



Society of Actuaries Research Brief

Impact of COVID-19

April 16, 2020





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AUTHORS

R. Dale Hall, FSA, MAAA, CERA, CFA
Cynthia S. MacDonald, FSA, MAAA
Peter J. Miller, ASA, MAAA
Achilles N. Natsis, FSA, MAAA
Lisa A. Schilling, FSA, EA, FCA, MAAA
Steven CSiegel, ASA, MAAA
J. Patrick Wiese, ASA

REVIEWERS

Michael C. Dubin, FSA, FCAS, FCA, MAAA
Jing Lang, FSA, FCIA
Max J. Rudolph, FSA, MAAA, CERA, CFA
Nazir Valani, FSA, FCIA, MAAA
Greger Vigen

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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,¹ and Wuhan and other areas in China instituted social distancing policies and travel restrictions.² On March 11, WHO publicly characterized COVID-19 as a pandemic,³ and on March 13, the United States declared the COVID-19 outbreak a national emergency.⁴

To stem the spread of the virus, several countries worldwide and many U.S. states and cities have issued travel restrictions or “stay at home” orders.⁵ Some markets that were early to detect and treat the virus have eased travel restrictions while remaining vigilant for a second wave of the outbreak.⁶

By April 2, 2020, the disease had spread to nearly all corners of the world. By April 14, 2020, 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)⁷—was approximately 1.98 million worldwide with general agreement that the number is higher due to delays in full testing and reporting in many countries. Approximately 170 countries have reported at least one case and nearly 126,000 deaths have resulted from COVID-19.⁸ 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 risen as the world adjusts to lower levels of economic activity.

By mid-April 2020, a confluence of risks has come together. Additional operational and financial risks may emerge, compounding 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 evolving story. This update to the Society of Actuaries (SOA) Research Brief on the Impact of COVID-19 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.

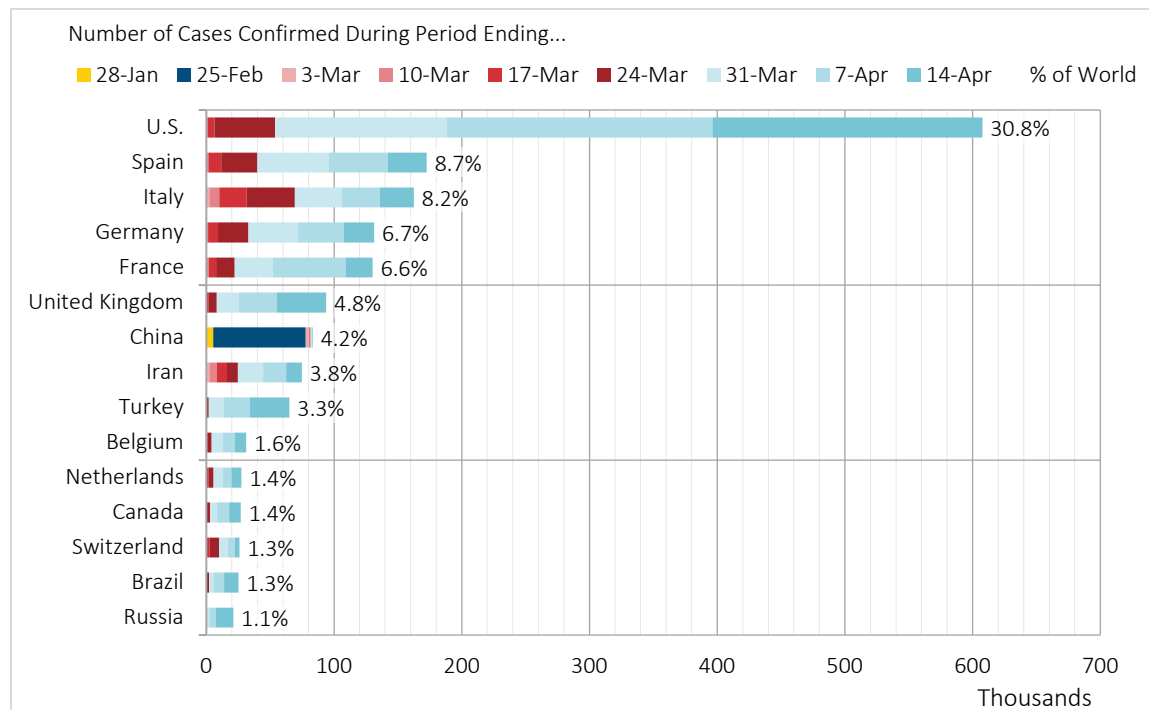
Key Statistics

REPORTED CASES

WORLDWIDE 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 14, 2020, approximately 1.98 million cases have been reported worldwide. Seven countries comprise 70% of the world’s cases, with nearly half (48%) of the world’s 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 14, 2020.

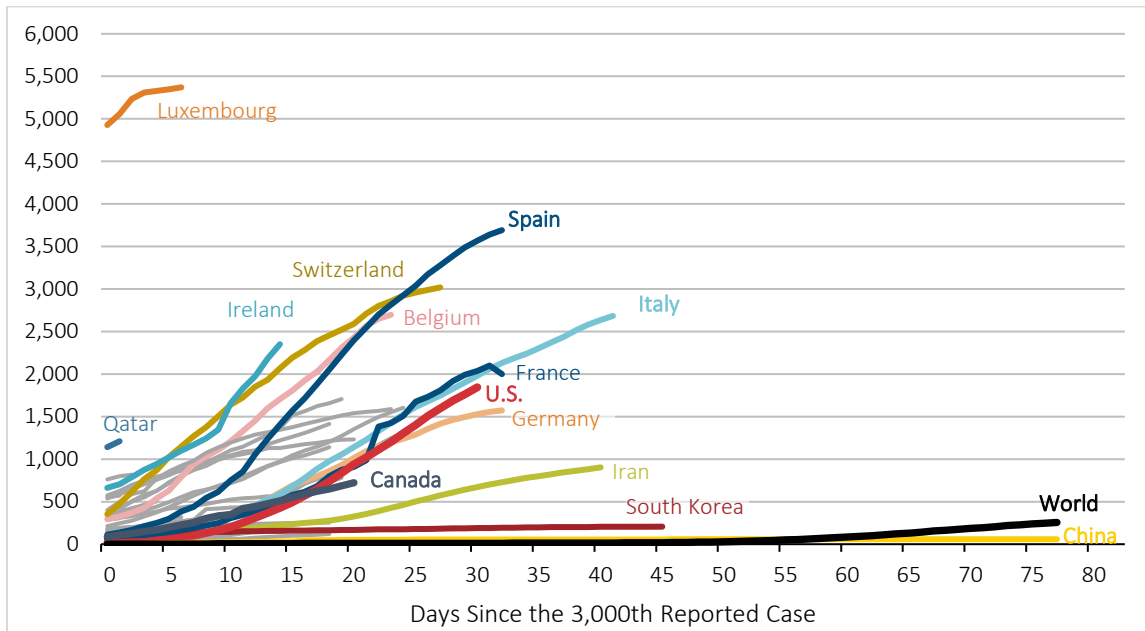
Figure 1
CONFIRMED COVID-19 CASES FOR 15 COUNTRIES WITH THE MOST CASES, APRIL 14, 2020



Data source: Johns Hopkins University

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).

Figure 2
CONFIRMED COVID-19 CASES PER MILLION THROUGH APRIL 14, 2020

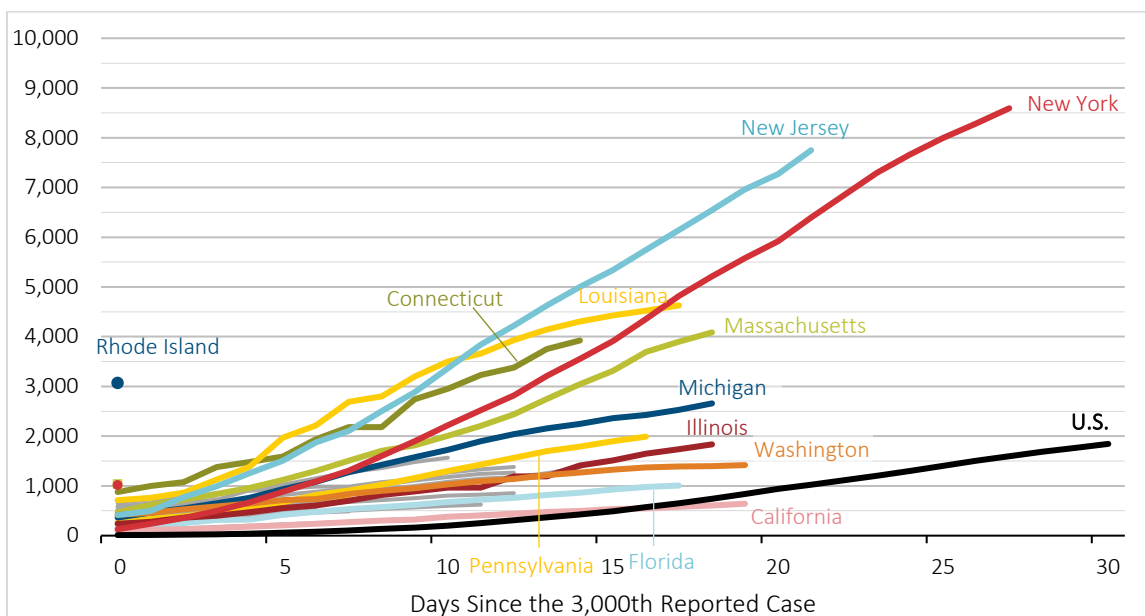


Data source: Johns Hopkins University

U.S. CASES

Within the U.S., Figure 3 shows cases per million for states with at least 3,000 confirmed cases as of April 14, 2020.

Figure 3
CONFIRMED CASES PER MILLION FOR U.S. STATES WITH 3,000 CASES, APRIL 14, 2020



Data source: Johns Hopkins University

As of April 14, 2020, 10 U.S. counties contained approximately 40% of the confirmed cases and 50% of COVID-19 deaths (Table 1). In total, these counties comprise only about 8.6% of the U.S. population.

Table 1
TOP 10 U.S. COUNTIES FOR COVID-19 CASES, APRIL 14, 2020

County	Number			Percent of U.S. Total		
	Cases	Deaths	Population	Cases	Deaths	Population
New York City	110,465	7,905	5,803,210	18.2%	30.6%	1.8%
Nassau, NY	25,250	1,001	1,356,924	4.2%	3.9%	0.4%
Suffolk, NY	22,691	608	1,476,601	3.7%	2.4%	0.4%
Westchester, NY	20,191	596	967,506	3.3%	2.3%	0.3%
Cook, IL	16,323	577	5,150,233	2.7%	2.2%	1.6%
Wayne, MI	12,209	820	1,749,343	2.0%	3.2%	0.5%
Bergen, NJ	10,426	550	932,202	1.7%	2.1%	0.3%
Los Angeles, CA	10,047	360	10,039,107	1.7%	1.4%	3.0%
Rockland, NY	8,335	263	325,789	1.4%	1.0%	0.1%
Hudson, NJ	8,242	277	672,391	1.4%	1.1%	0.2%
Total	244,179	12,957	28,473,306	40.3%	50.2%	8.6%

Data source: Johns Hopkins University

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 reporting 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.⁹

CASE FATALITY AND MORTALITY RATES

The ultimate rate of mortality from COVID-19 will evolve over time, after the actual number of cases, rather than the reported number of cases, is better understood.¹⁰ This may take years. 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 calculation, to settle in the 0.1%–1.0% range.¹¹

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.¹² Using this methodology and the Johns Hopkins University database through April 14, 2020, the COVID-19 CFR across the worldwide set of case information is 6.4%. These raw estimates, however, often are adjusted to produce updated rates, due to the current likelihood of underreporting 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, individuals with 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. ranged between 3.5% and 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, the CDC's estimate of the U.S. CFR has trended downward to the 1.8%–3.4% range.¹³

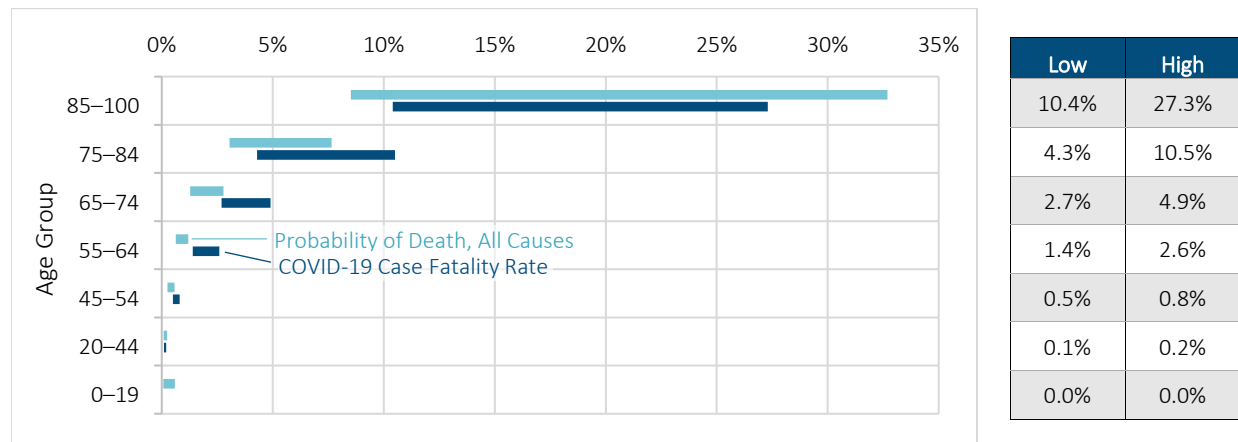
As of April 14, 2020, the U.S. CFR was 4.3%, based on Johns Hopkins University data. Because the epidemic is rapidly evolving, the U.S. CFR is likely overstated because the number of new cases each day has been increasing significantly. In Hubei province, China, where the pandemic began, the number of new cases daily had declined to a relatively small level by the beginning of March. The stability of the Hubei province data reduces the risk of CFR overestimation.¹⁴ As of April 14, the CFR for Hubei province, China, was 4.8% compared to 4.7% for each day from March 23 through April 12, 2020.

