RESPONDING TO COVID-19

Almanac Highlights

For complete Almanac, please contact COVID19info@oliverwyman.com

September 17, 2020 update
INTRODUCTION: COVID-19 ALMANAC

Context and purpose

The **novel coronavirus** has infected millions 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.
# Our Detailed Almanac Contains the Latest Perspectives on Key Areas Related to the COVID-19 Pandemic

## Key Topics

<table>
<thead>
<tr>
<th>Key Topics</th>
<th>Summary</th>
</tr>
</thead>
</table>
| **Epidemiologic perspectives**  
Sample pages: 4-6 | • Epidemiological background  
• Up-to-date statistics by geography  
• Coronavirus, declared a pandemic in March 2020, has infected millions globally  
• The virus displays unique and deadlier characteristics than other known diseases  
• The pace and maturity of infection is highly variable by region, largely hinging on speed and strength of government response |
| **First peak suppression and on-going management**  
Sample pages: 7-11 | • Current state of suppression by geography  
• Requirements for reopening and on-going management  
• Many countries have effectively suppressed the first peak through a range of measures, but reopening and recovery is just beginning  
• Key considerations for reopening and management of the virus – public health, economy, and school reopening |
| **Global reopening & management**  
Sample pages: 12-14 | • Global lessons learned  
• Tracking of future risk across the globe  
• As countries re-open, we are crystalizing best practices and assessing regions with greatest risk of further disruption |
| **US reopening & management**  
Sample pages: 15-17 | • US opening approach and initial learnings  
• Risk of future disruptions  
• Best practices and common themes have emerged from the US reopening  
• The United States is seeing rapid case growth across the country, jeopardizing existing levels of economic openness, though some states appear to be leveling off for a variety of reasons |
| **Testing & diagnostics**  
Sample pages: 18-19 | • Current landscape of available tests  
• Emerging tech profiles & development news  
• The current testing landscape is extremely fragmented, with hundreds of available tests and multiple different methodologies with different sample types and collection/analysis procedures  
• Some emerging tech promises to address a need for low-cost testing at scale |
| **Oliver Wyman Pandemic Navigator**  
Sample pages: 20-24 | • Overview  
• Example capabilities  
• Web-based version to explore  
• Oliver Wyman has developed a unique time-dependent SIR model to forecast the spread of the virus at the state and county level called the Pandemic Navigator Core Model  
• Along with a number of methodologies and tools, Pandemic Navigator provides business leaders and policymakers with the data needed to make informed decisions through the crisis  
• A sample of the Pandemic Navigator is freely available online |
| **Vaccines and therapeutics**  
Sample pages: 25-26 | • Therapeutics in development  
• Vaccine development timeline and current state  
• Key considerations and unknowns  
• Effective therapies and an eventual vaccine will be critical to bring economies and communities fully “back to normal” - further testing and development is to come  
• Constantly evolving understanding of the disease and limited understanding of the immune response to it propagates uncertainty around how and when the pandemic will resolve |
| **Macroeconomic outlook**  
Sample pages: 27-28 | • Most recent forecasts of US and global GDP and US unemployment  
• Latest GDP forecasts predict a severe shock to the US economy, mirrored by unemployment levels  
• Return to pre-COVID levels is anticipated early 2022 |
COVID-19 TRENDS AND SPREAD OF THE DISEASE
Cumulative confirmed cases continue to rise across the world; the epicenter has shifted to Asia and the Americas, but Europe is beginning to experience a minor resurgence

Cumulative Confirmed Cases of COVID-19

New Cases Per Day of COVID-19
Past 3 Mo, 7 Day Moving Average

Source: John Hopkins University & Medicine Coronavirus Resource Centre
1. Includes countries categorized under “European region” based off of latest WHO Situation Reports

Information as of 9/15/20
HOW DOES COVID-19 COMPARE TO OTHER DISEASE OUTBREAKS?

