Society of Actuaries Research Brief
Impact of COVID-19
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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 social distancing policies and, in some cases, quarantines.

By April 2, 2020, the disease spread to nearly all corners of the world. The number of confirmed cases involving the novel coronavirus now named “SARS-CoV-2”—which causes the respiratory disease now named “coronavirus disease 2019” (COVID-19)—exceeded 1,000,000 worldwide 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 April 2, 2020, approximately 170 World Health Organization (WHO) countries/regions have reported at least one case, and nearly 53,000 deaths worldwide 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. A key differentiation among some countries is the speed at which they have ramped up testing and identification processes across their populations.

The health, mortality and economic focus has become one of international concern. 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 evermore connected across continents. Unemployment rates have started to rise as the world adjusts to new, lower levels of economic activity.

The result in early April 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.
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. Through April 2, 2020, approximately 1,013,000 cases have been reported worldwide, with 55% of the cases in three countries: U.S., Italy and Spain. Figure 1 shows the weekly progression of confirmed cases for the 15 countries that have reported the most COVID-19 cases as of April 2, 2020.

Figure 1
CONFIRMED COVID-19 CASES FOR 15 COUNTRIES WITH THE MOST CASES, APRIL 2, 2020

To put the number of reported cases in context of country size, consider the number of confirmed cases per million of population. Figure 2 shows that cases per million vary significantly by country. For Figure 2, the day that a country first reported 3,000 or more cumulative cases of COVID-19 is considered day zero (day 0). Even though Switzerland, Italy and Spain are much earlier in the pandemic than Hubei province, China, the epicenter of the COVID-19 pandemic, their cases per million have exceeded those of Hubei. The appendix shows additional graphs of cases per million.

Revised
Within the U.S., as of April 2, 2020, 15 counties contain approximately 50% of the confirmed cases and 46% of COVID-19 deaths (Table 1). In total, those 15 counties comprise only about 11% of the U.S. population.

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. For example, as of early March, Indonesia, the world’s fourth most populous country, had reported only two cases. Epidemiologists noted this was implausible and statistically impossible, especially given Indonesia’s close ties to China and visits between the two countries.
Table 1
TOP 15 U.S. COUNTIES FOR COVID-19 CASES, APRIL 2, 2020

<table>
<thead>
<tr>
<th>County</th>
<th>Number of Cases</th>
<th>Number of Deaths</th>
<th>Population</th>
<th>Number of Cases</th>
<th>Number of Deaths</th>
<th>Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>New York, NY</td>
<td>51,809</td>
<td>1,397</td>
<td>5,803,210</td>
<td>21.3%</td>
<td>23.6%</td>
<td>1.7%</td>
</tr>
<tr>
<td>Westchester, NY</td>
<td>11,567</td>
<td>64</td>
<td>967,506</td>
<td>4.8%</td>
<td>1.1%</td>
<td>0.3%</td>
</tr>
<tr>
<td>Nassau, NY</td>
<td>10,587</td>
<td>76</td>
<td>1,356,924</td>
<td>4.3%</td>
<td>1.3%</td>
<td>0.4%</td>
</tr>
<tr>
<td>Suffolk, NY</td>
<td>8,746</td>
<td>69</td>
<td>1,476,601</td>
<td>3.6%</td>
<td>1.2%</td>
<td>0.4%</td>
</tr>
<tr>
<td>Cook, IL</td>
<td>5,575</td>
<td>107</td>
<td>5,150,233</td>
<td>2.3%</td>
<td>1.8%</td>
<td>1.5%</td>
</tr>
<tr>
<td>Wayne, MI</td>
<td>5,069</td>
<td>194</td>
<td>1,749,343</td>
<td>2.1%</td>
<td>3.3%</td>
<td>0.5%</td>
</tr>
<tr>
<td>Bergen, NJ</td>
<td>4,099</td>
<td>120</td>
<td>932,202</td>
<td>1.7%</td>
<td>2.0%</td>
<td>0.3%</td>
</tr>
<tr>
<td>Los Angeles, CA</td>
<td>4,045</td>
<td>78</td>
<td>10,039,107</td>
<td>1.7%</td>
<td>1.3%</td>
<td>3.0%</td>
</tr>
<tr>
<td>Rockland, NY</td>
<td>3,751</td>
<td>18</td>
<td>325,789</td>
<td>1.5%</td>
<td>0.3%</td>
<td>0.1%</td>
</tr>
<tr>
<td>Orleans, LA</td>
<td>3,148</td>
<td>125</td>
<td>390,144</td>
<td>1.3%</td>
<td>2.1%</td>
<td>0.1%</td>
</tr>
<tr>
<td>Oakland, MI</td>
<td>2,183</td>
<td>119</td>
<td>1,257,584</td>
<td>0.9%</td>
<td>2.0%</td>
<td>0.4%</td>
</tr>
<tr>
<td>Miami-Dade, FL</td>
<td>2,886</td>
<td>20</td>
<td>2,716,940</td>
<td>1.2%</td>
<td>0.3%</td>
<td>0.8%</td>
</tr>
<tr>
<td>King, WA</td>
<td>2,656</td>
<td>175</td>
<td>2,252,782</td>
<td>1.1%</td>
<td>3.0%</td>
<td>0.7%</td>
</tr>
<tr>
<td>Essex, NJ</td>
<td>2,617</td>
<td>99</td>
<td>798,975</td>
<td>1.1%</td>
<td>1.7%</td>
<td>0.2%</td>
</tr>
<tr>
<td>Hudson, NJ</td>
<td>2,270</td>
<td>44</td>
<td>672,391</td>
<td>0.9%</td>
<td>0.7%</td>
<td>0.2%</td>
</tr>
<tr>
<td>Total</td>
<td>121,008</td>
<td>2,705</td>
<td>35,889,731</td>
<td>49.7%</td>
<td>45.6%</td>
<td>10.7%</td>
</tr>
</tbody>
</table>

Data source: Johns Hopkins University

CASE FATALITY AND MORTALITY RATES

At the start of a pandemic, mortality rates are crudely estimated 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 worldwide set of case information is roughly 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 worldwide rate, primarily due to the disease initially being seen in higher age groups, per the Centers for Disease Control and Prevention (CDC). As more cases have been identified, CDC’s estimate of the U.S. CFR has trended downward to the 1.8%–3.4%. Figure 3 compares the CDC’s estimated case fatality rates by age group to general U.S. population mortality from all causes. As of April 2, 2020, based on Johns Hopkins University data, the U.S. CFR was 2.4%.
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. Using total case and death data for Hubei province as of March 24, the CFR is equal to 3,160 deaths divided by 67,801 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.