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 enough 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—the capital city of Hubei province and the location of most of the COVID-19 deaths in the province—to be 1.4%, with a 95% confidence interval running from 0.9% to 2.1%.¹⁵

CFRS BY AGE GROUP

CFR and mortality rates by age have become available as the pandemic progresses. Figure 4 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.

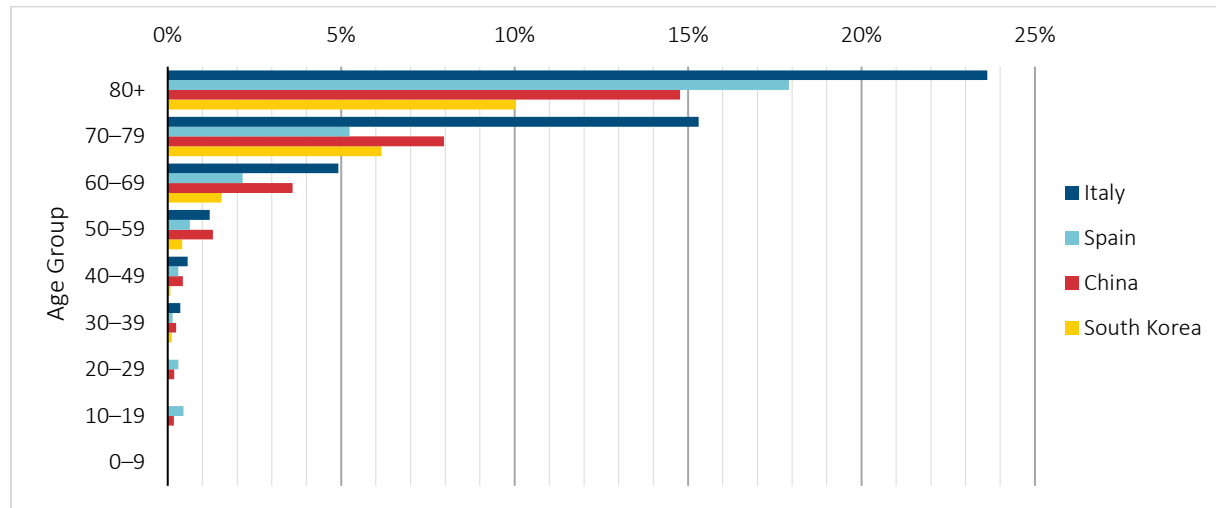
Figure 4
U.S. GENERAL POPULATION MORTALITY AND COVID-19 CASE FATALITY RATE RANGES BY AGE GROUP



Data sources: Centers for Disease Control and Prevention, *Morbidity and Mortality Weekly Report*, March 27, 2020 (published as early release March 18, 2020); Social Security Administration Period Tables for 2016, the most current tables available.

CFRs have also been calculated by age group in China, Italy, Spain and South Korea as shown in Figure 5. 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.¹⁶

Figure 5
SELECTED COUNTRIES COVID-19 CASE FATALITY RATES BY AGE GROUP



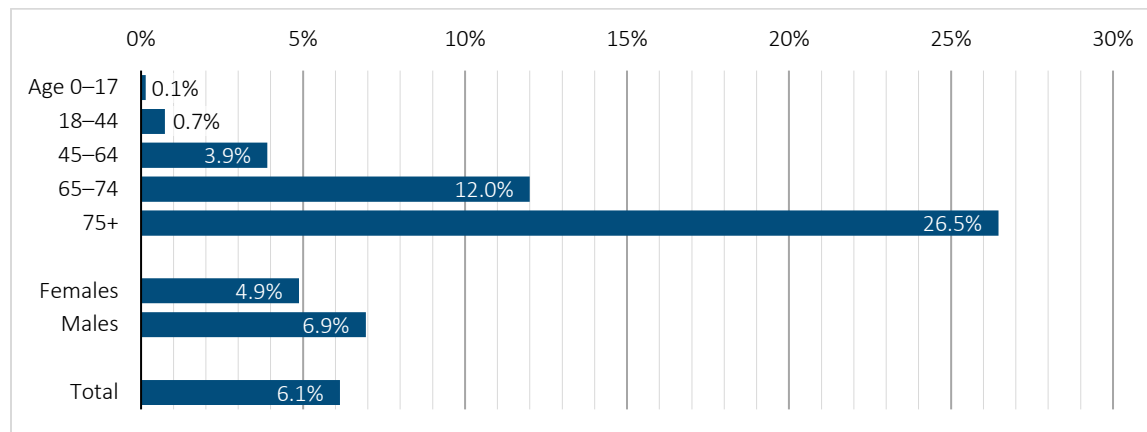
Data source: Sánchez, R.; Ordaz, A., Mendoza, S. P., *eldiarios.es*, March 22, 2020

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.¹⁷ In Spain, as of April 13, 61.6% of the deaths have been male.¹⁸ Other risk factors are also prevalent in those who have died. Of the 8,644 people who died in Spain as of April 1, 80.6% had one or more risk factors such as heart disease, respiratory disease or diabetes.¹⁹ In the U.S., 71% of the non-ICU hospitalizations and 78% of the ICU patients have had multiple risk factors.²⁰

U.S. SUBPOPULATIONS

New York City also has statistics on the number of cases and deaths by gender and age group (Figure 6). As of April 14, 2020, the New York City CFR for males is 6.9% and for females is 4.9%. 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 higher than the estimated CDC ranges (Figure 4).

Figure 6
NEW YORK CITY CASE FATALITY RATES, APRIL 14, 2020



Data source: New York City Department of Health

Several states and large cities have released preliminary data that COVID-19 is infecting and causing fatalities for African Americans at significantly higher rates. For instance, statistics released for Chicago show that African Americans make up more than half of those who have tested positive and 72 percent of virus-related fatalities in Chicago, even though they are slightly less than one-third of the population. Michigan and Louisiana have also reported disproportionate rates.²¹

Some health researchers and officials have attributed these rates to several factors including higher rates of underlying health conditions; less access to care; more individuals working essential jobs, which reduces social distancing; less available information about COVID-19; housing disparities; and living in more densely packed areas. At present, experts say the data is too limited to make broad conclusions. Federal authorities are currently working to provide further statistics on what might be explanations for these preliminary data.²²

Further, to the above reference about densely packed areas, an article prepared by the CDC COVID-19 response team noted that population density could be a significant factor in the transmission of COVID-19. Since COVID-19 is transmitted mainly by respiratory droplets, increased density could lead to acceleration in the transmission. Urban areas such as New York City and the District of Columbia are exceeding national averages. Louisiana has shown greater incidence and increase in incidence than other states in the South. This could be connected to the level of population density that occurred during Mardi Gras celebrations, before many major events were cancelled.²³

CFR LIMITATIONS

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 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 the 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.

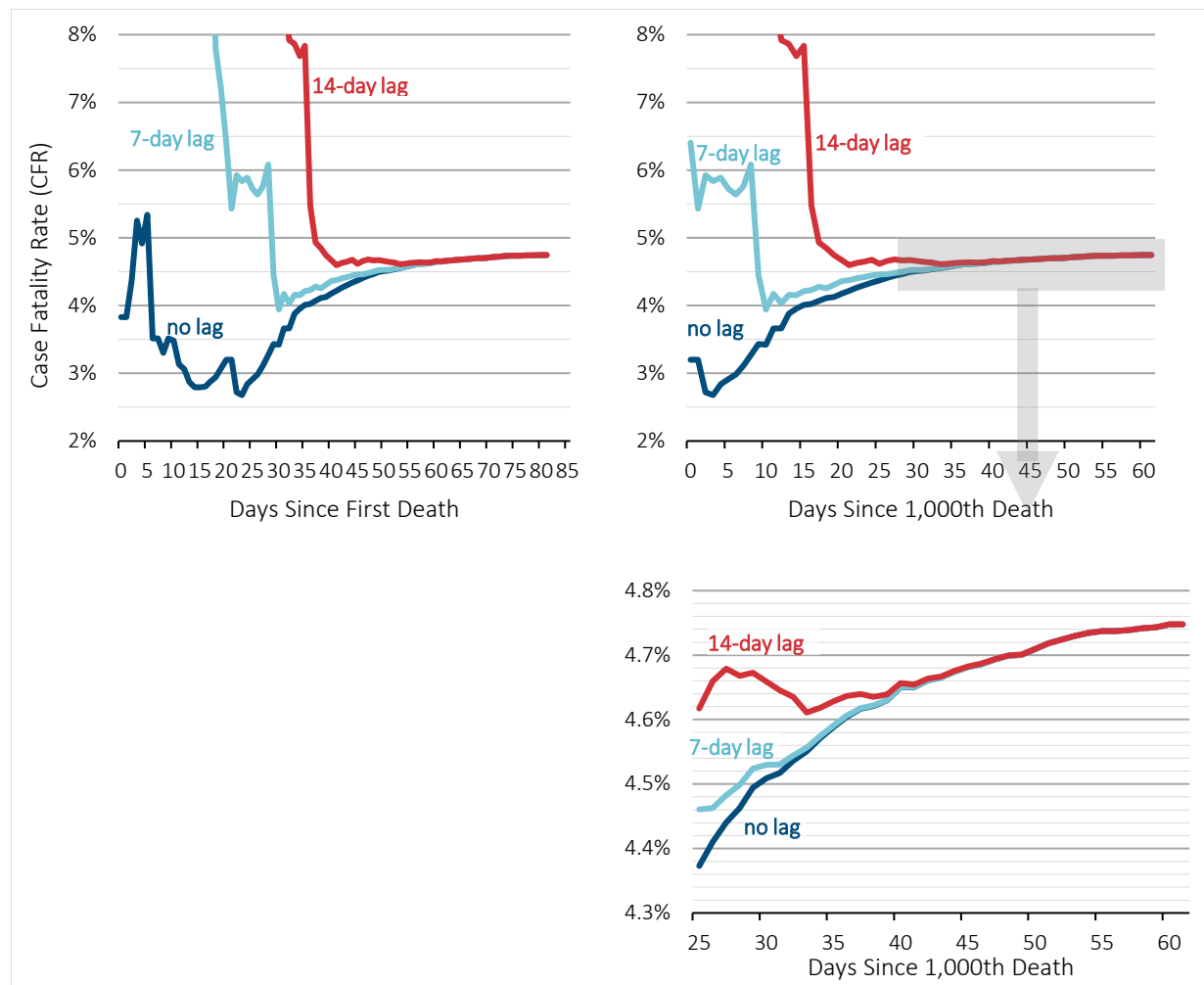
One technique to limit wild fluctuation in and gross under- or overstatement of CFRs that often occur during early reporting is to “lag” the number cases in the denominator by seven or 14 days. The lag better aligns the deaths with an appropriate exposure for calculating a CFR. However, CFRs calculated 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: Many of the CFRs shown in and quoted in this brief have been pulled from sources that did not clearly document whether a lag is included. The reader should be aware of these potential shortcomings when reviewing these statistics and other reported CFRs.

Figure 7 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. Without adjustment for reflecting unconfirmed and unreported cases, it appears the lagged and unlagged CFRs for Hubei province are converging and may stabilize between 4.7% and 4.8%.