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

Case Fatality Rate\(^1\)

Log scale

100%

10%

1%

0.1%

Bird Flu

MERS

Ebola

Smallpox

1918 Spanish Flu

SARS

Case Fatality Rate & Transmission Range

1918

More Deadly

More contagious

15

10

5

1

1918 Spanish Flu

~500 MM infected | ~50 MM deaths

COVID-19

~29MM infected | ~933 K deaths

H1N1 Swine Flu

700 MM–1.4 BN infected | 284 K deaths\(^2\)

Seasonal Flu

Common cold

Chickenpox

Measles

Legend and key statistics

- SARS
  8,096 infected | 774 deaths
- MERS
  2,494 infected | 858 deaths
- 1918 Spanish Flu
  ~500 MM infected | ~50 MM deaths
- COVID-19
  ~29MM infected | ~933 K deaths
- H1N1 Swine Flu
  700 MM–1.4 BN infected | 284 K deaths\(^2\)

Additional details

- R-naught (R0) represents the average number of cases an infected person will cause
  - R0 for the seasonal flu is around 1.3\(^3\)
  - Estimates for initial R0 for SARS-CoV-2 have ranged between 2 and 3\(^4\) on the lower end and closer to 5.7 on the higher end\(^6\)
  - R0 is time and region dependent, varying significantly based on country and individual measures used to contain the virus (e.g., wearing masks, socially distancing, shutting down businesses)
- Early evidence suggests COVID-19’s transmission is highly variable, with most infections resulting in no subsequent infections and a few resulting in many\(^7\)
- The global case fatality rate for confirmed COVID-19 cases is currently 3.2%\(^5\) according to WHO’s reported statistics versus 0.1% for the seasonal flu; the rate varies significantly by country (e.g. Italy – 12.3%, South Korea – 1.6%)\(^5\)
- 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. 6. Emerging Infectious Diseases (link) 7. Science (link)
### AT A GLANCE: SUMMARY FACTS

<table>
<thead>
<tr>
<th>Key facts</th>
<th>Key unknowns</th>
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<tbody>
<tr>
<td><strong>Contagion</strong></td>
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<tr>
<td>• Initial estimates suggested COVID-19 R0 is between 2 and 3 (with edge of range estimates closer to 1.4 and 3.6), which means each person infects 2–3 others¹; R0 for the seasonal flu is around 1.3²</td>
<td>• Frequency of transmission by asymptomatic individuals and kids</td>
</tr>
<tr>
<td>• New emerging estimates suggest R0 may be closer to 5.7 (edge of range 3.8–8.9)³</td>
<td></td>
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<tr>
<td>• Early evidence suggests COVID-19’s transmission is highly variable, with most infections resulting in no subsequent infections and a few resulting in many, which should color response⁴</td>
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<tr>
<td><strong>Current human immunity</strong></td>
<td></td>
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<tr>
<td>• No herd immunity exists yet as the virus is novel in humans</td>
<td>• Whether protective immunity is conferred and how long it lasts</td>
</tr>
<tr>
<td>• There is emerging evidence that some individuals have cross-reactive antibodies from exposure to other coronaviruses. It remains to be seen if these are protective¹⁷</td>
<td></td>
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<tr>
<td><strong>Infectious cycle</strong></td>
<td></td>
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<tr>
<td>• COVID-19 can be spread asymptomatically⁵</td>
<td>• Exact timing of when an individual is no longer contagious</td>
</tr>
<tr>
<td>• The incubation period is a median of 5.5 days (up to 14 days)⁶, ⁷ (vs 3-day period for common flu⁶)</td>
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<td>• Several epidemiological studies estimate that the infectious period begins 2-3 days prior to onset of symptoms, peaks 0.7 days before symptom onset and then declines within 7 days⁸</td>
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<tr>
<td>• While viral genetic material can linger in the body for 2-4 weeks, live virus cannot be cultured after day 11 of illness⁸</td>
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<tr>
<td><strong>Fatality</strong></td>
<td></td>
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<tr>
<td>• Case fatality rates (CFR) are trending at 3.1% globally⁹ (vs. 0.1% for flu)⁶</td>
<td>• True fatality rate</td>
</tr>
<tr>
<td>• Infected fatality rate (IFR) is estimated at 0.68% (0.53-0.82%) though the data shows a significant degree of heterogeneity¹⁰</td>
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<tr>
<td><strong>Portion of cases asymptomatic but contagious</strong></td>
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<tr>
<td>• In retrospective studies of those people tested and confirmed positive for COVID-19, experts estimate 18–30% are asymptomatic, with another 10–20% with mild enough symptoms to not suspect COVID-19¹¹</td>
<td>• Why some people are asymptomatic or have mild illness while others show severe symptoms</td>
</tr>
<tr>
<td>• Early indicators from point in time comprehensive testing of small populations (e.g., Vo, Italy; Iceland) suggest as many as 50% of cases could be asymptomatic¹²</td>
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<tr>
<td>• In cohorts of younger individuals (e.g., pregnant woman, sailors on USS Theodore) the proportion of asymptomatics exceeded 60%¹³, ¹⁴</td>
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<td><strong>Portion of cases reaching “critical”/“severe” infection</strong></td>
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<tr>
<td>• Initial data suggested that approximately 19% of confirmed cases are considered “severe” or “critical”, requiring hospitalization; 1/4th of those need ICU beds¹⁵</td>
<td></td>
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<tr>
<td>• According to recent data from the US CDC, approximately 14% of confirmed US cases required hospitalization; 1/6th of those needed ICU beds⁶, ¹⁶</td>
<td></td>
</tr>
</tbody>
</table>