CFR and mortality rates by age have become available as the pandemic progresses. Figure 3 compares ranges of COVID-19 CFR by age group in the U.S estimated by the CDC to the most recent mortality rates for the U.S. general population computed by the Social Security Administration. For someone between the ages of 45 and 84 who contracts COVID-19, the probability of dying from COVID-19 is generally higher than the probability of dying from all other causes combined. However, the chance that children who become infected with COVID-19 die from it is nearly zero, much lower than their mortality rates from all other causes combined. CFRs have also been calculated by age

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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.
group in China, Italy, Spain and South Korea as shown in Figure 4. 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.

**Figure 4**

**SELECTED COUNTRIES COVID-19 CASE FATALITY RATES BY AGE GROUP**

![Figure 4](image)

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

Gender differences in CFRs have also been emerging in the available data, and men have fared worse than women. In mainland China as of February 11, 63.8% of the deaths are male. In Spain, as of March 27, 65% of the deaths have been male. These higher rates could be a product of behavior such as smoking. In China, 48% of the men above age 15 smoke compared to 2% of the women. Other risk factors are also prevalent in those who have died. Of the 1,044 people who died in Spain as of March 27, 85% had one or more risk factors such as heart disease, respiratory disease or diabetes. In the U.S., 71% of the non-ICU hospitalizations and 78% of the ICU patients have had multiple risk factors.

**Figure 5**

**NEW YORK CITY CFR, APRIL 2, 2020**

![Figure 5](image)

Data source: New York City Department of Health
New York City also has updated statistics on the number of cases and deaths by gender and age group. As of April 2, 2020, the New York City CFR for males is 3.6% and for females is 2.9%, as seen in Figure 5. Because the city’s age groupings do not align with those shown for Italy, China, Spain and South Korea, it is difficult to compare results. However, New York City’s CFRs appear to be falling within the estimated CDC ranges in Figure 3.

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. Deaths also occur on a lagged basis. Deaths and death rates will greatly increase in many countries and communities over the next month.

As happens with other viruses such as influenza, climate conditions may have an impact on the ability of the virus to survive. Viruses often survive better in cold weather because of the coatings that allow them to survive in the air and be passed on from person to person. These features degrade in warm temperatures. However, it is questionable whether COVID-19 is similar to other viruses in this regard. In the Southern hemisphere, South America and Australia have seen significant outbreaks even in their warmer seasons.

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 to limit wild fluctuation in and gross under- or overstatement of CFRs that often occur during early reporting is to “lag” the number cases in the denominator by 7 or 14 days. The lag better aligns the deaths with an appropriate exposure for 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, especially during the early days of an epidemic.

Another approach for avoiding misrepresentation of mortality rates because of early reporting issues is to analyze data for a location only after a certain number of deaths have been recorded there.

A word of caution: The CFRs shown in and quoted in the accompanying paragraphs 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.

Figure 6 highlights the effect of using lagged CFRs for Hubei province, China, as well as the impact of analyzing data only after 1,000 deaths were recorded in Hubei province. It appears the CFR for Hubei province may stabilize between 4.0% and 4.1%.
The reader can see in Figure 7 that COVID-19 CFRs show clear effects of early reporting for all countries with at least 1,000 deaths through April 2, 2020, with the possible exception of Hubei province and all provinces of China. Although it is too early to draw conclusions about the likely long-term CFRs among countries, the differences are striking. At this early stage, CFRs in Italy significantly outpace those of all other countries that have suffered at least 1,000 COVID-19 deaths. Italy’s higher CFRs may be in part because in Italy the cases are geographically concentrated, which is overwhelming Italy’s health care system, while in other countries, the cases are more geographically spread out.
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.

<table>
<thead>
<tr>
<th>Coronavirus Epidemic</th>
<th>Number of Countries Reporting Cases</th>
<th>Estimated Deaths</th>
<th>Estimated Contracted Cases</th>
<th>Estimated Case Fatality Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>SARS (2002–2003)</td>
<td>29</td>
<td>774</td>
<td>8,098</td>
<td>9.6%</td>
</tr>
<tr>
<td>MERS (2012–2014)</td>
<td>27</td>
<td>858</td>
<td>2,494</td>
<td>34.4%</td>
</tr>
<tr>
<td>COVID-19 (2019–4/1/2020)</td>
<td>179</td>
<td>53,000</td>
<td>1,013,000</td>
<td>5.2%</td>
</tr>
</tbody>
</table>

Note: Significant differences between the estimated COVID-19 case fatality rates (CFRs) with and without lags indicate that CFRs are likely distorted by reporting issues that often exist in the early stages of epidemics. COVID-19 CFRs are expected to change as the epidemic matures.
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. As of April 1, 2020, the U.S. reported approximately 243,000 cases of COVID-19.

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 (0.012% to 0.020%) depending on the severity of the season.

During the 1918 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.

