

RESPONDING TO COVID-19

Primer, Scenarios, and Implications

March 25, 2020 UPDATE

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EPIDEMIOLOGIC PERSPECTIVES

INTRODUCTION: COVID-19 PRIMER

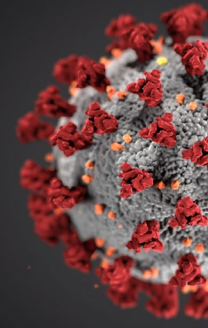
Context and purpose



The novel coronavirus has infected **hundreds of thousands of people globally and is taking a severe toll on individuals, families, and economies** as productivity drops and stock markets reflect increased global uncertainty

This document provides some **baseline facts and guidance for business leaders as to critical questions to address in the immediate and near-term** to ensure the continuity of their business and the safety, health, and wellbeing of their workforce and customers

What is it?



COVID-19 is the name for the illness caused by the novel coronavirus that originated in Wuhan, China in December 2019

It is from the **same family of viruses that cause some common colds**, as well as Severe Acute Respiratory Syndrome (**SARS**) and Middle East Respiratory Syndrome (**MERS**)

It is considered **similar to other respiratory infections such as influenzas**; symptoms range from fever, cough, shortness of breath to more severe cases of pneumonia and organ failure

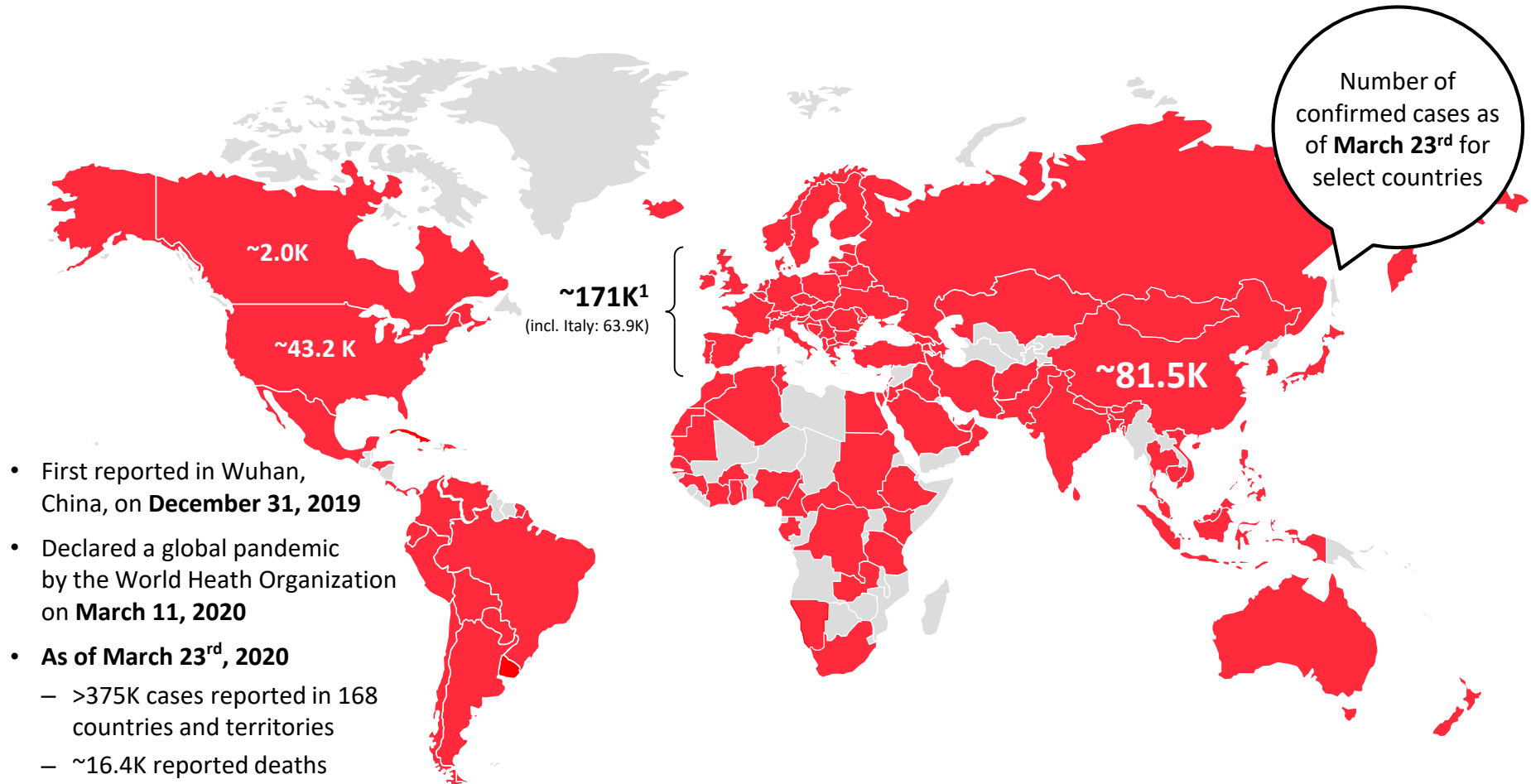
CURRENT UNDERSTANDING OF COVID-19 FACTS

Current pace of spread and understanding of the disease suggest that we must aggressive action

	Key facts	Implications
Contagion	<ul style="list-style-type: none"> 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 others³; R0 for the seasonal flu is around 1.3⁴ 	COVID-19 is twice as contagious as the seasonal flu
Current human immunity	<ul style="list-style-type: none"> No herd immunity exists yet as the virus is novel in humans 	Social distancing (quarantines, WFH, school closures) is the only “brake” to slow the spread
Incubation period	<ul style="list-style-type: none"> The infectious period is a median of 5.5 days (up to 14 days)^{1, 10}, while the annual flu is commonly a 3-day period¹; data suggests that viral shedding continues beyond symptom resolution⁶ 	People are contagious for longer periods than the flu or other illnesses, requiring longer bouts of quarantine to truly suppress spread
Fatality	<ul style="list-style-type: none"> Case fatality rates are trending at 4.9% globally⁸ (vs. 0.1% for the flu)⁹ 	Fatality is orders of magnitude higher than typical influenzas
Portion of cases asymptomatic but contagious	<ul style="list-style-type: none"> COVID-19 can be spread asymptotically⁵ Diamond Princess testing estimated asymptomatic rate of 17.9%²; emerging sources in Asia suggest rates potentially higher rates 	People who feel “fine” are capable of – and are -- transmitting COVID-19 to others
Portion of cases reaching “critical” / “severe” infection	<ul style="list-style-type: none"> Approximately 19% of confirmed cases are considered “severe” or “critical”, requiring hospitalization, and 1/4th of those need ICU beds⁷ 	Hospital systems risk being overtaxed (ICU beds, ventilators, PPE) meaning case fatality rates could rise further

