March 31st update

OLIVER WYMAN

# BENCHMARKING COVID-19 – AN ACTUARIAL PERSPECTIVE

March 31, 2020

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# BACKGROUND

COVID-19 is an illness caused by the novel coronavirus; this is from the same family of viruses that cause the common cold as well as SARS and MERS

**Transmission rate**

- ~2X the Flu
- Measured as number of cases an infected person causes → R-naught (R0)
  - The Flu R0 = 1.3
  - COVID-19 R0 between 2 and 3
- Even in asymptotic and mild cases, individuals will be contagious

**Containment**

- Typically anything with an R0 greater than 1 warrants countermeasures like quarantines
- The incubation period is far longer at 2-14+ days vs. the Flu at 1-4 days, thus creating additional containment issues
- Data suggests that viral shedding continues beyond symptom resolution

**Mortality**

- 20% of cases have been considered severe, requiring hospitalization for supportive care
- Global case fatality rate (as of March 29): 4.7% of confirmed cases, much higher than the Flu
- Mortality is much higher for the elderly and those with pre-existing conditions

**Unknowns**

- COVID-19 is still relatively new with many unknown factors; insurers' exposure to this risk will need to be monitored closely
- Mortality mitigants:
  - Mortality rate could decrease over time as milder cases (~80% of all cases) are often going undiagnosed
  - We expect mortality rate to decrease as testing expands and more cases are identified
- Mortality accelerants:
  - Hospital systems risk being overtaxed (ICU beds, ventilators, PPE) meaning case fatality rates could rise further

Source: Bing COVID-19 Tracker, China CDC, CDC, MedRxIv

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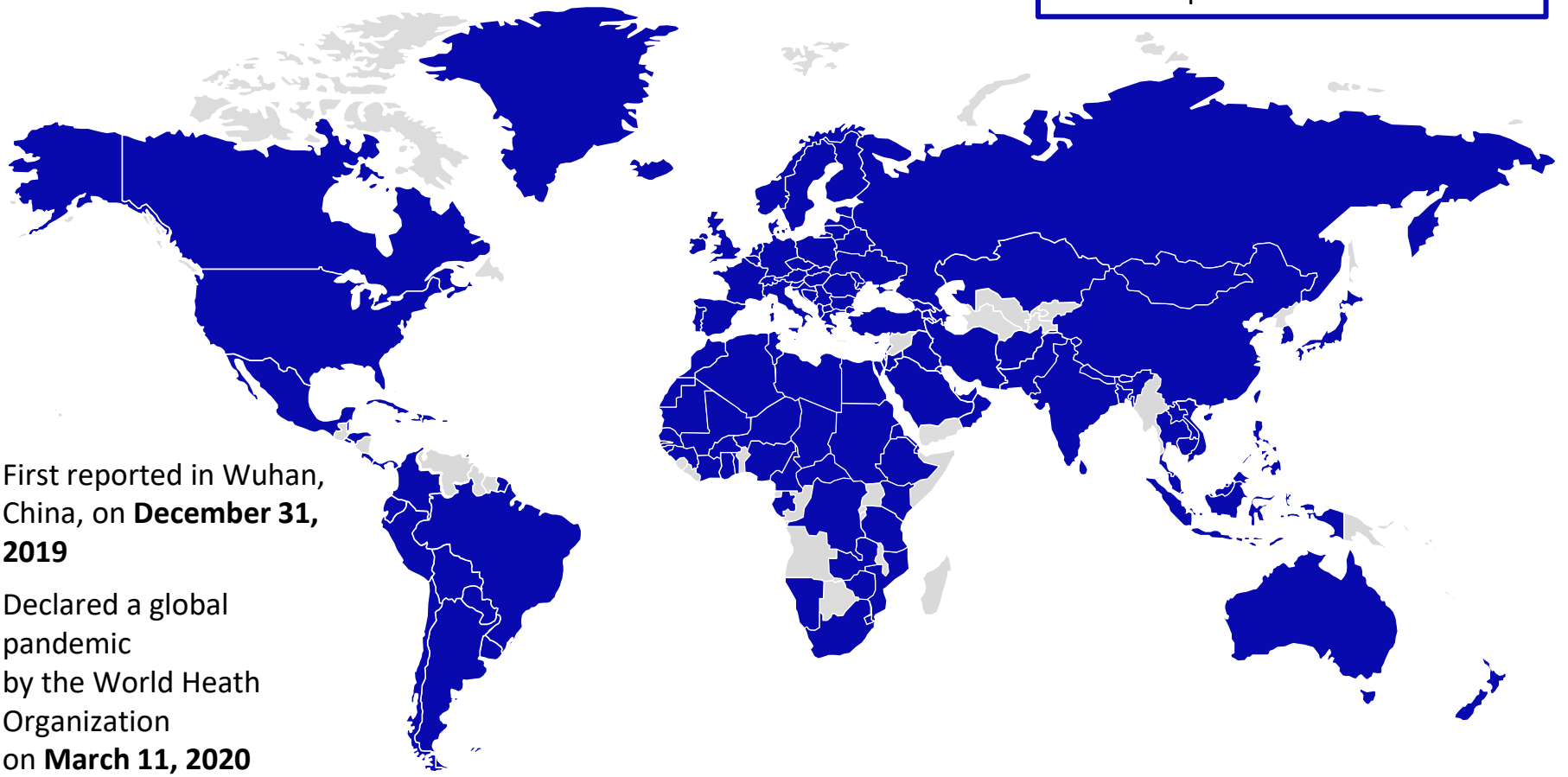
# COVID-19 SPREAD GLOBALLY

**As of March 31st, 2020**

- >800K cases reported in 179 countries and territories
- ~39K reported deaths



- First reported in Wuhan, China, on **December 31, 2019**
- Declared a global pandemic by the World Heath Organization on **March 11, 2020**

1. Countries included: All Countries in "European Region" Sub-region in WHO Situation Report
Source: Map from CDC (link), numbers from John Hopkins University & Medicine (link) as of March 31, 2020

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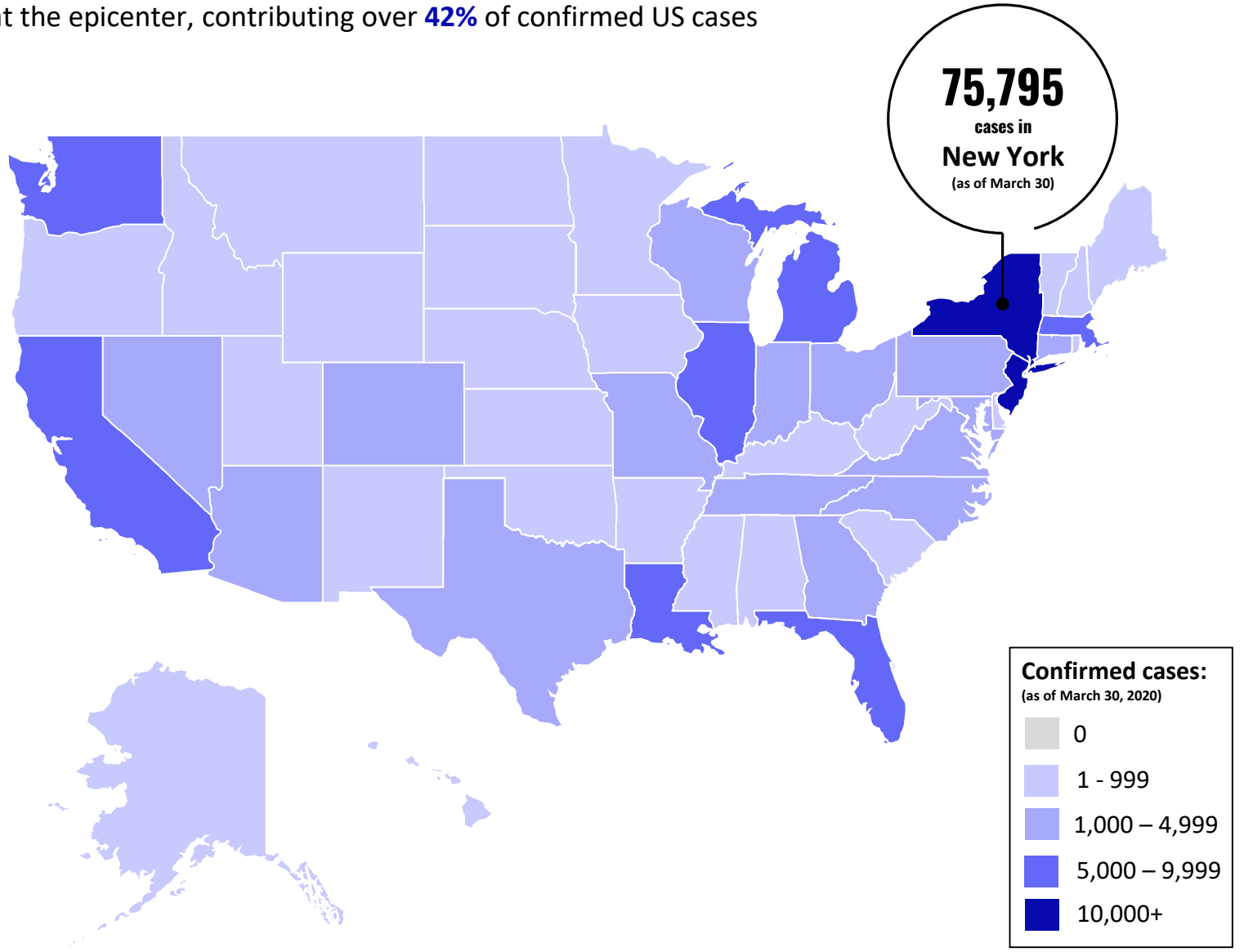
# COVID-19 SPREAD IN THE US