Besides total number of deaths, each influenza outbreak can differ by the time of year it will peak, the severity by age group, the number of outpatient influenza-like illness visits, and the number of hospitalizations required. A flu-season in the U.S. is measured by week and typically begins in week 40 of a calendar year through week 39 in the following calendar year. Week 40 in a calendar year will be flu week #1. The 2009-2010 season was unusual in that it peaked early in flu week 3, whereas the 2011–2012 flu-season peaked in flu week 24. Cumulative hospitalizations were higher for flu seasons 2014–2015 and 2016–2017 than the 2009-2010 pandemic. The 2009-2010 pandemic was unusual in that it tended to affect younger people, whereas most flu outbreaks impact older people. Emerging data on the COVID-19 pandemic indicates that older people are at greater risk, unlike the 2009-2010 pandemic.

Insurers who can segment their policyholders into various income level groupings may be able to make use of U.S. population mortality data, shown in Figure 8, to benchmark their own flu/pneumonia experience. Figure 8 demonstrates how flu and pneumonia death rates in the U.S. have varied historically by various county level income percentile groups. U.S. counties were ranked based on median household income. The 80-100% group represents the quintile of counties with the highest income and the 0–20% group is the quintile of counties with the lowest income. The bottom income quintile (0%–20%) has had significantly higher mortality, ranging from 8 to 24% higher, than the total population. The other quintile groups have clustered together, and their rank order has shifted over time. However, the top income quintile (80%–100%) has had lower mortality rates (2%–11% lower) than the total population since 2007.
Life insurance companies will focus on how general population mortality rates translate into the ultimate mortality of their own insured populations. Socioeconomic factors may be a key driver of how mortality plays out, because an individual’s access to healthcare services and current health condition are often factors that drive survival rates in a confirmed case.

HEALTH CARE COST AND UTILIZATION

Data on the cost and utilization of treatment for individuals who are diagnosed with COVID-19 still appear 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.

The financial impact of COVID-19 is seen through increases in underlying expenses for providers and is driven by costs for testing, special equipment, protective systems for health care workers and additional staffing needs. In some locations, additional hospital beds are needed, and they are being built or converted from other sources. These increased costs may be passed onto payers immediately through fee-for-service claims or later in other payment arrangements.

Increases in costs are directly connected to the critical care needed for the sickest patients who have contracted the virus. Intensive care units for these patients are very expensive and the costs are further compounded by the need for isolating them. The impact also varies by the outbreak situation in local areas depending on demographics and efforts such as social distancing to slow the spread.

An issue in many countries, including the U.S., is that the supply of many testing and critical care resources is lower than the current demand. Countries around the world are looking to find ways to improve their ability to meet this
demand. As an example, medical centers within the University of California system have been converting laboratory space into in-house coronavirus testing centers.

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.

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 has also seen the number of new cases decline since the start of March 2020. 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 U.S. has also commenced this process through health facilities in some states and is also eyeing expansion to private sector pharmacy partners. A new test that could expedite detection was granted “emergency-use authorization” by the Food and Drug Administration (FDA) on March 27 and is being rolled out the week of March 30. It is expected that this test can be given about 50,000 times per day. From insurer and consumer cost perspectives, 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.

Testing is most important early in the cycle of a pandemic to help detect infections and contain the spread of the virus. As the infection has spread and containment is no longer possible, the strategy has shifted from containment to protection of the most vulnerable through social distancing and self-isolation.

Based on analysis of data from China, the CDC found that 12% of COVID-19 patients were hospitalized, a much higher percentage than the hospitalization rate of 1%–2% for influenza patients. Imperial College also analyzed data from China and found that far more than 2% of COVID-19 patients were hospitalized.

The critical focus has now shifted away from testing kits towards having adequate numbers of hospital beds and ventilators for COVID-19 patients and sufficient personal protective equipment for front-line health care professionals and other critical service employees like police. The number of hospital beds per 1,000 people in the U.S. is 1.8 and lags Italy (3.2 per 1,000), China (4.3 per 1,000) and South Korea (12.3 per 1,000). Models and projections of hospital bed usage in the U.S. produced by ProPublica, https://projects.propublica.org/graphics/covid-hospitals, demonstrate why public health officials are so intent on “flattening the curve.”

New York City released data of cumulative number of COVID-19 cases and hospitalizations in the city, as shown in Figure 9 and Figure 10. The data show that persons age 18 to 44 are more likely than other age groups to contract COVID-19. However, compared to all older age groups, a much smaller percentage of persons age 18 to 44-who contracted COVID-19 have been hospitalized.
New York City’s data shows that 19% of COVID-19 patients have been hospitalized. It also shows that males are more likely than females to contract COVID-19, and they are more likely to get sicker from COVID-19 than are females. While males have contracted 55% of the cases, 59% of the hospitalized cases have been males.

This report previously mentioned that during the 2017–2018 influenza season, about 8% of hospitalized influenza patients died. The New York City COVID-19 data indicates that about 12% of hospitalized COVID-19 patients died.

On a cautionary note, data from China and New York City are instrumental to understanding the COVID-19 situation in those specific locales; however, experience in other locations may differ.

Several companies have been developing and testing treatments for symptoms of 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. On March 30, the FDA issued an emergency-use authorization for two anti-malarial drugs for use in treating patients.
infected with COVID-19. The drugs, chloroquine phosphate and hydroxychloroquine sulfate, have been previously used off-label anecdotally.

In addition, efforts to develop vaccines are well underway. More than 30 companies and academic institutions are racing to create such a vaccine, several of which already have candidates they have been testing in animals. It is expected that human trials will begin soon. Some estimates indicate that it may take up to 12–18 months to know the effectiveness and safety of any proposed vaccines.

Overall health care cost and utilization in many countries will also be impacted by the decisions that 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.

In the U.S., Humana and Cigna, two large health insurers, decided to waive out-of-pocket costs for healthcare treatment related to COVID-19.

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 address 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.