1. 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); 2. CDC Paper (link); 3. Emerging Infectious Diseases (link) 4. Science (link) 5. JAMA, “Presumed Asymptomatic Carrier Transmission of COVID-19” 6. CDC 7. Annals of Internal Medicine (link) 8. Academy of Medicine Singapore (link) 9. JHU. 10. medRxiv (link) 11. Nature (link), Eurosurveillance Paper (link) 12. ZMEScience report (link) 13. Business Insider (link) 14. NEJM (link) 15. 7. China CDC, JAMA (link) 16. Note: However, hospitalization status was only known for ~50% of all cases in CDC study 17. Science Immunology (link)

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### WHAT DOES IT TAKE TO REOPEN ONCE THE FIRST PEAK IS SUPPRESSED?

<table>
<thead>
<tr>
<th>Capability</th>
<th>Where are we?</th>
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</thead>
<tbody>
<tr>
<td><strong>1: Health system capacity</strong>&lt;br&gt;The personnel, PPE, beds, and other equipment to sustainably manage normal healthcare needs and a potential new surge</td>
<td>Most countries and US states have sufficient capacity though a few hot spots remain at the margin</td>
</tr>
<tr>
<td><strong>2: Testing</strong>&lt;br&gt;Sufficient rapid testing to screen essential workers, conduct random testing, effectively contract trace and ID new flareups</td>
<td>US as a whole and many European countries are making progress on building necessary capacity, some European and Asian Countries (Germany, Norway, S. Korea) and specific US States (CA) have adequate supply</td>
</tr>
<tr>
<td><strong>3: Contact tracing</strong>&lt;br&gt;Identification, testing, and isolation of infected individuals’ contacts</td>
<td>Most countries lack adequate capacity; rapid staff up and creation of technological tools are beginning to fill the gap</td>
</tr>
<tr>
<td><strong>4: Central surveillance</strong>&lt;br&gt;Processes and infrastructure for aggregating and analyzing data to drive decision-making around suppression strategies</td>
<td>Asian countries have led the way, and existing surveillance systems are being adapted elsewhere but face data and lag time issues</td>
</tr>
<tr>
<td><strong>5: Social distancing</strong>&lt;br&gt;Cultural and infrastructural changes to daily life and work</td>
<td>Businesses and individuals are just beginning to grasp the extent of the new normal</td>
</tr>
</tbody>
</table>

1. CDC has issued guidance on these topics that should be referenced by local authorities
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WE CANNOT AFFORD TO REMAIN SHUT DOWN, BUT IT’S NOT WITHOUT RISK TO RE-OPEN FULLY. WE EXPECT >12 MORE MONTHS OF SOCIAL DISTANCING “CYCLES”

**Initial Outbreak**

- ~2 Months

**Long Haul of Suppression**

- 12+ Months

- Cycles of relax/tighten as social distancing remains the only “brake”

- Ramp up testing to watch for resurgence of virus and gauge progress to herd immunity

**Containment**

- Therapeutic breakthroughs (treatment, vaccine) and/or scaled public health tools (testing, tracing, selective quarantine, surveillance) enable exit to New Normal

**Mitigation/Economy**

- Closure of non-essential businesses
- Community-wide stay-at-home mandates
- Widespread remote work
- Border closures and travel restrictions

- Gradually re-open less risky business with employee testing, social distancing
- Keep riskier businesses closed for longer periods of time (bars, gyms, concerts) to mitigate spread
- Truly rethink operations for riskier businesses to fully incorporate health surveillance and social distancing wherever possible
- Remote work and mask-wearing still the norm
- No large gatherings
- Quarantine for confirmed cases, close associates, and travelers
- Stay-at-home order for elderly, ill, and/or immunosuppressed