1. CDC. 2. Eurosurveillance Paper ([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. JAMA. “Presumed Asymptomatic Carrier Transmission of COVID-19” 6. MedRxiv. “Clinical presentation and virological assessment of hospitalized cases of coronavirus disease 2019 in a travel-associated transmission cluster”. Mar 8. 2020. 7. China CDC, JAMA ([link](#)). 8. JHU. 9. CDC. 10. Annals of Internal Medicine ([link](#))

COVID-19 SPREAD GLOBALLY



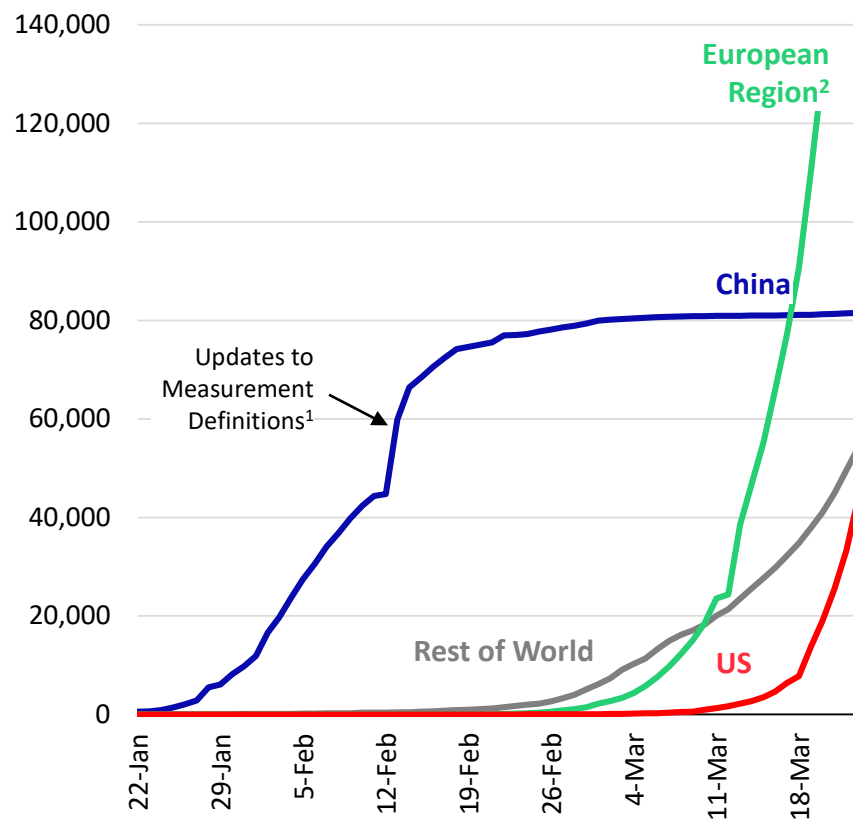
1. Countries included: All Countries in "European Region" Sub-region in WHO Situation Report
 Source: Map from CDC ([link](#)), Numbers from John Hopkins University & Medicine ([link](#))