Other factors that may impact resource demand include the region where a facility is located. Regions prone to extreme weather or other disaster events should plan for additional healthcare resource strain and the need for more beds in case should such an extreme event occurs concurrently with the pandemic. The level of additional strain will vary based on how well these regions have planned previously for future extreme events and the need for increased capacity.

**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 over the course of the illness 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 social distancing policies. The policies vary broadly, including limitations on entering the country and restrictions on movement within a region or country. 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 U.S. could occur if there were no risk-mitigating 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—more than a third 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.

Figure 11 and Figure 12, which were created from the model, illustrate the potential impact over time of low social distancing (Figure 11) compared to increased social distancing (Figure 12). 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.
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.

The question remains on whether a person who has recovered from COVID-19 has immunity from becoming sick again. For now, it appears people who have had the disease are unlikely to get it again, at least within the timeframe of the current outbreak. Researchers will need more time and data as the virus plays out before any definitive conclusions can be made. 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 worldwide 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.

**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 U.S. 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.

Since then, 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 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, the Federal Reserve announced in the release 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. However, some analysts are concerned that COVID-19-related disruptions could result in demotion of many companies currently rated BBB into junk bond status. Financial institutions that hold such bonds may be incented to sell them, likely during a time that prices reflect a large number of sellers relative to buyers.

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 euro 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, because 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 developing ways to use fiscal policy to maintain economic activity amid the COVID-19 pandemic. On March 27, the U.S. adopted and signed into law The Coronavirus Aid, Relief, and Economic Security (CARES) Act, the largest stimulus package in U.S. history. The CARES Act aims to inject $2 trillion into the economy, which equates to approximately 10% of gross domestic product (GDP), with benefits and programs from the wide-reaching provisions available to individuals, small businesses, large corporations, hospitals and public health organizations, state and local governments, and education institutions. The act helps facilitate direct payments to households depending on income and family size, with payments being shaped as an advance on a tax credit that is available for the entire year of 2020. Unemployment benefits have been widely expanded under the law, with primary focus on those who are unable to work from home. The expanded coverage is available to workers newly eligible for unemployment beginning in late January 2020 through the remainder of the year. The act also has options for small businesses and nonprofit organizations to receive federal government loans with the opportunity to have the portions of the loans used for covered payroll costs, interest on mortgage obligations, rent, and utilities to be forgiven. The CARES Act also had new and broader application to retirement accounts, including removing requirements to force required minimum distribution from individual retirement accounts or retirement savings plans during 2020, like a 401(k) plan or IRA.
As labor and production reports begin to emerge in March, 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.

In the U.S., persons who lose their jobs may lose their health insurance simultaneously, although some employers have furloughed their employees to allow continued coverage. Some firms have announced halts to their stock buyback programs and are contemplating cuts to 401(k) matching contributions.

Among the most dramatic and indicative economic reports received were the U.S. Department of Labor’s Unemployment Insurance Weekly Claims reports, released to the anticipation of the financial markets at 8:30 a.m. Eastern Time on Thursday, March 26, 2020, and Thursday, April 2, 2020. In their opening sentences, the News Releases by the Department of Labor simply put:

“In the week ending March 21, the advance figure for seasonally adjusted initial claims was 3,283,000, an increase of 3,001,000 from the previous week’s revised level. This marks the highest level of seasonally adjusted initial claims in the history of the seasonally adjusted series. The previous high was 695,000 in October of 1982.”

“In the week ending March 28, the advance figure for seasonally adjusted initial claims was 6,648,000, an increase of 3,341,000 from the previous week’s revised level. This marks the highest level of seasonally adjusted initial claims in the history of the seasonally adjusted series. The previous week’s level was revised up by 24,000 from 3,283,000 to 3,307,000.”

In early March, before closures of businesses swept across vast swaths of the U.S., the number stood at 211,000, close to a half-century low.

Additional upcoming reports expected on international production and 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 second 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-

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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. While some economists expect a V-shaped recovery, others anticipate lack of demand could lead to a slow rebound, resulting in a U- or even L-shaped recovery.

**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% from 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, which was enacted three days later. As of the time of this writing, equity markets remain approximately 25% down from their peak highs in mid-February 2020.

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 notable downturns in equity markets have occurred over time. Table 3 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 high point to final low point and 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 one- to two-year period, though notably having some strong declines over a one-month period.

**Table 3**

**HISTORICAL 40% DROPS IN S&P 500 INDEX**

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

**LOW INTEREST RATE ENVIRONMENT**

Low interest rates for investment 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 from the lowest interest rate levels. As of April 2, the 10-year Treasury yield was 0.63% and the 30-year Treasury yield was 1.26%.

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 70–90 basis points (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. Insurers have an advantage in that, for many contracts, premiums are required to keep a policy in force, and for those contracts, cash flow is not as dependent on investment income.

Impact on Insurance Industry

IMPACT ON LIFE INSURANCE COMPANIES
The individual life application process has seen some changes due to COVID-19. In a recent survey conducted by LIMRA, about one-third of life insurance companies are seeing a decrease in the number of applications and 24% have seen an increase in online/mobile applications.

The manual underwriting process for life insurers has also been disrupted because of the difficulty to obtain paramedical exams and lab reports in the current environment. Some companies are waiving paramedical exam requirements or postponing exams. Life insurers are looking at alternative sources for underwriting information to process life insurance applications. The use of attending physician statements and phone or face-time screenings are potential replacements. Several carriers have also added screenings for COVID-19 on their applications, adding questions on travel history and close contact with known COVID-19 persons.

Insurers are also looking for ways to use automatic underwriting programs to avoid the issues with manual underwriting. The LIMRA survey indicated that 26% of insurers are expanding their automated underwriting programs. Some state regulators have requested insurers extend the grace period on premium payments, a common practice used for disaster reliefs after hurricanes. For example, California has requested that all insurance companies provide a minimum 60-day grace period for policyholder to pay premiums before the policy is cancelled for the nonpayment of premium. Per the LIMRA survey, 77% of companies are extending grace periods.