**Severity will vary based on suppression tactics and population dynamics**
FINDING THE OPTIMAL R(t) BALANCE – REGIONS SHOULD STRIVE TO KEEP AS MUCH OF THE ECONOMY OPEN AS POSSIBLE WITHOUT RISK OF SERIOUS OUTBREAK

Case growth – long haul suppression

Rapid Case Growth
Limited suppression measures until public health strain is too high, followed by broad, reactive suppression measures in response

- Rapid progress towards herd immunity during “open” periods
- Economic instability driven by need to reclose broadly when case counts rise too high
- Population less willing to “reclose”, leading to lower compliance and less effective suppression

Managing Rt
Proactively tighten & ease suppression to maintain balance & keep Rt just below risk threshold; proper testing important to accurately calculate Rt

- Economy is as open as possible without threatening health infrastructure
- Maximal herd immunity without overwhelming health system
- Limited need for reactive, destabilizing suppression measures

Cautious suppression
Targeted suppression measures levied well before growth approaches risk threshold

- Limited public health risk
- Lower case count enables targeted suppression
- Longer road to herd immunity
- Higher likelihood of extended unemployment/economic disruption

© Oliver Wyman 1. Assumes protective immunity is conferred and lasts long enough for herd immunity to be impactful
REOPENING PLANS SHOULD BALANCE MOBILITY AND ECONOMIC OPPORTUNITY FOR YOUNGER RESIDENTS WITH PROTECTION FOR VULNERABLE POPULATIONS

While infection is prevalent in those under the age of 60, the risk for hospitalization and death is severely diminished in younger age groups.

Asymptomatic patients tend to be younger: there is less direct risk to them, but they are more likely to drive unknown community spread.

A smart re-opening strategy will allow the less at risk to return to work (safely) to drive economic recovery while carefully protecting the more vulnerable (e.g., elderly, those with co-morbid conditions, residents and workers of long term care facilities).

- Introducing age and health status-differentiated mobility restrictions may reduce infection and fatality risk among the most vulnerable, but governments should have plans in place to ensure those individuals have easy access to supplies and essential items.
- Dedicating stocks of tests and PPE to elder care facilities may decrease the risk of outside infection from staffers, as well as allowing for visitation from recently tested friends or family, improving mental health.
REOPENING SCHOOLS IS A CRITICAL AND HOTLY DEBATED ISSUE – IT LIKELY CAN BE DONE SAFELY ONLY WHEN COMMUNITY SPREAD IS LOW

- America’s economic system can not function fully without schools, placing economic pressure on reopening
  - More than 50 million Americans are unable to return to work fully until schools reopen\(^1\)
  - The federal government has significantly advocated for schools to reopen, suggesting funding may be tied to reopening status\(^3\)
- Pediatric welfare also depends on in-person learning
  - Research suggests students are falling behind standard progress due to remote learning\(^4\)
  - Children may also be at higher risk of abuse and neglect when not in school\(^5\), as well as food insecurity for those who rely on school meals\(^6\)

Our factbase on school reopening is constantly evolving to incorporate the most up to date scientific evidence, learnings from global experience and emerging best practices across a set of key considerations

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\(^1\) U Chicago, \(^2\) CDC, \(^3\) NYT, \(^4\) NYT, \(^5\) ABC News, \(^6\) IPS News, \(^7\) NPR
**THERE ARE A WIDE RANGE OF METRICS THAT CAN HELP INFORM THE “HEALTH RISK” OF A PARTICULAR GEOGRAPHY**

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<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
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<tbody>
<tr>
<td><strong>How severe are outbreaks today?</strong></td>
<td><strong>What is the near-term outlook?</strong></td>
<td><strong>How widespread is testing and contact tracing?</strong></td>
<td><strong>How at risk is my employee population?</strong></td>
<td><strong>How is human behavior changing?</strong></td>
<td></td>
</tr>
<tr>
<td>• Active cases</td>
<td>• Active case forecasts</td>
<td>• % positive tests</td>
<td>• Employee sentiment</td>
<td>• Impact of mobility on transmission</td>
<td></td>
</tr>
<tr>
<td>• Reproduction rate</td>
<td>• Projected reproduction rate</td>
<td>• # of people tested</td>
<td>• Employee vulnerability</td>
<td></td>
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<tr>
<td>• ICU bed utilization</td>
<td>• Hospitalization rates</td>
<td>• Level of contact tracing</td>
<td>• Public transit commuters in region</td>
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<tr>
<td>• Deaths</td>
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</table>