Figure 7
COVID-19 CASE FATALITY RATES FOR HUBEI PROVINCE, CHINA, THROUGH APRIL 12, 2020

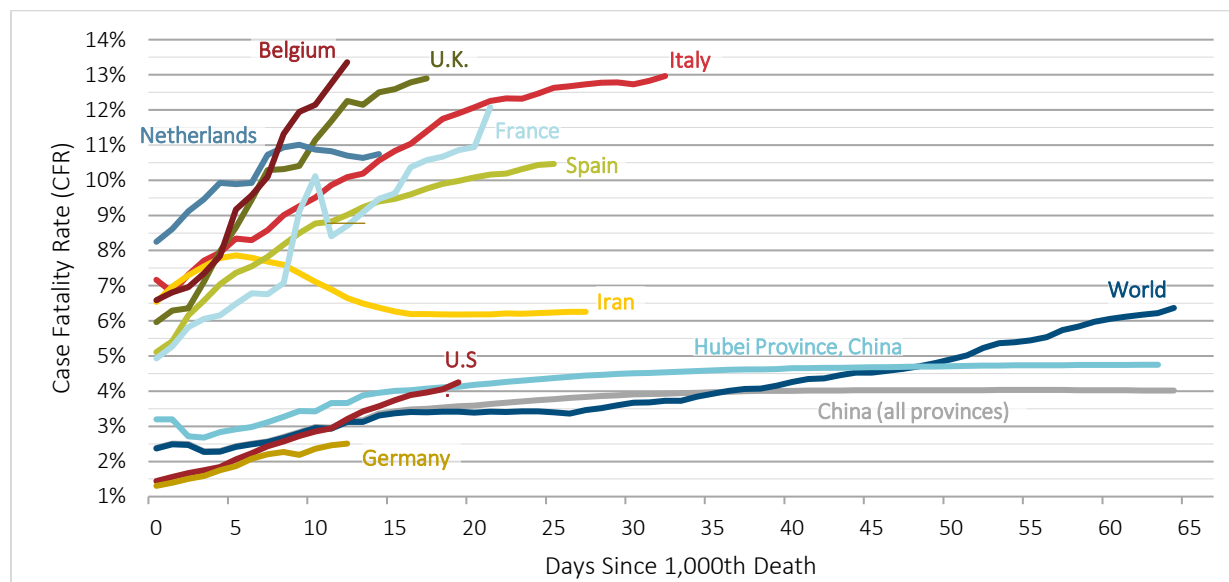


Data source: Johns Hopkins University

The reader can see in Figure 8 that COVID-19 CFRs show clear effects of early reporting for all countries with at least 1,000 deaths through April 14, 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.

Figure 8
CFRS WITHOUT LAG FOR COUNTRIES WITH AT LEAST 1,000 COVID-19 DEATHS, THROUGH APRIL 14, 2020



Data source: Johns Hopkins University

REPORTED CASES VS. ACTUAL CASES

As previously stated, at this early stage in the epidemic, the CFR focuses on mortality rates relative to only confirmed and reported cases. Due to resource constraints, most countries have focused COVID-19 testing almost exclusively on individuals who exhibit severe symptoms.²⁴ Consequently, a key question remains unanswered: What percentage of the population has already been exposed to the virus?

A high exposure percentage would be good news, indicating that a significant portion of the population has already contracted the virus, experiencing either mild or no symptoms. The greater the number of infected individuals who have experienced little or no discomfort as a result of the virus—relative to the number who have experienced severe complications or death—the less danger the virus poses to the population that has not yet been infected.

In the absence of random testing of the general population, some researchers have used indirect approaches to estimate the portion of the population that has already been infected by SARS-CoV-2, the coronavirus that causes the illness known as COVID-19. For example, researchers from Penn State University and Montana State University examined publicly available U.S. influenza-like illness (ILI) data for this past March and identified a surge in non-influenza ILI. The surge defied patterns seen in prior years. Across U.S. states, the researchers found that the surge correlates with COVID-19 case counts. The authors conclude that the “symptomatic case detection rate of SARS-CoV-2 in the U.S. to be 1/100 to 1/1000.”²⁵ This conclusion, in turn, suggests that tens of millions of Americans have already been infected by the SARS-CoV-2 and, correspondingly, implies that the mortality rate among infected persons may be far lower than previously believed.

COMPARISON TO PAST PANDEMICS AND INFLUENZA

COVID-19 AND PAST PANDEMICS

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 2003²⁶ and the MERS-CoV virus created the Middle East Respiratory Syndrome (MERS) in 2012.²⁷

Table 2
COMPARISON OF SELECTED CORONAVIRUS EPIDEMICS

Coronavirus Epidemic	Number of Countries Reporting Cases	Estimated Deaths	Estimated Contracted Cases	Estimated Case Fatality Rate
SARS (2002–2003)	29	774	8,098	9.6%
MERS (2012–2014)	27	858	2,494	34.4%
COVID-19 (2019–4/14/2020)				
No lag	170	125,578	1,972,254	6.4%
Lag-7	--	--	--	8.8%
Lag-14	--	--	--	14.7%

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.

Table 2 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 2012.²⁸

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 14, 2020, the U.S. had reported 607,670 cases of COVID-19, about 31% of the world's confirmed cases.

COVID-19 AND INFLUENZA

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.²⁹ 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.³⁰

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.³¹ 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 2009.³² 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.³³

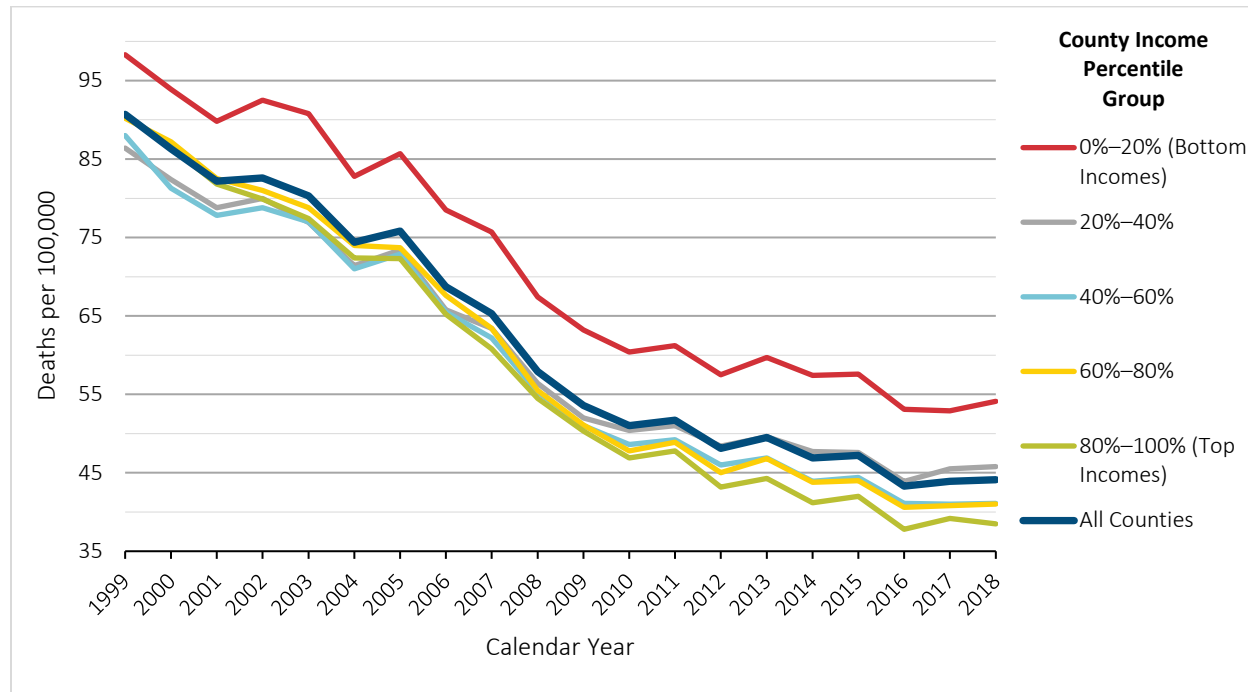
Besides total number of deaths, each influenza outbreak can differ by the time of year it will peak, the severity by age group, the number of outpatient influenza-like illness visits, and the number of hospitalizations required. A flu season in the U.S. is measured by week and typically begins in week 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.³⁴ 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.³⁵

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 health care services and current health condition are often factors that drive survival rates in a confirmed case.

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 9, to benchmark their own flu/pneumonia. This along with an understanding of the relationship between past flu events and the emerging COVID-19 experience can be useful in estimating the potential impact of COVID-19 on an insured block of business.

Figure 9 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 and split into five county level groups. 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 8.4% to 22.7% 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 the lowest mortality rates since 2005 and has ranged from 0.2% higher to 12.7% lower than the total population.³⁶

Figure 9
U.S. POPULATION DEATHS FROM FLU AND PNEUMONIA BY COUNTY INCOME PERCENTILE



Data source: CDC WONDER Online Database

In a recent survey completed by the SOA, the Life Insurance Marketing and Research Association (LIMRA), Oliver Wyman and the American Council of Life Insurers (ACLI), life insurance companies were asked which median household income quintile their policyholders fell into on average.³⁷ The results were across the board. Thirty-two of 53 responded with the following percentile groups: 7 in the top 20th; 4 in the 21st–40th; 9 in the 41st–60th; 9 in the 61st–80th; and 3 in the 81st–100th. The remaining 21 could not provide an answer. The results show a lack of homogeneity in the insurance industry and indicate that each insurer needs to consider its own block of business if using population mortality as a benchmark to its own flu/pneumonia and COVID-19 claims.

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-19.³⁸ 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.

Insurance premiums filed and approved for calendar year 2021 will depend on actuarial analysis and their insurance companies’ forecasts for claim activity in 2021, as well as the level of certainty in the forecast. Current year results for 2020 could show that margins for unexpected fluctuation were too small if COVID-19 causes excessive claim costs and are not mitigated fully by reductions in other health case services. In the U.S., state insurance

departments generally do not allow companies to build prior-year losses into future premium rates. Premium rates may be higher in 2021 due to higher uncertainty as to whether there will be a rebound of COVID-19 claims costs as predicted by some epidemiologists. Additionally, some insurers could project higher overall claim costs in 2021 due to pent-up demand for services in 2020 that had to be postponed.

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.³⁹ These increased costs may be passed onto payers immediately through fee-for-service claims or later in other payment arrangements. In the U.S., many insurers, are waiving out-of-pocket costs for health care treatment related to COVID-19.⁴⁰ As an example, a broad list of health care insurance activities being used to provide access to care and support in the current environment can be found on the website of America's Health Insurance Plans (AHIP), a U.S. national association whose members provide health insurance coverage and health-related services.⁴¹

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. Additional details on the range of estimates for COVID-19 health care claims can be seen in the Society of Actuaries report *COVID-19 Costs to Commercial Health Insurers* at <https://www.soa.org/resources/research-reports/2020/covid-19-cost-commercial/>.

SUPPLY OF MEDICAL RESOURCES

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.⁴² 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.⁴³

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.⁴⁴

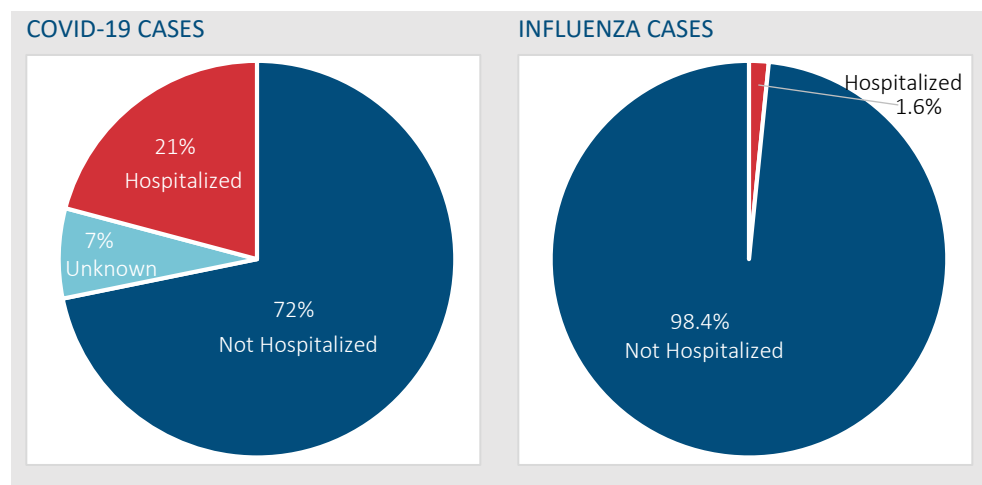
The U.S. has commenced this process through health facilities in some states and is also eyeing expansion to private sector pharmacy partners.⁴⁵ A new test that could expedite detection was granted “emergency-use authorization” by the Food and Drug Administration (FDA) on March 27 for rollout the week of March 30.⁴⁶ Manufacturers are currently producing 50,000 tests per day and looking to increase production. Some jurisdictions were able to purchase and implement large quantities of rapid tests to help increase the response to testing and treatment. Allocation of rapid tests have been under debate between various levels of government.⁴⁷ 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.⁴⁸

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.

