

Society of Actuaries Research Brief

Impact of COVID-19

March 25, 2020





Society of Actuaries Research Brief

Impact of COVID-19

March 25, 2020

AUTHOR	R. Dale Hall, FSA, MAAA, CERA, CFA Cynthia S. MacDonald, FSA, MAAA Lisa A. Schilling, FSA, EA, FCA, MAAA Steven C. Siegel, ASA, MAAA J. Patrick Wiese, ASA
REVIEWERS	Jing Lang, FSA, FCIA Benjamin Pugh, FSA, MAAA Max J. Rudolph, FSA, MAAA, CERA, CFA Greger Vigen

Caveat and Disclaimer

This study is published by the Society of Actuaries (SOA) and contains information from a variety of sources. The study is for informational purposes only and should not be construed as professional or financial advice. The SOA does not recommend or endorse any use of the information provided in this study. The SOA makes no warranty, express or implied, or representation whatsoever and assumes no liability in connection with the use or misuse of this study.

Copyright © 2020 by the Society of Actuaries. All rights reserved.

CONTENTS

Section 1: Introduction	4
Section 2: Key Statistics	6
Reported Cases	6
Case Fatality and Mortality Rates	7
Comparison to Past Pandemics and Influenza	10
Health Care Cost and Utilization	10
Infection Spread Rate	12
Section 3: Economic and Asset Impact	15
Macroeconomic Variables	15
Asset Values and Volatility.....	16
Low Interest Rate Environment	17
Reinvestment Risk.....	17
Section 4: Operational and Emerging Risks	18
Hospital Operations	18
Remote Work	19
Internet Service Provider and Virtual Private Network Capacity.....	19
Cyber Risk	19
Stockpiling	20
Event Cancellations and Restaurant Closings.....	20
Impact of Property/Casualty Coverages	21
International Trade Dependency	21
Alternative Entertainment Distribution.....	21
Section 5: Previous SOA Research Highlights.....	22
Impact on the U.S. Life Insurance Industry.....	22
Comparison to Current COVID-19 Events.....	22
Impact on the U.S. Health Insurance Industry	23
Low and Negative Interest Rate Research.....	24
References.....	25
Key Statistics.....	25
Economic and Asset Impact	29
Operational Risks	30
Previous SOA Research Highlights	32
About The Society of Actuaries	33

Society of Actuaries Research Brief

Impact of COVID-19

March 25, 2020

Section 1: Introduction

In late December 2019, doctors in the city of Wuhan, China began to piece together information from several medical cases showing similar symptoms. As 2019 ended, Chinese officials announced a pneumonia-like outbreak and began to identify a “novel coronavirus” linked to the cases. As the Lunar New Year banquet tradition occurred in Wuhan, a city in Hubei, in mid-January 2020, infections began to rapidly increase. By January 23, over 600 cases had been confirmed and Wuhan and other areas in China instituted quarantines.

Through February to mid-March, the disease spread to nearly all corners of the world. The number of confirmed cases involving the novel coronavirus now named “SARS-CoV-2”, and causes the respiratory disease now named “coronavirus disease 2019” (COVID-19), approached 426,000 world-wide with general agreement that the number is higher due to delays in full testing and reporting in many countries. On March 11, WHO publicly characterized COVID-19 as a pandemic, and shortly thereafter, the United States declared the COVID-19 outbreak a national emergency.

As of March 25, 170 World Health Organization (WHO) countries/regions have reported cases, and nearly 19,000 deaths world-wide have occurred. To stem the spread of the virus, several countries worldwide and many U.S. states and cities have issued “shelter in place” or “stay at home” orders. Some markets that were early to detect and treat the virus, are contemplating easing their quarantine restrictions. Others that began loosening restrictions have reverted after noticing new upticks in contracted cases. It is important to recognize that the number of reported cases for any disease typically lags behind the number of actual cases. As a result, the number of reported cases typically continues to rise after the actual number of new cases declines.

The health, mortality and economic focus has become one of international concern. As of March 25, almost 30 countries have reported over 1,000 confirmed cases. Increases in reported case count in these markets, as well as the growth in other locations, are highly dependent on the methods and timing of implementing testing protocols. A key differentiation among some countries is the speed at which they can ramp up testing and identification processes across their populations.

The impact of travel and shipping restrictions in a modern, interconnected international economy has had an exacerbating effect of the outbreak into logistics and the financial markets. Financial markets have seen high volatility as new economic information becomes available, monetary policies are implemented, and value and opportunity come in and out of favor with investors. Supply chains of international operations are greatly impacted as well, as many major worldwide manufacturers are ever-more connected across continents.

The result in late March 2020 has been one where a confluence of risks has come together. Additional operational and financial risks may emerge as additional events compound on the current situation. Actuaries will be watching for any additional risk events that layer on to the current environment, especially ones that may cause additional property, mortality and health risks such as catastrophic weather events. Morbidity, mortality, asset/liability management and operational risks are all a part of the initial and evolving story. This update to the Society of

Actuaries Research Brief has been constructed to highlight some of the key continuing and new features of the pandemic all around the world and contemplate the risks for the actuarial profession to consider in their work.

Section 2: Key Statistics

REPORTED CASES

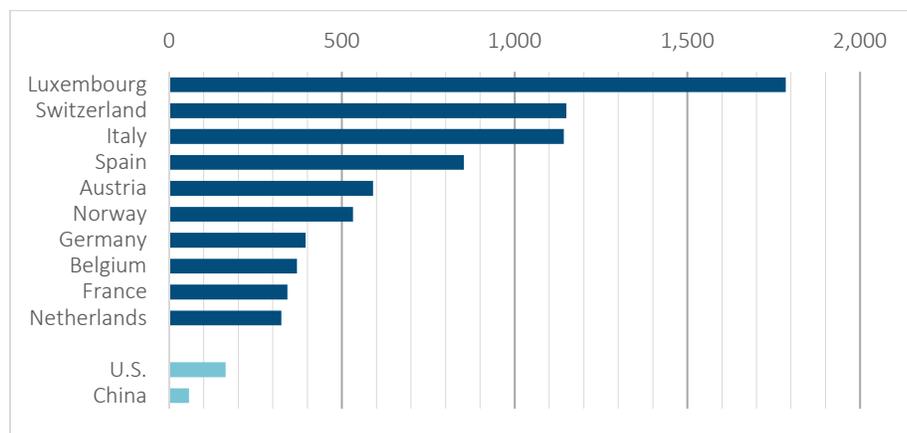
National health organizations around the world have been fast at work in connecting with health care providers to collect current case information. Confirmed case are a function of the ability for any public health agency across countries to distribute, administer and collect results from their respective health systems. As of approximately 5:30 am Central Daylight Time on March 25, 2020, nearly 426,000 cases have been reported world-wide; Table 1 shows the countries that have reported over 1000 cases of COVID-19:

Table 1
COUNTRIES REPORTING AT LEAST 1,000 CONFIRMED COVID-19 CASES

Country	Confirmed Cases	Percentage of World-Wide Cases
China	81,637	19.2%
Italy	69,176	16.3%
US	55,225	13.0%
Spain	42,058	9.9%
Germany	33,593	7.9%
Iran	24,811	5.8%
France	22,637	5.3%
Switzerland	9,991	2.3%
South Korea	9,137	2.1%
United Kingdom	8,164	1.9%
Netherlands	5,585	1.3%
Austria	5,448	1.3%
Belgium	4,269	1.0%
Norway	2,868	0.7%
Canada	2,792	0.7%
Australia	2,364	0.6%
Portugal	2,362	0.6%
Sweden	2,300	0.5%
Brazil	2,247	0.5%
Israel	2,030	0.5%
Turkey	1,872	0.4%
Denmark	1,852	0.4%
Malaysia	1,796	0.4%
Czechia	1,497	0.4%
Ireland	1,329	0.3%
Japan	1,193	0.3%
Luxembourg	1,099	0.3%
Ecuador	1,082	0.3%
Pakistan	1,000	0.2%

Populations vary significantly by country, however. To put the number of reported cases in context of country size, Figure 1 shows the 10 countries with the greatest number of cases per million of population.

Figure 1
CASES PER MILLION OF POPULATION, MARCH 24, 2020



Source: Johns Hopkins University
 Note: U.S. and China are not among the top ten countries but are included as reference points.

It is important to recognize that these data show **reported** cases, not actual cases. Major differences exist between testing and reporting, and the differences vary by country. Countries with the highest reported case rates likely reflect serious infection rates, while countries with low reported case rates may reflect slower or underreporting.

CASE FATALITY AND MORTALITY RATES

World-wide mortality is currently crudely estimated at first using a statistic known as the “case fatality rate” (CFR), which divides the known deaths by the identified number of cases. Using this methodology, the CFR across the world-wide set of case information is approximately 4.5% and is generally reported by health and media publications in the 3.0%–5.0% range. These raw estimates, however, often are adjusted to produce updated rates, due to the current likelihood of under-reporting of actual cases. Many potential cases may yet be identified in some countries due to limited supply of testing kits, and a reduced ability to process tests in laboratory settings. In addition, asymptomatic and mild cases of the disease may not actively seek treatment in the local health care systems. Death rates are also substantially impacted by other factors such as age, smoking and social interactions in each country. Initial CFRs in the U.S. started in the 3.5%–4.5%, slightly higher than the world-wide rate, primarily due to the disease initially being seen in higher age groups. As more cases have been identified, the U.S. CFR has trended downward to the 1.8%–3.4% range per the CDC, as shown in Figure 2.

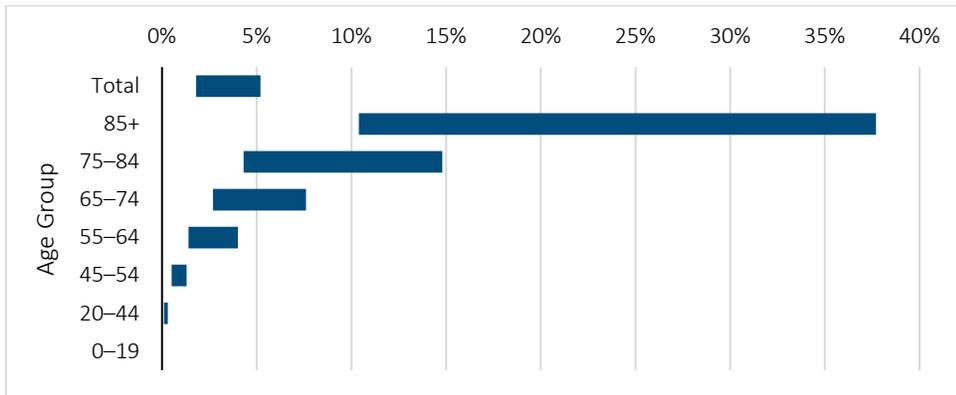
The case and death data from Johns Hopkins University’s Coronavirus database can be used to estimate the case fatality rate by dividing the number of cumulative deaths by the number of cumulative cases. This approach generally leads to overestimates when it is applied to a rapidly evolving epidemic in which the number of cases is increasing significantly with each passing day. However, for Hubei province, China, the number of new cases declined to a relatively small level in the beginning of March, and few new cases have been reported since that time.