New York is at the epicenter, contributing over **42%** of confirmed US cases




Source: Bing COVID-19 Tracker, as of March 30, 2020

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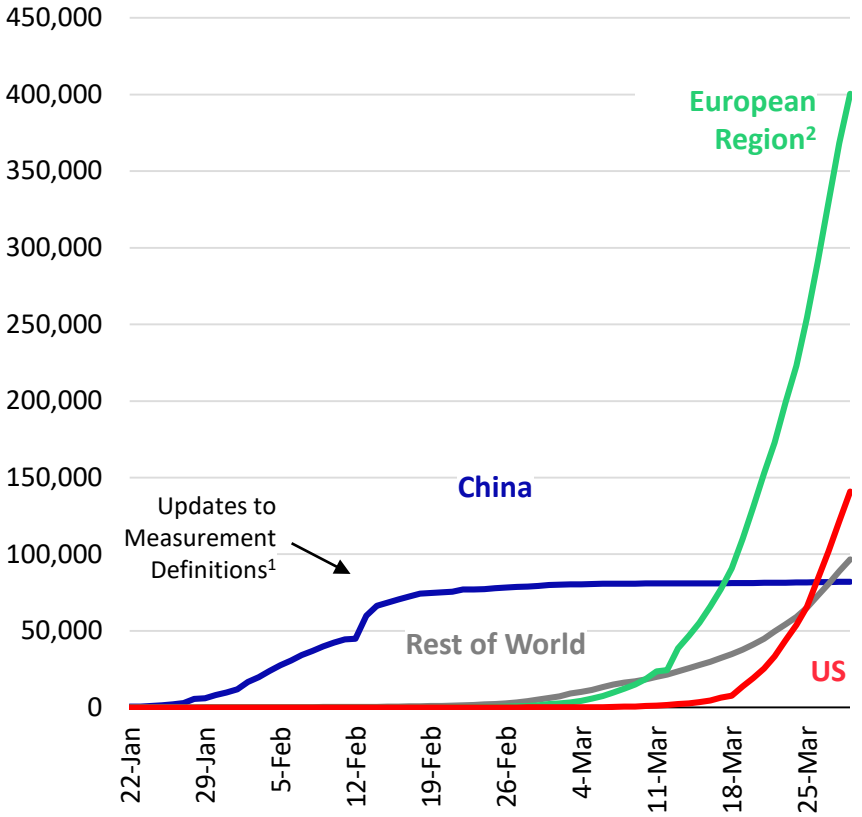
# COVID-19 TRENDS AND SPREAD OF THE DISEASE

The number of new cases in China has slowed – likely due to significant containment measures – as the outbreak spreads to other countries

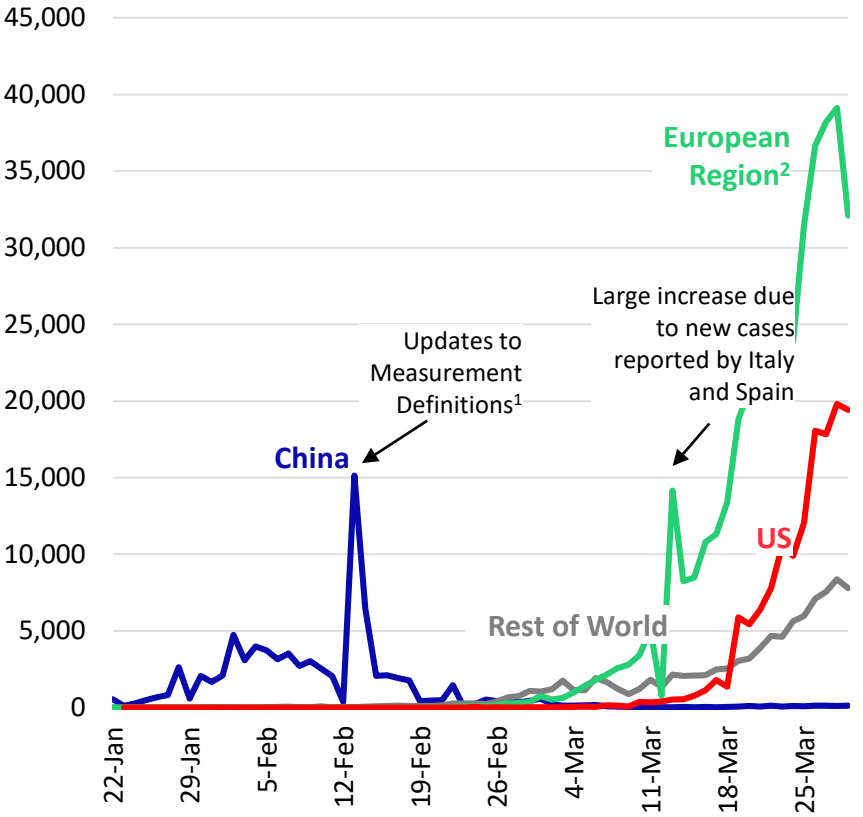
## Confirmed Cases of COVID-19

Cumulative Number of Cases as of March 29




## New Cases Per Day of COVID-19

New Cases Per Day as of March 29




Source: John Hopkins University & Medicine Coronavirus Resource Centre

1. Until February 17, the WHO situation reports included only laboratory confirmed cases causing a spike in total cases. Some sources include this update as of February 13. The jump due to inclusion of non lab confirmed cases is not included in the new cases data in WHO situation reports.; 2. Includes countries categorized under "European region" based off of latest WHO Situation Reports

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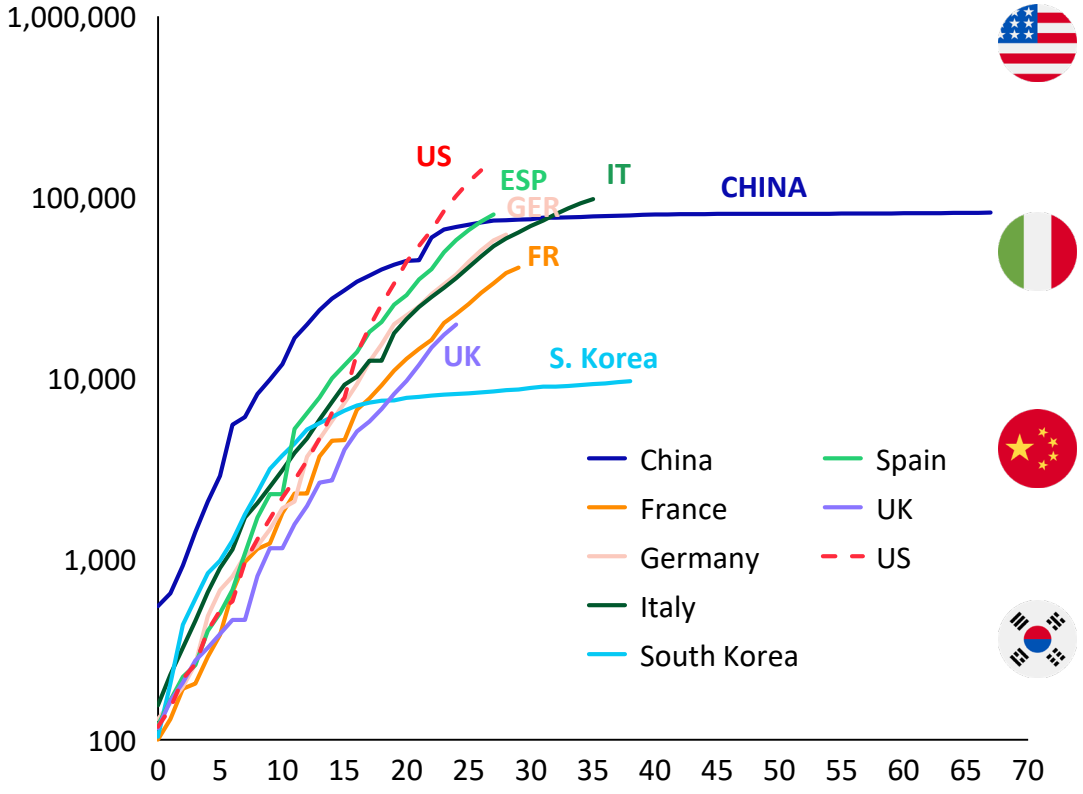
# MOST COUNTRIES – INCLUDING THE US – CONTINUE TO SEE EXPONENTIAL GROWTH; CHINA AND SOUTH KOREA HAVE FLATTENED THE CURVE