HOSPITALIZATION RATES

Hospitalization rates for COVID-19 patients appear to be high. Based on analysis of data from China, the CDC found that 21% of COVID-19 patients were hospitalized, a much higher percentage than the hospitalization rate of 1%–2% for influenza patients (Figure 10).

Figure 10
PERCENTAGE OF CHINESE COVID-19 AND U.S. INFLUENZA CASES THAT REQUIRED HOSPITALIZATION

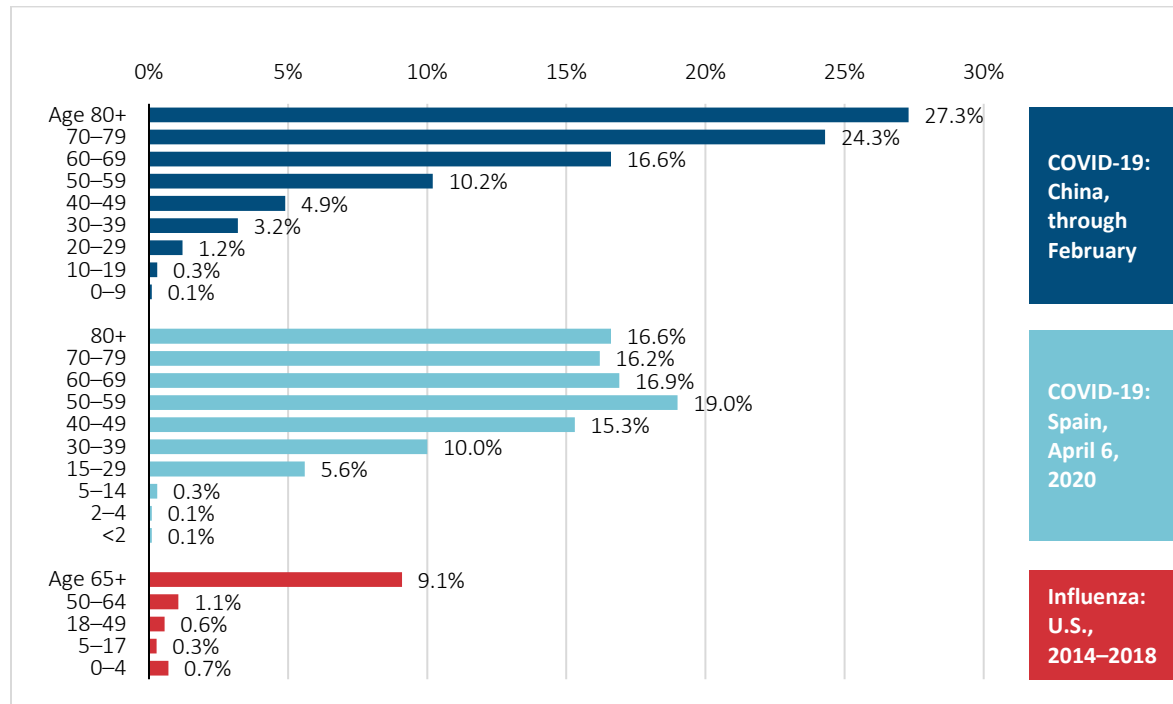


Data source: Centers for Disease Control and Prevention

Figure 11 digs into hospitalization rates a little deeper and compares COVID-19 hospitalization rates by age groups for COVID-19 and influenza. Based on COVID-19 data from China and Spain and influenza data from the U.S., COVID-19 hospitalization rates significantly exceed influenza hospitalization rates for ages 18 and up.⁴⁹

However, there are other comparisons of COVID-19 to influenza that may be used to get a better understanding of COVID-19 populations as they relate to comorbidities. According to the CDC, comorbidities played a key role in helping to determine the severity of COVID-19 patients. In fact, according to one of their recent studies, individuals with underlying conditions had a 40.5% chance of hospitalization versus 9% of those with no underlying conditions. Similarly, Hospitalized patients had underlying health conditions 71% of the time for non-ICU admissions and 78% of ICU patients. This helps to validate the frequently repeated trope that comorbidities and underlying medical conditions can lead to more severe cases of COVID-19.⁵⁰

Figure 11
PERCENTAGE OF CASES REQUIRING HOSPITALIZATION BY AGE GROUP



Data sources: Imperial College of London for COVID-19 (China); Red Nacional de Vigilancia Epidemiológica for COVID-19 (Spain); Centers for Disease Control and Prevention for U.S. influenza.

It is worth noting, though, that comorbidities also play a key role in influenza hospitalizations. As shown in Figure 10, the rate of hospitalization for influenza cases is very low. However, when looking at Health Care Cost Institute (HCCI) data from 2013–2017, there is a high rate of comorbidities for hospitalized influenza patients. Figure 12 shows rates of the main comorbidity for hospitalized influenza patients. The most common ones fall into main categories of Respiratory conditions, Circulatory conditions, Metabolic conditions, and Urinary Tract conditions.

The critical focus has now shifted away from testing kits toward having adequate numbers of hospital beds and ventilators for COVID-19 patients and sufficient personal protective equipment for frontline 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).⁵¹ Models and projections of hospital bed usage in the U.S. produced by ProPublica demonstrate why public health officials are so intent on “flattening the curve.”⁵²

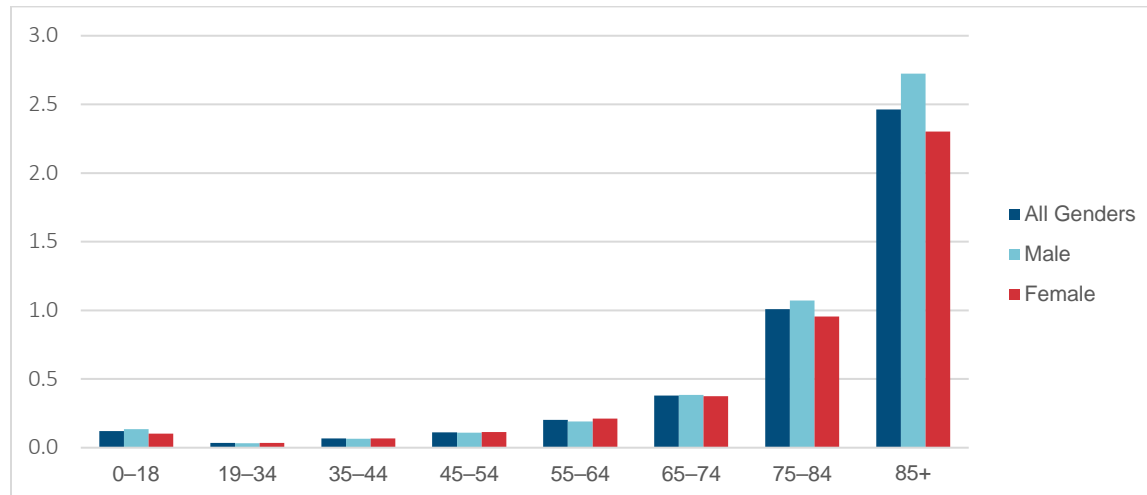
Figure 12
MAIN COMORBIDITIES FOR HISTORICAL INFLUENZA CLAIMS



Source: Health Care Cost Institute Enrollment and Inpatient Claims Data from 2013-2017

Figure 11 emphasized the distribution of hospitalization related to influenza claims. Figure 13 shows the incidence rates of influenza hospitalizations by age group for each flu season. These results are similar in that there are significant increases in flu hospitalizations as members age, with incidence rates more than doubling as members shift into different 10-year age bands. In addition, males tend to have slightly higher hospitalization rates with those discrepancies increasing at higher ages.

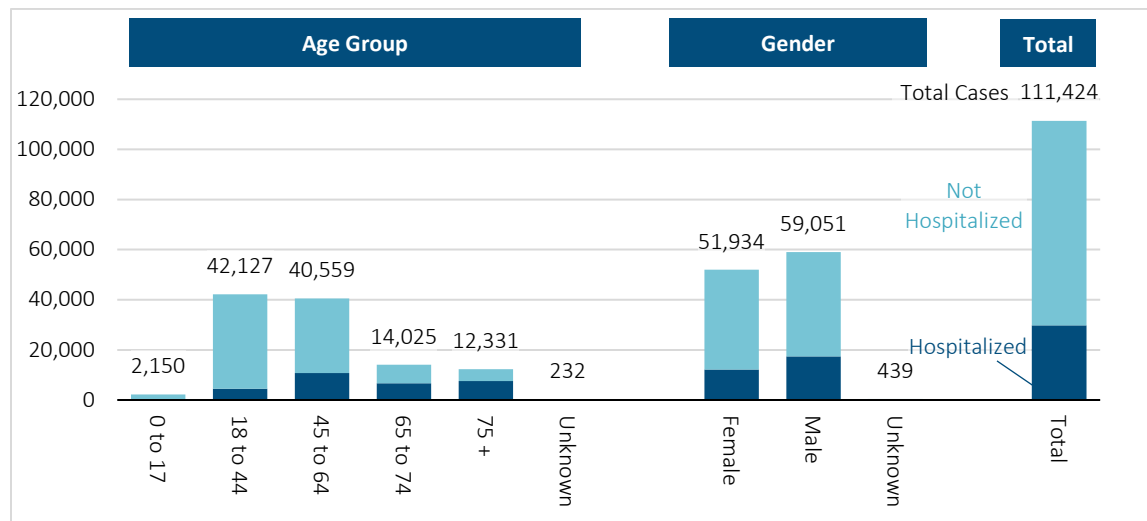
Figure 13
HOSPITAL ADMISSION RATE PER THOUSAND MEMBERS DUE TO INFLUENZA 2013–2017



Source: Health Care Cost Institute Enrollment and Inpatient Claims Data from 2013–2017.

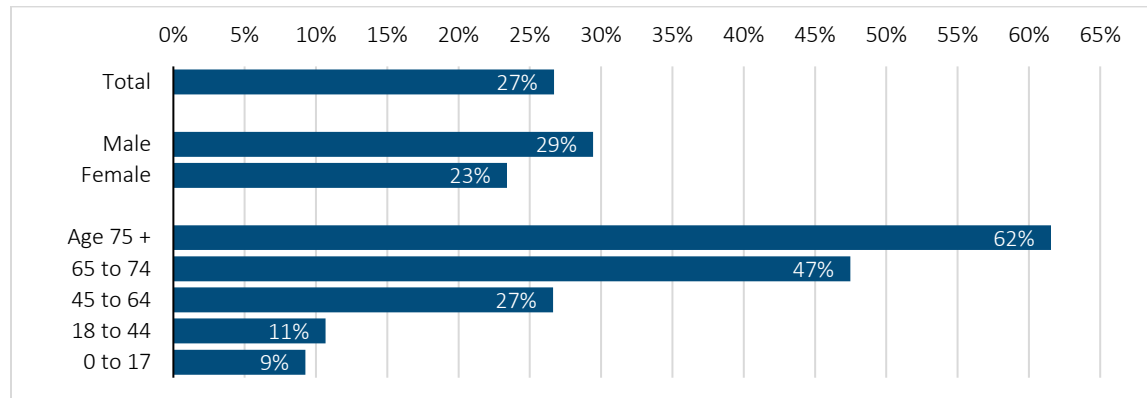
New York City released data of the cumulative number of COVID-19 cases and hospitalizations in the city, as shown in Figures 14 and 15. The data show that persons age 18 to 44 are more likely than other age groups to contract COVID-19. However, compared to all older age groups, a much smaller percentage of persons age 18 to 44 who contracted COVID-19 have been hospitalized.⁵³

Figure 14
CUMULATIVE NUMBER OF NEW YORK CITY COVID-19 CASES AND HOSPITALIZATIONS, APRIL 14, 2020



Data source: New York City Department of Health

Figure 15
PERCENTAGE OF NEW YORK CITY COVID-19 CASES THAT HAVE BEEN HOSPITALIZED, APRIL 14, 2020



Data source: New York City Department of Health

New York City’s data shows that through April 14, 2020, 27% 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 53% of the cases, 58% 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.