The stability of the data reduces the risk of CFR overestimation.¹ Using total case and death data for Hubei as of March 24, the CFR is equal to 3160 deaths divided by 67801 cases, or 4.66%.

While the CFR is a useful starting point for mortality analysis, it does not address the fact that some symptomatic individuals – particularly those with mild symptoms -- may be excluded from the data. With sufficient time, researchers may be able to assemble the information required to estimate the size of this pool of individuals. The estimate can be used to calculate the symptomatic case fatality rate, which is equal to the number of deaths divided by the estimated number of individuals who developed symptoms associated with the virus. Joseph T. Wu and other researchers estimated the COVID-19 symptomatic case mortality rate for Wuhan to be 1.4%, with a 95% confidence interval running from 0.9% to 2.1%. Note that Wuhan is the capital of Hubei province, and the location of most of the COVID-19 deaths in that province.

The ultimate rate of mortality from COVID-19 will evolve over time. Some key health officials in the U.S. expect an ultimate case fatality rate from the disease, once all known cases are included in the denominator of the calculation, to settle in the 0.5%–1.0% range.

Figure 2
U.S. COVID-19 CASE FATALITY RATE RANGES BY AGE GROUP

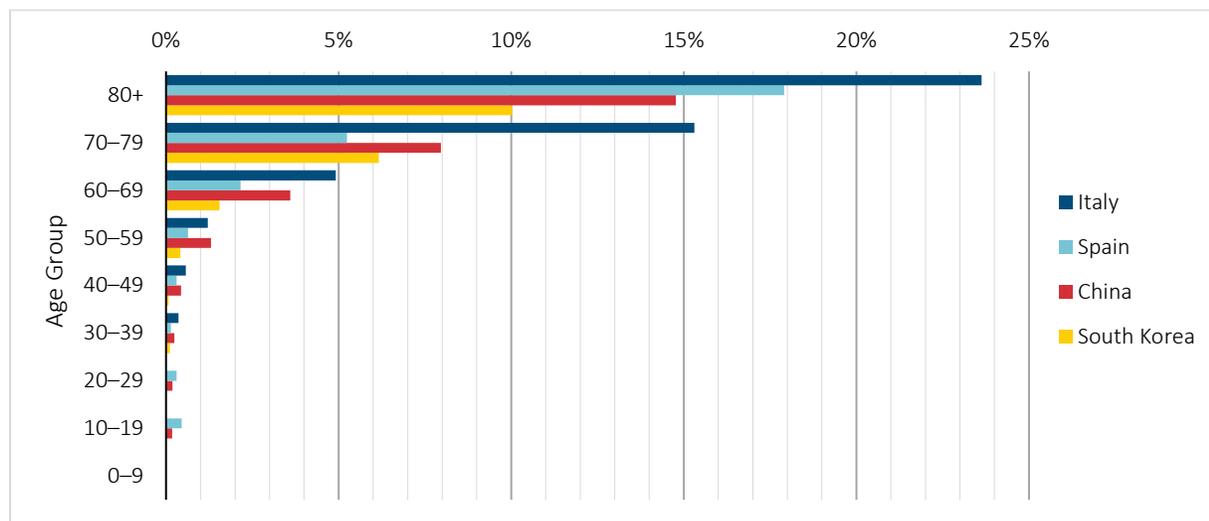


Source: Centers for Disease Control and Prevention, *Morbidity and Mortality Weekly Report*, March 18, 2020

CFR and mortality rates appear to be emerging as very dependent on age, with much higher mortality rates being seen for patients over ages 70, especially for those with health conditions that weaken the lungs and immune system. Figure 2 contains ranges of CFR by age group in the U.S. estimated by the CDC. CFRs have also been calculated by age group in China, Italy, Spain and South Korea as shown in Figure 3. Italy has the highest rate in most age groups while South Korea has the lowest CFR in most age groups. The range of CFR across these countries is greatest at the older age groups. CFR for the 70-79 age group ranges between 5.2% in Spain and 15.3% in Italy. And for those above age 80, CFR ranges between 10.0% in South Korea and 23.6% in Italy.

¹ When dealing with unstable data, a possible approach is to divide the number of deaths as of date “x” by the number of cases reported at an earlier date, such as 14 days prior to “x”. This adjustment accounts for the fact that death does not generally occur rapidly after infection.

Figure 3
SELECTED COUNTRIES COVID-19 CASE FATALITY RATES BY AGE GROUP



Source: Sánchez, R.; Ordaz, A., Mendoza, S. P., *eldiarios.es*, March 22, 2020

It should continue to be reinforced that emerging statistics on the pandemic contraction and case fatality rates lag real-time information. In the early onset of the disease, cases might often be realized in datasets between one to two weeks after the first identification of the case occurred. The amount of time between contraction of the disease, onset of symptoms and its ultimate treatment and identification in public health statistics could be much longer in counties without complete implementation of test processing.

As happens with other viruses such as influenza, climate conditions have an impact on the ability of the virus to survive. Viruses often survive better in cold weather due to coatings that allow them to survive in the air and be passed on from person to person. These features degrade in warm temperatures. The risk exists that the spread of COVID-19 may deteriorate in the late spring in the Northern hemisphere, but also then come back as a second wave in the late months of 2020.

Death rates and reported cases will grow rapidly over coming weeks. However, the pace will be very different in each community and country. It is important to understand the different timing of different numbers. Deaths are a lagging indicator. Deaths will greatly increase in many communities over the next month—even if the personal and private actions have slowed the growth of the virus. The same is true for reported cases. The numbers of reported cases will greatly increase over the next months. One technique that has been suggested in the calculation of CFRs is to ‘lag’ the number cases in the denominator by 7 or 14 days to better align the deaths with an appropriate exposure in calculating a CFR. However, CFRs calculated with a ‘lagged’ case number could potentially be significantly higher than a CFR using a non-lagged case number. The CFR rates quoted in this section have been pulled from various sources that have not clearly documented whether a lag is included. The reader should be aware of these potential shortcomings when reviewing these statistics and other reported CFRs.

Life insurance companies will focus on how the population mortality rate translates into the ultimate mortality of their own insured populations. Socioeconomic factors may be a key driver of how mortality plays out, as an individual’s access to healthcare services and current health condition are often factors that drive survival rates in a confirmed case.

COMPARISON TO PAST PANDEMICS AND INFLUENZA

By comparison, the spread of COVID-19 has been much greater than similar epidemics witnessed in the 21st century, but also with much lower mortality rates. SARS-CoV-2 is one of seven distinct coronaviruses that can infect humans and get their name from the crown-like spikes on their surfaces. Four common coronaviruses (known as 229E, NL63, OC43, and HKU1) rarely cause serious complications or mortality events. Two other coronaviruses have been more prominent in their impact on human illness and mortality. The SARS-CoV virus caused the severe acute respiratory syndrome (SARS) outbreak of 2003 and the MERS-CoV virus created the Middle East Respiratory Syndrome (MERS) in 2012.

The following table shows comparative statistics of COVID-19 compared to the severe acute respiratory syndrome (SARS) outbreak of 2003 and the Middle East Respiratory Syndrome (MERS) in 2012, using data as of March 25, 2020.

Epidemic	Number of Countries Reporting Cases	Estimated Deaths	Estimated Contracted Cases	Estimated Case Fatality Rate
SARS (2002–2003)	29	774	8,098	9.6%
MERS (2012–2014)	27	858	2,494	34.4%
COVID-19 (201 –2020)	170	19,000	426,000	4.5%

The U.S. was a very small part of these previous outbreaks in comparison to the level of activity seen with COVID-19. Eight U.S. patients had evidence of the SARS infection, and no deaths occurred in the U.S. due to SARS. The U.S. saw only two cases and no deaths due to MERS in 2014, both associated with individuals who had lived or worked on the Arabian Peninsula.

In addition, it can be beneficial to compare the extent of the impact of a sample influenza year to understand the magnitude and strain on health care systems and population mortality. The most recent full year of mortality in the U.S. is from 2018, which was also a fairly harsh year for the age-adjusted influenza mortality rate. The U.S. influenza season across 2017-2018 saw over 48 million people become ill, with over 950,000 people hospitalized and over 79,000 deaths. The annual case fatality rate for influenza in the U.S. typically is observed between 0.1% and 0.2%, with population mortality generally in the range of 12 to 20 deaths per 100,000 of population depending on the severity of the season.

Additionally, in 1918 the world faced an influenza H1N1 pandemic as World War I was ending. Mortality was high in people younger than 5 years old, people aged 20 through 40, and in people age 65 years and older. The high mortality in healthy people, including those in the 20-40-year age group, was a unique feature of this pandemic. Health officials estimate mortality was approximately 50 million deaths worldwide. Since 1918, the world has experienced three additional pandemics, in 1957, 1968, and most recently in 2009. These subsequent pandemics were less severe and caused considerably lower mortality rates than the 1918 pandemic. The 1957 H2N2 pandemic and the 1968 H3N2 pandemic each resulted in an estimated 1 million global deaths, while the 2009 H1N1 pandemic resulted in fewer than 300,000 deaths in its first year.

HEALTH CARE COST AND UTILIZATION

Data on the cost and utilization of treatment for individuals who are diagnosed with COVID-19 still appears to be emerging. On March 24, Covered California, an independent part of the California state government whose job is to make the health insurance marketplace work for California’s consumers, released a national projection of health care costs due to COVID-19. Estimated one-year projected costs related to treatment and care of COVID-19 in the U.S. commercial health insurance market, which covers a population of approximately 170 million people, ranges

from a low of \$34 billion to \$251 billion or more. As a percent of commercial health premium, these costs could range from about 2% to over 21% of premiums. Covered California also estimated that 2021 premium increases could range from 4% to 40% if carriers look to recoup 2020 costs, price for the same level of costs for the 2021 calendar year and look to protect their solvency.

An issue in some countries, including the U.S., is that the supply of products needed to perform tests is lower than the current demand. Testing for the virus involves collecting respiratory specimens from a patient and running it through test kits at public health laboratories that perform real-time RT-polymerase chain reaction (rRT-PCR) detection of the SARS-CoV-2 virus. Inside the labs, reagents are required to test the specimen provided. Supply of test kits is appearing to grow, but one constraint may also be the amount of public and clinical lab capacity that can be used or increased.