These factors combined into a “health risk score”, alongside judgement on the ground, can help quickly assess the potential health risk posed by geography in a structured way.
OW’S GLOBAL MONITORING CAPABILITIES PROVIDE DEEP AND ACTIONABLE INSIGHT TO GOVERNMENTS, EXECUTIVES AND PUBLIC HEALTH AUTHORITIES

Daily updated database covering 50+ metrics and 200+ countries; access to relevant COVID information in one convenient location

Risk tracker and dashboard identifying likely hotspots and areas of resurgence with key global archetypes

In-depth profiles highlighting global themes and detailed developments from any given country

- Complete history of pandemic by region (cases, deaths, infection rates, testing)
- Daily updated case projections for select countries of interest
- Mobility indices and leading indicators
- Population risk factors, include health risks, urban density, age and demographics
- Flexible chart builder and data export tool; explore metrics from any region over any period of time

- Convenient dashboard highlighting key risk factors and current pandemic status by day
- Deep dive worksheets exploring mobility, case, and infection rate growth over variable periods of time
- Analysis of mobility correlations with Oliver Wyman derived infection rates
- Flexible segmentation and archetyping tool, with editable risk thresholds

- Timeline of key developments and government responses over the lifetime of COVID in a given country
- Key lessons learned from each region – detailed notes on what caused a countries response to be successful (or not)
- Themes that governed a country’s COVID response policy and philosophy
- Other cultural or endogenous factors that directly affected the impact of the disease
THIS METHODOLOGY ENABLES HEALTH RISK MONITORING CAPABILITIES SPANNING THE GLOBE

Illustrative Example

Legend:
- Low risk
- Medium risk
- High risk
- Critical risk

1. Highlighted countries indicate risk monitoring coverage.
2. Due to the heterogeneous nature of outbreaks in large countries, certain countries dealing with substantial outbreaks in certain localities (India, Australia) may appear to be low risk at an aggregate level.
SEVERAL THEMES HAVE EMERGED FROM US REOPENING, PARTICULARLY AS WE EXAMINE STATES THAT HAVE EXPERIENCED SIGNIFICANT NEW CASE GROWTH

<table>
<thead>
<tr>
<th>1</th>
<th>A meaningful decline prior to reopening (highly correlated with a significant first wave) is the key course-determining issue</th>
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<tbody>
<tr>
<td></td>
<td>• The states that waited for a significant drop in cases (e.g., PA, NY, MA) have continued to reopen without seeing a jump in cases, although it should be noted that they are farther behind in reopening</td>
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<td></td>
<td>• A number of the states that reopened with the belief that they were on the cusp of a decline, instead saw a plateau. Weeks later, this contributed to a surge in new cases (e.g., AZ, AL)</td>
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</tbody>
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<table>
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<tr>
<th>2</th>
<th>The course can change, so constant vigilance is required</th>
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<tbody>
<tr>
<td></td>
<td>• Many of the states that originally reopened with more cautious policies or strong testing are seeing a surge in cases (e.g., AZ, UT, OR)</td>
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<td></td>
<td>• Other states that appeared to be spared from the recent outbreaks have now begun to show signs of rapid growth (MS, NM, ND, IN), and even heavily rural states are beginning to see alarming trajectories (WY, NM, AK, ID)</td>
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<thead>
<tr>
<th>3</th>
<th>De-average, de-average, de-average: State-level trends can be misleading</th>
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<tbody>
<tr>
<td></td>
<td>• States like Alabama saw declining growth as a whole when the state reopened, but some counties were still experiencing an uptick in cases, leading to a resurgence</td>
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<td></td>
<td>• In contrast, states like Pennsylvania opened only the areas with a significant decline in cases while waiting for others to cool off, and have not yet seen a resurgence</td>
</tr>
<tr>
<td></td>
<td>• Nationwide, rural areas continue to see case growth while new cases stabilize or decline in urban areas - these rural areas can fly under the radar and must be monitored purposefully</td>
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<tr>
<th>4</th>
<th>Outbreaks are driven by risky behavior; adequate compliance with COVID guidance is imperative to stopping the spread</th>
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<tbody>
<tr>
<td></td>
<td>• States with high recent case growth tend to have strong correlation between mobility and infection rates, suggesting lower rates of &quot;learned behavior&quot; and increased risk of resurgence</td>
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<td></td>
<td>• States that enforced mask mandates were significantly correlated with declining case growth, with the effect increasing over time; Enforcing mask wearing early (and creating a culture of compliance) will likely reduce spread substantially</td>
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<tr>
<th>5</th>
<th>Rising temperatures may be driving people indoors where transmission is more likely</th>
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<tr>
<td></td>
<td>• The vast majority of states now seeing renewed growth are concentrated in the Southern half of the US where summer temperatures are among the hottest in the U.S., often exceeding 90°+</td>
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<td></td>
<td>• Like U.S. states, Iraq is seeing an uptick as the temperature becomes uncomfortable and people move indoors – this is similar to what we see with the flu during cold seasons</td>
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</tbody>
</table>
CASES ARE DECLINING ACROSS THE US, THOUGH THERE IS SLIGHT GROWTH IN SOME MIDWESTERN AND RURAL STATES