It is yet to be seen if insured death claims will increase due to COVID-19. However, given the impact the pandemic has had on the economy and unemployment, the potential for increased suicides will be an area to monitor.

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.

With the large amount of reduced or stopped economic activity occurring in most major international markets, business interruption insurance coverages are getting prominent attention among insurers and their customers,
Congress, the insurance regulatory community and insurance trade organizations. Business interruption insurance generally compensates the insured for the financial loss of a business being unable to operate, as well as physical loss to property. Contingent business interruption insurance policies additionally protect the insured against supply chain disruptions but often may require that property damage has occurred. Typically, business interruption policies will include mandatory exclusions to not cover business losses prompted by virus-related events. Policies often look to some form of physical damage linked to business losses to enable a claim and may have intentional exclusions for losses in connection with viruses. Contingent business interruption insurance policies protect against losses from supply chain disruptions but may require the occurrence of the typical property damage to trigger coverage.

Cancellation insurance provides coverage for expenses arising from delays, rescheduling or cancellations due to unforeseen covered events. Current circumstances, however, are likely unprecedented. Policies may contain civil authority provisions, which may provide coverage for losses suffered in connection with a governmental order prohibiting access to a covered location. Issues of what constitutes physical damage or loss will likely arise. Driven by legislators, some states are looking to draft bills that will cause insurers to provide coverage for these types of losses. Typically, these updated rules or proclamations specifically cite property damage from COVID-19 as part of the basis for prompting the shutdown of local business.

Workers Compensation coverages in the U.S. have also been discussed in industry as employee health issues or injuries could be associated with the emergence of COVID-19. Similar to business interruption insurance, often there may be specific limitations or exclusions in state laws that would apply to “ordinary diseases.” Often these types of diseases would include viruses such as the common cold or commonly recurring seasonal diseases such as influenza. Occupational diseases that would arise out of the typical time spent in employment would generally be covered. Some U.S. states are contemplating creating new laws, or amending their current statutes, to expand the coverages. As an example, legislation introduced in several states, including Ohio, New Jersey, Alaska and Washington, would specifically designate COVID-19 as an occupational disease for frontline healthcare and protection workers such as police, firefighters and emergency medical workers. Complicating the impact of workers compensation insurance in the new interaction of federal and state programs that allow or encourage employers to continue with payroll payments to workers, even if they are furloughed. Insurers and businesses will need to sort out how wages and salaries paid to employees while they aren’t working due to the stoppage of business operations will be included in exposure amounts that lead to premium determinations.

The amount of vehicle miles traveled and degree of road congestion will be important variables to watch over the coming months because they are a key indicator for personal and commercial auto claim frequencies. Federal authorities in many countries will specifically track mileage and mobility statistics using a wide array of data sources. In the U.S. the Department of Transportation actively gathers information so that vehicle activity can be monitored and analyzed. In addition, local authorities responsible for toll roads and maintenance of highways and bridges will continuously review vehicle statistics. Already, data are showing the impact of increased social distancing and remote work leading to less auto coverage exposures. In early March, as the San Francisco Bay area began to implement more shelter-in-place initiatives, bridge officials at the Golden Gate Bridge noted a 70% reduction in traffic during peak rush hour times.

The use of telematics to determine vehicle miles traveled, speed and acceleration trends and to use as a basis for “Pay as You Drive” auto insurance programs has grown in recent years. Advocates of these pricing mechanisms from consumer and auto insurance industry groups note the ability to provide more accurate pricing, because it depends on individuals’ own behavior and is directly based on exposure to risk. In addition, subsidies across rating category groups have the potential to be decreased, and some studies have noted the ability to reduce the proportion of uninsured driving.

With reduced vehicle miles traveled leading to anticipated fewer auto insurance claims over the short-term environment, some consumer advocates have started to publicly call for the auto insurance industry to lower or refund premiums due to the extensive and growing shelter-in-place rules in many markets.
CHANGES IN INSURANCE REGULATION AND CONTRACTUAL REQUIREMENTS

In times of crisis or catastrophe, insurance regulators and supervisors often move to ensure consumers have flexibility to meet their payment obligations and claim filing opportunities. In such times, consumers may be displaced from their residences, be contending with higher priority activities involved with recovering from catastrophe or have less of an ability to communicate with their insurance carrier. These crisis situations tend to occur due to natural extreme weather events or terrorism events. With the development of COVID-19 internationally, many insurance regulatory authorities have begun to work with their local insurance markets to set new temporary rules for insurance contracts. 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.

One example is with the supervision of the insurance industry in Hong Kong, where the local regulator and the Hong Kong Federation of Insurers (KFI) have seen the market adapt to the new environment. In late February 2020, HKFI announced the creation of an “Insurance Dashboard on COVID-19” at https://www.hkfi.org.hk/covid19, noting actions the local industry had taken to respond to shelter-in-place requirements. Among the alleviation measures taken by insurers were to waive waiting periods on medical insurance and critical illness policies, extend premium grace periods for several lines of business and adopt simplified or express claim filing procedures.

Similarly, in the U.S. the National Association of Insurance Commissioners (NAIC) and industry trade associations have been monitoring how policy contract requirements, such as the lengthening of grace periods and extending coverage requirements. As an example of many quickly evolving requirements put in place is the emergency proclamation by the New York State Department of Financial Services regarding the requirement for coverage of telehealth services. On Friday March 20, the 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. A Society of Actuaries(SOA) Research Insights Podcast interview with NAIC CEO Mike Consedine, 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.