Countries around the world are looking to find ways to improve their ability to meet the demand for test and to process them efficiently. For example, in recent days medical centers within the University of California system have been converting laboratory space into in-house coronavirus testing centers. To encourage early detection and treatment, some U.S. health insurers announced that they would waive copays and cost sharing for COVID-19 detection tests. Since then, on March 18, 2020, Congress passed a new law, the Families First Coronavirus Response Act, that requires most private health plans to cover testing for the coronavirus with no cost-sharing during the current emergency period. Some states have adopted similar requirements for insurers they regulate, and many private insurance companies plan to voluntarily expand coverage for testing.

Several pharmaceutical companies have been developing and testing treatments for COVID-19, though results are still preliminary. In addition to these antiviral and anti-infective treatments, preventive medicines and therapeutic antibodies are being reviewed. The newness of the virus complicates research efforts, even with increasing information coming from early cases in China to help guide what might be potential treatments or solutions. Some estimates indicate that it may take up to 12–18 months to know the effectiveness and safety of any proposed vaccines. There is anecdotal evidence that the anti-malaria drug, hydroxychloroquine, can be effective in dealing with the symptoms of coronavirus. On March 24, there were indications that the FDA would approve off-label use of hydroxychloroquine to help coronavirus patients.

Some countries have dramatically increased capacity for testing over recent weeks, leveraging off past investments in health care infrastructure. As an example, South Korea has had a high number of detections of SARS-CoV-2 but have also seen the number of new cases decline since the start of March 2020. Approximately 300,000 tests have been administered there since the outbreak started, translating to a per capita rate of more than 40 times the United States. Estimates place the daily capacity around 15,000 tests. In many parts of the country, drive-through test centers have been established to expedite the process and extend testing ability. These methods also help limit health care workers from having extended direct exposure to the virus. The United States has also commenced this process through health facilities in some states and is also eyeing expansion to private sector pharmacy partners.

Overall health care cost and utilization in many countries will also be impacted by the decisions individuals make surrounding other typical illnesses that may arise and elective procedures that have been scheduled. Some patients have procedures that may not be able to be deferred indefinitely due to the nature of the illness, such as scheduled chemotherapy treatments. In these cases, hospitals are looking to make sure high-risk patients with compromised immune systems are not exposed to the virus. With more encouragement by public health officials to reduce social interaction, however, and individuals potentially nervous about entering a hospital setting where the virus may be present, more deferrals of services may occur, and minor ailments may not be seen as frequently. In addition, health officials are strongly encouraging patients to carefully consider use of emergency room services and not to use them for minor health issues. Telemedicine providers may see an expected rise in utilization. Low utilization of telehealth services in the U.S. to date have been typically attributed to lower consumer awareness and higher comfort with traditional methods but are expected to grow with increased emphasis on technology for social

engagement and remote work. Related to this, insurers should be prepared to see an increase in short term disability claims as patients recover from the disease and other complications.

Mental health concerns and treatments may see an increased demand in the coming weeks as populations deal increasingly more with self-isolation and reduced social interaction. Mental side effects of the COVID-19 crisis are increasingly looking to be addressed by health professionals and heightened as health resources are diverted to the most immediate concerns. In past national disasters, such as terrorism attacks or large-scale weather catastrophes, the primal human social instinct has been to seek comfort in a larger group — whether it be family, friends, neighbors or co-workers. In the COVID-19 pandemic, isolation is recommended to reduce the spread of the virus. While social media outlets have certainly increased since past national disasters in the U.S., such as 9/11 and Hurricane Katrina, it may not be a full replacement for social interaction or as available and used by older or more remote segments of the population. To give perspective on the stress of isolation, and to offer advice on ways to contend with living in confined spaces for long periods of time, the U.S. National Aeronautics and Space Administration (NASA) identified key skills the public can consider. Using insights from NASA astronauts, the agency promoted personal skills including maintaining a plan and schedule, taking time for creative and fun activities and finding time, if possible, to get in a daily walk and fresh air.

Insurance regulators across many markets will be discussing in coming days how claim handling and insurance premium processing may need to change in the face of the current virus pandemic. In similar situations in the past insurance regulators have taken steps to ensure that policies across all lines of business are not inadvertently cancelled due to an inability of policyholders to make timely payments. On Friday March 20, the National Association of Insurance Commissioners (NAIC) held a full-day special virtual session to discuss state response, coordination and potential guidance for the U.S. insurance industry around COVID-19. Presentation topics included pandemic modeling, information around policy coverage, financial impact to the insurance industry and insurer readiness. The remainder of the NAIC Spring National Meeting was suspended to allow participants to focus on the health emergency. An SOA Research Insights Podcast interview with NAIC CEO Mike Considine, highlighting the U.S. insurance regulatory perspective on COVID-19 implications, can be found on the SOA website at <https://www.soa.org/resources/newsroom/covid-19-updates/#research>.

INFECTION SPREAD RATE

Transmission rates for diseases, and the intensity of an outbreak, are highly dependent on how the pathogen travels between people. Coronaviruses generally can travel up to six feet from an infected person, as they move through respiratory droplets produced through sneezes, coughs or conversations. Some estimates suggest that each person with the new coronavirus could infect between two and four people without effective containment measures. The incubation period for COVID-19 is also relatively long compared to other diseases, with estimates running from 2–14 days from the time of exposure to when the individual shows symptoms. With concerns about the spread of the disease and the length of the incubation period, many countries have implemented quarantines. The quarantines vary broadly, including limitations on entering the country to full regional or national quarantines of the population. A report was released on March 16 indicating the potential for infection spread on the virus from a team at Imperial College in London, led by Neil Ferguson. It warned that spread of the disease could cause over 500,000 deaths in the United Kingdom if a more forward government response on reducing population mobility was not taken. The report also noted that up to 2.2 million deaths in the United States could occur from a relaxed response to the virus.

In early March, the Italian government declared the entire country a "red zone," meaning people should stay home except for work and emergencies. Since that time, several additional countries including Spain, New Zealand and England have issued stay-at-home orders. On March 24, India issued a lockdown of the entire country of 1.3 billion people for three weeks. Businesses are taking action for their employees, such as offering or mandating remote work. Action is also specific to particular regions and communities. As of this writing, at least 15 U.S. states have issued "stay at home" or "shelter-in-place" orders, although businesses, such as grocery stores, that provide

essential services can remain open. At least 1.5 billion people—a fifth of the world's population—have been asked or ordered to stay home to try to dampen the spread of the coronavirus.

The concept of “social distancing,” or “physical distancing,” has become common vocabulary. This includes personal action as people are encouraged to maintain distance between themselves and others to reduce the spread of the disease. Actuarial model simulations can illustrate the impact of social distancing. The SOA has made available a simple example of a social distancing model (<https://www.soa.org/resources/research-reports/2020/impact-coronavirus/>). This model simulates the proportion of a population in various states of health across time: healthy, mild illness, severe illness and death, using probabilities from a hypothetical virus. Because this is a simplified model for illustration purposes only, these health states are conceptual and are not explicitly defined.

The following graphs, created from the model, illustrate the potential impact over time of low social distancing (Figure 1) compared to increased social distancing (Figure 2). For this modeling exercise, the healthy state includes persons who have contracted and recovered from the disease. Through these examples, one can observe the potential benefit of moderating the disease’s overall impact by spreading the strain of health care systems across time. The maximum peak of both the mild illness and severe illness states are lowered, and also pushed out further in time, helping defer onset and spread the stress on the health care system. In the current environment, this phenomenon has been referred to as “flattening the curve” through a much slower pace and accumulation of ill patients.

These examples are for illustration only and do not represent actual estimates of probabilities for transition between health states due to COVID-19 or any other virus.

Figure 4
Low Social Distancing

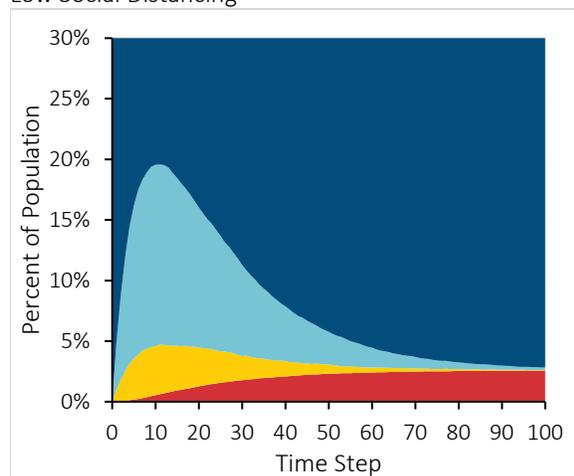
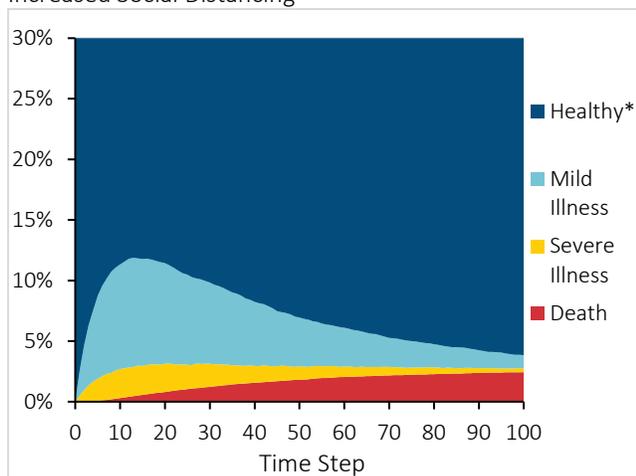


Figure 5
Increased Social Distancing



*Healthy includes individuals who have recovered as well as those not yet infected.

By comparison to COVID-19, other pathogens more easily travel through the air for longer distances, such as up to 30 meters for tuberculosis, chickenpox and measles. With the SARS coronavirus in 2003, world health authorities were able to eventually track and isolate cases. The result was to bring the average number each sick person infected down to 0.4, suppressing the outbreak.

Health and public officials have responded in several cases by canceling spectator events that would bring large groups of individuals in close proximity. Examples are numerous, including the cancellation of the U.S. National

Collegiate Athletic Association's (NCAA) basketball championships, commonly referred to as "March Madness", as well as suspension of many world-wide professional sports leagues such as the National Basketball Association, National Hockey League, and football (soccer) matches in the English Premier League. The International Olympic Committee has postponed the 2020 Summer Olympics in Japan until 2021.