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.

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 health care resource strain and the need for more beds in case 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.

COVID-19 TREATMENT

Several companies have been developing and testing treatments for symptoms of COVID-19, though results are still preliminary.⁵⁴ 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-19.⁵⁵ The drugs, chloroquine phosphate and hydroxychloroquine sulfate, have been previously used off-label anecdotally.

The World Health Organization (WHO) and its partners launched the Solidarity international clinical trial in March to help find an effective treatment for COVID-19. The Solidarity trial is comparing four treatment options to assess their relative effectiveness against COVID-19. The four treatment options are: remdesivir (previously tested for Ebola treatment); lopinavir/ritonavir (used for HIV treatment); lopinavir/ritonavir with interferon beta-1a (used for multiple sclerosis treatment); and chloroquine or hydroxychloroquine (used for malaria treatment—see above). The

goal is to assess as quickly as possible the effectiveness of the treatment options by enrolling patients in multiple countries. As of April 8, over 90 countries are participating.⁵⁶

The Gates Foundation, the Wellcome Trust and Mastercard announced in mid-March the launch of the COVID-19 Therapeutics Accelerator, a \$125 million fund for coronavirus pandemic initiatives. The Accelerator's initial efforts are focused on exploring how existing drugs can help treat COVID-19. It has two current trials: one for the drug chloroquine and the other for hydroxychloroquine. The goal of these trials is to see how the two drugs can stop people who are exposed to the virus from getting sick. This differs from the WHO's Solidarity trial, which is investigating chloroquine treatment for its use to shorten COVID-19 patient symptoms.⁵⁷ 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.

NON-COVID-19 HEALTH CARE

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 encouragement by public health officials to reduce social interaction, however, individuals may be nervous about entering a hospital setting where the virus may be present. Consequently, individuals may defer some services, and health care providers may see minor ailments less frequently. In addition, health officials are strongly encouraging patients to carefully consider use of emergency room services and not to use them for minor health issues.

Telemedicine providers may see an expected rise in utilization. Low utilization of telehealth services in the U.S. to date have been typically attributed to lower consumer awareness and higher comfort with traditional methods but are expected to grow with increased emphasis on technology for social engagement and remote work. Related to this, insurers should be prepared to see an increase in short-term disability claims as patients recover from the disease and other complications.

MENTAL HEALTH

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.⁵⁸ Mental side effects of the COVID-19 crisis are increasingly looking to be addressed by health professionals and heightened as health resources are diverted to the most immediate concerns. In past national disasters, such as terrorism attacks or large-scale weather catastrophes, the primal human social instinct has been to seek comfort in a larger group—whether it be family, friends, neighbors or co-workers.⁵⁹ 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.⁶⁰

The SOA has released a report focused on mental health trends and COVID-19, which is available at this link: <https://www.soa.org/resources/research-reports/2020/covid-19-mental-health/>.

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.⁶¹

In early March, the Italian government declared the entire country a “red zone,” meaning people should stay home except for work and emergencies.⁶² 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.⁶³ Action is also specific to regions and communities. As of April 13, all but eight U.S. states have issued statewide “stay at home” or “shelter-in-place” orders, although businesses, such as grocery stores, that provide essential services can remain open.⁶⁴ At least 1.5 billion people—more than one-third of the world’s population—have been asked or ordered to stay home to try to dampen the spread of the coronavirus.⁶⁵ Businesses have taken action for their employees, such as offering or mandating remote work.

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.

Figures 16 and 17, which were created from the model, illustrate the potential impact over time of low social distancing (Figure 16) compared to increased social distancing (Figure 17). 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 pushed out further in time, helping defer onset and spread the stress on the health care system. In the current environment, this phenomenon has been referred to as “flattening the curve” through a much slower pace and accumulation of ill patients.

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

Figure 16
LOW SOCIAL DISTANCING

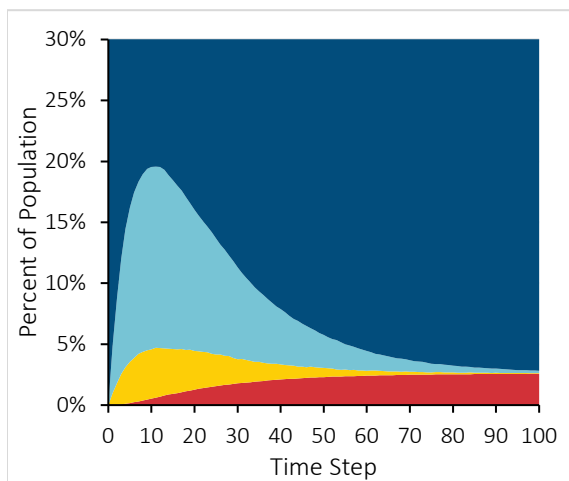
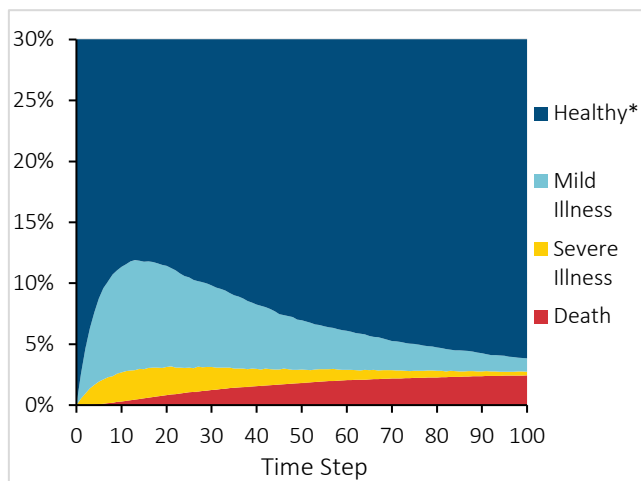


Figure 17
INCREASED SOCIAL DISTANCING



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

By comparison to COVID-19, other pathogens more easily travel through the air for longer distances, such as up to 30 meters for tuberculosis, chickenpox and measles. With the SARS coronavirus in 2003, world health authorities were able to eventually track and isolate cases. The result was to bring the average number each sick person infected down to 0.4, suppressing the outbreak.⁶⁶

Among the concerns to life and health insurers is the potential for the virus to spread quickly among older individuals who are highest at risk and living in close proximity to others, such as in senior care facilities and nursing homes. In U.S. senior care facilities alone, the disease has reportedly caused over 2,000 deaths, with some level of illness in over 14,000 individuals at over 2,000 distinct centers.⁶⁷ The CDC has provided guidance to nursing home facilities on practices that are designed to stem the transmission of the virus within care centers and to staff and visitors. The guidance includes restricting all visitation except for certain compassionate care situations, such as end-of-life situations; restricting all volunteers and nonessential health care personnel; stopping all group activities and communal dining; and screening of residents and health care providers for fever and respiratory symptoms.⁶⁸

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 relatively unlikely to get it again, at least within the timeframe of the current outbreak.⁶⁹ Researchers will need more time and data as the virus plays out before any definitive conclusions can be made. In addition, secondary health impacts of having coronavirus infection and recovery are beginning to be seen. Early reports on the impact of the disease beyond respiratory illness are being noted, especially in relation to neurological conditions with symptoms such as brain inflammation, hallucinations, seizures, cognitive deficits and loss of smell and taste. Recent studies on recovered Chinese patients have indicated that more than one-third had some form of neurologic symptoms.⁷⁰

Economic and Asset Impact

MACROECONOMIC VARIABLES

With COVID-19 impacting business around the world, domestic and international financial markets have reacted to reflect anticipated 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.

Starting on March 3, the U.S. Federal Reserve reduced the benchmark U.S. interest rate twice, first by half a percentage point and then by another 100 basis points, taking the rate from about 1.75% to nearly 0%.⁷¹ In similar moves, starting on March 11, the Bank of England reduced the rates used by banks and lenders to 0.10%, the lowest rate recorded in the history of the bank (established 1694).⁷²

Reacting to volatile financial markets, the Federal Reserve and other Central Banks make funds available to banks at these benchmark rates to support the liquidity and stability of the banking system. Effective implementation of monetary policies such as these support the flow of credit to individuals and businesses

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.⁷³ Many of these programs bring back those used in the Great Financial Crisis, but some go further. The Treasury will now manage entities called Special Purpose Vehicles (SPV) that are allowed to own assets the Federal Reserve can't such as corporate bonds, both investment grade and some noninvestment grade, asset backed securities and municipal bonds. This will provide liquidity for many asset classes utilized by insurers and pension funds.

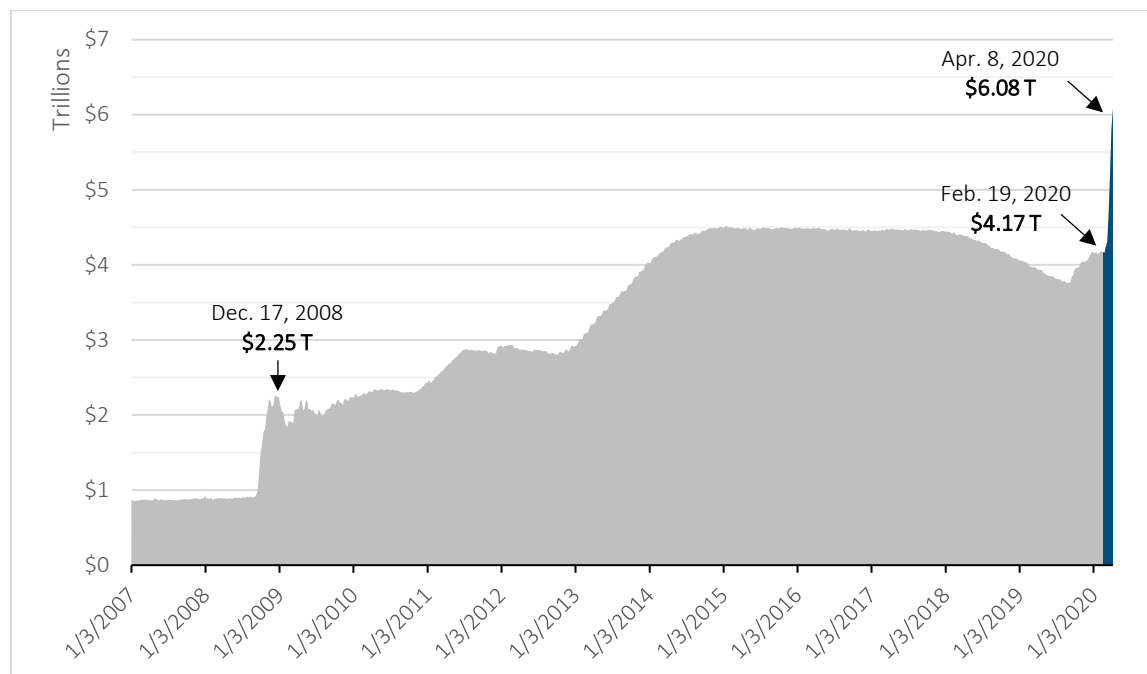
For the actuarial profession, the Federal Reserve announcement that it would buy corporate bonds, including fallen angels that started off as investment grade but are now rated as junk, for the first time in its history.⁷⁴ Corporate bonds rated at BBB or higher by Standard and Poor's or Moody's, which are key investments for many financial institutions, are eligible and help ensure liquidity in these markets under this program.

Similarly, Australia's central bank proposed to buy \$2.35 billion in government bonds and Germany agreed for a package worth up to \$808 billion. The Bank of Korea cut its benchmark rate on March 16 by 0.50% to a level below 1.00% for the first time and did so during its first emergency meeting since the financial crisis of 2008.⁷⁵ 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.⁷⁶ 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%.⁷⁷

While these monetary policy changes help to offset the impact of low economic activity resulting from COVID-19, they come at a cost. Figure 18 looks at the U.S. Federal Reserve Bank total assets less eliminations from consolidation: Wednesday level (WALCL) from the start of 2014 to present. From February 19, 2020, considered the start of COVID-19 impact on the U.S. economy, to April 8, 2020, the Fed's balance sheet increased from \$4.17 trillion to \$6.08 trillion. Also notable to compare is how the history of Fed assets has changed over time relative to previous

eras, such as the Financial Crisis of 2007–2008, which saw high default rates in the U.S. subprime home mortgage sector.

Figure 18
FEDERAL RESERVE BANK TOTAL ASSETS



Data source: FRED Economic Data, Federal Reserve of St. Louis

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.⁷⁸ 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 to cover 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.⁷⁹

Mortgage lenders are also keeping an eye on the stimulus package and other economic programs in order to track any potential increase in mortgage defaults. Commercial defaults on retail, lodging and office properties may be under higher levels of concern due to slowdown in economic activity. Both residential and commercial mortgages

are often combined into mortgage-backed investment securities that the actuarial profession models, and assumptions for defaults can be reviewed and updated as information develops.