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. Virtual private network (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 internet service providers (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.
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. The number of hospital beds per 1,000 people in the U.S. is 1.8 and lags Italy (3.2 per 1,000), China (4.3 per 1,000) and South Korea (12.3 per 1,000). U.S. Navy hospital ships are being deployed to areas with the greatest need such as Los Angeles and New York City. 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 a 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. Private industry, for the most part, has voluntarily stepped up to help the situation, and the need to enforce the 1950s act has not been needed. 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. Other private businesses are looking to make face masks. However, for the first time on March 27, the power of the 1950 act was used when the U.S. president...
required General Motors to accept, perform and prioritize federal contracts for ventilators deemed necessary by the health and human services secretary amid the coronavirus pandemic.

Estimates of the date or a range of dates at which the outbreak will peak have been closely followed at all governmental levels. These estimates vary based on the numerous statistical models that have been built to provide projections and the techniques the models use. The models do not provide a consensus as to when the peak will occur. White House coronavirus task force adviser Dr. Deborah Birx has mentioned these models at press briefings. Dr. Birx singled out projections by the Institute for Health Metrics and Evaluation (IMHE) at the University of Washington in Seattle, suggesting that model is close to how government experts see the situation.

The IMHE model defines the peak as the point at which there is the most demand for resources—hospital beds and ventilators—and when the most health care workers will be needed to care for coronavirus patients. Projected peaks vary by state in the model with an overall estimate of the peak for the U.S. on April 15, based on current data as of March 31.

A comparison done by the Chicago Tribune for when the virus will peak in Illinois showed a prediction of April 17 from the IMHE model versus an estimate of May 14–May 26 by another model from a group called COVID Act Now. The estimate range of the COVID Act Now model varies based on the level of compliance with stay at home measures.

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.

EMPLOYMENT LAW

In many countries, employment law is being amended to adjust how paid leave will work for employees impacted by the pandemic. In the U.K., the Coronavirus Job Retention Scheme was implemented giving employers the ability to apply for grants to keep employees on the payroll if they’re unable to operate or have no work for employees due to economic impacts from COVID-19. The minimum time that an employee can be furloughed is three weeks, and companies cannot rotate furloughed workers.

Effective April 1, the Families First Coronavirus Response Act was enacted in the U.S., applying to businesses based in the U.S. with fewer than 500 employees. The law ensures that employees who can’t work due to symptoms associated with COVID-19 or under quarantine or isolation obligations must receive up to two weeks of paid sick leave. Additionally, if the employee is caring for a quarantined or isolated person or child due to the pandemic, up to two weeks of leave must be granted at rate equal to two-thirds of normal pay rates. The requirements are currently applicable until December 31, 2020.

An additional side effect of employment law and practices under COVID-19 stems from the dwindling capacity for commercial laboratories to process standard drug testing for employees. With the focus and allocation of space of time higher on testing new coronavirus patients, labs may be deferring on slowing down their process rates for employers testing current employees or looking to add additional hires.

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 ISP capacity. Remote work in large volumes across many organizations may put different pressure loads on ISPs. 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. VPN bandwidth adds to the concern, because 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.

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 cancelations 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, the state of Illinois
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 p.m. local time on Sunday,
March 15. Establishments would be allowed to continue carryout and delivery services. On March 31, the governor
of Illinois extended the shelter-in-place order through April 30.

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.

RISK OF EXTREME WEATHER AND OTHER NATURAL HAZARDS

In the weeks and months to come, the COVID-19 crisis could potentially be compounded by extreme weather
events, adding an additional layer of stress to a situation that is already dire. In addition, earthquakes are an ever-
present risk for the West Coast.
Extreme weather, earthquakes and wildfires caused an average of $29 billion in property damage per year in the U.S. across the period from 1980 to 2018, of which 18%—or $5 billion per year—occurred during the months of March, April and May (Figure 13).³

Figure 13
HISTORICAL DISTRIBUTION OF PROPERTY LOSSES BY NATURAL HAZARD DURING MARCH–MAY

![Pie chart showing the distribution of property losses by natural hazard during March–May. Tornadoes account for 23%, floods for 24%, and other hazards for 18%.]

Source: authors’ tabulations of SHELDUS loss data across the 1980 to 2018 period

With respect to geographic region, loss data suggest that the risk posed by natural hazards during March through May is greatest across the Great Plains and the Gulf Coast (Figure 14). Given these factors, additional strain on health care resources will vary based on geography, severity of any extreme event and previous efforts to boost preparedness for such situations.

³ This result was computed using the Spatial Hazard Events and Losses Database (SHELDUS) for the U.S., which tracks property losses, crop losses, fatalities and injuries due to natural hazards in the U.S. SHELDUS property and crop losses are “economic” as opposed to insured. The $32 billion result includes property losses from weather events, while excluding losses from geological risks such as earthquakes and volcanoes. To account for changes in property exposure across time, losses were adjusted forward to 2018 using county-level census data for the number of residential housing units, and state-level data for the median value of a residence.
Previous SOA Research Highlights

Over the years, many committees and sections within the 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.

IMPACT ON THE U.S. LIFE INSURANCE INDUSTRY

The report series on “Potential Impact of Pandemic Influenza on the U.S. Life Insurance Industry” https://www.soa.org/resources/research-reports/2007/research-impact-pan-influ-life-ins/ gives guidance through several reports on the potential impact of a disease outbreak on population and insured mortality in the U.S. and additionally has information on the potential impact on financial markets, corporate bond spreads, monetary policy and economic output.

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 available include:
- Potential Impact of Pandemic Influenza on the U.S. Life Insurance Industry Report
- Pandemic Model Tool with documentation
- 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 0.7 excess deaths per 1,000 of population, and the 1918 pandemic (“Severe Scenario”) produced approximately 6.5 excess deaths per 1,000.

Table 4 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:

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

**IMPACT ON THE U.S. HEALTH INSURANCE INDUSTRY**

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.

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 available include:

- Potential Impact of Pandemic Influenza on the U.S. Health Insurance Industry Report
- Health Company Pandemic Modeling Tool and documentation

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
https://www.who.int/emergencies/diseases/novel-coronavirus-2019/situation-reports

Centers for Disease Control and Prevention. “Coronavirus Disease 2019 (COVID-19).”