**Cumulative confirmed cases by country**

Log scale




**Days since 100th confirmed COVID-19 case**

- Lack of broad testing early, followed by rapid ramp-up may explain part of steep growth rate
- Response left largely to individual states
- More than half of states implemented state-wide stay at home orders between March 19 and April 1

- Initial ring-fencing limited to Lombardy, at 8,000 cases (day 15 in chart), with ongoing travel still permitted
- Broader shutdown at 12,000 cases (day 17 in chart)

- Enforced city-wide quarantine of Wuhan post-outbreak
- Early containment outside Hubei halted growth
- Mobile monitoring / enforcement (via WeChat, etc.)

- Massive early testing (as of March 28, >6,500 tests per million vs. US estimated ~2,000 tests per million people)
- Quarantined patients monitored via mobile app
- Epidemic response in place from SARS outbreak

Sources: JCSSE, local news and county health departments, as of March 17. Pre-WHO China data from NHC) Containment sources: China, S. Korea, US and testing stats, Italy
100th case on: Italy: February 23, S. Korea: February 20, US: March 3, China: before January 18, UK: March 5, France: February 29, Germany: March 1; Spain March 2. Data from JHU March 29, 2020

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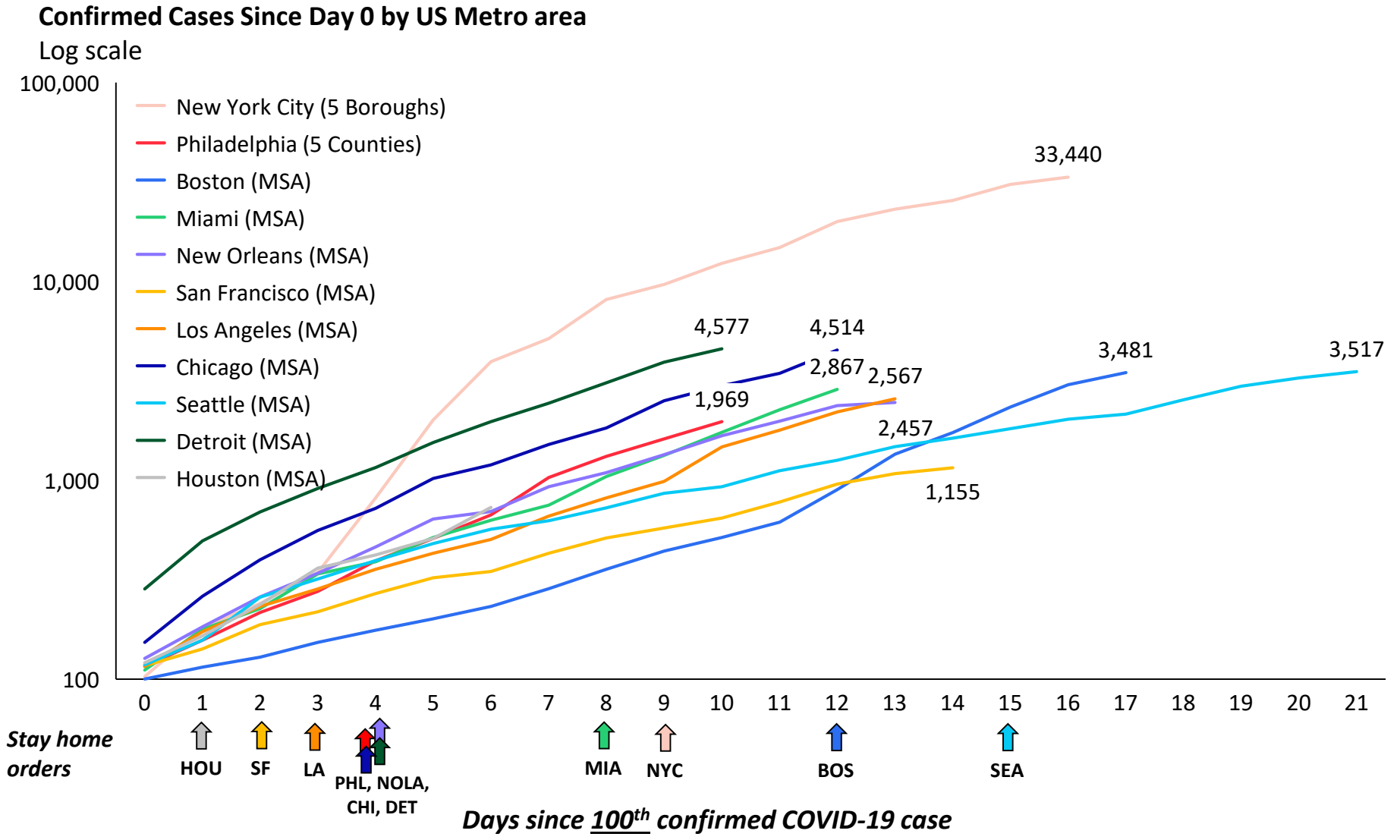
# THE CASE COUNT OF COVID-19 CONTINUES TO GROW ACROSS THE UNITED STATES




Data: USA Facts County Level Data as of March 29, 2020. Stay at home orders data from New York Times.

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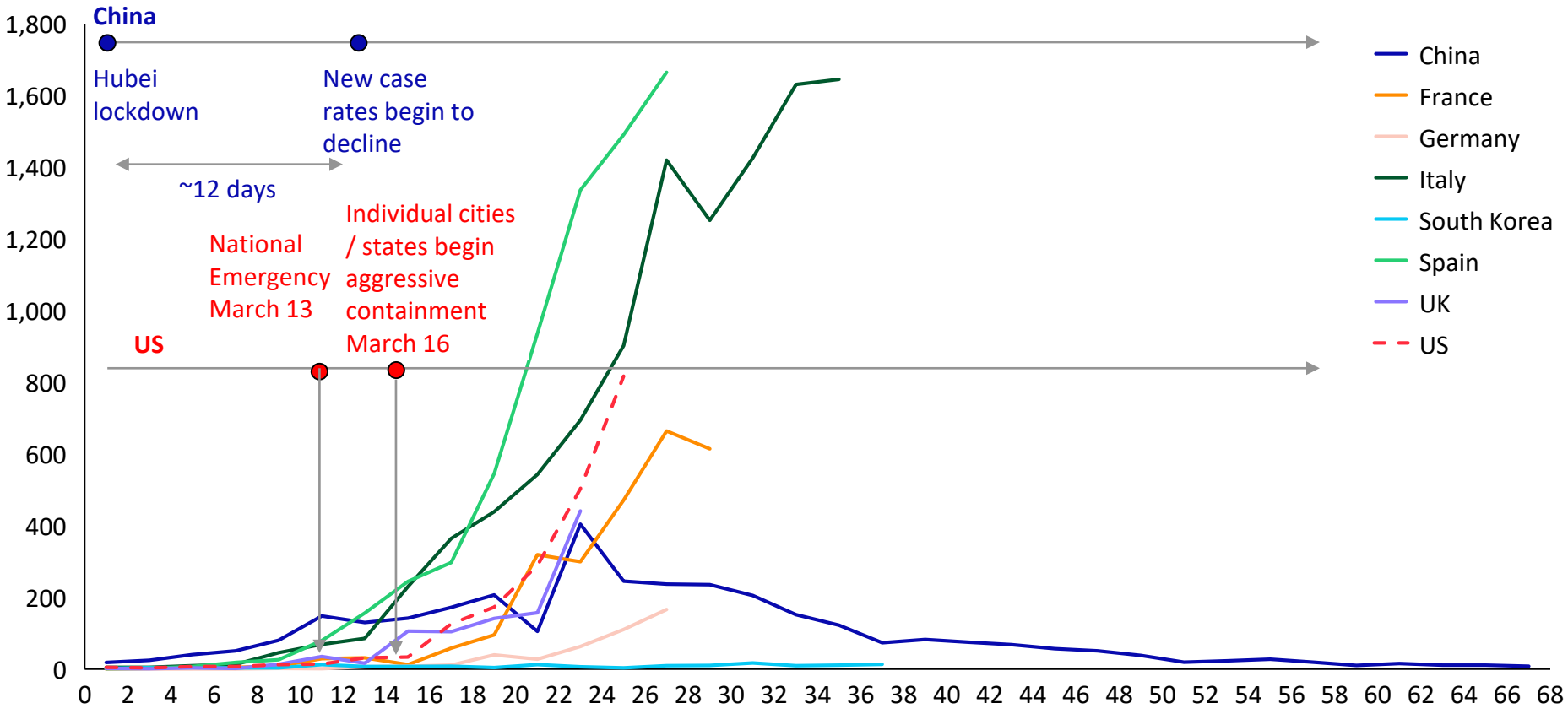
# COVID-19 TRENDS AND SPREAD OF THE DISEASE