As labor and production reports emerged in March, several reports noted 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 signal economic contraction.⁸⁰

COVID-19 has heavily influenced employment in key economic markets around the world. 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 also lose their health insurance simultaneously, although some employers have furloughed their employees to allow continued coverage. Some firms have announced halts to their stock buy-back programs and are contemplating cuts to 401(k) matching contributions and dividend payments.

Among the most dramatic and indicative economic reports received in many years were the recent series of U.S. Department of Labor's (DOL) Unemployment Insurance Weekly Claims reports. The report released on March 26, 2020, announced a record-setting 3.3 million initial claims for unemployment during the week ending March 21. The weekly claims reports issued April 2, 9 and 16 reported over 6 million initial claims for the each of the weeks ending March 28 and April 4, and over 5 million initial claims for the week ending April 11. In total, the DOL has received approximately 22 million initial claims for unemployment since March 14, 2020.⁸¹

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

Reductions in growth estimates of 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, the 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.⁸² Early indicators such as traffic patterns and shipping data within some early onset COVID-19 Asia-Pacific markets show signs of potential. The shape of a recovery will determine the tools used to effectively counter it, whether it be a fast rebound V, slower rebound U or worst-case depression L.⁸³

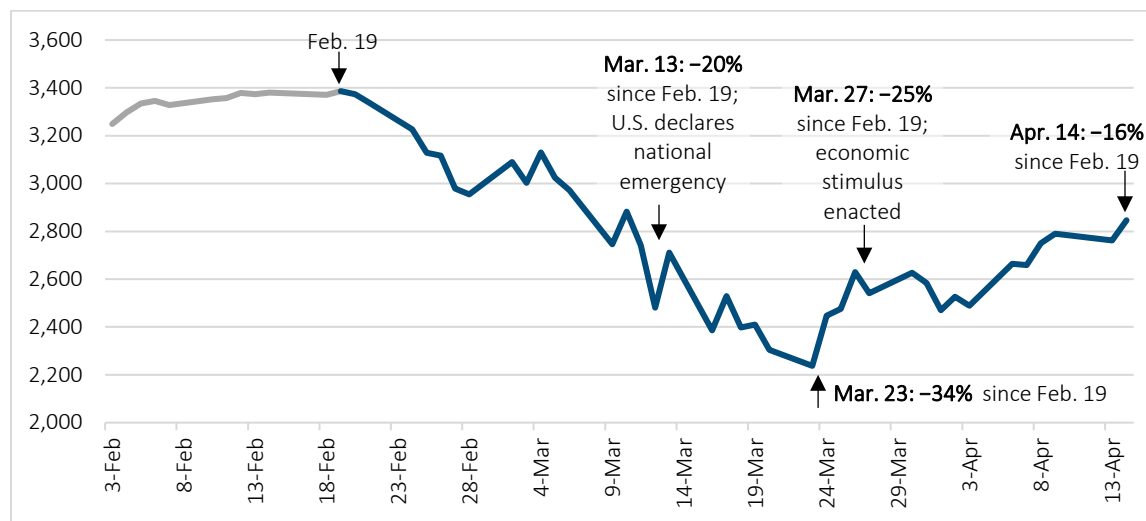
On March 23, International Monetary Fund (IMF) Managing Director Kristalina Georgieva made the following statement, "... the outlook for global growth for 2020 is negative—a recession at least as bad as during the global financial crisis or worse. But we expect recovery in 2021."⁸⁴ On April 14, the IMF followed up its signature World Economic Outlook report with new updated estimates of world growth and began to use the phrase "Great Lockdown" to denote the current environment as compared to past economic events such as the "Great Depression." Updated estimates projected global GDP growth to fall to -3% in 2020, rebounding to 5.8% growth in 2021. The 2021 projection presumes the current pandemic recedes through 2020 and that government actions worldwide can prevent widespread corporate bankruptcies, extended unemployment, and economic strain.⁸⁵

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.

U.S. markets have been volatile since February 19, 2020, the date generally recognized as the start of COVID-19 impact on U.S. financial markets. Figure 19 tracks the S&P 500 since February 3, 2020.⁸⁶ By March 13, when the U.S. declared the COVID-19 outbreak a national emergency, the S&P 500 cratered on March 23, down 34% from its February 19 level. By April 10, the S&P 500 had regained some of what it had lost, ending 18% below its February 19 level.

Figure 19
S&P 500, FEBRUARY 3–APRIL 14, 2020



Data source: Federal Reserve Bank of St. Louis

An additional item of note is the length and 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.

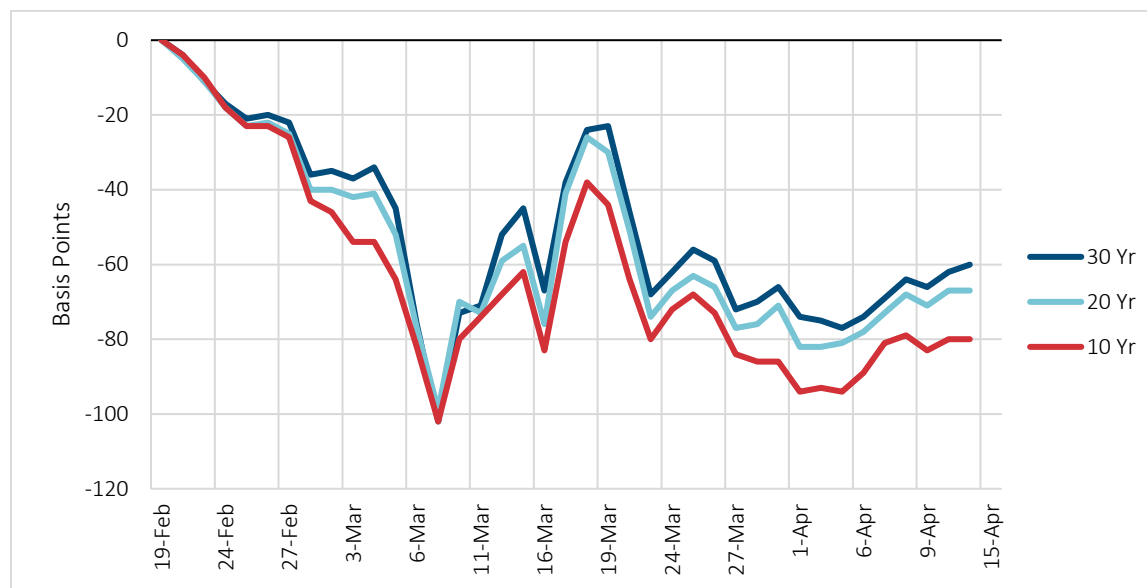
Table 3
HISTORICAL 40% DROPS IN S&P 500 INDEX

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

LOW INTEREST RATE ENVIRONMENT

Low interest rates for investment in major international financial markets have been more the norm over recent years, and the impact of COVID-19 has further driven down interest rate levels. In early March, benchmark Treasury yields in the U.S. fell nearly 100 basis points from February 19 levels (Figure 20).⁸⁷The benchmark 10-year Treasury yield temporarily reached a record low of under 0.40% and the 30-year Treasury moved below 1.00% for the first time ever.⁸⁸ Some reversion has occurred from the lowest interest rate levels. As of April 14, the 10-year Treasury yield was 0.76% and the 30-year Treasury yield was 1.41%. Treasury rates at the long end of the curve are down approximately 70–80 basis points (bps) from their February 19, 2020 levels.

Figure 20
SELECTED U.S. DAILY TREASURY CURVE RATES RELATIVE TO FEBRUARY 19, 2020



Data source: U.S. Department of the Treasury

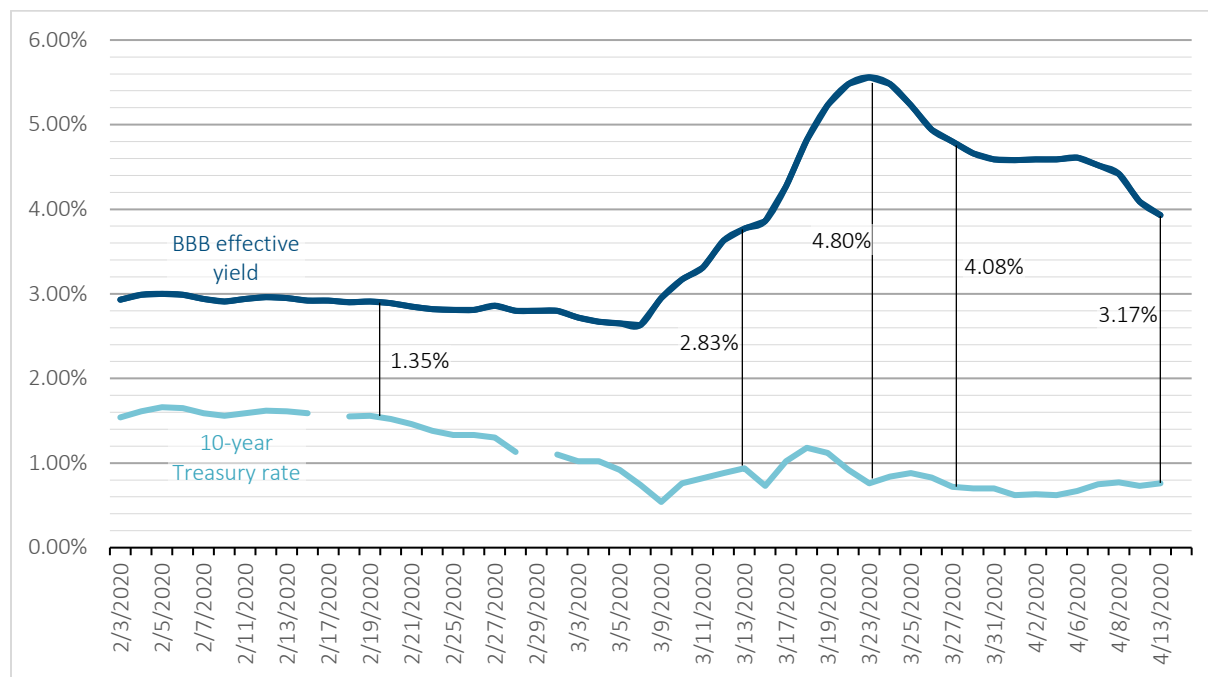
REINVESTMENT AND DEFAULT RISK

Corporate spreads, while initially stable through early March, have widened substantially in the most recent weeks (Figure 21). 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 2002.⁸⁹ Credit spreads widen due to anticipated higher risk of defaults and an increasing probability of some bonds being downgraded to be below investment grade. Some life insurance companies may still have long-term fixed interest crediting liabilities in their books, which have strained earnings in recent years and could be further strained by higher levels of asset defaults.

The concept of quickly rising interest rates, especially if mainly triggered by Treasury rates and no additional anticipation of default, is closely monitored by the international life insurance industry. While the current situation appears to be more driven toward potential downgrades of defaults, the widening of corporate bond yields and the opportunity to purchase investment-grade bonds at higher rate levels than in recent history could pose a risk to financial institutions of policyholders surrendering contracts at low or no surrender charge in favor of obtaining a high new money interest rate.

Life insurance companies may face this risk most prominently in cases where mature deferred annuity balances may be free of surrender charges and earning an aggregated portfolio interest rate driven by investments purchased in a low interest rate environment. The threat of this may be lower in the current financial scenario due to rising corporate rates being driven more by anticipated default risk, because new products being priced may typically recognize the higher default risk and not offer as attractive new money rates.

Figure 21
U.S. CORPORATE BBB EFFECTIVE YIELD COMPARED TO 10-YEAR TREASURY RATES



Data source: YCharts and U.S. Department of the Treasury

The current interest rate environment enhances the strong need for life insurers to be aware of these evolving risks, including the interactions between interest rates, credit spreads and defaults to construct products that emphasize risk management practices through financial modeling of the company’s assets and liabilities. Life and health insurers typically use cash flow testing methods to perform regulatory asset adequacy analysis, as well as for internal risk management practices. Strong scenario testing within insurance companies includes the ability for actuaries to identify key assumptions for asset modeling, as well as to be able to model assets and liabilities with contingent cash flows and risks. Strategies to mitigate these risks may also involve the use of interest rate forwards, futures and swaps. Life insurance companies may be contemplating a wide range of interest rate scenarios in their risk management modeling and asset adequacy analysis as the year moves along, noting that credit spreads and expected default rates may interact in unexpected ways. Low Treasury rates may have insurers contemplating future interest rate scenarios that are broader than historical deterministic interest rate scenarios used in asset adequacy exercises, including stresses that result in negative Treasury rates, stagflation, spikes in defaults and economically driven lapses.