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

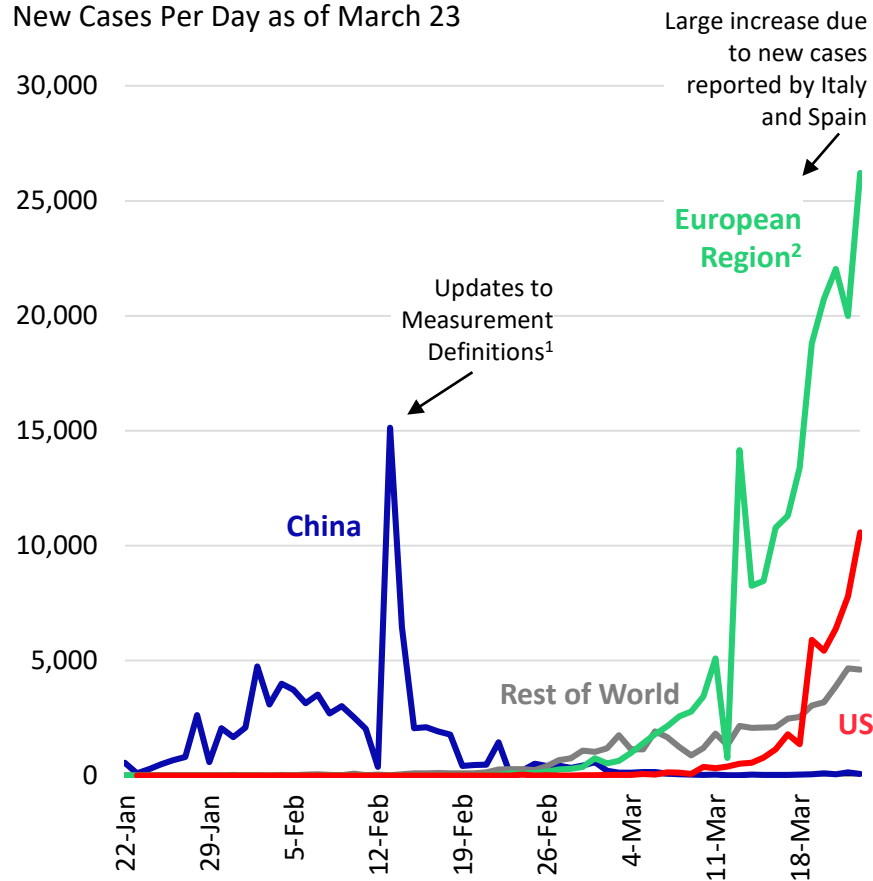
Confirmed Cases of COVID-19

Cumulative Number of Cases as of March 23



New Cases Per Day of COVID-19

New Cases Per Day as of March 23



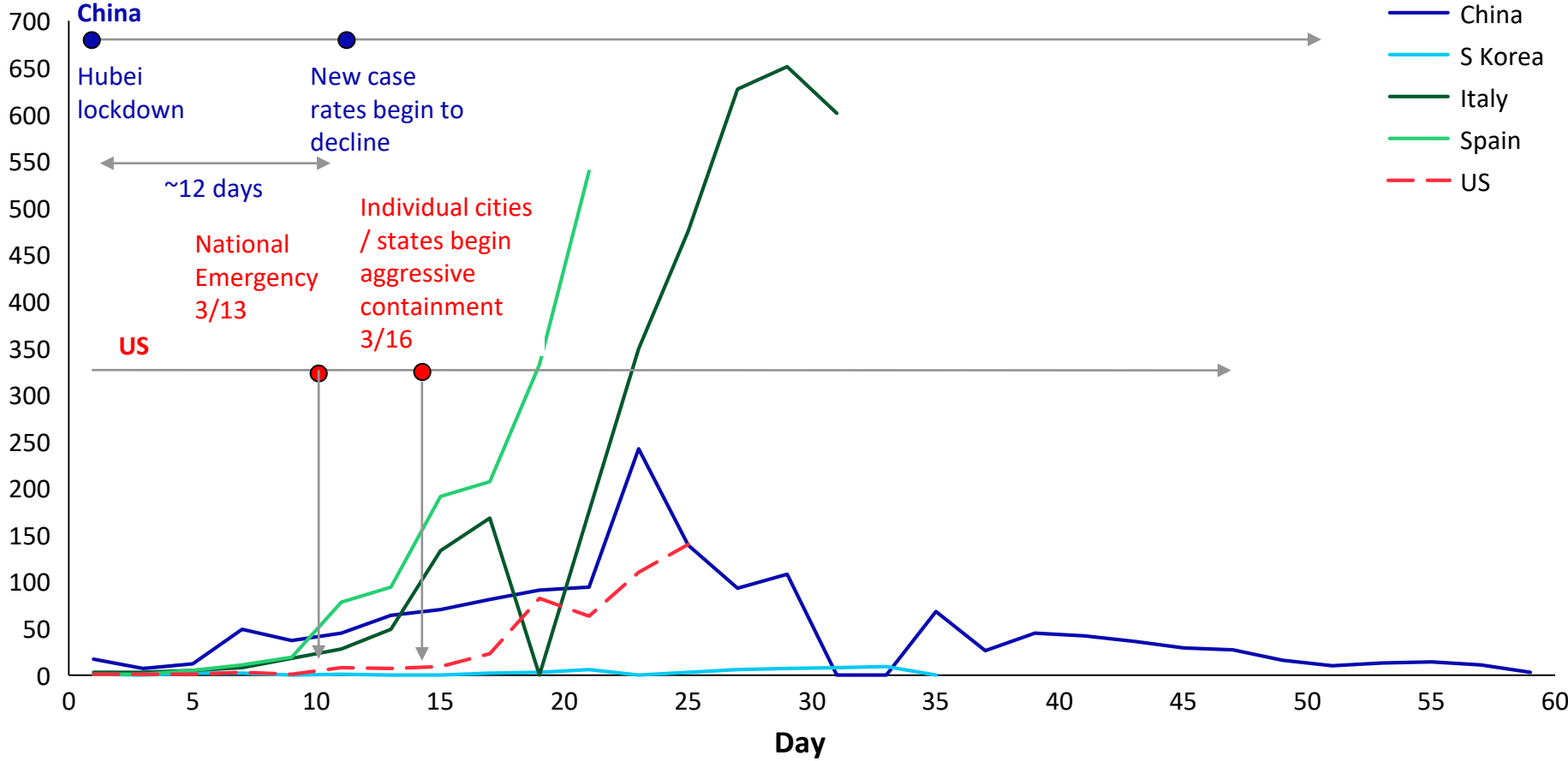
Source: John Hopkins University & Medicine Coronavirus Resource Centre

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

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



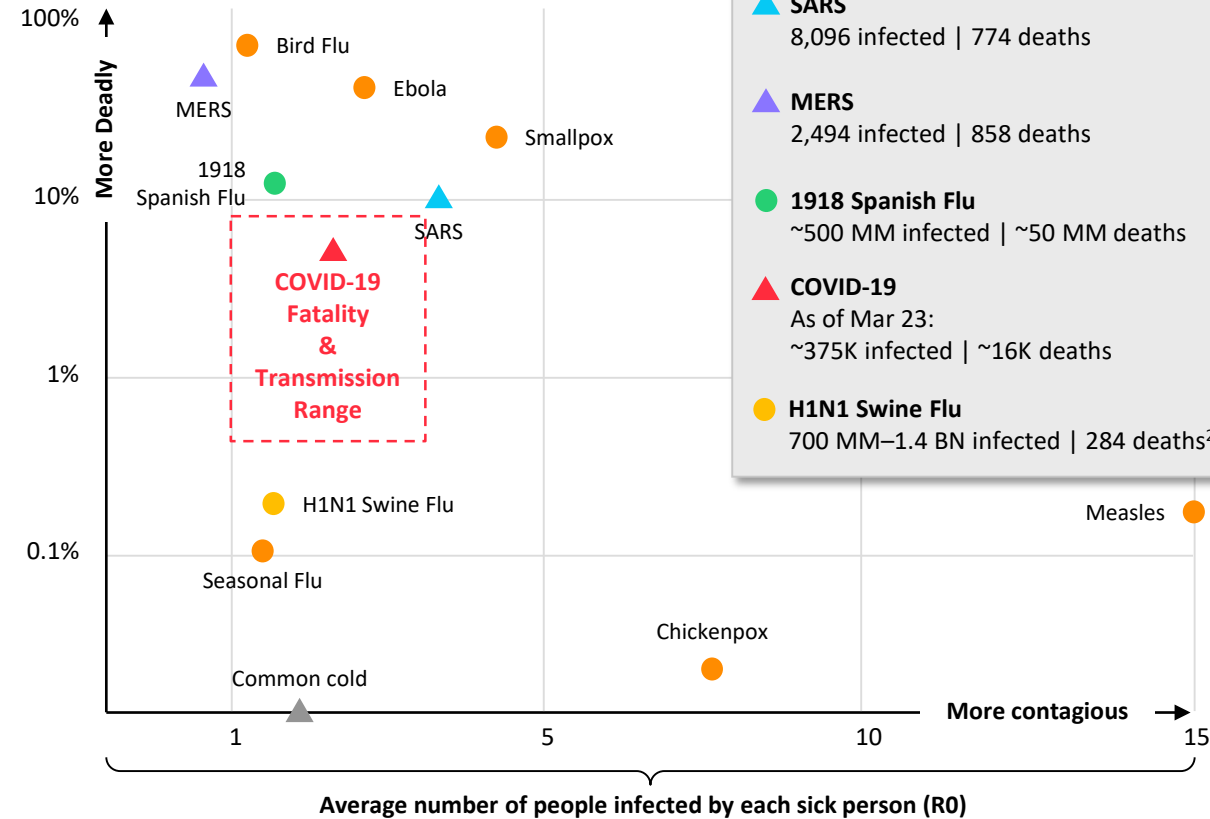
Day 0 is the day each country reached 100 cases. Day 0 for China – 1/22/2020 based on data availability

Source: John Hopkins University & Medicine Coronavirus Resource Centre, as of 03/23/2020
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HOW DOES COVID-19 COMPARE TO OTHER DISEASE OUTBREAKS? (1 OF 2)