Centers for Disease Control and Prevention. “Coronavirus Disease 2019 (COVID-19).”


European Centre for Disease Prevention and Control. “Situation Update Worldwide.”

https://ncov.dxy.cn/ncovh5/view/pneumonia?scene=2&clicktime=1579582238&enterid=1579582238&from=singlemessage&isappinstalled=0


Centers for Disease Control and Prevention. “Lesson 3: Measures of Risk.”


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


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/


ECONOMIC AND ASSET IMPACT


INSURANCE INDUSTRY


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**OPERATIONAL AND EMERGING RISKS**


https://www.forbes.com/sites/rachelsandler/2020/03/15/cdc-guidelines-cancel-events-with-50-or-more-people/#1e03fffc15f51


PREVIOUS SOA RESEARCH HIGHLIGHTS


Appendix: Reported Cases by State

This appendix shows data by U.S. state without commentary.

CUMULATIVE COVID-19 CASES FOR STATES WITH AT LEAST 1.0% OF U.S. CASES, APRIL 2, 2020

<table>
<thead>
<tr>
<th>State</th>
<th>12-Mar*</th>
<th>19-Mar</th>
<th>26-Mar</th>
<th>02-Apr</th>
<th>% of U.S.</th>
</tr>
</thead>
<tbody>
<tr>
<td>New York</td>
<td>4.4%</td>
<td></td>
<td></td>
<td></td>
<td>10.5%</td>
</tr>
<tr>
<td>New Jersey</td>
<td>2.2%</td>
<td></td>
<td></td>
<td></td>
<td>4.4%</td>
</tr>
<tr>
<td>Michigan</td>
<td>3.8%</td>
<td></td>
<td></td>
<td></td>
<td>3.7%</td>
</tr>
<tr>
<td>California</td>
<td>4.4%</td>
<td></td>
<td></td>
<td></td>
<td>3.2%</td>
</tr>
<tr>
<td>Louisiana</td>
<td>3.7%</td>
<td></td>
<td></td>
<td></td>
<td>0.8%</td>
</tr>
<tr>
<td>Florida</td>
<td>3.7%</td>
<td></td>
<td></td>
<td></td>
<td>0.8%</td>
</tr>
<tr>
<td>Massachusetts</td>
<td>3.0%</td>
<td></td>
<td></td>
<td></td>
<td>0.8%</td>
</tr>
<tr>
<td>Illinois</td>
<td>2.6%</td>
<td></td>
<td></td>
<td></td>
<td>0.8%</td>
</tr>
<tr>
<td>Pennsylvania</td>
<td>2.2%</td>
<td></td>
<td></td>
<td></td>
<td>0.8%</td>
</tr>
<tr>
<td>Washington</td>
<td>2.1%</td>
<td></td>
<td></td>
<td></td>
<td>0.8%</td>
</tr>
<tr>
<td>Texas</td>
<td>1.6%</td>
<td></td>
<td></td>
<td></td>
<td>0.8%</td>
</tr>
<tr>
<td>Connecticut</td>
<td>2.6%</td>
<td></td>
<td></td>
<td></td>
<td>0.8%</td>
</tr>
<tr>
<td>Colorado</td>
<td>1.2%</td>
<td></td>
<td></td>
<td></td>
<td>0.8%</td>
</tr>
<tr>
<td>Indiana</td>
<td>1.2%</td>
<td></td>
<td></td>
<td></td>
<td>0.8%</td>
</tr>
<tr>
<td>Ohio</td>
<td>1.2%</td>
<td></td>
<td></td>
<td></td>
<td>0.8%</td>
</tr>
<tr>
<td>Tennessee</td>
<td>1.0%</td>
<td></td>
<td></td>
<td></td>
<td>0.8%</td>
</tr>
<tr>
<td>Maryland</td>
<td>0.8%</td>
<td></td>
<td></td>
<td></td>
<td>0.8%</td>
</tr>
</tbody>
</table>

* Data reflects all confirmed cases reported through March 12.
## CUMULATIVE CONFIRMED COVID-19 CASES BY STATE, APRIL 2, 2020