Impact on Insurance Industry

IMPACT ON LIFE AND HEALTH 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.⁹⁰

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.⁹¹

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.⁹² 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.⁹³ Per the LIMRA survey, 77% of companies are extending grace periods. Roughly 20% of companies in the LIMRA survey noted that they are postponing paramedical exams until staff can conduct them, and a smaller percentage are waiving paramedical requirements entirely. Other changes being seen in the underwriting process are postponements for travel or virus exposure, additional questions related to COVID-19, and shifts to accept more electronic health data and past medical exams/lab results.

Insurance companies are preparing for the potential to see an increase in the use of mental health benefits in health care insurance systems. With governments around the world issuing “stay at home” orders and workers transitioning to a work-from-home environment, individuals may quickly begin to feel a higher degree of social isolation. As businesses slow down production and many retail outlets are forced to close or convert to carryout or delivery services, unemployment claims and the overall unemployment rate have increased in most markets.

In addition, even in cases where individuals still hold employment, many households may perceive lesser income security and face a more uncertain financial future. These items combine to raise a new awareness of mental health within the work of the actuarial profession and in a much different world situation than has been previously considered. Health actuaries will be increasingly more interested in the utilization of mental health benefits in their insured population through the coming months. Life insurance actuaries will want to revisit the mortality patterns that could unfortunately evolve through increased depression and anxiety, accompanied by an increasing potential for new suicide claims. The SOA has produced an overview of mental health insurance trends in a separate brief, located at <https://www.soa.org/resources/research-reports/2020/covid-19-mental-health/>.

It is yet to be seen how much 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, workers compensation, and personal and commercial auto coverages.

BUSINESS INTERRUPTION INSURANCE

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.

In many cases, business interruption insurance is provided as part of a property insurance policy. In these cases, the policyholder typically must incur a physical loss on a covered property to trigger business insurance coverage. 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. On March 16, a lawsuit in the district court of New Orleans was filed to seek a declaratory judgment for a restaurant policyholder about whether the business income coverage in a Lloyd's of London property policy would cover a government-mandated shutdown.⁹⁴

CANCELLATION INSURANCE

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

Workers' compensation in all states covers medical expenses, lost income and survivor benefits for disease that is the result of occupation. Usually viruses are not considered an occupational disease. While it ultimately will be subject to determination by the Workers Compensation Boards of each state, it appears that COVID-19 will generally be deemed an occupational disease for workers who are likely to have caught the disease as the result of their work, such as grocery and health care workers. Since many of the COVID-19 medical costs will first be borne by health insurers, health insurers may need to investigate how each individual caught the disease in order to pass cost of the occupational disease component on to workers' compensation insurers. Depending on the ultimate number of fatalities of infected workers, survivor benefits could be a significant impact to the workers' compensation industry.

In addition to the impact on losses, there is also an impact on premiums due to the economic shutdown. Workers' compensation insurance premiums are generally based on estimated payroll of the employer at the start of the policy. After the policy expires, the actual audited payroll from the insurance period determines the premium. Due to the high levels of unemployment projected, many employers will have less actual payroll than the amount that was estimated at the start of their current workers' compensation policy and used to determine premium. As a result, insurers will have to decrease premium for employers with reduced payroll, either during the policy term or after expiry by issuing a premium refund due to a payroll audit.

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 health care 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.⁹⁵

PERSONAL AUTOMOBILE INSURANCE

The amount of vehicle miles traveled and the 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.⁹⁶ 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.⁹⁷

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 personal and commercial 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. Many industry auto insurers are announcing some form of premium refund of credit given observed and expected experience in their loss ratios on auto lines of business. As one of many examples, State Farm announced a program to give policyholders an approximate 25% credit on premiums paid between March 20 and May 31. The magnitude of the credit is estimated to return \$2 billion to policyholders from coverage on over 40 million vehicles.⁹⁸ Recently, California Insurance Commissioner Ricardo Lara ordered insurers to provide a premium credit, reduction, return of premium or other appropriate adjustments as soon as possible for auto premiums paid for the months of March and April. Additionally, if shelter-in-place orders continue, the program will be extended to May.⁹⁹

MEDICAL MALPRACTICE INSURANCE

For physicians and medical professionals working directly with COVID-19, it remains to be seen how the actual malpractice exposure differs from expected. Many other physicians have seen a great drop in activity because most of the procedures performed are elective and have been subject to the economic shutdown. For these physicians, the medical malpractice insurance premium they have paid will likely be greater than needed by insurers for the actual losses and expenses. Similar to automobile insurance, some insurers have voluntarily refunded some premium for affected physicians.

The California initiative also extends to medical malpractice insurance where exposures for some practices may be low or nonexistent due to current "stay-at-home" orders in the state and the reduction or full removal of some elective health procedures and treatment. Medical malpractice insurance also is impacted by the "return to work" of many retired medical professionals, who have been asked or volunteered to return to medical facilities to assist with the growing number of COVID-19 and related cases. Insurers have developed programs that aim to extend

medical professional liability coverage to retired members coming back to volunteer to provide care during the COVID-19 pandemic. In addition, the transition of many working medical professionals to use online or virtual session techniques have prompted liability insurance carriers to respond by extending coverage to telemedicine.¹⁰⁰

FINANCIAL GUARANTY/MORTGAGE GUARANTY

Financial guaranty insurance and mortgage guaranty insurance are subject to high levels of loss during an economic downturn. For now, the economic shutdown has not caused many bankruptcies or defaults partially due to the government bailout. Depending on the duration of the economic downturn and the level of future bailouts, it remains to be seen how significant the impact will be on these insurers.

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 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.¹⁰¹

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.¹⁰² On Friday, March 20, 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.¹⁰³ The remainder of the NAIC Spring National Meeting was suspended to allow participants to focus on the health emergency. A SOA *Research Insights Podcast* interview with NAIC CEO Mike Considine, highlighting the U.S. insurance regulatory perspective on COVID-19 implications, can be found on the SOA website at <https://www.soa.org/resources/newsroom/covid-19-updates/#research>.

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 cyberattacks. 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 U.S. National Security Council acknowledged a cyber incident aimed on the U.S. Health and Human Services network.¹⁰⁴

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.

LOOSENING COVID-19 RESTRICTIONS

As the rate of infections, hospitalizations and deaths from COVID-19 slows, counties are considering how to lift restrictions to return people back to work and school. Countries that have not yet met the apex of their “curves” can learn from other countries that are ahead on the COVID-19 pandemic cycle. China, Hong Kong and Singapore have lifted restrictions and are seeing a resurgence of cases tied to international travelers.¹⁰⁵ These countries have resorted to implementing rules and requirements that are far from normal and that may have to continue until a vaccine can be developed and widely distributed. China has severely cut back on international travel. Singapore uses citizen’s phone data to track whether they are complying with government-ordered quarantines. Counties and cities are tightening their borders. Hong Kong citizens returning from abroad must quarantine for 14 days and wear tracking bracelets. Punishments for breaking the rules include fines, imprisonment and invalidating passports. The discussion on the benefits of having increased economic activity compared to the impact on public health continues to countries that are now experiencing higher levels of cases from COVID-19.

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, construct pop-up hospital settings or provide services to health care workers. The number of hospital beds per 1,000 people in the U.S. is 2.8

and lags Italy (3.2 per 1,000), China (4.3 per 1,000) and South Korea (12.3 per 1,000).¹⁰⁶ U.S. Navy hospital ships have been deployed to areas with the greatest need. USNS Mercy was deployed to Los Angeles, and the USNS Comfort was deployed to New York.¹⁰⁷ Large, empty spaces such as convention centers are being converted to house temporary hospital units.¹⁰⁸ The 1.8 million square foot Javits Center in New York was converted and added an additional 1,000 hospital beds.¹⁰⁹ In Chicago, McCormick Place, North America's largest convention center, is being converted to a 3,000-bed alternative care facility designed to treat non-COVID-19 cases and relieve pressure on city hospitals.¹¹⁰

In addition, hotels in some cities like Chicago are renting empty hotel rooms to isolate individuals and patients who need to be quarantined.¹¹¹ In London, the National Health Service (NHS) was granted use of the Millennium Hotel at Stamford Bridge by the Chelsea Football Club to support medical staff who had become accustomed to working long shifts and would otherwise have to make long commutes to their residences.¹¹² 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 health care 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 because 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.¹¹³ Auto and truck manufacturers are looking into producing ventilators.¹¹⁴ Other private businesses are looking to make face masks.¹¹⁵ 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.¹¹⁶

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 (IHME) at the University of Washington in Seattle, suggesting that model is close to how government experts see the situation.¹¹⁷

The IHME 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 14–26 by another model from a group called COVID Act Now.¹¹⁸ The estimate range of the COVID Act Now model varies based on the level of compliance with stay-at-home measures.

In general, there are two main types of COVID-19 forecasting models:

1. Outbreak curve models, and
2. Susceptible-infected-recovered (SIR) models.

The IMHE model uses an outbreak curve approach, while the COVID Act Now model uses an SIR approach. An outbreak curve model focuses on the time series of COVID-19 deaths, separately by city or geographic region, and fits this data to a curve that describes the anticipated rise, peak and fall of the number of daily deaths.

An SIR model, in contrast, requires estimates of the transmissibility and lethality of the virus and uses this information to project shifts in the population from “susceptible” (i.e., not yet infected) to “infected” and from “infected” to either “recovered” or deceased. A description of these modeling approaches is available in this SOA brief published on April 14, 2020, that compares forecasts of the COVID-19 outbreak for the U.S.: <https://www.soa.org/resources/research-reports/2020/covid-19-hospitalizations-deaths/>.

FOOD SUPPLY RISKS

COVID-19 disruptions in the U.S. have resulted in some farmers being unable to get their produce to market.¹¹⁹ The dairy industry was the first to feel the impact because of the short shelf life and perishable nature of dairy products. Restaurant and school closures have forced a shift from those wholesale markets to retail grocery stores, where demand remains high. However, because of disruptions in the trucking industry, some dairy products are not getting to stores in time before they perish. This results in a unique situation where there is high demand and shortages at the grocery stores at the same time there is an excess supply at the farms.

COVID-19 is also impacting meat production with workers falling ill in meat processing plants.¹²⁰ Smithfield Foods announced a shutdown of a South Dakota plant on April 12 after 230 workers became ill with COVID-19. This was more than half of South Dakota’s active COVID-19 cases. Smithfield produces more than 5% of the nation’s pork. Other plants such as JBS USA and Cargill in Pennsylvania and Tyson in Iowa have also closed. Even with these closures, the food supply currently remains robust. U.S. residents may have less variety and also may not get desired products when they want it.

Outside the U.S., as of April 3, global cereal stocks are at comfortable levels, and the outlook for wheat and other staple crops is positive.¹²¹ The growing issue broader than food supply may also be on behavioral change over food security. If bulk buyers believe they won’t be able to get wheat or rice shipments in May or June, it could result in negative consequences for low-income countries in Africa and the Middle East where people spend the largest share of income on food.

REMOTE WORK

Many employers around the world have encouraged 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.¹²²

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.¹²³ 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.¹²⁴

EVENT CANCELLATIONS AND RESTAURANT CLOSINGS

Many large spectator events, concerts and professional development meetings around the world have been cancelled to prevent the spread of COVID-19 among individuals in close proximity.¹²⁵ Health and public officials have responded in generally all 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 nearly all worldwide professional sports leagues such as the National Basketball Association, National Hockey League and football (soccer) matches in the major national leagues. The International Olympic Committee has postponed the 2020 Summer Olympics in Japan until 2021.¹²⁶ In the U.S., where 2020 is a presidential election year, the Democratic National Committee has moved its convention from mid-July to mid-August.¹²⁷

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

The impact of event cancellations will be noticeable in local economies that rely on spectator events, such as sports and concerts, and in particular on those individuals who work in service industries. In response, many high-profile sports celebrities and/or employers have been offering financial assistance commitments to assist those impacted by the cancellations, such as staff who work as ushers or security for large spectator venues. Some sports and entertainment companies are maintaining employee pay while their events are canceled 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 30.¹²⁸ 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 15.¹²⁹ 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 maintenance or replacement.