Daily death rates indicate that suppression, aggressive testing, and active tracing / isolation strategies (as seen in countries like South Korea) can effectively ease the burden on the healthcare system, leading to lower death rates

**Number of daily COVID-19 deaths by country**




Source: John Hopkins University & Medicine Coronavirus Resource Centre

100th case on: Italy: February 23, S. Korea: February 20, US: March 3, China: before January 18, UK: March 5, France: February 29, Germany: March 1; Spain March 2. Data from JHU.

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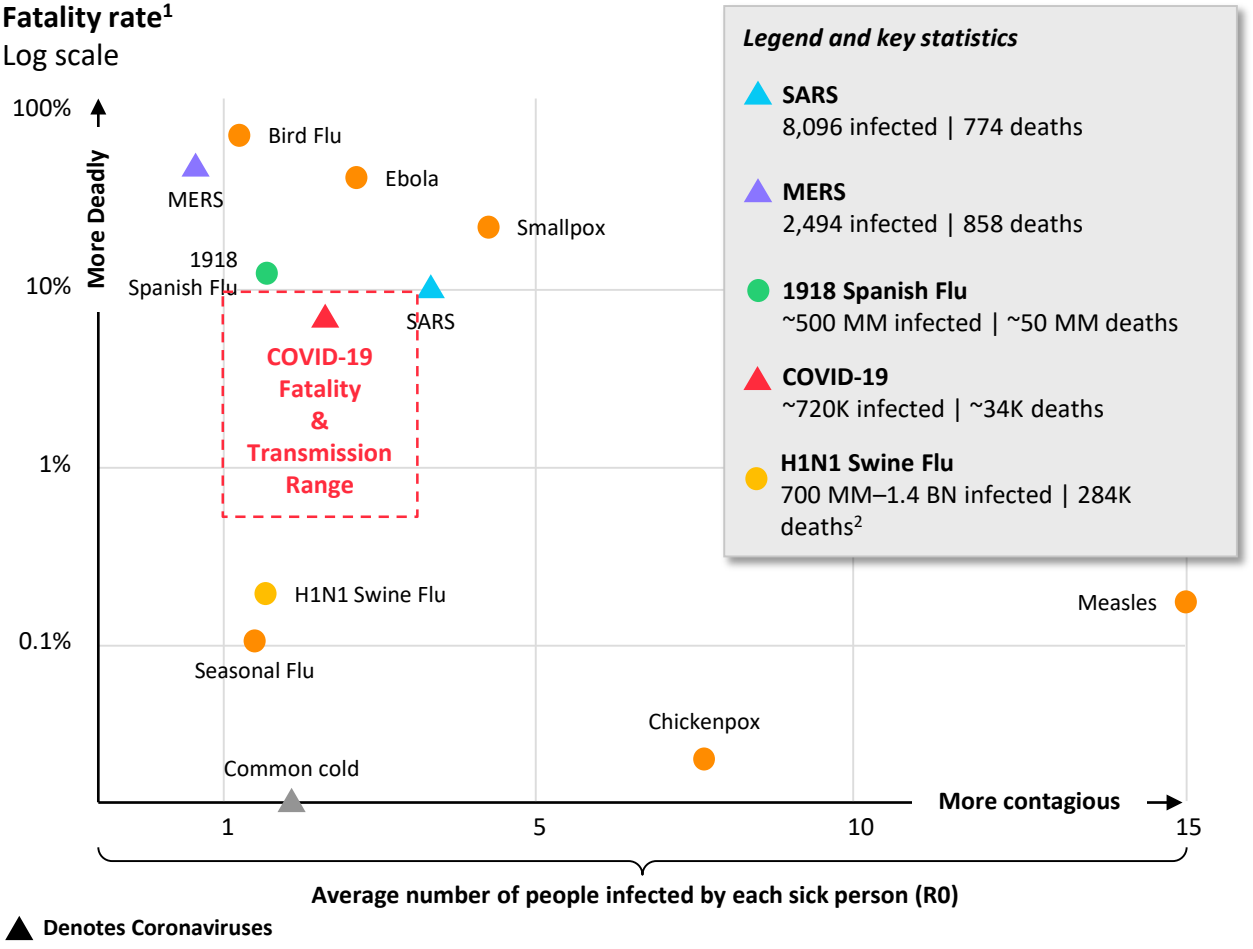
# HOW DOES COVID-19 COMPARE TO OTHER DISEASE OUTBREAKS?

COVID-19 is currently more deadly that the Flu, but the science on transmission and mortality continues to evolve




## Additional details

- R-naught (R0) represents the number of cases an infected person will cause. R0 for COVID-19 is currently estimated at between 2 and 3 (with edge of range estimates closer to 1.4 and 3.6), which means each person infects 2-3 others[3]; R0 for the seasonal flu is around 1.3[4]
- The global case fatality rate for confirmed COVID-19 cases is currently 4.7%[5] according to WHO's reported statistics versus 0.1% for the seasonal flu; the rate varies significantly by country (e.g., Italy – 11.03%, South Korea – 1.59%[5])
- We expect case fatality rates to fluctuate as testing expands identifying more cases and as existing cases are resolved

1. New York Times (link) for fatality and R-naught comparisons, CDC timelines for case numbers (selected link: CDC SARS timeline); 2. Updated CDC estimates (link); 3. The R0 for the coronavirus was estimated by the WHO to be between 1.4 -2.5 (end of January estimate) (link), other organizations have estimated an R0 ranging between 2-3 or higher (link); 4. CDC Paper (link); 5. Calculated as Number of Deaths / Total Confirmed Cases as reported by John Hopkins University.

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# COMPARISON TO PAST EVENTS

The current COVID-19 death toll is a fraction of historical events; however, we are in the early stages and this number has potential to expand greatly

| Year | Description | Region | Global death toll (000s, approx.) | US death toll (000s, approx.) |
|---|---|---|---|---|
| **1906** | Great Earthquake and Fire | San Francisco, CA | 3 | 3 |
| **1918** | Spanish Flu | International epidemic | 50,000 | 675 [6.54] |
| **1928** | Okeechobee Hurricane | Puerto Rico, Bahamas, U.S. | 4 | 2.5 [0.02] |
| **1931** | Central China Floods | Central China | 3,700 | 0 |
| **1952** | Polio Epidemic | U.S. | 3.1 | 3.1 [0.02] |
| **1957** | Asian Flu | International epidemic | 2,000 | 70 [0.41] |
| **1968** | Hong Kong Flu | International epidemic | 1,000 | 36 [0.18] |
| **1980** | Summer heat wave | California | 10 | 10 [0.04] |
| **2004** | Indian Ocean Earthquake | Bangladesh and West India | 230 | 0 |
| **2005** | Hurricane Katrina | Southern U.S. | 1.8 | 1.8 [0.01] |
| **2009** | H1N1 Flu | International epidemic | 280 | 12.5 [0.04] |
| **2020** | COVID-19 | International epidemic | 33.9 | 3.7 [0.01] |

*Brackets: additional # of deaths per 1000 persons*

3,721 US deaths reported to date (March 31), but evolving

*Values in blue mark pandemic events*

Source: Oliver Wyman research and analysis, John Hopkins University & Medicine, as of March 31, 2020

