	4.96
65 - 69	9,956,467	100%	6.50	200%	13.00	24%	1.53	95%	6.19
70 - 74	8,507,005	100%	6.50	250%	16.25	24%	1.53	141%	9.17
75 - 79	7,410,757	100%	6.50	320%	20.80	12%	0.77	191%	12.39
80 - 84	5,560,125	100%	6.50	390%	25.35	12%	0.77	286%	18.58
85+	4,859,631	100%	6.50	1000%	65.00	12%	0.77	381%	24.77
Total	293,655,404		**6.50**		**6.50**		**6.50**		**6.50**

Column Notes:

(1) Implementation Plan for the National Strategy for Pandemic Influenza
(2) Selected excess death curve, based on historical data
(3) Based on HHS figures
(4) SOA Pandemic Mortality Delphi Study
(5) 2000 US Census projected to 2004
(6) Flat extra mortality %
(7) (6) x (3)
(8) Hypothetical distribution based on data from 1957 and 1968
(9) (8) x (3)
(10) Hypothetical distribution based on data from 1918
(11) (10) x (3)
(12) Hypothetical distribution extrapolating historic data
(13) (12) x (3)

Insurance Industry Assumptions

Corporate Tax Rate (1)	35.0%	
Individual Reins (2)	5,396.6	Billion
Group Reins (3)	167.0	Billion

	INDIVIDUAL ASSUMPTIONS				GROUP ASSUMPTIONS			
Age Range	Reserve per 1000 (4)	Percent Owning (5)	Average Face (6)	Reinsurance Distribution (7)	Reserve per 1000 (8)	Percent Owning (9)	Average Face (10)	Reinsurance Distribution (11)
0 - 4	9.00	15.0%	25,000	0.1%	0.75	15.0%	18,000	0.1%
5 - 9	20.00	25.0%	25,000	0.2%	0.40	25.0%	18,000	0.1%
10 - 14	35.00	30.0%	25,000	0.2%	0.40	30.0%	18,000	0.1%
15 - 19	60.00	35.0%	50,000	0.2%	0.75	30.0%	20,000	0.2%
20 - 24	75.00	25.0%	75,000	0.6%	0.80	25.0%	35,000	0.7%
25 - 29	25.00	25.0%	150,000	4.2%	0.80	40.0%	70,000	5.8%
30 - 34	25.00	30.0%	200,000	6.9%	0.90	50.0%	90,000	12.7%
35 - 39	25.00	40.0%	300,000	14.6%	1.15	50.0%	135,000	15.2%
40 - 44	40.00	45.0%	300,000	17.6%	1.70	50.0%	135,000	16.6%
45 - 49	65.00	50.0%	200,000	15.8%	2.50	50.0%	100,000	16.6%
50 - 54	100.00	50.0%	150,000	14.8%	3.70	50.0%	100,000	14.1%
55 - 59	160.00	45.0%	125,000	10.2%	5.75	45.0%	100,000	10.7%
60 - 64	240.00	45.0%	100,000	6.5%	8.50	40.0%	80,000	5.0%
65 - 69	350.00	50.0%	75,000	3.4%	14.00	30.0%	60,000	1.1%
70 - 74	470.00	50.0%	75,000	2.3%	21.00	25.0%	35,000	0.3%
75 - 79	580.00	50.0%	65,000	1.6%	35.00	20.0%	35,000	0.2%
80 - 84	690.00	50.0%	50,000	0.5%	55.00	20.0%	35,000	0.2%
85+	810.00	50.0%	50,000	0.3%	82.50	20.0%	35,000	0.1%

Column Notes:

(1) US Corporate tax rate
(2) Based on 2005 NAIC One Source data
(3) Based on 2006 SOA/Munich American Re Study
(4) Based on data provided by industry leaders
(5) Estimated from 2005 LIMRA study
(6) Estimated from 2005 LIMRA study
(7) Based on data provided by industry leaders
(8) Based on data provided by industry leaders
(9) Estimated from 2005 LIMRA study
(10) Estimated from 2005 LIMRA study
(11) Based on data provided by industry leaders