Section 3: Economic and Asset Impact

MACROECONOMIC VARIABLES

With COVID-19 impacting business around the world, domestic and international financial markets have reacted to reflect potential lower levels of economic activity. Travel restrictions across many countries have been implemented with intentions to slow the spread of the virus. In cases where citizens and legal permanent residents are returning to countries from high-risk areas, their return often has been required to be to designated airports set up to review and inspect the returning travelers.

On Tuesday, March 3, in an attempt to limit the economic and financial fallout from COVID-19, the Federal Reserve reduced the benchmark U.S. interest rate by half a percentage point to just below 1.25%, down from about 1.75%. In a similar move, on March 11 the Bank of England reduced the rates used by banks and lenders by 0.50%, from 0.75% to 0.25%, to tackle the impact the coronavirus outbreak is having on the economy.

These moves were then followed up by an additional round of quantitative easing on Sunday, March 15 as the Federal Reserve announced dropping the benchmark interest rate to 0.00%. With an anticipation of volatile financial markets, the Federal Reserve makes funds to banks available at these benchmark rates to support the liquidity and stability of the banking system and the effective implementation of monetary policy and to support the flow of credit to individuals and businesses. The Bank of England also followed suit by bringing down its benchmark rate to 0.1%, which is the lowest rate recorded in the history of the bank, since its establishment over 325 years ago in 1694.

During recent days, many central banks around the world have continued to use monetary policy levers to help stem the tide of low economic activity due to travel, trade and shelter-in-place restrictions. The U.S. Federal Reserve rolled out an array of programs to make loans available to companies and governments, so they can cover current expenses and potentially avoid laying off employees. It also committed to buy as much government debt and mortgage-backed securities it deems necessary to ensure functioning liquidity in these markets and ensure cash is available to the financial system. Of even further importance to the actuarial profession is that with this release, the Federal Reserve announced that it would buy corporate bonds, including the riskiest investment-grade debt, for the first time in its history. Corporate bonds rated at 'BBB' or higher by Standard and Poor's or Moody's, which are key investments for many financial institutions, would be eligible and help ensure liquidity in these markets under this program. Similarly, Australia's central bank proposed to buy \$2.35 billion in government bonds and Germany agreed for a package worth up to \$808 billion. The Bank of Korea cut its benchmark rate on March 16 by 0.50% to a level below 1.00% for the first time and did so during its first emergency meeting since the financial crisis of 2008. The European Central Bank (ECB) announced a €750 billion emergency purchase program aimed to mitigate the financial risks and maintain higher economic outlook for the European countries impacted by the outbreak. It can be challenging in the current environment for the ECB to make large alterations to benchmark interest rates, as the key deposit facility rate, which banks may use to make overnight deposits with the Eurosystem, already sits at -0.50%.

Legislative branches of many countries are also contemplating ways to maintain economic activity amid the COVID-19 pandemic. As of the time of this writing, the U.S. Congress is strongly contemplating a stimulus bill that would seek to inject \$2 trillion into the economy, which equates to approximately 10% of Gross Domestic Product for the U.S. The result of the legislation contemplates the potential of including direct payments to households, and additional loan and assistance programs for businesses, states and cities.

As labor and production reports begin to emerge over recent days, several reports are noting the impact on worldwide service providers and manufacturing. IHS Markit, an international economic information and analytics firm, noted that its U.S. services Purchasing Managers Index (PMI) declined to a record low of 39.1 for the month, falling from a reading of 49.4 in February. Readings below 50 on the index note signals of economic contraction.

Employment in key economic markets around the world are being heavily influenced by the current COVID-19 environment. With travel restrictions anticipated to be in place for extended periods of time, and less of an ability to convert work or services to a remote work basis, the transportation, travel planning and leisure and hospitality labor sectors are expected to be among the industries highest at risk for reduced work or unemployment. Conversely, industries allowed to stay open and operate, even in shelter-in-place scenarios, such as pharmacies and grocery markets are hiring at a rapid pace to meet the demand created. Additional upcoming reports expected on international production, purchasing and on labor markets will further indicate the level of unemployment changes, and the types of industries that could be subject to lower capital levels and taking advantage of financial assistance from government sources.

Reductions in expected growth in Gross Domestic Product (GDP) for high-GDP countries have been made over the past weeks from many sources with nearly daily changes in the expectation and timing. Updated estimates depend heavily on monetary policy moves and legislative approvals. Most consistently, economic outlook for a majority of economists expected large downturns in 2nd quarter 2020 GDP, with early impacted markets like China having growth rebound in the near term. Early indicators such as traffic patterns and shipping data within some early onset COVID-19 Asia-Pacific markets show signs of potential. On March 23, International Monetary Fund Managing Director Kristalina Georgieva made the following statement, "...the outlook for global growth for 2020 is negative—a recession at least as bad as during the global financial crisis or worse. But we expect recovery in 2021." Many of these outlooks for growth are very strongly tied to the progression, treatment and containment of COVID-19. Short-term projections over the coming weeks or months might be more easily modeled, but long-term impacts can be harder to pin down with precision.

ASSET VALUES AND VOLATILITY

International financial markets have reacted to COVID-19 as some investors sought increasing shelter in government bonds amid uncertain future economic activity arising from the impact of COVID-19.

The week of March 9 saw one of the most volatile swings since the worldwide financial crisis of 2008. Major financial indexes ended the week with a 9% surge on Friday March 13 following a 10% decrease the day before. For the week of March 9, indexes were generally down 4–5%, and over 20% recent highs seen in early February 2020. The downturn continued in equity markets on Monday March 16, with circuit breakers being hit in early trading due to initial losses on indexes and ending with a nearly 12 - 13% drop in the main U.S. equity market indexes. Volatility continued to be the main song of the international markets through the week of March 16 and through the time of this writing. On Friday March 13, the Dow Jones Industrial Average climbed 9.3% on new economic news, only to drop 12.9% on Monday March 16. By Monday, March 23, indexes were down more than 30 percent since their peak in February. However, on Tuesday March 24, the Dow Jones Industrial Average saw its best one-day gain since 1933, increasing 11.3% on news of a potential economic stimulus package.

An additional item of note is the length of magnitude of past economic financial market downturns. Using the U.S. S&P 500 as a barometer, some notables downturns in equity markets have occurred over time. Table 2 notes occurrences in the past 100 years where a decrease in the index has eventually reached over 40%, the amount of time it has taken from its starting highpoint to final low point, and also how the index performed for the 12 months after completion of the downturn. Historically, many of the most severe financial downturns have been more prolonged events, with large declines occurring over at least a 1 to 2-year period, though notably having some strong declines over a one-month period.

Table 2

HISTORICAL 40% DROPS IN S&P 500 INDEX

Start	Finish	Duration (months)	Decrease in S&P 500 Index over 1 month	Decrease in S&P 500 Index over Full Duration	1-Year Index Return after Finish
Sep 3, 1929	Jul 8, 1932	34	-20%	-86%	124%
Mar 10, 1937	Apr 28, 1942	61	-9%	-60%	59%
Oct 9, 2007	Mar 9, 2009	17	-2%	-59%	68%
Mar 24, 2000	Oct 9, 2002	31	-3%	-49%	34%
Jan 11, 1973	Oct 3, 1974	21	-41%	-48%	38%
Feb 19, 2020	Mar 23, 2020	1	-34%	-34%	TBD

LOW INTEREST RATE ENVIRONMENT

Low interest rates for investment by financial institutions in major international financial markets have been more the norm over recent years, and the current impact of COVID-19 has further driven down interest rate levels. Benchmark Treasury yields in the U.S. fell nearly 100 basis points in early March since levels seen in mid-February, with the benchmark 10-year Treasury yield temporarily reaching a record low of under 0.40% and the 30-year Treasury moving below 1.00% for the first time ever. Some reversion has occurred since the lowest interest rate levels, with the 10-year Treasury yield moving closer towards 1.00% and the 30-year Treasury yield near 1.50%.

Using the date of February 19, 2020 as the start of financial market impact in the US, Treasury rates at the long end of the curve are down approximately 60–70 bps. Corporate spreads, while initially stable through early March, have widened substantially in the most recent weeks. Current credit spread levels, while still below those seen in the financial crisis of 2008–2009, are higher than those seen in other economic environments such as the tech bubble and Enron / MCI WorldCom accounting crises of 2002.

REINVESTMENT RISK

With the material drop in interest rates to even lower levels, the opportunity to reinvest maturing assets becomes even more difficult for financial institutions. Maintenance of fixed income portfolio yields that support fixed interest crediting rates will pose a continuing challenge as the prolonged low interest rate environment continues.

Section 4: Operational and Emerging Risks

As businesses around the world work with their employees to minimize the impact of COVID-19, new operational risks and concerns begin to emerge. The following risks have been identified as key ones to watch through discussions with actuarial profession thought leaders.

HOSPITAL OPERATIONS

A significant portion of the risk for public health systems in combating the virus outbreak and for private health care providers and insurance carriers to monitor is the ability for hospitals to contend with the increasing cases. The volume of hospital beds and rooms in some markets will be stressed by the outbreak. In addition, equipment that is critical to responding to respiratory diseases will be in strong demand. Equipment such as ventilators are key to the health care response and treatment of COVID-19, especially as the disease strains the breathing of patients who are already weak or have other health conditions.

Governor Andrew Cuomo of New York issued an emergency order to hospitals in New York State to increase capacity by at least 50% to contend with the sharp increase in case. As of March 23, New York City had 2,000 ventilators, but is expected to need 15,000 by the end of May according to Mayor de Blasio, demonstrating further capacity strains.

Some countries have taken early measures to convert available spaces into hospitals, or additionally construct pop-up hospital settings. Hospital beds per capita in economically developed countries around the world outside the U.S. tend to average slightly above 5.0 beds per 1000 people, while recent averages in the U.S. have been approximately 3.0 beds per 1000. U.S. Navy hospital ships are being deployed to areas with the greatest need such as Los Angeles. Large empty spaces such as convention centers are being converted to house temporary hospital units. In addition, hotels in some cities like Chicago are renting empty hotel rooms to isolate individuals and patients who need to be quarantined. Health system capacity will be a substantive issue and risk that will be emerging in the U.S. in the next few weeks.

Health care systems are also looking to take advantage of technology, and prevent the spread of potential virus cases, by emphasizing screening that can be done through online methods. Many healthcare systems are encouraging diagnosis through online screening methods, or through the use of chatbots that can analyze patient symptoms and give advisement on what steps individuals should take next. Through these methods, health care systems are looking to avoid the spread of the virus in common health care settings such as physician's offices and emergency rooms and avoid situations where potential virus carriers would need isolation in the hospital setting prior to formal admittance.