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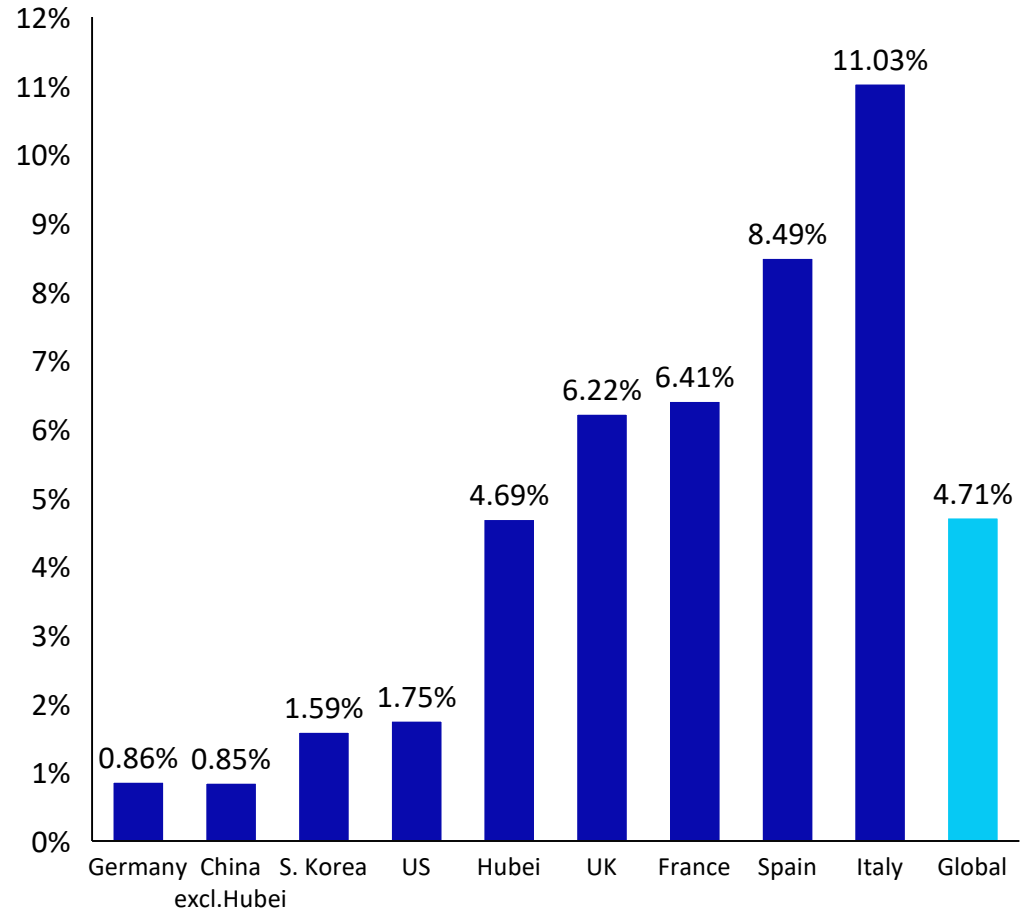
# CASE FATALITY RATE (CFR) BY COUNTRY

While the global CFR is a useful metric to understand COVID-19, country-specific CFRs range by an order of magnitude

**CFR by country[1]**




## What is driving the variation?

- **Position along the trajectory of the outbreak:** For many countries (e.g., Europe, US), the vast majority of cases have not yet resolved and the CFR is changing rapidly
- **Breadth of testing:** Broader testing leads to a larger confirmed base of patients, decreasing CFR
- **Distribution of key risk factors within the population:** Age, gender and pre-existing conditions have a significant influence on mortality; countries with higher CFRs have a population skewed towards these risk factors (e.g., Italy has the second oldest population on earth)
- **Health system threshold:** Every country has a health system capacity, that when exceeded, will result in the inability to provide sufficient support to all patients thereby resulting in a higher CFR

Note that case fatality rates are still unstable as greater than 80% of cases outside of China are still active

1. Calculated as Number of Deaths / Total Confirmed Cases as reported by Johns Hopkins University as of March 29, 2020

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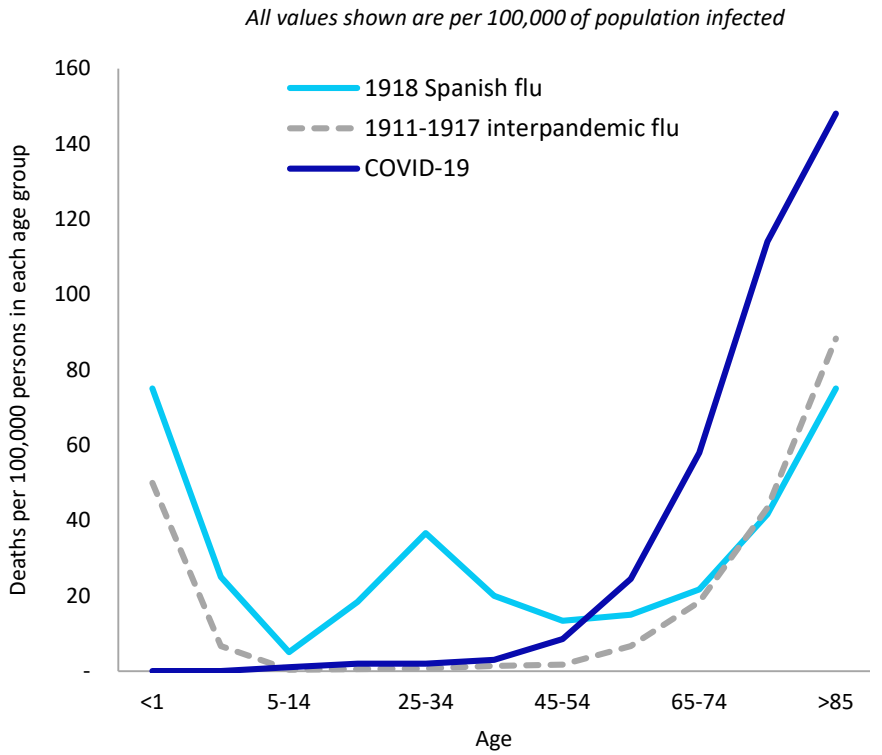
# DEATHS BY AGE

COVID-19 exhibits a different mortality curve than historical pandemics; the chart below shows deaths per 100,000 persons in each age group for the 1918 Flu pandemic, 1911-1917 interpandemic period, and COVID-19




**Commentary**

- Most pandemics follow a "U-shaped" mortality curve where most deaths are due to secondary pneumonia infection in immunocompromised people (mostly young and old)
- The 1918 Spanish Flu was partly so devastating because the mortality rates spiked for young adults likely due to "cytokine storm", resulting in its "W-shape"
- COVID-19 follows an unusual "L-shaped" distribution that disproportionally impacts individuals over 55 years old
- Exposure to COVID-19 needs to be considered in the context of each insurer's inforce block demographics and may not match the overall impact to the general population

Potential COVID-19 mortality impacts should be modeled by age rather than a single additive factor

Source: Taubenberger and Morens 2006, pp. 15-22; China CDC Weekly. Vital Surveillances: The Epidemiological Characteristics of an Outbreak of 2019 Novel Coronavirus Diseases (COVID-19) — China, 2020

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# CASE FATALITY RATE (CFR) BY AGE AND GENDER

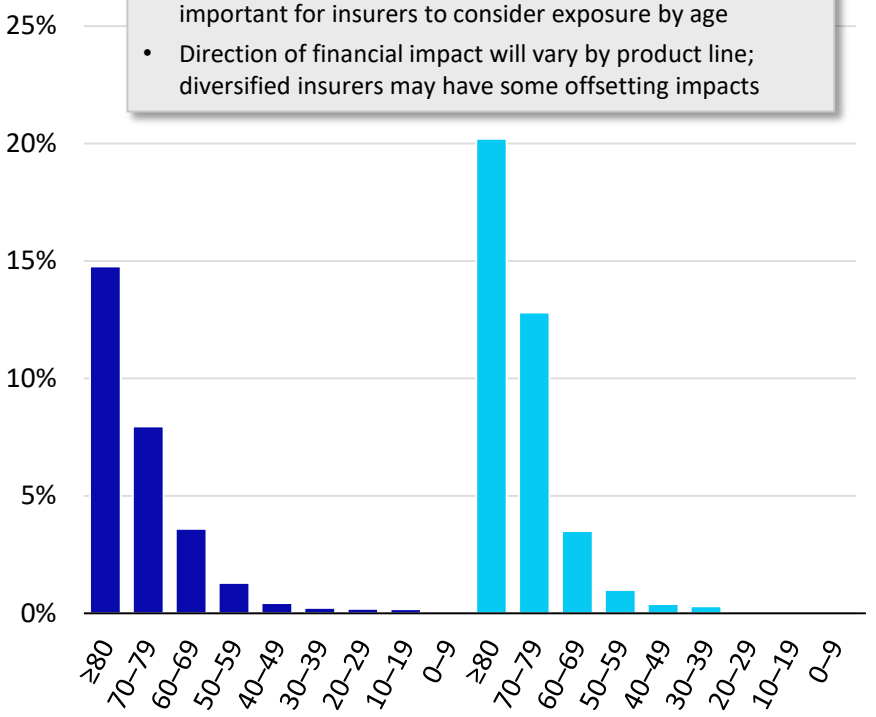
Significantly higher death rates occur among the elderly and males