<table>
<thead>
<tr>
<th>State</th>
<th>March 12</th>
<th>March 19</th>
<th>March 26</th>
<th>April 2</th>
<th>Percent of U.S.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alabama</td>
<td>0</td>
<td>78</td>
<td>517</td>
<td>1,233</td>
<td>0.8%</td>
</tr>
<tr>
<td>Alaska</td>
<td>0</td>
<td>8</td>
<td>56</td>
<td>143</td>
<td>0.1%</td>
</tr>
<tr>
<td>Arizona</td>
<td>9</td>
<td>45</td>
<td>508</td>
<td>1,715</td>
<td>0.9%</td>
</tr>
<tr>
<td>Arkansas</td>
<td>0</td>
<td>62</td>
<td>335</td>
<td>643</td>
<td>0.4%</td>
</tr>
<tr>
<td>California</td>
<td>221</td>
<td>1,005</td>
<td>3,899</td>
<td>10,773</td>
<td>6.5%</td>
</tr>
<tr>
<td>Colorado</td>
<td>45</td>
<td>277</td>
<td>1,430</td>
<td>3,342</td>
<td>2.1%</td>
</tr>
<tr>
<td>Connecticut</td>
<td>5</td>
<td>159</td>
<td>1,012</td>
<td>3,824</td>
<td>2.1%</td>
</tr>
<tr>
<td>Delaware</td>
<td>1</td>
<td>30</td>
<td>130</td>
<td>393</td>
<td>0.2%</td>
</tr>
<tr>
<td>District of Columbia</td>
<td>0</td>
<td>71</td>
<td>231</td>
<td>653</td>
<td>0.4%</td>
</tr>
<tr>
<td>Florida</td>
<td>30</td>
<td>331</td>
<td>2,357</td>
<td>9,008</td>
<td>4.8%</td>
</tr>
<tr>
<td>Georgia</td>
<td>31</td>
<td>287</td>
<td>1,525</td>
<td>5,348</td>
<td>3.0%</td>
</tr>
<tr>
<td>Hawaii</td>
<td>2</td>
<td>25</td>
<td>95</td>
<td>256</td>
<td>0.2%</td>
</tr>
<tr>
<td>Idaho</td>
<td>0</td>
<td>23</td>
<td>146</td>
<td>776</td>
<td>0.4%</td>
</tr>
<tr>
<td>Illinois</td>
<td>32</td>
<td>422</td>
<td>2,538</td>
<td>7,695</td>
<td>4.4%</td>
</tr>
<tr>
<td>Indiana</td>
<td>13</td>
<td>60</td>
<td>645</td>
<td>3,038</td>
<td>1.5%</td>
</tr>
<tr>
<td>Iowa</td>
<td>14</td>
<td>44</td>
<td>179</td>
<td>614</td>
<td>0.3%</td>
</tr>
<tr>
<td>Kansas</td>
<td>4</td>
<td>35</td>
<td>172</td>
<td>553</td>
<td>0.3%</td>
</tr>
<tr>
<td>Kentucky</td>
<td>10</td>
<td>50</td>
<td>247</td>
<td>770</td>
<td>0.4%</td>
</tr>
<tr>
<td>Louisiana</td>
<td>19</td>
<td>392</td>
<td>2,304</td>
<td>9,159</td>
<td>4.9%</td>
</tr>
<tr>
<td>Maine</td>
<td>1</td>
<td>52</td>
<td>155</td>
<td>376</td>
<td>0.2%</td>
</tr>
<tr>
<td>Maryland</td>
<td>12</td>
<td>107</td>
<td>583</td>
<td>2,331</td>
<td>1.2%</td>
</tr>
<tr>
<td>Massachusetts</td>
<td>107</td>
<td>328</td>
<td>2,417</td>
<td>8,966</td>
<td>4.9%</td>
</tr>
<tr>
<td>Michigan</td>
<td>2</td>
<td>259</td>
<td>2,845</td>
<td>10,791</td>
<td>5.7%</td>
</tr>
<tr>
<td>Minnesota</td>
<td>9</td>
<td>89</td>
<td>344</td>
<td>742</td>
<td>0.5%</td>
</tr>
<tr>
<td>Mississippi</td>
<td>1</td>
<td>50</td>
<td>485</td>
<td>1,177</td>
<td>0.7%</td>
</tr>
<tr>
<td>Missouri</td>
<td>2</td>
<td>39</td>
<td>520</td>
<td>1,857</td>
<td>1.0%</td>
</tr>
<tr>
<td>Montana</td>
<td>0</td>
<td>11</td>
<td>90</td>
<td>241</td>
<td>0.1%</td>
</tr>
<tr>
<td>Nebraska</td>
<td>10</td>
<td>29</td>
<td>74</td>
<td>246</td>
<td>0.1%</td>
</tr>
<tr>
<td>Nevada</td>
<td>10</td>
<td>95</td>
<td>420</td>
<td>1,463</td>
<td>0.8%</td>
</tr>
<tr>
<td>New Hampshire</td>
<td>6</td>
<td>42</td>
<td>137</td>
<td>316</td>
<td>0.2%</td>
</tr>
<tr>
<td>New Jersey</td>
<td>29</td>
<td>741</td>
<td>6,876</td>
<td>25,590</td>
<td>13.7%</td>
</tr>
<tr>
<td>New Mexico</td>
<td>5</td>
<td>35</td>
<td>113</td>
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<tr>
<td>New York</td>
<td>327</td>
<td>5,704</td>
<td>37,877</td>
<td>92,506</td>
<td>56.0%</td>
</tr>
<tr>
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<td>136</td>
<td>738</td>
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<td>1.2%</td>
</tr>
<tr>
<td>North Dakota</td>
<td>1</td>
<td>19</td>
<td>51</td>
<td>159</td>
<td>0.1%</td>
</tr>
<tr>
<td>Ohio</td>
<td>5</td>
<td>119</td>
<td>868</td>
<td>2,901</td>
<td>1.6%</td>
</tr>
<tr>
<td>Oklahoma</td>
<td>3</td>
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</tr>
<tr>
<td>Oregon</td>
<td>24</td>
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<td>316</td>
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<td>0.5%</td>
</tr>
<tr>
<td>Pennsylvania</td>
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<td>7,268</td>
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</tr>
<tr>
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</tr>
<tr>
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<tr>
<td>South Dakota</td>
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<td>0.1%</td>
</tr>
<tr>
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<td>18</td>
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<td>1,097</td>
<td>2,845</td>
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</tr>
<tr>
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<td>27</td>
<td>306</td>
<td>1,563</td>
<td>5,069</td>
<td>2.9%</td>
</tr>
<tr>
<td>Utah</td>
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<td>62</td>
<td>396</td>
<td>1,092</td>
<td>0.6%</td>
</tr>
<tr>
<td>Vermont</td>
<td>2</td>
<td>22</td>
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<td>0.2%</td>
</tr>
<tr>
<td>Virginia</td>
<td>12</td>
<td>103</td>
<td>466</td>
<td>1,706</td>
<td>0.9%</td>
</tr>
<tr>
<td>Washington</td>
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<td>3,207</td>
<td>6,389</td>
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</tr>
<tr>
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</tr>
<tr>
<td>Wisconsin</td>
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<td>728</td>
<td>1,748</td>
<td>1.1%</td>
</tr>
<tr>
<td>Wyoming</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.0%</td>
</tr>
</tbody>
</table>
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.

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