Data as of: 9/15

Legend:
% Change in new daily cases (2 weeks)
Circle size: # of active cases
- 0% or less
- 1-25%
- 26-50%
- 51-100%
- 101+
- Testing capacity insufficient to capture true case growth

Testing rates >10% indicate capacity issue, suggesting confirmed case growth is limited by tests, not true caseload in region

South/West
High Risk
- 5 of 10 states with highest active cases are in region (CA, FL, TX are 1st-3rd)
- Case growth appears to be slowing, but risk remains from high as reopened schools may facilitate a resurgence
- Possible explanations for slowing growth in following slides

Rural States
Moderate-High Risk
- All fully reopened and fared well for multiple weeks
- Case counts generally low, though per capita rates are fairly high in ID, NE, and the Dakotas
- Case counts appear to be slowing down, but SD and ND have continued to grow for ~2 months with few signs of slowing down

Midwest
High Risk
- Cases rising across much of the region
- IL, MO, OH, WI are all in the top 10 states by active cases, signaling potential shifting of epicenter
- These states also tend to have higher growth rates and worse testing rates, increasing risk

Northeast/Mid-Atlantic
Moderate Risk
- Generally hit hard by initial outbreak
- Cautiously reopening after case decline; most states who had paused reopening are now moving forward (NY, NJ, DE)
- Most states are declining, though Mid-Atlantic states (VA, NC) still have relatively high active case counts

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1. "Fully reopened" defined as when a majority of high risk businesses, including bars, movie theaters, or gyms, have been reopened with indoor service. This chart does not account for regulatory restrictions that may or may not be in place in those businesses, including mask wearing or capacity constraints. 2: Florida has considered reclosure of a number of risky venues, including bars, gyms, & restaurants, but ultimately decided to only reclose bars; thus, Florida is still considered “fully reopened”
ILLUSTRATIVE PLAYBOOK COMPONENTS ON WORKFORCE RESILIENCE AND READINESS