Supply chain risks also exist for hospitals, pharmacies and other health care providers as international shipping and delivery services play vital role in getting pharmaceutical drugs from their manufacturing source to the site of use. The U.S. may be a key example. Research and development of new pharmaceuticals is often done within the U.S., but manufacturing is often done outside the country. High proportions of commonly used drugs such as antibiotics, ibuprofen, hydrocortisone, acetaminophen and heparin are produced outside the U.S., often in the Chinese market. Many other countries such as India, South Korea and Germany are reducing the amount of medical supplies and protective gear they export to retain supplies in their local market.

On March 18, the U.S. 1950 Defense Production Act was invoked and empowers the U.S. government to mobilize private industry to ramp up production in the name of national security if needed. To date, this has not been necessary as private industry has begun voluntarily converting their facilities to begin production of medical devices and supplies that are likely to be in high demand. Distilleries are converting their gin, whiskey and rum production

lines to the production of hand sanitizer. Auto and truck manufacturers are looking into producing ventilators. An electronics makers of display screens will start making surgical masks.

REMOTE WORK

A common step implemented by many organizations around the world has been to encourage remote work environments. In this setup, employees work from a remote location outside the normal office setting, often from their own personal residence. This helps maintain physical distance and reduce the chance of spreading disease among an employee population.

While remote work is not a new concept, the volume of remote work that is expected to be implemented due to COVID-19 may greatly exceed previous expectations. Employers will be looking to maintain productivity and keep processes moving.

A mitigation to this risk is that many employers have already implemented some form of remote work, ranging from arrangements that allow employees to periodically work remotely up to full time remote work. The previous investment of these work arrangements may be beneficial to companies in any prolonged transition for their employees.

Physical asset and information security risk also increases as remote work becomes more the norm. Organizations are often encouraged to remind staff of basic security practices, like ensuring that they do not leave company assets, documentation, confidential information or property unattended in public places, and to be aware of others who may be working around them.

Some employees may feel uncomfortable if asked to work in a large corporate environment during a time of pandemic, though employers in some countries may not have an obligation to allow telecommuting unless they would be required to accommodate an employee disability. Employers in most countries generally may have the right to ask employees to work in a remote setting if they are not discriminatory in their practices or infringe on protected classes.

Complicating the remote work phenomenon for many individuals is the fact that many schools, universities and daycare facilities have been either closing or instituting “distance learning” methods. Many parents may be juggling the need to do work for their employer while also ensuring children have appropriate care or ensuring their focus on school activities. The concern may be greatest for health care providers as they look to contend with the increasing demand of providing services.

INTERNET SERVICE PROVIDER AND VIRTUAL PRIVATE NETWORK CAPACITY

With the growth of remote work, many employers are looking to determine if there will be any new or different strains on internet service provider (ISP) capacity. Remote work in large volumes across many organizations may put different pressure loads on internet service providers. Organizations and their employees will be monitoring connection speeds needed for a range of work, especially if work is done using a remote desktop connection. Virtual Private Network (VPN) bandwidth adds to the concern, as some companies may consider advising employees to use cellular phone methods to join on conference calls as opposed to using voice-over-internet through a computer connection.

CYBER RISK

Cyber criminals may take the opportunity, with both less physical presence at offices and more remote nodes connecting to an organization’s network, to increase cyber-attacks. Distributed denial of service (DDoS) attacks may increase where attackers flood the bandwidth or resources of a targeted system, usually one or more web servers.

These types of attacks can severely slow or cut off system access at critical times for organizations. As example, on Monday March 16, the United States National Security Council acknowledged a cyber incident aimed on the U.S. Health and Human Services network.

Organizations will look to refresh or implement additional cyber protections, such as ensuring devices use full disk encryption. If a physical computer asset is lost or stolen, organizations will look to further ensure that data on the device would not be accessible. VPN connections are expected to further increase in their usage to enable access to corporate networks remotely, but also creating a higher risk of unauthorized access and data leakage. The use of personal ISPs, and an expected growth in the use of public Wi-Fi services, create opportunities that enhance cyber risk. In a growing era of data privacy, and the costs associated with reconciling the loss of customer data, this risk may become more prominent.

STOCKPILING

As may happen in other emergency or disaster situations, especially ones where individuals perceive that mobility and service disruptions may take place, the phenomenon of stockpiling critical goods has been seen in countries around the world. Some individuals have taken to acquiring and storing large quantities of staple goods to ensure a supply is available when needed, to have on hand over potentially long periods of isolation, or with intent to capitalize on short supply and sell goods at inflated prices. Many stores have placed purchase limitations on key products related to the outbreak to ensure a more consistent supply for their customer population. Products being stockpiled in the current environment include facemasks, toilet paper, hand sanitizer, disinfecting soap and canned goods, although shelves are being restocked. Complaints of price gouging and citations for price gouging have increased during the pandemic.

EVENT CANCELLATIONS AND RESTAURANT CLOSINGS

Many large spectator events, concerts and professional development meetings are being cancelled around the world to prevent the spread of COVID-19 among individuals in close proximity.

The world of event cancellation insurance has evolved quickly over the past few months, with some insurance providers beginning to exclude coronavirus as a triggering event. Policyholders who procured event cancellation insurance generally before January 2020, typically would have had the ability to purchase either “all-cause” coverages, or specified coverages with options for cancellations due to infectious or communicable diseases. Beginning in early 2020, as the virus began to gain traction in China and other markets, this type of coverage began to greatly decrease in its offering. Today, many insurance companies are including specific coronavirus exclusions in newly issued event cancellation policies.

The impact of event cancellations will be noticeable in local economies that rely on spectator events, such as sports and concerts, and in particular on those individuals who work in service industries. In response, many high-profile sports celebrities and/or employers have been offering financial assistance commitments to assist those impacted by the cancellations, such as staff who work as ushers or security for large spectator venues. Some sports and entertainment companies are maintaining employee pay while their events are cancelled, or venues are closed.

To stem the spread of the virus, many jurisdictions around the world implemented measures to close restaurants, bars and nightclubs which are prone to larger gatherings and social interaction. As an example, in the state of Illinois, the state ordered all restaurants and bars to close to dine-in customers by the end of Monday March 16, with the closures lasting from March 16 through March 30. Subsequently, the governor of Illinois put into place a shelter-in-place order through April 7. The state of Ohio implemented similar orders beginning at 9 PM local time on Sunday March 15. Establishments would be allowed to continue carryout and delivery services.

IMPACT OF PROPERTY/CASUALTY COVERAGES

In addition to the impact on life and health insurance coverages, the impact of current events impacts the concepts of business interruption and personal and commercial auto coverages. Typically, business interruption policies will include mandatory exclusions to not cover virus-related losses. Some states, however, are looking to draft bills that will cause insurers to provide coverage for these types of losses. The amount of vehicle miles traveled will be an important variable to watch over the coming months. Increased social distancing and remote work may lead to less auto coverage exposures and potentially to fewer auto insurance claims.

INTERNATIONAL TRADE DEPENDENCY

Many manufacturing organizations around the world today are dependent on international trade and shipping systems to receive supplies, facilitate sales and distribute products. Financial services companies may be less exposed to these operational risks on a short-term basis, but longer-term events could cause risks when physical assets (such as computers, and network servers) need maintained or replaced.

ALTERNATIVE ENTERTAINMENT DISTRIBUTION

With the growing trend of reduced social interaction, but the continuing public appetite for entertainment, new methods of dissemination appear to be occurring. With the suspension of the National Basketball Association's season, some teams have taken to their fans and players continuing to "play out the season" through internet-connected game devices. Online streaming video services have increased their push into the markets with new releases or bringing forward anticipated future releases to meet the demand expected. With lower expectations anticipated for consumers gathering to watch movies in theaters, some film distributors have pushed releases to later dates or released directly to video on demand. Release schedules among major motion picture providers worldwide often are inflexible given the long-range planning and coordination that goes into film production, but there is anticipation that the industry will be careful not to layer large releases too close to each other to optimize attendance at theaters.

Section 5: Previous SOA Research Highlights

IMPACT ON THE U.S. LIFE INSURANCE INDUSTRY

Over the years, many committees and sections within the Society of Actuaries (SOA) have helped support, fund and promote research related to disease outbreaks. The following is a short highlight of key reports previously released by the SOA or highlighted at SOA professional development sessions that may be of benefit for the actuarial profession. The SOA is committed to updating these types of reports as new information emerges.

The report series on “**Potential Impact of Pandemic Influenza on the U.S. Life Insurance Industry**” gives guidance through several reports on the potential impact of a disease outbreak on population and insured mortality in the United States, and additionally has information on the potential impact on financial markets, corporate bond spreads, monetary policy and economic output.

<https://www.soa.org/resources/research-reports/2007/research-impact-pan-influ-life-ins/>

Potential Impact of Pandemic Influenza on the U.S. Life Insurance Industry

Research Projects – Life Insurance

Sponsored by the Committee on Life Insurance Research and the Risk Management Section’s Research Team, Jim Toole of MBA Actuaries evaluates the financial effects of different flu pandemic scenarios on the U.S. Life Insurance industry. In addition to the research report, he has developed an accompanying spreadsheet tool for individual insurers to better understand the associated financial risks of a flu pandemic.

During this study, the Project Oversight Group conducted two Delphi studies. One study examined how excess insured mortality as a result of a flu pandemic might differ from that of the general population. The second study examined the potential economic effects of a flu pandemic. Results are presented in the following reports.

Materials

[Potential Impact of Pandemic Influenza on the U.S. Life Insurance Industry Report](#) 

[Pandemic Model Tool Documentation](#) 

[Pandemic Model Tool](#) 

[Study of the Effect of a Flu Pandemic on Economic Values Using the Delphi Method](#) 

[Study of the Effect of a Flu Pandemic on Insured Mortality Using the Delphi Method](#) 

COMPARISON TO CURRENT COVID-19 EVENTS

The report series included a survey, using the Delphi Method, on the impact on various economic values should the U.S. enter an influenza pandemic. Two pandemic virulence scenarios were analyzed; a moderate scenario similar in mortality severity to the 1957 H2N2 pandemic and a severe scenario similar in mortality severity to the 1918 H1N1 pandemic. The 1957 pandemic (“Moderate Scenario”) produced approximately .7 excess deaths per 1000 of population, and the 1918 pandemic (“Severe Scenario”) produced approximately 6.5 excess deaths per 1000.