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

Fatality rate¹
Log scale



Additional details

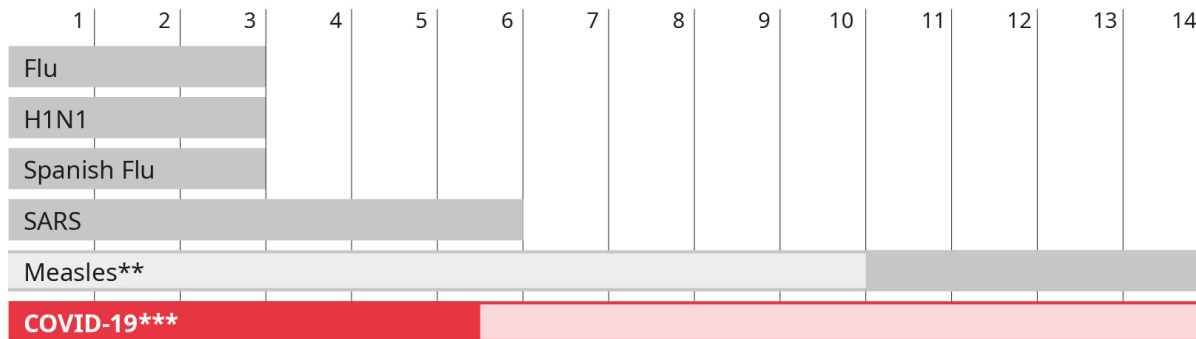
- R-naught (R0) represents the number of cases an infected person will cause. R0 for COVID-19 is currently estimated at between 2 and 3 (with edge of range estimates closer to 1.4 and 3.6), which means each person infects 2-3 others³; R0 for the seasonal flu is around 1.3⁴
- The global case fatality rate for confirmed COVID-19 cases is currently 4.9%⁵ according to WHO's reported statistics versus 0.1% for the seasonal flu; the rate varies significantly by country (e.g., Italy – 10.28%, South Korea – 1.24%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 as of 03/23/2020

HOW DOES COVID-19 COMPARE TO OTHER DISEASE OUTBREAKS? (2 OF 2)

The infectious cycle of COVID-19 is unlike that of any other outbreak we have seen before

Incubation Timeline (Days)*, 1



*All but SARS have the potential for asymptomatic transmission

**Symptoms most commonly appear on Days 10-14

***The median incubation period for COVID-19 is 5.5 days, but symptoms can develop as late as 14 days post exposure

Why does this matter?

- The combination of a longer incubation period with asymptomatic transmission means that there is a longer window of time during which infected individuals are unaware that they are contagious

Why is quarantine 14 days?

- While the median incubation period is 5.5 days, symptoms have been documented to occur over a longer time frame; 14 days should capture 99% of all cases²

What do we still not know?

- We still do not accurately understand the full infectious period for COVID-19

What we know about the infectious cycle?

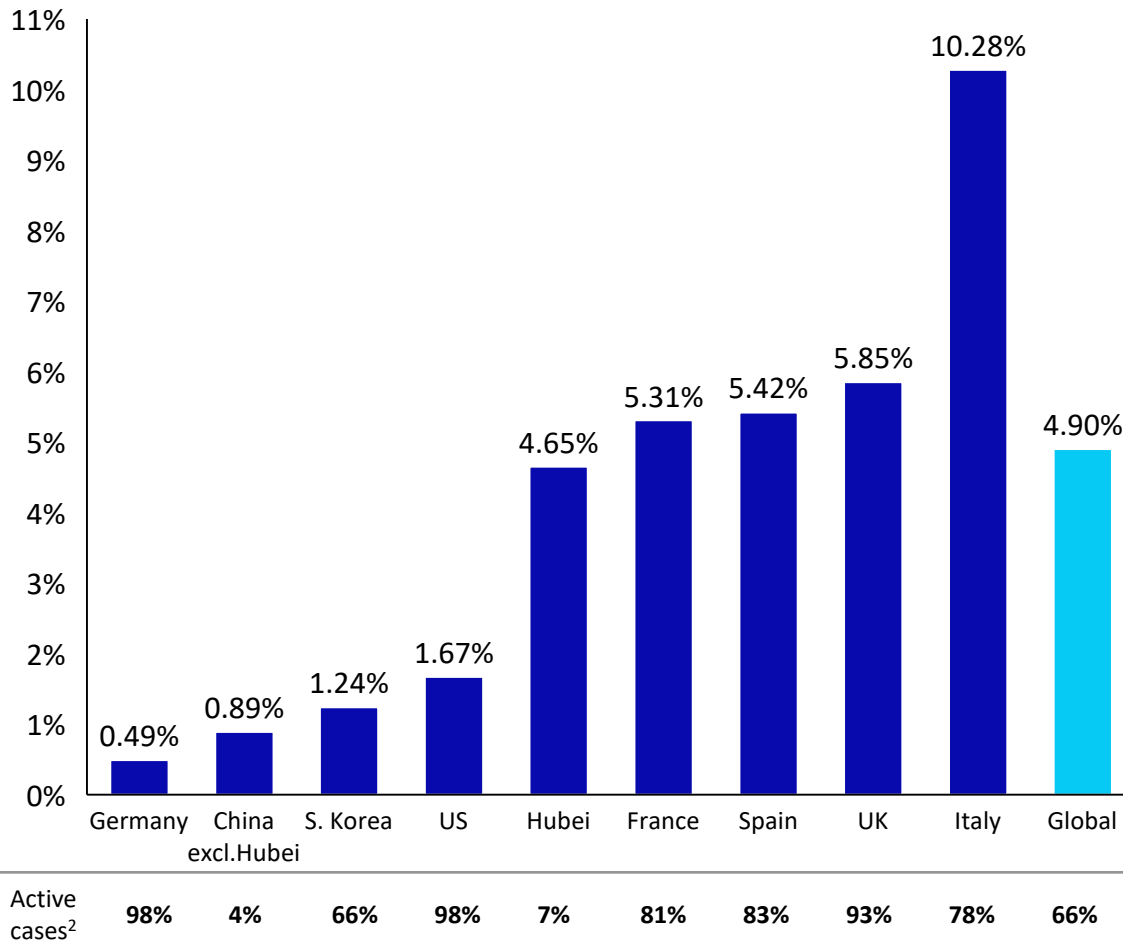
- Multiple sources confirm asymptomatic transmission, but the exact timing of when an exposed individual becomes contagious is not known^{3, 4, 5}
- Viral loads build rapidly and continue to shed until 6-12 days after symptoms have cleared⁶

1. CDC 2. Annals of Internal Medicine ([link](#)) 3. JAMA ([link](#)) 4. NEJM ([link](#)) 5. Science ([link](#)) 6. medRxiv ([link](#))

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 country¹



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 (see next page); 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

1. Calculated as Number of Deaths / Total Confirmed Cases as reported by Johns Hopkins University as of 3/21/2020. 2. Calculated as Number of Active Cases / Total Confirmed Cases as reported by Johns Hopkins University as of 3/23/2020.