## Case Fatality Rate by Specific Patient Characteristics

Based on all confirmed cases in China as of February 11, 2020 and Italy as of March 17, 2020

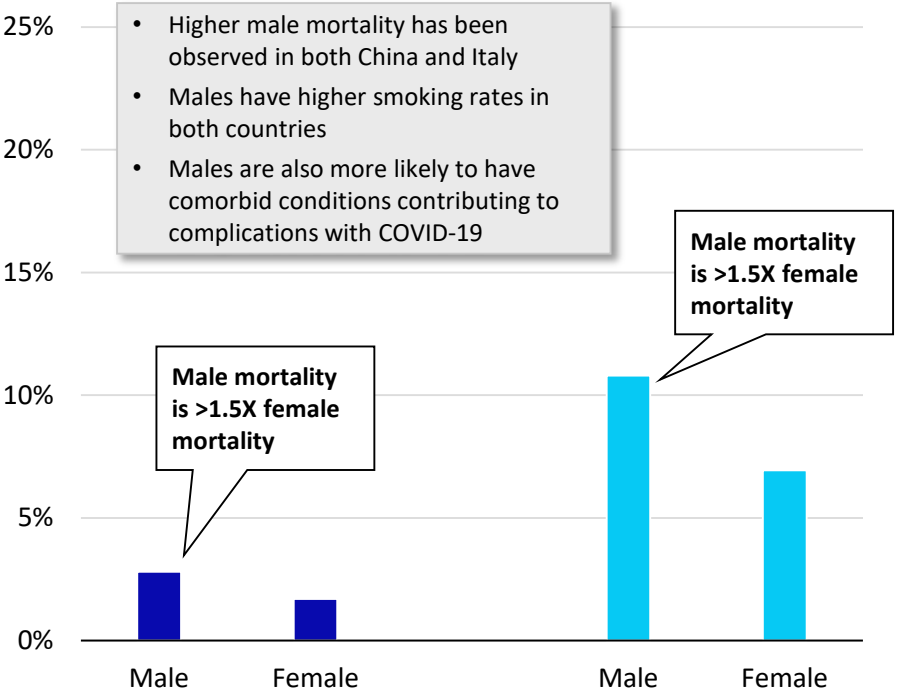
### by Age

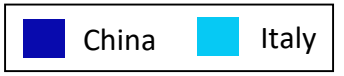
- Higher elderly mortality rates in both China and Italy; thus, important for insurers to consider exposure by age
- Direction of financial impact will vary by product line; diversified insurers may have some offsetting impacts




### by Gender

- Higher male mortality has been observed in both China and Italy
- Males have higher smoking rates in both countries
- Males are also more likely to have comorbid conditions contributing to complications with COVID-19




Source: China CDC Weekly. Vital Surveillances: The Epidemiological Characteristics of an Outbreak of 2019 Novel Coronavirus Diseases (COVID-19) — China, 2020, Case-Fatality Rate and Characteristics of Patients Dying in Relation to COVID-19 in Italy - Graziano Onder, MD, PhD; Giovanni Rezza, MD; Silvio Brusaferro, MD, Italy's National Health Institute (ISS)

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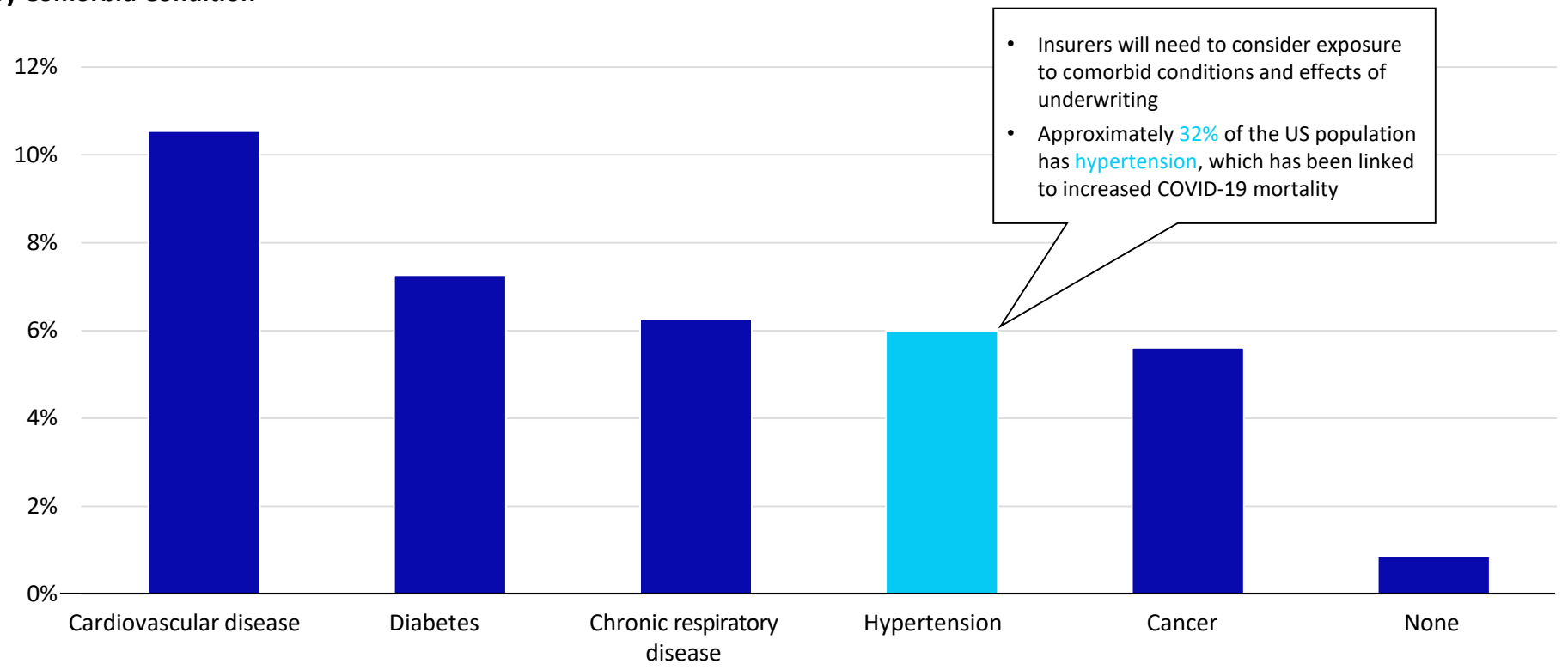
# CASE FATALITY RATE (CFR) BY COMORBIDITY

Significantly higher death rates occur among those with underlying conditions

**Case Fatality Rate by Specific Patient Characteristics**

All confirmed cases in China as of February 11, 2020

**by Comorbid Condition**




Source: China CDC Weekly, Vital Surveillances: The Epidemiological Characteristics of an Outbreak of 2019 Novel Coronavirus Diseases (COVID-19) — China, 2020, American Heart Association
Notes: Data includes 44,672 confirmed cases reported through February 11, 2020, which is the latest data available as of March 29, 2020.