The following table summarizes the survey results in comparison to current observations under the COVID-19 pandemic, using February 1, 2020 as an approximate average start of the worldwide outbreak:

Estimated Asset Values	SOA Research Report	Current Environment, Measuring from February 1, 2020
Maximum Percentage Change in S&P 500 Index within 180 days from onset; Average response for Moderate Scenario	-11%	-25%
Maximum Percentage Change in S&P 500 Index within 180 days from onset; Average response for Severe Scenario	-24%	
Maximum Change in Aa Corporate Bond Yield within 180 days from onset; Average response for Moderate Scenario	Up 28 basis points	Up 123 basis points
Maximum Change in Aa Corporate Bond Yield within 180 days from onset; Average response for Severe Scenario	Up 35 basis points	
Maximum Change in the Federal Funds Rate within 180 days from onset; Average response for Moderate Scenario	Down 27 basis points	Down 150 basis points
Maximum Change in the Federal Funds Rate within 180 days from onset; Average response for Severe Scenario	Down 77 basis points	

IMPACT ON THE U.S. HEALTH INSURANCE INDUSTRY

The report series “**Potential Impact of Pandemic Influenza on the U.S. Health Insurance Industry Report**” highlights the potential impact of an outbreak on health care costs, including information on how costs may vary by the site of care, and the impact on operational risks to health care providers.

<https://www.soa.org/resources/research-reports/2010/research-pandemic/>

Potential Impact of Pandemic Influenza on the U.S. Health Insurance Industry Report

Research Projects – Health

Sponsored by the Committee on Life Insurance Research, the Joint Risk Management Section's Research Team, and the Health Section, Jim Toole of MBA Actuaries evaluates the financial effects of different flu pandemic scenarios on the U.S. health insurance industry. In addition to the research report, he has developed an accompanying spreadsheet tool for individual health insurers to better understand the associated financial risks of a flu pandemic.

This is the second paper in a two-part series examining the potential impact of pandemic influenza on the insurance industry. The [first paper](#) focused on the potential impact of pandemic influenza on the life insurance industry.

Materials

[Potential Impact of Pandemic Influenza on the U.S. Health Insurance Industry Report](#) 

[Health Company Pandemic Modeling Tool Spreadsheet Documentation](#) 

[Health Company Pandemic Modeling Tool](#) 

LOW AND NEGATIVE INTEREST RATE RESEARCH

- Sustained Low Interest Rate Environment: Can It Continue? Why It Matters
<https://www.soa.org/research-reports/2014/research-2014-sustained-low-interest/>
- Transition to a high interest rate environment: Preparing for Uncertainty
<https://www.soa.org/resources/research-reports/2015/research-2015-rising-interest-rate>
- A Low-Growth World: Implications for the Insurance Industry and Pension Plans
<https://www.soa.org/resources/research-reports/2019/low-growth-world/>
- Negative Interest Rates and the Insurance Industry: A Survey of Risk-Management Capabilities and Practice
<https://www.soa.org/resources/research-reports/2020/negative-interest-rates/>

References

KEY STATISTICS

World Health Organization. “Coronavirus disease (COVID-2019) situation reports.”
<https://www.who.int/emergencies/diseases/novel-coronavirus-2019/situation-reports>

Centers for Disease Control and Prevention. “Coronavirus Disease 2019 (COVID-19).”
<https://www.cdc.gov/coronavirus/2019-ncov/cases-updates/summary.html>

Centers for Disease Control and Prevention. “Coronavirus Disease 2019 (COVID-19).”
<https://www.cdc.gov/coronavirus/2019-ncov/index.html>

Centers for Disease Control and Prevention. *Morbidity and Mortality Weekly Report*, Vol. 69, “Severe Outcomes Among Patients with Coronavirus Disease 2019 (COVID-19)—United States, February 12–March 16, 2020.” March 18, 2020. <https://www.cdc.gov/mmwr/volumes/69/wr/pdfs/mm6912e2-H.pdf>

European Centre for Disease Prevention and Control. “Situation update worldwide.”
<https://www.ecdc.europa.eu/en/geographical-distribution-2019-ncov-cases>

National Health Commission of the People’s Republic of China. “Outbreak notification.”
<https://ncov.dxy.cn/ncovh5/view/pneumonia?scene=2&clicktime=1579582238&enterid=1579582238&from=single-message&isappinstalled=0>

Falconer, Rebecca. (2020, March 15). “New CDC coronavirus guide: Cancel large gatherings of 50-plus people.”
 Axios.com. <https://www.axios.com/cdc-coronavirus-cancel-large-gatherings-a157a76c-9b3c-41d0-be63-43caa917adaa.html>

Bureau of Transportation Statistics. https://www.transtats.bts.gov/Data_Elements.aspx?Data=5

Centers for Disease Control and Prevention. “Lesson 3: Measures of Risk.”
<https://www.cdc.gov/csels/dsepd/ss1978/lesson3/section3.html>

Weixel, Nathaniel. (2020, March 6). “Coronavirus mortality rate likely to drop, say health experts.” The Hill.
<https://thehill.com/policy/healthcare/486231-health-experts-warn-coronavirus-mortality-rate-likely-to-drop>

Doyle, Liam. (2020, March 10). “Coronavirus named: What does COVID-19 stand for?” Express.
<https://www.express.co.uk/life-style/health/1241302/Coronavirus-named-COVID-19-meaning-WHO-coronavirus-latest-update>

Holman, R. J., C. S. MacDonald, and P. J. Miller. (March 2020). “U.S. Population Mortality Observations-Updated with 2018 Experience.” Society of Actuaries. <https://www.soa.org/resources/research-reports/2020/population-mortality-observations/>

Healthline.com. (March 2020). <https://www.healthline.com/health-news/if-you-get-the-coronavirus-what-will-it-cost-you#How-much-will-coronavirus-testing-cost?>

Aon.com (2020, March 2). “Pandemic Flu vs. 2019 Novel Coronavirus—Comparison and Context”
<https://www.aon.com/getmedia/10f63fe6-9da4-4b96-9b38-c6c3acf27d01/Pandemic-Flu-VS-COVID-Comparison-And-Context-Mar-02-2020.aspx>

Chinese Center for Disease Control and Prevention. <http://www.chinacdc.cn/en/>

Centers for Disease Control and Prevention. 1918 Pandemic (H1N1 virus). <https://www.cdc.gov/flu/pandemic-resources/1918-pandemic-h1n1.html>

Amin, Priya. (2020, March 9). “Early mortality rates for coronavirus are likely misleading, experts say.” ABC News. <https://abcnews.go.com/Health/early-mortality-rates-covid-19-misleading-experts/story?id=69477312>

Ducharme, Jamie. (2019, June 20). “This Past Flu Season Was the Longest in 10 Years, the CDC Says.” Time. <https://time.com/5610878/2018-2019-flu-season/>

Cigna.com. (2020, March 5). “Cigna Covers Cost Of Coronavirus Tests For Customers.” <https://www.cigna.com/newsroom/news-releases/2020/cigna-covers-cost-of-coronavirus-tests-for-customers>

Centers for Disease Control and Prevention. “Information about Middle East Respiratory Syndrome (MERS)” https://www.cdc.gov/coronavirus/mers/downloads/factsheet-mers_en.pdf

McKay, Betsy. (2020, March 10). “What We Know About the Coronavirus, From Symptoms to Who Is at Risk.” Wall Street Journal. https://www.wsj.com/articles/what-we-know-about-the-wuhan-virus-11579716128?mod=article_inline

Centers for Disease Control and Prevention. “Revised U.S. Surveillance Case Definition for Severe Acute Respiratory Syndrome (SARS) and Update on SARS Cases—United States and Worldwide, December 2003” <https://www.cdc.gov/mmwr/preview/mmwrhtml/mm5249a2.htm>

World Health Organization. “Middle East respiratory syndrome coronavirus (MERS-CoV)” <https://www.who.int/emergencies/mers-cov/en/>

Armour, Stephanie and Thomas M. Burton. (2020, March 13). “Trump Administration Confronts New Coronavirus Testing Woes.” Wall Street Journal. <https://www.wsj.com/articles/trump-administration-moves-to-speed-up-coronavirus-testing-11584117597>

Gorman, James. (2020, March 13). “The Coronavirus, by the Numbers.” New York Times. https://www.nytimes.com/2020/03/05/health/coronavirus-deaths-rates.html?utm_campaign=5aa6d9038cf2c257e2007a50&utm_content=5e67b55952551200017d7baf&utm_medium=smarpshare&utm_source=linkedin

Larson, Jennifer. (2020, February 28.) “When is flu season and why there is a flu season in the first place.” Insider.com. <https://www.insider.com/when-is-flu-season>

Centers for Disease Control and Prevention. “Human Coronavirus Types.” <https://www.cdc.gov/coronavirus/types.html>

Centers for Disease Control and Prevention. “Frequently Asked Questions on COVID-19 Testing at Laboratories.” <https://www.cdc.gov/coronavirus/2019-ncov/lab/testing-laboratories.html>

Kelley, Alexandra. (2020, March 12). “UC health systems launching in-house coronavirus testing.” The Hill. <https://thehill.com/changing-america/well-being/prevention-cures/487232-uc-health-systems-launching-in-house-coronavirus>

Bureau of Labor Statistics. (2020, March 6). “The Employment Situation—February 2020.” <https://www.bls.gov/news.release/pdf/empst.pdf>

Sheikh, Knvul, Derek Watkins, Jin Wu and Mika Gröndahl. (2020, February 8). “How Bad Will the Coronavirus Outbreak Get? Here Are 6 Key Factors.” The New York Times.

<https://www.nytimes.com/interactive/2020/world/asia/china-coronavirus-contain.html>

Elliott, Helene. (2020, March 8). “BNP Paribas Open at Indian Wells canceled because of coronavirus concerns.” Los Angeles Time. <https://www.latimes.com/sports/story/2020-03-08/bnp-paribas-open-at-indian-wells-canceled-because-of-coronavirus-outbreak>

Simpson, Christopher. (2020, March 10). “Multiple Champions League Matches to Be Behind Closed Doors Due to Coronavirus.” Bleacher Report. <https://bleacherreport.com/articles/2880130-barcelona-confirm-ucl-tie-with-napoli-behind-closed-doors-due-to-coronavirus>

Elliott, Rebecca and Elizabeth Findell. (2020, March 6). “Austin’s South by Southwest Festival Canceled Due to Coronavirus.” Wall Street Journal. <https://www.wsj.com/articles/south-by-southwest-festival-canceled-over-coronavirus-11583530566>

Hopkins, Jared S. (2020, March 12). “As Virus Spreads, Drugmakers Are On the Case.” Wall Street Journal.

<https://www.wsj.com/articles/as-virus-spreads-drugmakers-are-on-the-case-11584034493>

Kuhn, Anthony. (2020, March 13). “South Korea’s Drive-Through Testing For Coronavirus is Fast—And Free.” NPR.