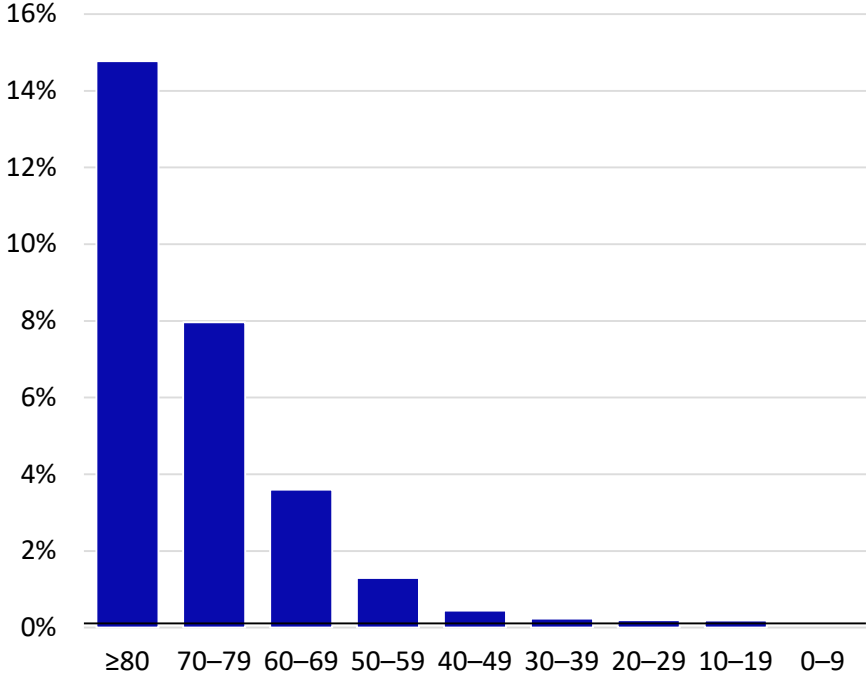
CASE FATALITY RATE (CFR) BY PATIENT CHARACTERISTIC

Significantly higher death rates occur among the elderly and those with underlying conditions

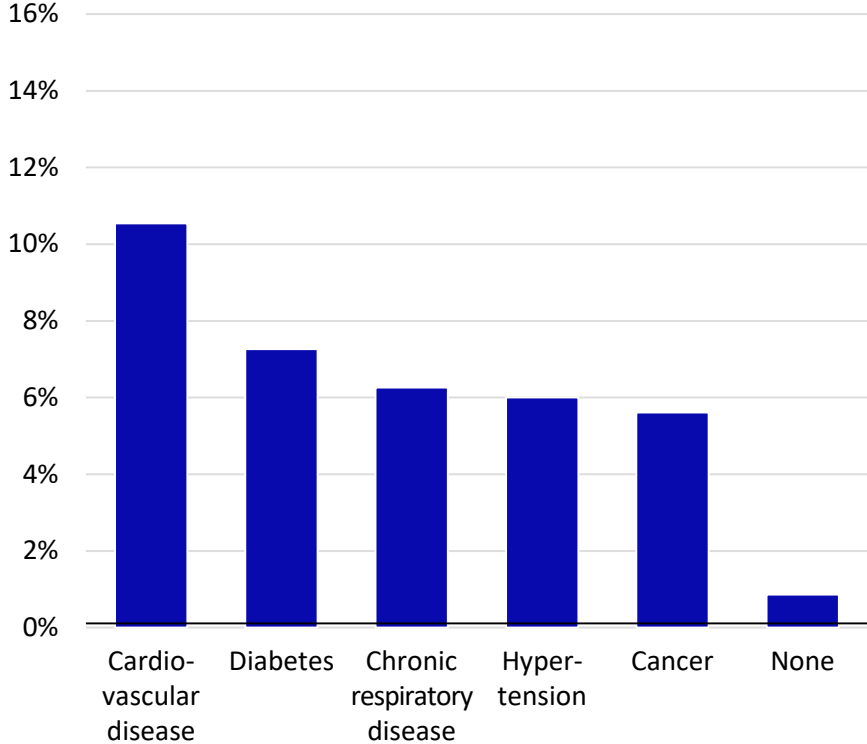
Case Fatality Rate by Specific Patient Characteristics

All confirmed cases in China as of February 11, 2020

by Age



by Comorbid Condition



Source: China CDC Weekly. Vital Surveillances: The Epidemiological Characteristics of an Outbreak of 2019 Novel Coronavirus Diseases (COVID-19) — China, 2020.

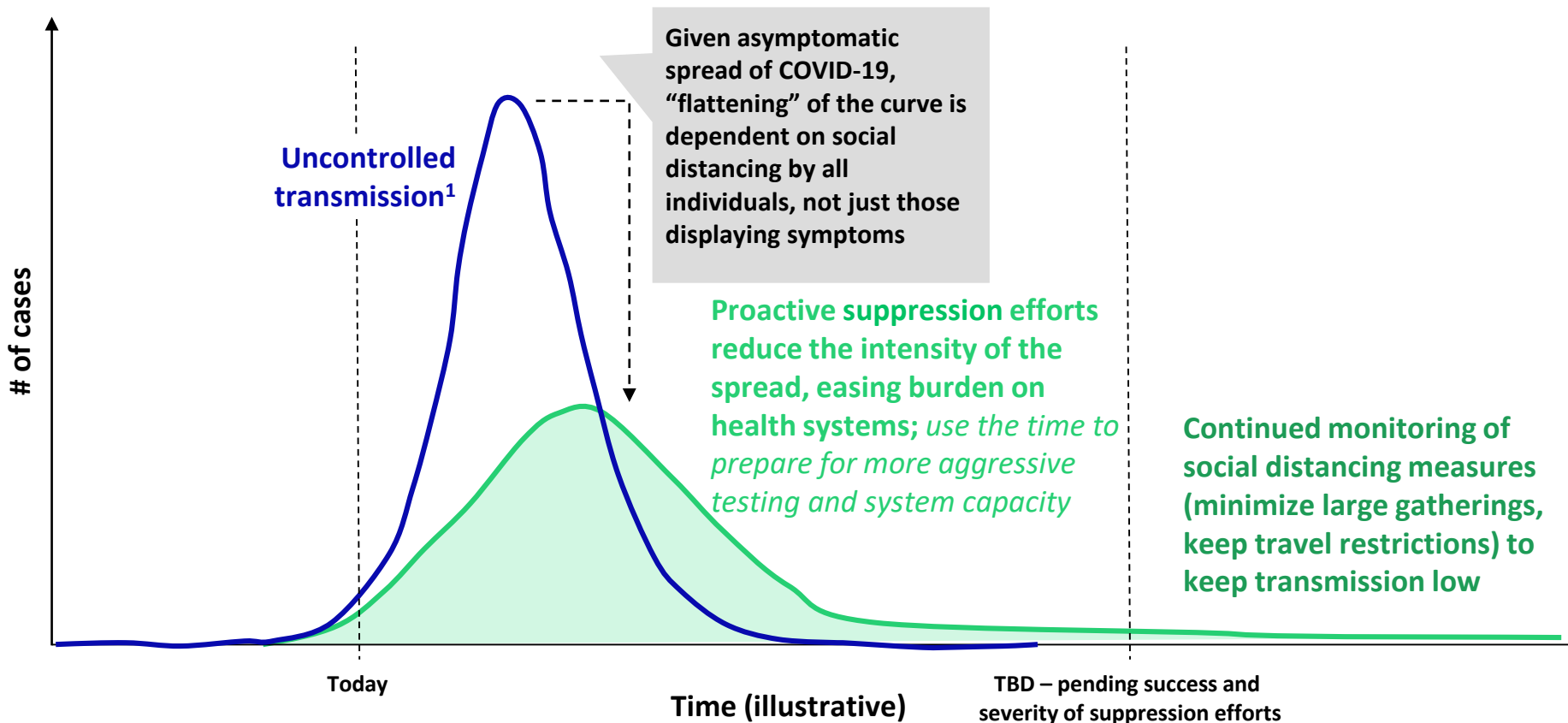
Notes: Data includes 44,672 confirmed cases reported through February 11, 2020, which is the latest data available as of 3/23/20.