<table>
<thead>
<tr>
<th>Physical work space safety</th>
<th>Functional redesigns</th>
<th>Alternative staffing models</th>
<th>Health screening/testing</th>
<th>Proactive monitoring and intervention</th>
<th>Scalable employee support</th>
<th>Management of special people situations</th>
<th>Legal and labor agreements</th>
</tr>
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<tbody>
<tr>
<td>• Increased ventilation</td>
<td>• Workflow redesign to reduce hand-offs, complexity, and intensity of rare skills</td>
<td>• Formal separation of a-teams and b-teams to ensure backup availability</td>
<td>• Temperature checks or assessments at entry</td>
<td>• Elevation of centralized risk monitoring function</td>
<td>• Expanded communications, e.g. educational campaign on social responsibility</td>
<td>• Formal identification of higher risk employees (demographics, health status, rare skills)</td>
<td>• Managing responsibilities to labor unions with regards to lay offs, reduced work hours, testing, etc.</td>
</tr>
<tr>
<td>• Floor layout redesigns and foot traffic guidance to reduce congestion and maintain 6 ft distance</td>
<td>• Automation of critical processes and processes with higher personnel risks</td>
<td>• “Flex pool” or “pool of pools” to plug live gaps</td>
<td>• Testing (on site or protocol for referral to local public health entity/physician)</td>
<td>• Comprehensive disinfection practices at appropriate intervals (particularly of high touch surfaces and restrooms)</td>
<td>• Infrastructure and IT configured for enablement of full program portfolio</td>
<td>• Reallocation of workforce across sites to mitigate undue risk in one location</td>
<td>• Policies related to health screening/testing (e.g. management of medical data and privacy, payment for testing and time required for testing, reporting of results, policy for use of results in deployment of staff)</td>
</tr>
<tr>
<td>• Bans on 10+ person meetings</td>
<td>• No sharing of equipment when possible</td>
<td>• Reallocation of workforce across sites to mitigate undue risk in one location</td>
<td>• New behaviors, e.g. masks/gloves at all times in public spaces, frequent hand washing, toilet closure)</td>
<td>• Proactive monitoring and intervention</td>
<td>• No sharing of equipment when possible</td>
<td>• All who can work-from-home do so</td>
<td>• Education of management about disease and control measures</td>
</tr>
<tr>
<td>• Comprehensive disinfection practices at appropriate intervals (particularly of high touch surfaces and restrooms)</td>
<td>• Cafeteria/social space closure</td>
<td>• Cross-training of all critical skill sets</td>
<td>• Flexible pool” or “pool of pools” to plug live gaps</td>
<td>• Contingency plans for opening/closing/relocating operations based on evolving local risk</td>
<td>• ...</td>
<td>• ...</td>
<td>• ...</td>
</tr>
<tr>
<td>• New behaviors, e.g. masks/gloves at all times in public spaces, frequent hand washing, toilet closure)</td>
<td>• ...</td>
<td>• Realtime tracking and evaluation of all key risks</td>
<td>• Education of management about disease and control measures</td>
<td>• ...</td>
<td>• ...</td>
<td>• Economic hardship coaching resources</td>
<td>• ...</td>
</tr>
<tr>
<td>• Cafeteria/social space closure</td>
<td>• ...</td>
<td>• SWAT teams for rapid intervention</td>
<td>• ...</td>
<td>• ...</td>
<td>• Productivity training for remote collaboration</td>
<td>• ...</td>
<td>• ...</td>
</tr>
<tr>
<td>• ...</td>
<td>• ...</td>
<td>• Contingency plans for opening/closing/relocating operations based on evolving local risk</td>
<td>• ...</td>
<td>• Alerts and compliance monitoring</td>
<td>• Policy &amp; technology provision for extended work-from-home for large portions of workforce</td>
<td>• ...</td>
<td>• ...</td>
</tr>
<tr>
<td>• ...</td>
<td>• ...</td>
<td>• Alerts and compliance monitoring</td>
<td>• ...</td>
<td>• ...</td>
<td>• Child care assistance</td>
<td>• ...</td>
<td>• ...</td>
</tr>
</tbody>
</table>

Non-exhaustive
OUR FACTBASE ON DIAGNOSTIC METHODOLOGY AND AVAILABILITY IS CONSTANTLY EVOLVING TO INCORPORATE RECENT DEVELOPMENTS AND PROVIDE ACTIONABLE INSIGHTS

IN ADDITION, THERE ARE THREE EMERGING COVID-19 TEST TECHNOLOGIES THAT ARE EXPECTED TO ENTER THE MARKET AT SCALE OVER THE REST OF 2020

THESE THREE TYPES VARY WIDELY IN COST, TURNAROUND, ACCURACY, AND AVAILABILITY

THREE PRIMARY TYPES OF TESTS ARE BEING UTILIZED TODAY; WORK IS ONGOING TO IMPROVE AND EXPAND EACH TYPE

<table>
<thead>
<tr>
<th>Type of test</th>
<th>Molecular test (PCR)</th>
<th>Antigen test</th>
<th>Serology test (antibody)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test detects genetic material from the virus, provides a series of chemical reactions that amplify the viral genome.</td>
<td>Test detects antigens/antibodies that stimulate an immune response recognition.</td>
<td>Test detects antibodies to SARS-CoV-2 through chemiluminescence or fluorescence.</td>
<td></td>
</tr>
<tr>
<td>Sample type</td>
<td>Nasal or throat swab, some saliva tests available,特朗普</td>
<td>Nasal or throat swab</td>
<td>Blood draw</td>
</tr>
<tr>
<td>Sample size</td>
<td>100-200</td>
<td>1-2</td>
<td>1-2</td>
</tr>
<tr>
<td>Turnaround time</td>
<td>1-2 hours</td>
<td>15-30 minutes</td>
<td>1-2 hours</td>
</tr>
<tr>
<td>Accuracy</td>
<td>95%</td>
<td>90%</td>
<td>90%</td>
</tr>
<tr>
<td>Sensitivity</td>
<td>90%</td>
<td>80%</td>
<td>80%</td>
</tr>
<tr>
<td>Specificity</td>
<td>99%</td>
<td>95%</td>
<td>95%</td>
</tr>
<tr>
<td>Limitations</td>
<td>False negatives can occur due to inhibition of the test</td>
<td>False positives can occur due to cross-reactivity with other viruses</td>
<td>False negatives can occur due to low antibody levels</td>
</tr>
</tbody>
</table>