<https://www.npr.org/sections/goatsandsoda/2020/03/13/815441078/south-koreas-drive-through-testing-for-coronavirus-is-fast-and-free>

Secon, Holly. (2020, March 13). “7 US States are setting up drive-through coronavirus testing stations. Trump said

Americans can expect to see more soon.” Business Insider. <https://www.businessinsider.com/drive-through-coronavirus-tests-states-2020-3>

Nathan-Kazis, Josh. (2020, March 4). “How Health Care Utilization Under Coronavirus Could Shake Up the Industry.”

Nasdaq.com. <https://www.nasdaq.com/articles/how-health-care-utilization-under-coronavirus-could-shake-up-the-industry-2020-03-04>

NYC 9/11 Health. “Physical and Mental Health”. <https://www1.nyc.gov/site/911health/researchers/physical-and-mental-health.page>

Sacks, Ethan. (2020, March 16). “Social distancing could have devastating effect on people with depression.” NBC

News. <https://www.nbcnews.com/health/health-news/social-distancing-could-have-devastating-effect-people-depression-n1157871>

Fonda, Daren. (2020, March 9). “Two Companies Are Making Progress on Coronavirus Treatments. The Stocks Aren’t

Responding.” Barron’s. <https://www.barrons.com/articles/two-companies-are-making-progress-on-coronavirus-treatments-the-stocks-arent-responding-51583779661>

Romo, Vanessa and Sylvia Poggioli. (2020, March 9). “Italy Expands Quarantine Measures Nationwide To Stem

Spread Of Coronavirus.” NPR. <https://www.npr.org/sections/goatsandsoda/2020/03/09/813791575/italy-expands-quarantine-measures-nationwide-to-stem-spread-of-coronavirus>

Houston Chronicle. (2017, September 4). “FEMA extends grace period for paying flood insurance premiums.”

<https://www.houstonchronicle.com/news/houston-texas/houston/article/FEMA-extends-grace-period-for-paying-flood-12172339.php>

- National Association of Insurance Commissioners. (2020, March). “NAIC Announces Special Session on COVID-19 Impact & Response”.
https://content.naic.org/article/news_release_naic_announces_special_session_covid_19_impact_response.htm
- Stevens, Harry. (2020, March 14). “Why outbreaks like coronavirus spread exponentially, and hot to ‘flatten the curve’”. Washington Post. <https://www.washingtonpost.com/graphics/2020/world/corona-simulator/>
- Sánchez, Raúl; Ordaz, Ana; Mendoza, Sofía Pérez. (2020, March 22). “Health reveals the age profile of coronavirus cases: 67% of the Deceased are Over 80 Years Old.” Eldiario.es. https://www.eldiario.es/sociedad/fallecidos-coronavirus-Espana-anos_0_1008599338.html
- Jaramillo, Antonia. (2020 March 23). *Florida Today*. “NASA Astronauts Give Tips on Handling Isolation Amid Coronavirus Outbreak.” <https://www.floridatoday.com/story/tech/science/space/2020/03/23/nasa-astronauts-give-tips-handling-isolation-amid-coronavirus-outbreak/2897339001/>
- Wong, Chun Han. (2020, March 24). *The Wall Street Journal*. “China’s Hubei Province to Ease Coronavirus Lockdown This Week; Wuhan to Follow in April.” <https://www.wsj.com/articles/chinas-hubei-province-to-ease-restrictions-11585029440?mod=searchresults&page=1&pos=3>
- Covered California. (2020, March 21). “The Potential National Health Cost Impacts to Consumers, Employers and Insurers Due to the Coronavirus (COVID-19).” <https://hbex.coveredca.com/data-research/library/COVID-19-NationalCost-Impacts03-21-20.pdf>
- New York Times, (2020, March 24). “Coronavirus Updates,”
<https://www.nytimes.com/2020/03/24/world/coronavirus-updates-maps.html?action=click&auth=login-email&login=email&module=Spotlight&pgtype=Homepage>
- Kaiser Family Foundation, “The Families First Coronavirus Response Act: Summary of Key Provisions”
<https://www.kff.org/global-health-policy/issue-brief/the-families-first-coronavirus-response-act-summary-of-key-provisions/>
- Cohen, Kelly. (2020, March 24). “Tokyo 2020 Olympics officially postponed until 2021.” ESPN.
https://www.espn.com/olympics/story/_/id/28946033/tokyo-olympics-officially-postponed-2021
- Hauck, Grace and Lorenzo Reyes. (2020, March 24). “Coronavirus lockdowns: These states are ordering residents to stay home or shelter in place.” USA Today. <https://www.usatoday.com/story/news/nation/2020/03/21/coronavirus-lockdown-orders-shelter-place-stay-home-state-list/2891193001/>
- Brackett, Ron and Jan Wener Childs. (2020, March 23). “Coronavirus Updates: 15 States Have Stay at Home Orders; ‘This Week, It’s Going to Ge Bad,’ U.S. Surgeon General Says.” The Weather Channel.
<https://weather.com/health/coronavirus/news/2020-03-23-coronavirus-updates-number-of-cases-lockdowns-quarantines-united>
- Centers for Disease Control and Prevention. (2020, March 18). “Severe Outcomes Among Patients with Coronavirus Disease 2019 (COVID-19)—United States, February 12–March 16, 2020.” Morbidity and Mortality Weekly Report.
<https://www.cdc.gov/mmwr/volumes/69/wr/pdfs/mm6912e2-H.pdf>
- Fredericks, Bob. (2020, March 24). “Pence hopeful anti-malaria drug works for coronavirus.” New York Post.
<https://nypost.com/2020/03/24/pence-hopeful-anti-malaria-drug-works-for-coronavirus/>

Ferguson, Neil, et al. (2020, March 16). "Impact of non-pharmaceutical interventions (NPIs) to reduce COVID-19 mortality and healthcare demand. Imperial College." <https://www.imperial.ac.uk/media/imperial-college/medicine/sph/ide/gida-fellowships/Imperial-College-COVID19-NPI-modelling-16-03-2020.pdf>

Wu, Joseph T., et al. (2020 March 19). "Estimating clinical severity of COVID-19 from the transmission dynamics in Wuhan, China." Nature Medicine. <https://www.nature.com/articles/s41591-020-0822-7>.

ECONOMIC AND ASSET IMPACT

FederalReserve.gov. (2018, March 8). "Monetary Policy Strategies of Major Central Banks." <https://www.federalreserve.gov/monetarypolicy/monetary-policy-strategies-of-major-central-banks.htm>

Long, Heather. (2020, March 3). "Fed makes largest emergency cut to interest rates since the financial crisis." The Washington Post. <https://www.washingtonpost.com/business/2020/03/03/economy-coronavirus-rate-cuts/>

Londoño, Ernesto, Aimee Ortiz, Nancy Coleman and Andrea Salcedo. (2020, March 16). "Coronavirus Travel Restrictions, Across the Globe." New York Times. <https://www.nytimes.com/article/coronavirus-travel-restrictions.html>

Liesman, Steve. (2020, March 15). "Federal Reserve cuts rate to zero and launches massive \$700 billion quantitative easing program. CNBC. <https://www.cnbc.com/2020/03/15/federal-reserve-cuts-rates-to-zero-and-launches-massive-700-billion-quantitative-easing-program.html>

Chavez-Dreyfuss, Gertrude. (2020, March 15). "Goldman cuts U.S. growth forecast for first and second quarter due to coronavirus." Reuters. <https://www.reuters.com/article/us-healthcare-coronavirus-goldman/goldman-downgrades-u-s-growth-forecast-for-first-quarter-second-quarter-due-to-coronavirus-idUSKBN21217L>

The Economist. (2020, March 14). "Tracking the economic impact of COVID-19 in real time." <https://www.economist.com/united-states/2020/03/14/tracking-the-economic-impact-of-covid-19-in-real-time>

Schneider, Avie. (2020, March 13). "Dow soars nearly 2,000 points in rebound from biggest drop since 1987." MPR News. <https://www.mprnews.org/story/2020/03/13/npr-dow-expected-to-open-up-more-than-1-100-points>

Gondo, Nancy. (2020, March 16). "Dow Jones dives 3,000 points to new session lows as coronavirus crash continues." Investor's Business Daily. <https://www.investors.com/market-trend/stock-market-today/dow-jones-plunges-further-fed-rate-cut-fails-boost-confidence-coronavirus-cases-rise/>

FederalReserve.gov. (2020, March 3). "Implementation Note issued March 3, 2020." <https://www.federalreserve.gov/newsevents/pressreleases/monetary20200303a1.htm>

Mohamed, Theron. (2020, March 9). "The entire US yield curve plunged below 1% for the first time ever. Here's why that's a big red flag for investors." Markets Insider. <https://markets.businessinsider.com/news/stocks/us-treasury-yield-curve-below-1-percent-red-flag-investors-2020-3-1028975968>

YCharts.com. (2020, March 9). "Moody's Seasoned Aaa Corporate Bond Yield." https://ycharts.com/indicators/moodys_seasoned_aaa_corporate_bond_yield

CNBC. (2020, March 24). "Gold futures pop 5% amid extraordinary central bank actions." <https://www.cnbc.com/2020/03/24/gold-markets-us-federal-reserve-coronavirus-in-focus.html>

European Central Bank. (2020, March 18). "ECB announces €750 billion Pandemic Emergency Purchase Programme (PEPP)." https://www.ecb.europa.eu/press/pr/date/2020/html/ecb.pr200318_1~3949d6f266.en.html

McCormick, Emily. (2020, March 24). “Markit U.S. PMI reports signals ‘steepest downturn since 2009 in March’.” Yahoo Finance. <https://finance.yahoo.com/news/ihs-markit-march-2020-flash-us-purchasing-managers-index-134651548.html>

Muro, Mark; Maxim, Robert; and Whiton, Jacob. (2020, March 17). “The places a COVID-19 recession will likely hit hardest.” Brookings. <https://www.brookings.edu/blog/the-avenue/2020/03/17/the-places-a-covid-19-recession-will-likely-hit-hardest/>

The Economist. (2020, March 12). “The challenge of addressing covid-19’s economic effects in Europe.” <https://www.economist.com/finance-and-economics/2020/03/12/the-challenge-of-addressing-covid-19s-economic-effects-in-europe>

Werner, Erica; Kane, Paul; Bade, Rachel; and DeBonis, Mike. (2020, March 23). The Washington Post. “Senate negotiators cite progress on coronavirus bill after day of drama and rancor.” <https://www.washingtonpost.com/us-policy/2020/03/23/trump-coronavirus-senate-economic-stimulus/>