HOW CAN MITIGATION MEASURES LOWER THE BURDEN OF THE PANDEMIC?

Proactive and swift suppression measures (e.g., lockdowns, social distancing) are critical to control the spread and reduce the overall burden on the healthcare system, as ~15–20% of confirmed cases require hospitalization

Illustrative COVID-19 transmission with and without suppression measures

Timing and width of peaks may vary between countries



1. Assuming case-based isolation only

Source: Adapted from “How will country-based mitigation measures influence the course of the COVID-19 epidemic”. Lancet. Mar 6 2020. [https://doi.org/10.1016/S0140-6736\(20\)30567-5](https://doi.org/10.1016/S0140-6736(20)30567-5). Concepts sourced from Tomas Puyeo.

EARLY OBSERVATIONS ON CONTAINMENT MEASURES

- To arrest the growth of the confirmed cases, we have observed a number of **best practices**:
 - Moving quickly with a seemingly small number of cases to implement **tracing and suppression actions**
 - Deploying **extensive testing across a population to identify cases**, particularly in light of asymptomatic transmission of the virus
 - Implementing **aggressive containment measures** (e.g., closing bars, schools, restaurants, gyms, churches to maintain social distancing, restricting non-essential travel, quarantining all infected patients including asymptomatic ones)
- Experience to date in Europe and the United States points to a much lower level of containment than seen in China
 - Response has been **fragmented**: from “**wait-and-see**” approaches and “**partial**” solutions (i.e., limiting gatherings or travel in a city or region), to **total lockdown** of a country
 - Compliance with recommendations and declarations has been mixed (e.g., beach goes in CA post declaration of lockdown)



OPPORTUNITY FOR PHARMACEUTICAL INTERVENTIONS

While researchers are exploring potential existing therapeutics and new vaccines which could relieve the COVID-19 disease burden, the path is not short as clinical trials and subsequent manufacturing ramp-up will take months

Therapeutics

Vaccines

Description & Status

- **No existing therapeutics are currently FDA approved** to treat COVID-19, though studies and trials are underway to test efficacy of existing drugs for COVID-19
- **Three general classes** of therapeutics which act differently could be tested / approved: **1) Antiviral** – slow virus spreading, **2) Symptom relief**, **3) Immune system enhancement**
- **Front-line physicians are using some therapies off-label**, which are approved for other indications
- Several **clinical trials are underway** with the CDC:
 - **Remdesivir** (antiviral) – Gilead – originally for Ebola, but low efficacy -- highly limited supply
 - **Hydroxychloroquine** (antiviral) – generic – used to treat Malaria -- limited supply

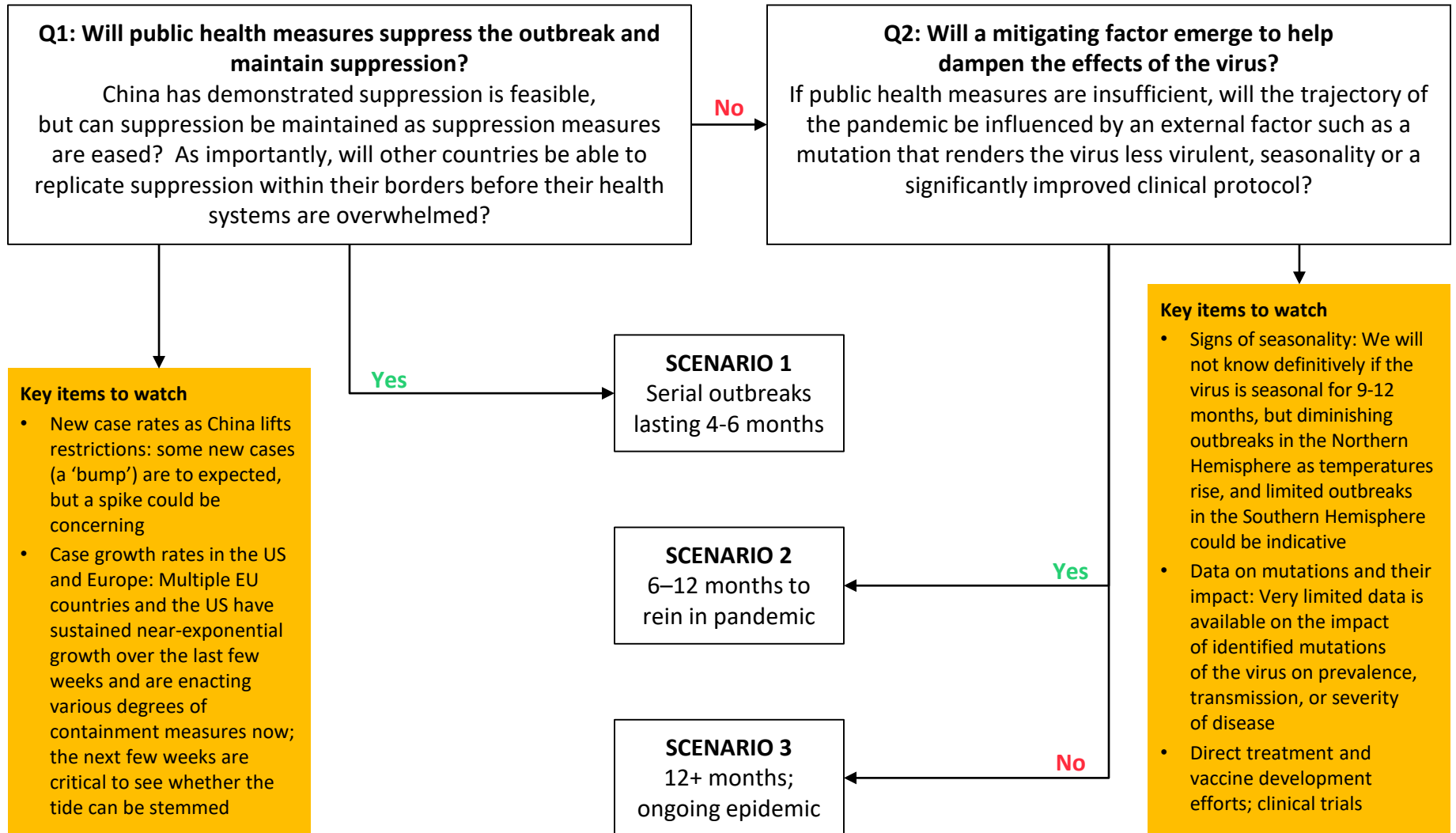
- Several vaccine types could be considered for COVID-19 : **1) traditional protein-based** (longer development, manufacturing timeframe but proven approach), **2) mRNA-based** (quick to design but less proven technology and efficacy, **3) DNA-based** (quick to design but less proven technology)
- At the outset of the pandemic, multiple biotechs have moved to create a COVID-19 vaccine – the first out of the gate are mRNA varieties
 - **Moderna**, a biotech, is the first to have launched clinical testing of an mRNA vaccine in humans on 3/16/20 – but has not yet partnered with a larger, scaled PharmaCo
 - **Pfizer and BioNTech** have partnered to test another mRNA vaccine starting in in late April 2020