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# KEY ASSUMPTIONS TO DETERMINE RANGE OF PANDEMIC SCENARIOS

Estimating a range of infection and mortality rates is essential to determining the potential impact of COVID-19 given rapidly emerging data and a quickly changing situation

| | Infection rate (% of population with disease) | Mortality rate (% of deaths in infected population) |
|---|---|---|
| **COVID-19** | • Wuhan, China (ground 0) infection rate: ~1%<br>• Quarantine and social distancing measures are being implemented globally<br>• Vaccines are being developed, but not expected to be available on a large scale for a year or more | • Mortality rate expected to be closer to 1% when proper healthcare can be provided<br>• Rate increases significantly when healthcare system is overloaded, as seen in Italy (11.0% rate)<br>• Virus-fighting drugs are in the process of being developed |
| **Other pandemics** | • Annual Flu infection rates range from ~3% to 16%<br>• 1918 Spanish Flu infection rate was ~28% of the US population | • Annual Flu mortality rate range from 0.1% to 0.3%<br>• 1918 Spanish Flu mortality rate was ~2.5% for the US population (higher globally) |
| **Potential assumption ranges (US)** | • Rate of 0.5 – 30% | • Base case: 0.5 – 1%<br>• Stress: 2%+ if healthcare system overloaded |
| **What to monitor** | • Effectiveness of containment measures<br>• When containment measures are lifted, and if subsequent outbreak waves occur<br>• Pharmaceutical treatments | • Stability of healthcare system in “hot spots”<br>• Amount of testing (also impacts reported infection rate) |

Source: United States Department of Health and Human Services, Johns Hopkins University , as of March 29, 2020

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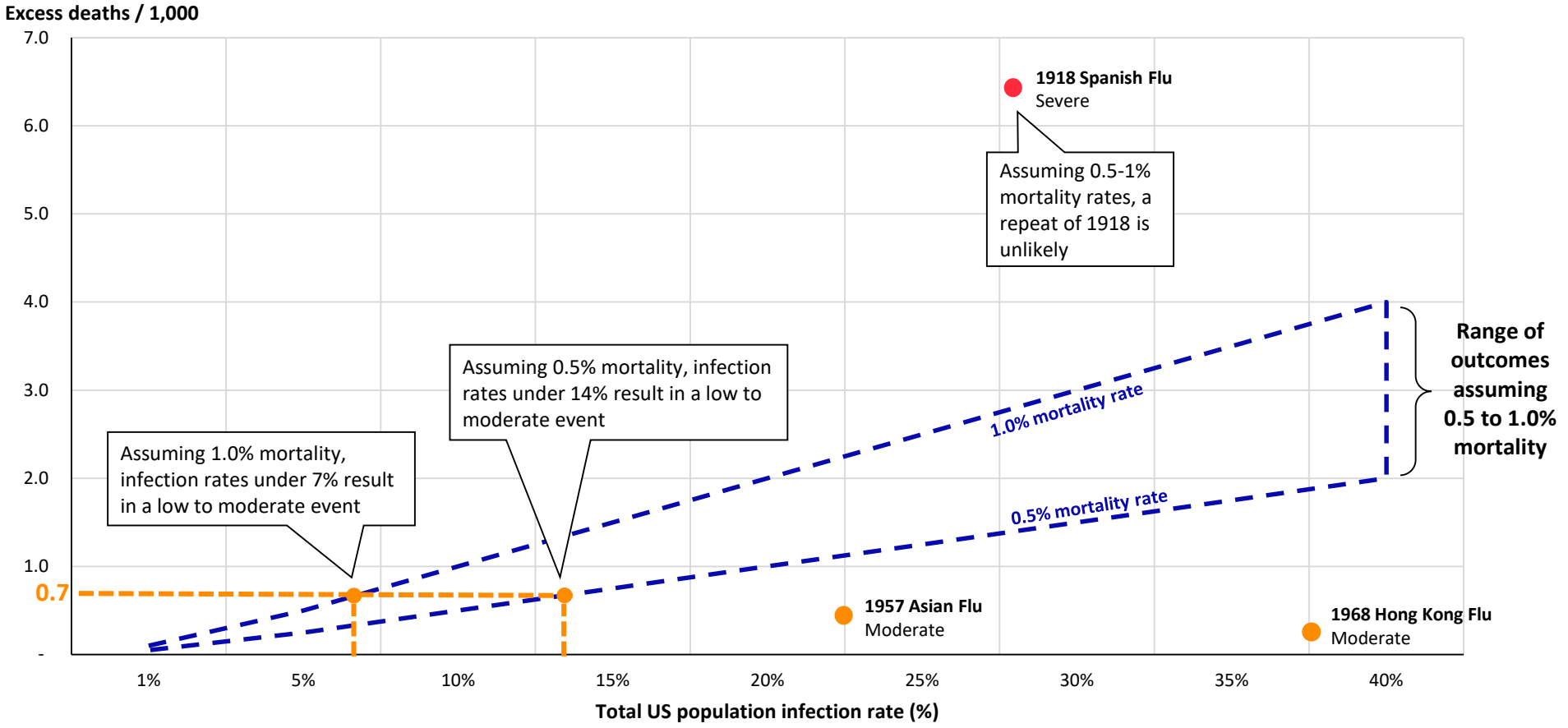
# COVID-19 IS UNLIKELY TO REPEAT 1918 SPANISH FLU SCENARIO; HOWEVER, HIGHLY DEPENDENT ON HEALTHCARE SYSTEM STABILITY

**Additional deaths per 1,000 people**

Range of 1 year shocks in US; moderate pandemic scenario = 0.7 / 1,000 additional deaths in one year

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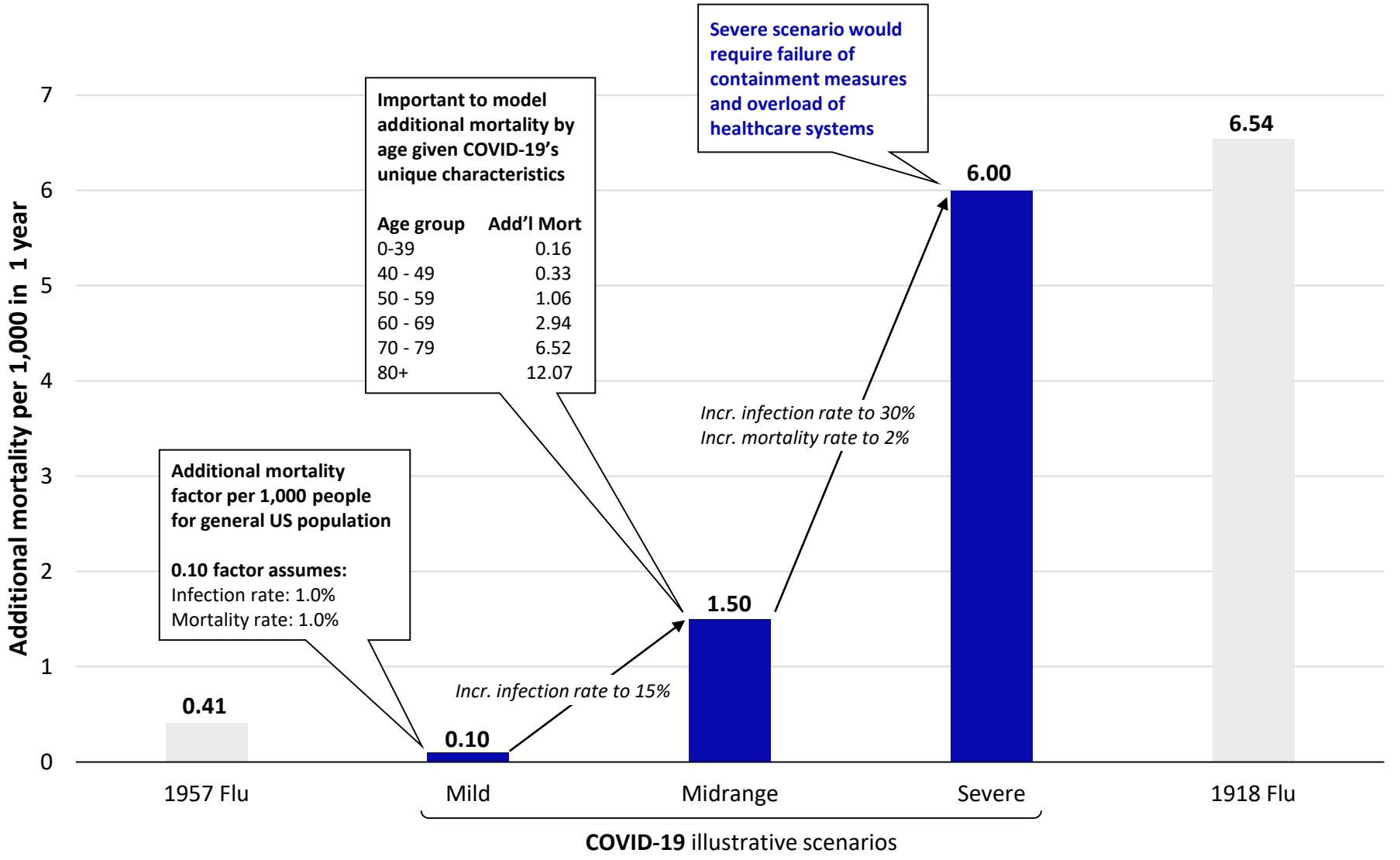
# COVID-19 ILLUSTRATIVE MORTALITY SCENARIOS