Gruenwald, Paul F. (March 24, 2020). S&P Global Ratings. “Global Macroeconomic Update, March 24: A Massive Hit to World Economic Growth.” <https://www.spglobal.com/ratings/en/research/articles/200324-global-macroeconomic-update-march-24-a-massive-hit-to-world-economic-growth-11402099>

Fidelity. (2020, March 19). “Bear market basics: With stocks reaching bear market territory, here’s what to think about.” <https://www.fidelity.com/viewpoints/market-and-economic-insights/bear-markets-the-business-cycle-explained>

Kim, Cynthia; and Roh, Joori. (2020, March 16). Reuters. “Update 2-S.Korea c.bank takes policy rate below 1% for first time with 50bp cut.” <https://www.reuters.com/article/health-coronavirus-cenbankbanks-southkor/update-2-s-korea-c-bank-takes-policy-rate-below-1-for-first-time-with-50bp-cut-idUSL4N2B41NW>

Sekora, Dave. (2020, March 23). Morningstar. “Corporate Bonds at Second-Widest Level in 20 Years.” <https://www.morningstar.com/articles/973818/corporate-bonds-at-second-widest-level-in-20-years>

International Monetary Fund (2020, March 23), <https://www.imf.org/en/News/Articles/2020/03/23/pr2098-imf-managing-director-statement-following-a-g20-ministerial-call-on-the-coronavirus-emergency>

OPERATIONAL RISKS

OSF Healthcare. “Novel Coronavirus (COVID-19)”. <https://www.osfhealthcare.org/covid19/>

Swanson, Ana. (2020, March) “Coronavirus Spurs U.S. Efforts to End China’s Chokehold on Drugs.” New York Times. <https://www.nytimes.com/2020/03/11/business/economy/coronavirus-china-trump-drugs.html>

Soo-youn, Song. (2019, May 20). “Hospital beds going up in Korea contrary to OECD’s trend.” Korea Biomedical Review. <http://www.koreabiomed.com/news/articleView.html?idxno=5780>

Evans, Melanie and Anna Wilde Mathews. (2020, March 12). “U.S. Hospitals Face Major Challenges as Coronavirus Spreads.” Wall Street Journal. <https://www.wsj.com/articles/u-s-hospitals-face-major-challenges-as-coronavirus-spreads-11584056336>

BBC News. (2020, March 16). “Coronavirus: PM urges industry to make NHS ventilators.” BBC News. <https://www.bbc.com/news/business-51896168>

Feintzeig, Rachel and Chip Cutter. (2020, March 12). "The Coronavirus and Your Job: What the Boss Can—and Can't—Make You Do." Wall Street Journal. <https://www.wsj.com/articles/the-coronavirus-and-your-job-can-my-boss-make-me-do-that-11583981316>

Watson, Kathryn. (2020, March 16). "Feds investigating possible cyber attack at HHS amid coronavirus pandemic." CBS News. <https://www.cbsnews.com/news/feds-investigating-possible-cyber-attack-at-hhs-amid-coronavirus-pandemic/>

Mao, Frances. (2020, March 4). "Coronavirus panic: Why are people stockpiling toilet paper?" BBC News. <https://www.bbc.com/news/world-australia-51731422>

Conradis, Brandon. (2020, March 15). "Illinois, Ohio closing all bars, restaurants in response to coronavirus." The Hill. <https://thehill.com/policy/healthcare/487684-illinois-ohio-closing-all-bars-restaurants-in-response-to-coronavirus>

Centers for Disease Control and Prevention. "Get You Mass Gatherings or Large Community Events Ready." <https://www.cdc.gov/coronavirus/2019-ncov/community/large-events/mass-gatherings-ready-for-covid-19.html>

Sandler, Rachel. (2020, March 15). "CDC Guidelines: Cancel Events With 50 Or More People." Forbes. <https://www.forbes.com/sites/rachelsandler/2020/03/15/cdc-guidelines-cancel-events-with-50-or-more-people/#1e03ffc15f51>

Noel, Josh, Louisa Chu, Grace Wong and Phil Vettel. (2020, March 16). "Chicago bar and restaurant owners scramble amid unprecedented closing order to stem COVID-19 spread." Chicago Tribune. <https://www.chicagotribune.com/coronavirus/ct-food-covid-19-bar-restaurant-closing-illinois-reaction-20200315-mwgpqbtvd4djj7jxupxcxhwy-story.html>

Rudolph, Max. (January 2007). "Pandemic Influenza's Impact on Health Systems." http://rudolph-financial.com/Pandemic_articles.html

Aon.com. (March 2020). "COVID-19 Response Site." <https://www.aon.com/event-response/coronavirus.aspx>.

Mourselas, Costas. (2020, March 6). "A peek inside op risk managers' coronavirus response." Risk.net <https://www.risk.net/risk-management/7491576/a-peek-inside-op-risk-managers-coronavirus-toolkit>

Gutman, Yotam. (2020, March 5). "COVID-19 Outbreak | Employees Working from Home? It's Time to Prepare." Sentinel One. <https://www.sentinelone.com/blog/covid-19-outbreak-employees-working-from-home-its-time-to-prepare/>

Correa, Luis. (2020, March 13). "Real Life NBA Teams Using NBA 2K20 to Finish the Season." GameRant. <https://gamerant.com/nba-2k20-continue-season-phoenix-suns/>

Whiten, Sarah. (2020, March 6). "'No Time to Die' box-office release delayed for coronavirus, but don't expect other Hollywood films to follow." CNBC. <https://www.cnbc.com/2020/03/06/no-time-to-die-pushed-its-box-office-release-but-others-wont-follow.html>

Kheel, Rebecca. (2020, March 23). "Navy hospital ship deploying Monday to Los Angeles." The Hill. <https://thehill.com/policy/defense/489020-navy-hospital-ship-deploying-monday-to-los-angeles>

Palmer, Barbara. (2020, March 23). "Convention Centers Repurposed to Hold Hospital Beds." PCMA. <https://www.pcma.org/covid-19-javits-baltimore-santa-clara-convention-centers-medical-units/>

Spielman, Fran. (2020, March 23). “Lightfoot forges deals with hotels, shuttered hospital to provide space for quarantined COVID-19 patients.” Chicago Sun Times.

<https://chicago.suntimes.com/coronavirus/2020/3/23/21190805/coronavirus-hotels-quarantined-patients-hospitals-ymca-homeless-metro-south-blue-island-unite-here>

Heeb, Gina. (2020, March 18). “Trump announces the US will use a 1950s-era law to ramp up production of masks and protective gear as coronavirus spreads.” Markets Insider.

<https://markets.businessinsider.com/news/stocks/trump-us-defense-production-act-announced-1950s-era-law-coronavirus-2020-3-1029009805>

Hernandez, David. (2020, March 18). “Deputies issue eight citations for price gouging amid COVID-19 state of emergency.” The San Diego Union-Tribune. <https://www.sandiegouniontribune.com/news/public-safety/story/2020-03-18/8-cited-for-price-gouging-amid-covid-19-state-of-emergency>

Levenson, Michael. (2020, March 20). “Distilleries race to make hand sanitizer amid coronavirus pandemic.” Chicago Tribune. <https://www.chicagotribune.com/coronavirus/sns-nyt-distilleries-race-make-hand-sanitizer-coronavirus-pandemic-20200320-7bchr2fzwvbknotgcw7owtau3u-story.html>

Krisher, Tom. (2020, March 21). “Factories pivot to fight coronavirus, but it won’t be easy—or fast.” Business.

<https://www.pressherald.com/2020/03/21/factories-pivot-to-fight-coronavirus-but-it-wont-be-easy-or-fast/>

Kageyama, Yuri. (2020, March 1). “Japan electronics maker Sharp to make masks at display plant.” Winston-Salem Journal. https://www.journalnow.com/news/national/japan-electronics-maker-sharp-to-make-masks-at-display-plant/article_f46ac8a6-7141-5fe3-afbc-4ad046ef432a.html

De Rugy, Veronique. (2020, March 22). “Price gouging laws make it harder for the market to work.” Opinion.

<https://www.dailynews.com/2020/03/22/price-gouging-laws-make-it-harder-for-the-market-to-work/>

PREVIOUS SOA RESEARCH HIGHLIGHTS

Toole, Jim. (May 2007). “Potential Impact of Pandemic Influenza on the U.S. Life Insurance Industry.” Society of Actuaries. <https://www.soa.org/resources/research-reports/2007/research-impact-pan-influ-life-ins>

Toole, Jim. (June 2010). “Potential Impact of Pandemic Influenza on the U.S. Health Insurance Industry.” Society of Actuaries. <https://www.soa.org/resources/research-reports/2010/research-pandemic/>

About The Society of Actuaries

With roots dating back to 1889, the [Society of Actuaries](#) (SOA) is the world's largest actuarial professional organizations with more than 31,000 members. Through research and education, the SOA's mission is to advance actuarial knowledge and to enhance the ability of actuaries to provide expert advice and relevant solutions for financial, business and societal challenges. The SOA's vision is for actuaries to be the leading professionals in the measurement and management of risk.

The SOA supports actuaries and advances knowledge through research and education. As part of its work, the SOA seeks to inform public policy development and public understanding through research. The SOA aspires to be a trusted source of objective, data-driven research and analysis with an actuarial perspective for its members, industry, policymakers and the public. This distinct perspective comes from the SOA as an association of actuaries, who have a rigorous formal education and direct experience as practitioners as they perform applied research. The SOA also welcomes the opportunity to partner with other organizations in our work where appropriate.

The SOA has a history of working with public policymakers and regulators in developing historical experience studies and projection techniques as well as individual reports on health care, retirement and other topics. The SOA's research is intended to aid the work of policymakers and regulators and follow certain core principles:

Objectivity: The SOA's research informs and provides analysis that can be relied upon by other individuals or organizations involved in public policy discussions. The SOA does not take advocacy positions or lobby specific policy proposals.

Quality: The SOA aspires to the highest ethical and quality standards in all of its research and analysis. Our research process is overseen by experienced actuaries and nonactuaries from a range of industry sectors and organizations. A rigorous peer-review process ensures the quality and integrity of our work.

Relevance: The SOA provides timely research on public policy issues. Our research advances actuarial knowledge while providing critical insights on key policy issues, and thereby provides value to stakeholders and decision makers.

Quantification: The SOA leverages the diverse skill sets of actuaries to provide research and findings that are driven by the best available data and methods. Actuaries use detailed modeling to analyze financial risk and provide distinct insight and quantification. Further, actuarial standards require transparency and the disclosure of the assumptions and analytic approach underlying the work.

Society of Actuaries
475 N. Martingale Road, Suite 600
Schaumburg, Illinois 60173
www.SOA.org