Key hurdles

- Even if off-label efficacy was confirmed, **significant manufacturing and distribution capacity would be needed** to ramp up production of existing therapeutics; current global stores insufficient

- **Large-scale manufacturing capacity would be needed** and is not readily available/scalable (GSK Shingrix example demonstrates multi-year lag between vaccine approval and production scale)
- **Timelines to produce required safety and efficacy clinical trial results estimated to take 12-18 months**, even if ‘fast tracked’

HOW LONG COULD THIS LAST? HOW MIGHT THIS PLAY OUT?



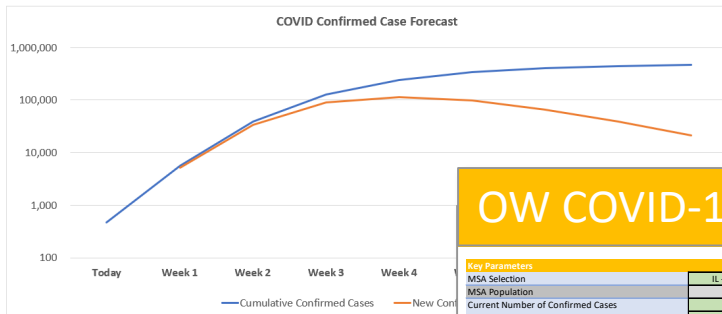
OUR SCENARIO FORECAST GENERATOR HELPS TO QUANTIFY POTENTIAL SCENARIOS

The model paints the picture of the “book-end” scenarios and a range of trajectories in between and is now incorporated into our hospital supply and demand model

OW COVID-19 Scenario Generator

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

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



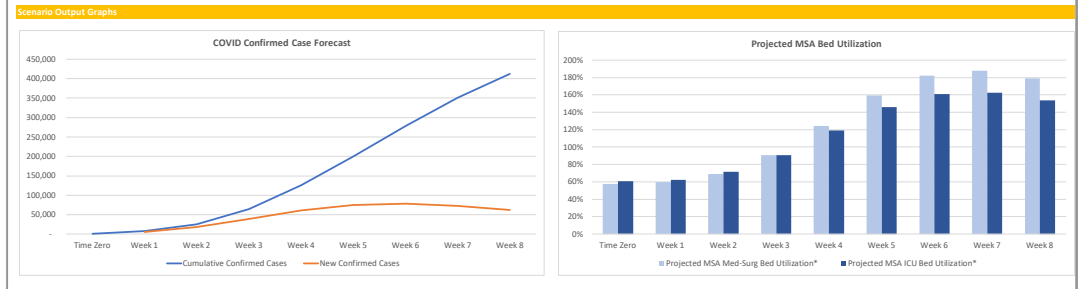
Oliver Wyman created a model to forecast the number of confirmed cases in a region or area based on the starting number of cases, daily case growth rates, the speed with which officials move to enact containment measures, and the effectiveness of those measures. The model has been applied to forecast 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 <small>For custom market definition, select "Custom Market" and adjust Counties to include / exclude in Column G in "County Summary" tab</small>
MSA Population	9,679,808
Current Number of Confirmed Cases	1,500 <small>Current number of Confirmed Cases for forecast region</small>
Current Daily Growth Rate in Cases	30% <small>This is ideally calculated as: (Confirmed Cases(day)/Confirmed Cases(prior day)) - 1. If data are not available, see guiding logic on the right</small>
Delay Until Containment Effort Starts (days)	7 <small>Estimated days until increased containment measures are implemented</small>
Expected Effectiveness of Containment Effort	Low <small>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.</small>
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
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



HOW LONG COULD THIS LAST? HOW MIGHT THIS PLAY OUT?