Insurers can begin to understand the range of potential outcomes by applying additional deaths in their models; a given scenario may be framed using different combinations of underlying assumptions

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# OUR SCENARIO FORECAST GENERATOR HELPS TO QUANTIFY NEAR TERM SCENARIOS

The model paints the picture of the "book-end" scenarios – and a range of trajectories in between – up to 8 weeks out and is now incorporated into our hospital supply and demand model

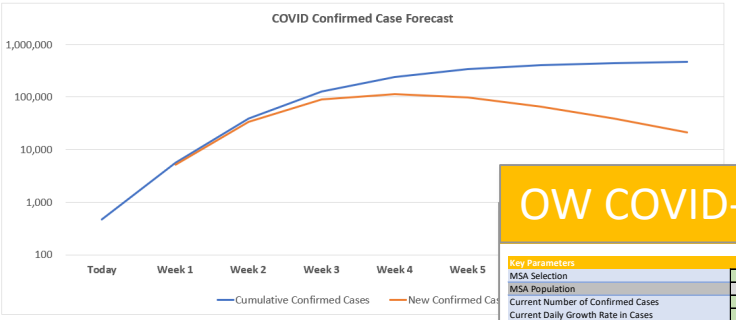
## OW COVID-19 Scenario Generator

**Modeling Assumptions**

| | | |
|---|---|---|
| Current Number of Confimed Cases | 476 | *Current number of Confirmed Cases for forecast region* |
| Delay Until Containment Effort Starts (days) | 7 | *Estimated days until increased containment measures are implemented* |
| Expected Effectiveness of Containment Effort | Medium | *Expected levels of containment measures (testing, social distancing, quarantines)* |
| Current Daily Growth Rate in Cases | 50% | *s is ideally calculated as: (Confirmed Cases(day)/Confirmed Cases(prior day)) - 1. If data are not available, see* |

**Scenario Output**

| Case Type | Today | Week 1 | Week 2 | Week 3 | Week 4 | Week 5 | Week 6 | Week 7 | Week 8 |
|---|---|---|---|---|---|---|---|---|---|
| Cumulative Confirmed Cases | 476 | 5,698 | 39,479 | 128,744 | 243,284 | 340,545 | 406,033 | 444,917 | 466,518 |
| New Confirmed Cases | | 5,222 | 33,782 | 89,264 | 114,540 | 97,261 | 65,488 | 38,884 | 21,601 |




Oliver Wyman created a model to forecast the number of confirmed cases in a region or area based on the starting number of cases, daily case growth rates, the speed with which officials move to enact containment measures, and the effectiveness of those measures.

The model has been applied to forecast scenarios for hospital capacity in US geographies.

Link to the model can be found at https://oliverwymangroup.wufoo.com/forms/s12hwj5h0qqcxx1/

## OW COVID-19 US Hospital Supply / Demand Model

**Key Parameters**

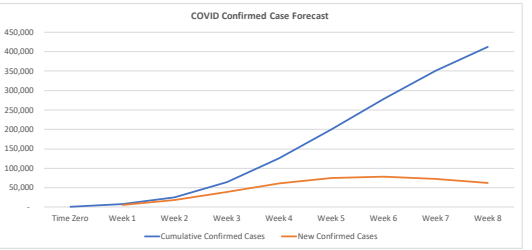
| | | |
|---|---|---|
| MSA Selection | IL - Chicago | *For custom market definition, select "Custom Market" and adjust Counties to include / exclude in Column G in "County Summary" tab* |
| MSA Population | 9,679,808 | |
| Current Number of Confirmed Cases | 1,500 | *Current number of Confirmed Cases for forecast region* |
| Current Daily Growth Rate in Cases | 30% | *This is ideally calculated as: (Confirmed Cases(day)/Confirmed Cases(prior day)) - 1. If data are not available, see guiding logic on the right* |
| Delay Until Containment Effort Starts (days) | 7 | *Estimated days until increased containment measures are implemented* |
| Expected Effectiveness of Containment Effort | Low | *See text box to the right for further explanation. Recent trends for most markets in the US, as well as most democratic countries abroad, follows the Low containment growth path* |
| Include Children Hospital Bed Capacity? | No | |

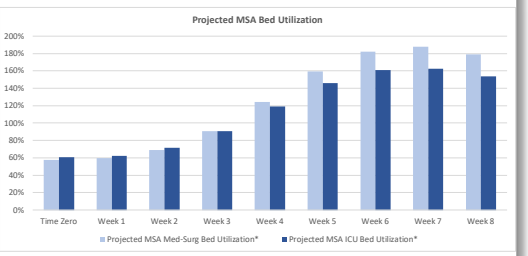
**Baseline MSA Capacity & Utilization**

| | User Input | | Default Values | | |
|---|---|---|---|---|---|
| | Med-Surg Beds | ICU Beds | Med-Surg Beds | ICU Beds | |
| Average Free Beds | 7,141 | 970 | 7,141 | 970 | |
| Average Occupied Beds | 9,759 | 1,500 | 9,759 | 1,500 | *Occupied beds and average utilization is estimated for steady state (pre-COVID-19)* |
| Total Beds | 16,900 | 2,470 | 16,900 | 2,470 | |
| Average Utilization Rate | *58%* | *61%* | *58%* | *61%* | |

**Note: You must input both Avg. Occupied Beds and Total Beds to override Default Values**

**Scenario Output Graphs**

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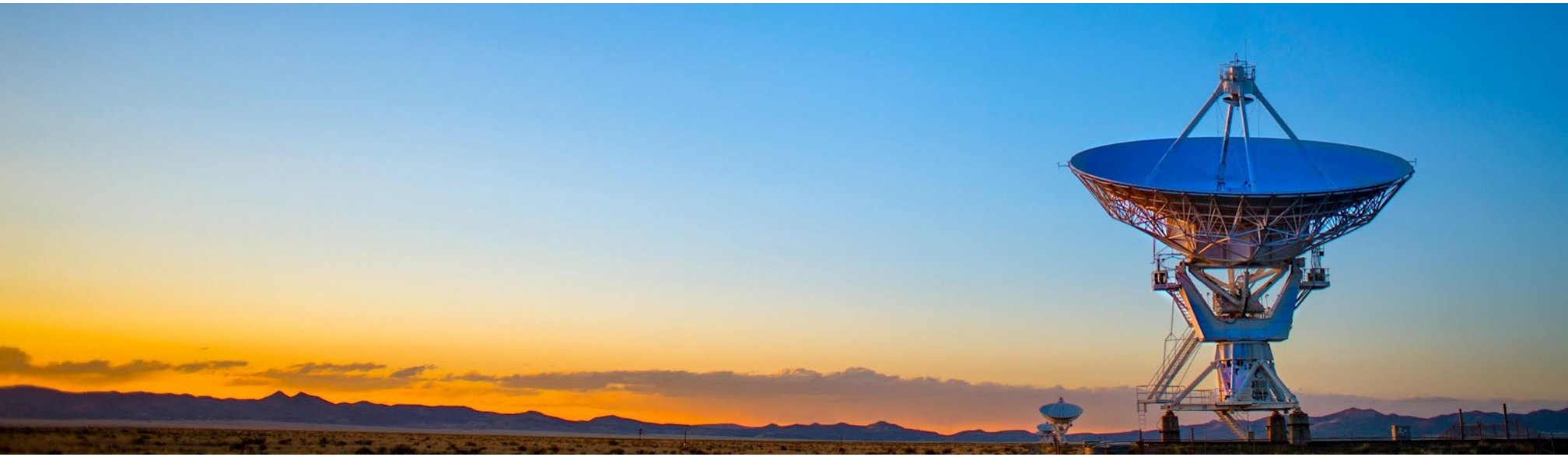
# READ OUR LATEST INSIGHTS ABOUT COVID-19 AND ITS GLOBAL IMPACT ONLINE

Oliver Wyman and our parent company Marsh & McLennan (MMC) have been monitoring the latest events and are putting forth our perspectives to support our clients and the industries they serve around the world. Our dedicated COVID-19 digital destination will be updated daily as the situation evolves.

Visit our dedicated COVID-19 website



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