Total Net Life Insurance Claims - Moderate Scenario

General population 0.7 excess deaths per 1000, "U " mortality curve

Age Range	Gross Claims (1)	Reserve Release (2)	Reinsurance Credit (3)	Net Claims Before Taxes (4)	Tax Rate (5)	Net Claims After Taxes (6)
0 - 4	129,459,670	663,680	6,249,006	122,546,984	35%	79,655,539
5 - 9	12,645,594	138,348	553,612	11,953,634	35%	7,769,862
10 - 14	16,366,351	313,800	642,068	15,410,483	35%	10,016,814
15 - 19	29,229,022	1,267,049	762,671	27,199,303	35%	17,679,547
20 - 24	34,602,652	1,643,825	1,860,894	31,097,932	35%	20,213,656
25 - 29	153,748,727	1,565,037	28,657,825	123,525,865	35%	80,291,812
30 - 34	257,935,013	2,658,814	47,472,270	207,803,928	35%	135,072,553
35 - 39	473,677,148	5,415,058	97,296,060	370,966,029	35%	241,127,919
40 - 44	560,268,905	10,691,741	117,344,948	432,232,217	35%	280,950,941
45 - 49	796,414,680	21,842,102	211,512,048	563,060,530	35%	365,989,345
50 - 54	877,327,920	25,194,403	295,572,714	556,560,803	35%	361,764,522
55 - 59	801,389,700	30,966,486	272,742,116	497,681,098	35%	323,492,714
60 - 64	620,406,733	35,254,699	230,018,452	355,133,583	35%	230,836,829
65 - 69	442,067,160	54,871,344	149,094,317	238,101,499	35%	154,765,974
70 - 74	393,449,010	92,007,888	127,087,510	174,353,612	35%	113,329,848
75 - 79	374,687,898	118,848,364	107,831,289	148,008,245	35%	96,205,360
80 - 84	277,561,479	124,389,072	41,811,660	111,360,746	35%	72,384,485
85+	622,032,840	353,366,218	64,444,683	204,221,939	35%	132,744,261
Total	6,873,270,501	881,097,928	1,800,954,143	4,191,218,431		2,724,291,980

Column Notes:

(1) Exhibit 2, Page 3, Column 11
(2) Exhibit 3, Page 1, Column 5 + Exhibit 4, Page 1, Column 5
(3) Exhibit 2, Page 2, Column 6
(4) (1) - (2) - (3)
(5) Exhibit 1, Page 3, Entry 1
(6) (4) x [1 - (5)]

Reinsurance Analysis Total - Moderate Scenario

General population 0.7 excess deaths per 1000, "U " mortality curve

Age Range	Reinsurance Distribution (1)	Reinsurance Ceded by Age (2)	Excess deaths per K (3)	Reinsurance Claims (4)	Reinsurance Credit Pecent (5)	Reinsurance Credit (6)
0 - 4	0.1%	6,249,005,835	1.00	6,249,006	100.0%	6,249,006
5 - 9	0.2%	9,226,874,230	0.06	553,612	100.0%	553,612
10 - 14	0.2%	10,701,137,454	0.06	642,068	100.0%	642,068
15 - 19	0.2%	12,711,176,753	0.06	762,671	100.0%	762,671
20 - 24	0.6%	31,014,906,960	0.06	1,860,894	100.0%	1,860,894
25 - 29	4.3%	238,815,207,593	0.12	28,657,825	100.0%	28,657,825
30 - 34	7.1%	395,602,253,028	0.12	47,472,270	100.0%	47,472,270
35 - 39	14.6%	810,800,503,757	0.12	97,296,060	100.0%	97,296,060
40 - 44	17.6%	977,874,563,110	0.12	117,344,948	100.0%	117,344,948
45 - 49	15.8%	881,300,199,856	0.24	211,512,048	100.0%	211,512,048
50 - 54	14.8%	821,035,315,420	0.36	295,572,714	100.0%	295,572,714
55 - 59	10.2%	568,212,741,448	0.48	272,742,116	100.0%	272,742,116
60 - 64	6.5%	359,403,830,604	0.64	230,018,452	100.0%	230,018,452
65 - 69	3.3%	186,367,896,746	0.80	149,094,317	100.0%	149,094,317
70 - 74	2.3%	127,087,510,089	1.00	127,087,510	100.0%	127,087,510
75 - 79	1.5%	84,243,194,193	1.28	107,831,289	100.0%	107,831,289
80 - 84	0.5%	26,802,346,292	1.56	41,811,660	100.0%	41,811,660
85+	0.3%	16,111,170,632	4.00	64,444,683	100.0%	64,444,683
Total	100.0%	5,563,559,834,000		1,800,954,143		1,800,954,143

Column Notes:

(1) (2) / Total of (2)
(2) Exhibit 3, Page 2, Column 2 + Exhibit 4, Page 2, Column 2
(3) Exhibit 2, Page 3, Column 8
(4) (2) x (3) / 1000
(5) Exhibit 5, Row 9
(6) (4) x (5)