Scenario 1: Outbreak suppression in 4-6 months

What you'd have to believe

- New case rates spike with initial outbreak in a region and increased testing, but level off within ~8 weeks
- Public health officials enact early and aggressive suppression measures to contain localized outbreaks (e.g., Norway, India, Czech Republic), learning from the “playbook” set by China, Singapore and refined by the next regions to experience outbreak
- Population largely complies with public health directives, slowing human-to-human transmission ($R_0 < 1$); health systems are not overwhelmed, CFR does not rise
- Cases in China do not increase after broad public health measures (e.g., school closures, travel restrictions) are lifted
- China is then able to maintain suppression through testing, contact tracing and selective quarantine (particularly for international travelers)

What we know so far

- Aggressive suppression measures in China (100 MM under quarantine in February 2020, 59 MM remain so as of early March) contained spread within 8 weeks of identification
- New case rates in China have declined; similar compliance would be necessary in rest of world to contain
- China has not yet returned to “normal” (e.g., schools are still closed with staggered re-opening planned for Mar-May, Wuhan scheduled to re-open on April 8)

Anticipated business impacts

- Supply chain shocks in some sectors; Chinese manufacturing shutdown in part tempered by inventories stockpiled in advance of Lunar New Year
- Corporate and government-mandated travel restrictions lead to drop-off in demand in airlines and hotels and impact some retail supply and demand
- Earnings dented for 1-2 quarters post outbreak with gradual recovery and rebounding consumer confidence allowing companies to return to normal 2-3 quarters later
- Small local businesses (e.g., restaurants, gyms, salons) struggle to tread water during suppression measures, some do not reopen
- Central bank intervention and government stimulus implemented
- As international travel restrictions and quarantines are lifted, recovery in travel and hospitality begins

Oliver Wyman COVID-19 Scenario Generator insights

- Containment measures can take a few days to two weeks to demonstrate steady decay in the growth of confirmed cases (flattening of the curve) driven by a lag in case identification and variation in testing breadth
- High levels of containment (suppression) in a country with 100 starting cases and a growth rate of 50% per day, can contain the problem to 10,000 cases over an 8 week period (a ~100X difference compared to delayed, and minimal, containment measures)

HOW LONG COULD THIS LAST? HOW MIGHT THIS PLAY OUT?

Scenario 2: 6–12 months to rein in pandemic

What you'd have to believe

- While some countries move rapidly to replicate aggressive suppression measures, others either do not or are unable to drive compliance
- Countries with slower, less aggressive response and/or poor compliance are not able to suppress the virus with case rates continuing to increase beyond expected 8 week window; in some places overwhelming healthcare systems
- Some countries with initial containment see spike of cases after lifting containment measures
- Insufficient public health measures are offset by an external factor (e.g., viral mutation affecting virulence, early identification and improved treatment, seasonality) that either decreases CFR or helps contain spread

What we know so far

- Multiple other countries have thus far been unable (e.g., lack of resources to rapidly erect hospitals, lack of infrastructure and surveillance capabilities to track and isolate cases) or unwilling to mount the same public health response as China
- Compliance with public health recommendations is more difficult to enforce in many countries (e.g., packed beaches in California post “shelter in place” order)
- Virulence-lowering viral mutations have been observed previously (e.g., SARS) and there is emerging evidence of at least two strains of COVID-19, one less virulent than the other
- While ~50% of coronavirus family have proved to be seasonal, no direct evidence yet indicates COVID-19 is seasonal
- Aggressive testing and documentation of effective treatment protocols has contributed to a dramatically reduced CFR in South Korea (1.24% as of 3/23) compared to that of other regions
- There is a pipeline of pharmaceutical products in various stages of development

Anticipated business impacts

- Employers reluctant to relax travel and WFH mandates without guidance from public health officials
- Vulnerable industries experience a continued drop in demand driven by suppressive measures and shaken consumer confidence; take measures to stabilize balance sheets and ensure liquidity
- Supply chain shocks play out over a six+ month period, after which momentum could begin to stabilize and recover
- Moderate to potentially severe recession in impacted countries; larger, more diversified economies with less dependence on international trade and/or foreign income than other economies prove better able to weather slowing growth
- Significant central bank intervention and government support programs (e.g., extended unemployment insurance, credit support for SMEs) are implemented
- Some governments may choose to remove suppression measures to resuscitate economy, leading to restart of once dormant economic sectors, but re-emergence of COVID cases suggests more suppression measures may be needed

HOW LONG COULD THIS LAST? HOW MIGHT THIS PLAY OUT?

Scenario 3: 12+ months; ongoing pandemic

What you'd have to believe

- Virus proves to either not be seasonal, or seasonal and endemic (rising, falling and returning seasonally by Hemisphere)
- Regions are unable or unwilling for economic reasons to contain outbreaks; virus spreads widely, affecting ~20–60%¹ of adult population in next 2 years
- Mortality rates do not decline, placing significant strain on or overwhelming health systems and further increasing fatality rates for other clinical conditions
- Vaccine or immunity after natural infection is required to halt progress of disease

What we know so far

- Insufficient data to support scenario as of yet
- Multiple vaccines under development but at least 1 year out
- Unless “spike” of cases in a region can be smoothed over a longer period of time, health systems become overtaxed and cannot adequately meet all patients’ needs (e.g., Wuhan, Italy)
- As health systems become overwhelmed, transmission and case fatality increases

Anticipated business impacts

- Severe recession on the order of Global Financial Crisis in 2020, possibly into 2021
- Dramatic drop in demand (consumer confidence, access to supply, part-time/gig economy workers with less discretionary income) results in severe contraction in Q2 and Q3 with uncertain recovery in Q4
- Companies in particularly vulnerable industries (travel, energy, hospitality) require additional liquidity, and may trigger complications for related industries
- Massive central bank intervention plus government stimulus injected to protect vulnerable workers and businesses on a scale exceeding TARP
- Some governments may choose to remove suppression measures to resuscitate economy, leading to restart of once dormant economic sectors, but re-emergence of COVID cases suggests more suppression measures may be needed

Oliver Wyman COVID-19 Scenario Generator insights

- If daily growth rate is 50%, a totally passive approach to managing the outbreak leads to a growth trajectory just shy of a truly exponential curve
- 100 cases become almost 1,000,000 over an 8-week period

WHAT SHOULD COMPANIES BE THINKING ABOUT RIGHT NOW?



Confirm Business Resiliency

All companies should be implementing business continuity plans to reassure employees and ensure readiness for **supply chain constraints, demand shocks, and impacts to business partners**, prioritizing critical business activities and creating contingency plans for disruption



Model Financial scenarios

Companies should be **evaluating their financial outlook, modelling supply and demand** across a number of scenarios, identifying potential interventions and contingency plans for subsequent impacts and/or sustained challenges (e.g. *strategies for managing variable costs, cash flow, liquidity*)



Reassure Customers

Consumer concerns need to be understood, mapped, and incorporated into the business continuity plan such that consumer needs are addressed and trust is maintained



Move to Digitization Rapidly

Some industries are likely to see a **massive acceleration in the use of digital channels**. Retail, Financial Services, and Healthcare companies have experienced 100–900% growth in key digital channels in China during the outbreak. Customers with positive digital experiences are unlikely to return to analog channels



Prepare for Long Haul

Pandemic business continuity plans will get companies through the next 2–4 weeks, but strategies may be required to get through 6–12 months (or more) of disruption if subsequent demand shocks exist. Companies should consider the nature and required timing associated with more structural changes to their operations



Convene Industry

Companies should consider which industry and government collaborations are necessary to address safety concerns, share best practices, stimulate demand, and rebuild consumer trust

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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