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.¹³⁰ As evidence of the increasing use of streaming distribution, Universal Studios released initial estimates for the April 10 digital rental release of DreamWorks Animation's *Trolls World Tour*. Initial estimates are placing the release as a record weekend and opening-day digital rental. The title became the top performing entry across all major on-demand platforms, topping expectations on digital distributors including Amazon, Comcast, Apple, Vudu, Google/YouTube, DirecTV and FandangoNOW.¹³¹

In addition, with the change in personal and entertainment services, demand has changed to a broad array of new technologies and entertainment. Jigsaw puzzle makers are struggling to keep up with a large spike in demand, with year-over-year sales reported in excess of 300%. Hair dyes have become harder to come by with increasing use at home in lieu of being able to visit professional salons. Spring religious holidays such as Passover, Easter and Ramadan are being celebrated in new and creative ways, with families and religious congregations joining together through online streaming services and remote video sessions.¹³²

RISK OF EXTREME WEATHER AND OTHER NATURAL HAZARDS

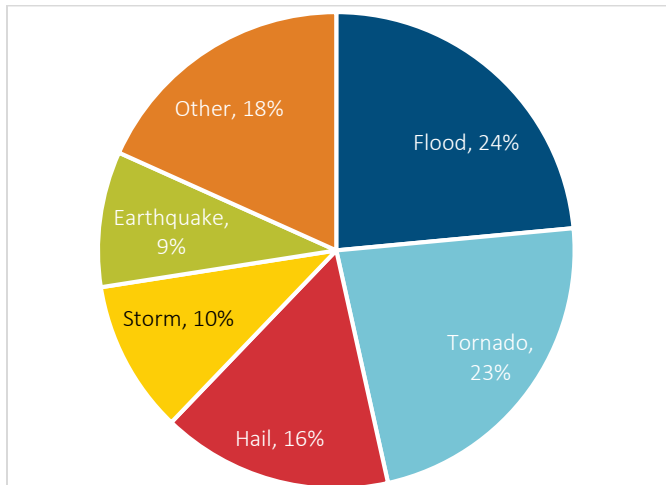
In the weeks and months to come, the COVID-19 crisis could potentially be compounded by extreme weather events, adding an additional layer of stress to a situation that is already dire. In addition, earthquakes are an ever-present risk for many areas.

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 22).¹³³

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 23). 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.

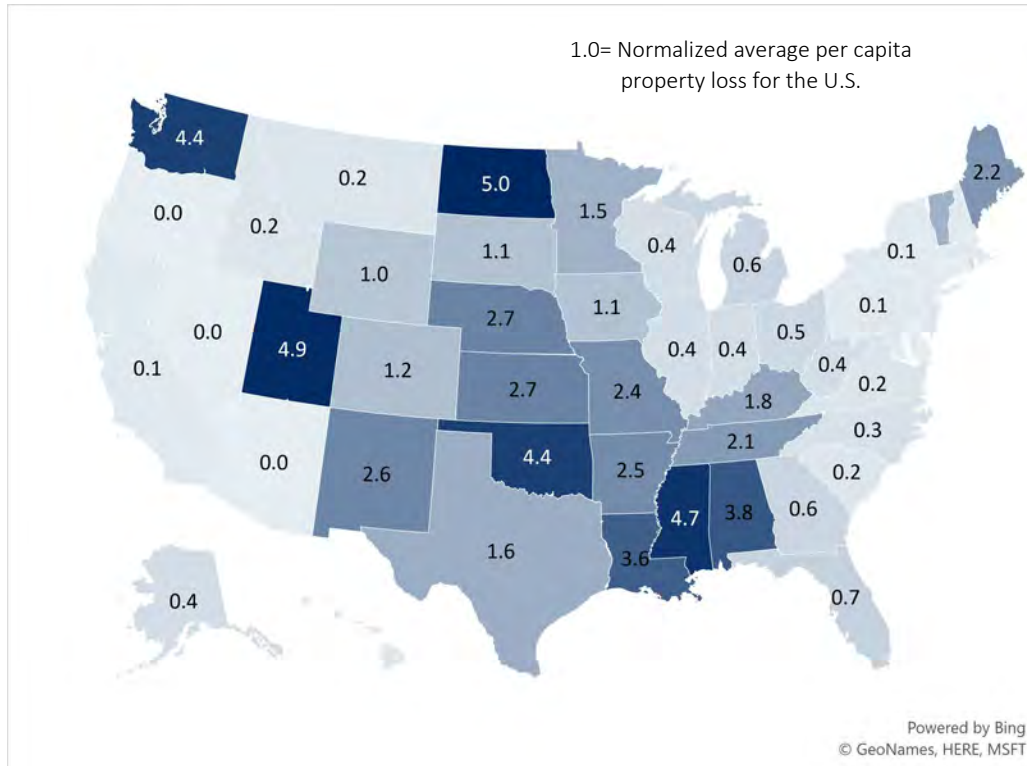
events, while excluding losses from geological risks such as earthquakes and volcanoes. To account for changes in property exposure across time, losses were adjusted forward to 2018 using county-level census data for the number of residential housing units, and state-level data for the median value of a residence.

Figure 22
HISTORICAL DISTRIBUTION OF PROPERTY LOSSES BY NATURAL HAZARD DURING MARCH–MAY



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

Figure 23
NORMALIZED HISTORICAL PER CAPITA PROPERTY LOSSES DUE TO NATURAL HAZARDS, FOR MARCH–MAY



Source: authors’ tabulations of SHELDUS loss data across the 1980 to 2018 period. Note that a value of 2.0 indicates that a state’s per capita historical losses are twice the national average, while a value of 0.5 indicates per capita losses of half the national average.

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 4
SURVEY RESULTS COMPARED TO CURRENT OBSERVATIONS

Estimated Asset Values	SOA Research Report	Current Environment: February 1, 2020 to April 13, 2020
Maximum Percentage Change in S&P 500 Index within 180 days from onset; Average response for Moderate Scenario	-11%	-15%
Maximum Percentage Change in S&P 500 Index within 180 days from onset; Average response for Severe Scenario	-24%	
Maximum Change in Aa Corporate Bond Yield within 180 days from onset; Average response for Moderate Scenario	+28 basis points	-20 basis points
Maximum Change in Aa Corporate Bond Yield within 180 days from onset; Average response for Severe Scenario	+35 basis points	
Maximum Change in the Federal Funds Rate within 180 days from onset; Average response for Moderate Scenario	-27 basis points	-133 basis points
Maximum Change in the Federal Funds Rate within 180 days from onset; Average response for Severe Scenario	-77 basis points	

IMPACT ON THE U.S. HEALTH INSURANCE INDUSTRY

The report series *Potential Impact of Pandemic Influenza on the U.S. Health Insurance Industry Report* <https://www.soa.org/resources/research-reports/2010/research-pandemic/> highlights the potential impact of an outbreak on health care costs, including information on how costs may vary by the site of care and the impact on operational risks to health care providers.

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/>

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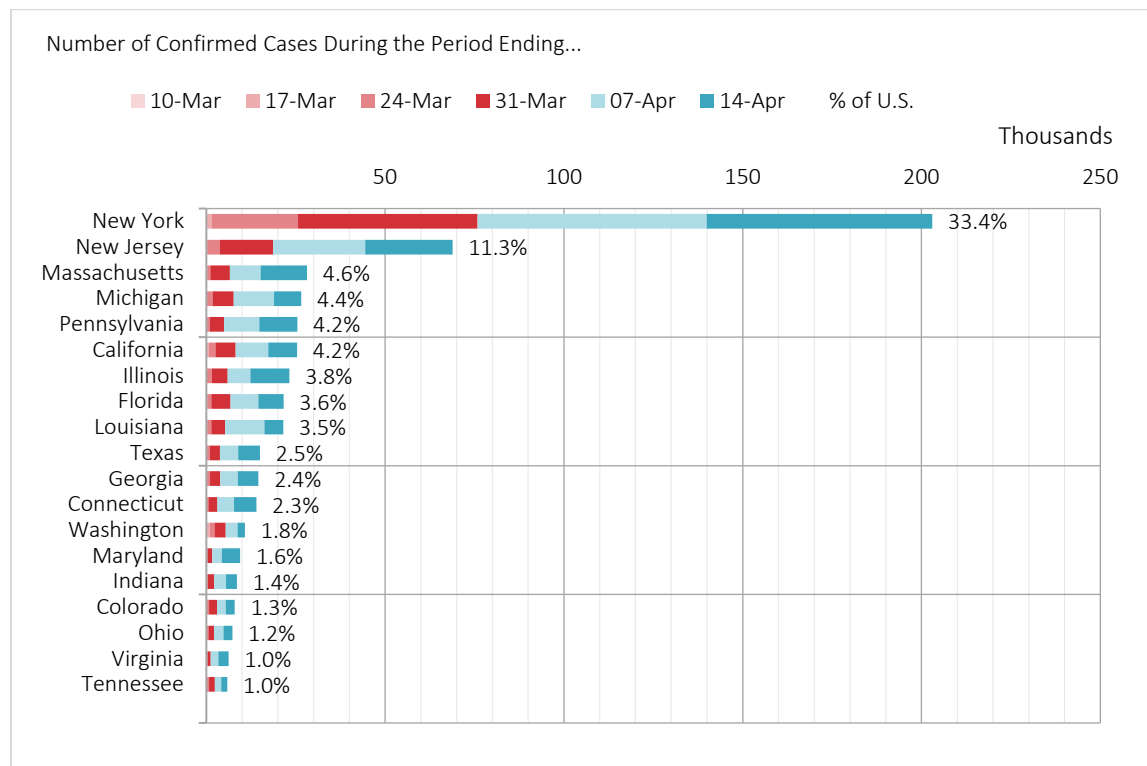
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Appendix: Reported Cases by U.S. State

Figure 24 displays states that have at least 1% of the total number of confirmed COVID-19 cases in the U.S. Table 5 shows data for all states and the District of Columbia.

Figure 24
CUMULATIVE COVID-19 CASES FOR STATES WITH AT LEAST 1.0% OF U.S. CASES, APRIL 14, 2020



Data source: Johns Hopkins University

Table 5
CUMULATIVE CONFIRMED COVID-19 CASES AND DEATHS BY STATE, APRIL 14, 2020

State	Number of Cases	Percent of U.S. Cases	Number of Deaths	Percent of U.S. Deaths
Alabama	3,953	0.7%	114	0.4%
Alaska	285	0.0%	9	0.0%
Arizona	3,809	0.6%	131	0.5%
Arkansas	1,498	0.2%	32	0.1%
California	25,356	4.2%	768	3.0%
Colorado	7,950	1.3%	327	1.3%
Connecticut	13,989	2.3%	671	2.6%
Delaware	1,926	0.3%	43	0.2%
District of Columbia	2,058	0.3%	67	0.3%
Florida	21,628	3.6%	571	2.2%
Georgia	14,578	2.4%	525	2.0%
Hawaii	511	0.1%	9	0.0%
Idaho	1,464	0.2%	33	0.1%
Illinois	23,248	3.8%	868	3.4%
Indiana	8,527	1.4%	387	1.5%
Iowa	1,899	0.3%	49	0.2%
Kansas	1,441	0.2%	69	0.3%
Kentucky	2,048	0.3%	106	0.4%
Louisiana	21,518	3.5%	1,013	3.9%
Maine	735	0.1%	20	0.1%
Maryland	9,472	1.6%	302	1.2%
Massachusetts	28,164	4.6%	844	3.3%
Michigan	26,549	4.4%	1,759	6.8%
Minnesota	1,695	0.3%	79	0.3%
Mississippi	3,087	0.5%	111	0.4%
Missouri	4,746	0.8%	149	0.6%
Montana	399	0.1%	7	0.0%
Nebraska	897	0.1%	20	0.1%
Nevada	3,134	0.5%	126	0.5%
New Hampshire	922	0.2%	25	0.1%
New Jersey	68,824	11.3%	2,805	10.9%
New Mexico	1,345	0.2%	31	0.1%
New York	203,020	33.4%	10,842	42.0%
North Carolina	5,113	0.8%	112	0.4%
North Dakota	341	0.1%	8	0.0%
Ohio	7,285	1.2%	324	1.3%
Oklahoma	2,184	0.4%	108	0.4%
Oregon	1,633	0.3%	55	0.2%
Pennsylvania	25,465	4.2%	691	2.7%
Rhode Island	3,251	0.5%	80	0.3%
South Carolina	3,553	0.6%	97	0.4%
South Dakota	988	0.2%	6	0.0%
Tennessee	5,827	1.0%	124	0.5%
Texas	15,006	2.5%	342	1.3%
Utah	2,417	0.4%	18	0.1%
Vermont	752	0.1%	29	0.1%
Virginia	6,182	1.0%	154	0.6%
Washington	10,799	1.8%	530	2.1%
West Virginia	640	0.1%	9	0.0%
Wisconsin	3,555	0.6%	170	0.7%
Wyoming	282	0.0%	1	0.0%

Data source: Johns Hopkins University

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