RECENT DIAGNOSTIC DEVELOPMENT NEWS

<table>
<thead>
<tr>
<th>Test</th>
<th>Recent development news</th>
<th>Recent partnership news</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCR</td>
<td>Options for rapid, scalable PCR tests continue to expand.</td>
<td>Pfizer and Harvard partner to speed delivery of tests.</td>
</tr>
<tr>
<td>Antigen test</td>
<td>Abbott receives FDA Emergency Use Authorization for BinaxNOW antigen test.</td>
<td></td>
</tr>
<tr>
<td>Serology test</td>
<td>New serology tests available.</td>
<td>Oxford University and Microsoft partner for large-scale testing.</td>
</tr>
</tbody>
</table>

EMERGING TECH. PROFILE: SALIVADIRECT IS A LOW COST, NON-INVASIVE ALTERNATIVE TO TRADITIONAL PCR TESTS

<table>
<thead>
<tr>
<th>Key facts</th>
<th>Cost: $5 per test, does not require equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turnaround time</td>
<td>15 minutes</td>
</tr>
<tr>
<td>Accuracy</td>
<td>97.1% sensitivity, 98.8% specificity.</td>
</tr>
<tr>
<td>Much higher than other antigen tests on market</td>
<td></td>
</tr>
<tr>
<td>Availability</td>
<td>Shipping millions of tests in Sept. and up to 50M in Oct. US gov't to purchase 150M</td>
</tr>
<tr>
<td>Display</td>
<td>Results displayed via phone app, similar to an airline boarding pass for proof of results</td>
</tr>
</tbody>
</table>

EMERGING TECH. PROFILE: NEW ABBOTT TEST SHOWS PROMISE, BUT ACCESSIBLE SUPPLY IS UNKNOWN AND IT REQUIRES MEDICAL PROFESSIONAL TO ADMINISTER

<table>
<thead>
<tr>
<th>BinaxNOW antigen test summary</th>
<th>Abbott received FDA Emergency Use Authorization for BinaxNOW antigen test on 8/28</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive: Potential to be a gamechanger when it comes to price, manufacturing scale and accuracy (for antigen tests)</td>
<td></td>
</tr>
<tr>
<td>Pros: Low cost, rapid results, easy to use in remote locations.</td>
<td></td>
</tr>
<tr>
<td>Cons: Requires medical professional to administer and supplies are limited.</td>
<td></td>
</tr>
</tbody>
</table>

© Oliver Wyman
CURRENT SNAPSHOT: MOST OF THE UNITED STATES NOW HAS ADEQUATE TESTING CAPACITY, THOUGH MANY STATES IN THE MIDWEST AND SOUTH ARE STILL AT RISK

New cases per thousand (including undetected cases) by tests per thousand for each state
As of September 15th, 2020
OLIVER WYMAN’S PANDEMIC NAVIGATOR PROVIDES COVID-19 FORECASTS AND SCENARIOS, AND HELPS TRANSLATE THEM TO ECONOMIC AND BUSINESS IMPACTS

Robust model for 90+ countries, 50 states, and 3000+ counties...

...with predictive forecasts and plausible scenarios...

...to support high-stakes business decisions to help you manage the long haul of suppression and emerge stronger from the pandemic

SELECT USE CASES

1. Review the evolution of the pandemic from granular near-term forecasts
2. Design and study long-term scenarios
3. Public policy setting
4. Assess macroeconomic impact
5. Evaluate sector level impact
6. Credit risk assessment
7. Assess demand and manage supply chain
8. Re-baseline and revisit plan / budget
9. Control tower for return to work and managing over the long haul of suppression
10. Employer’s medical plan estimation
11. Insurance premium rate estimation
12. Hospital management

Explore select insights at https://pandemicnavigator.oliverwyman.com/
Centers for Disease Control and Prevention
United States cumulative deaths; forecasts from 7/19

Modelling institutions

<table>
<thead>
<tr>
<th>Universities</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Columbia</td>
<td>✓</td>
</tr>
<tr>
<td>Georgia Institute of Technology</td>
<td>✓</td>
</tr>
<tr>
<td>Harvard</td>
<td>✓</td>
</tr>
<tr>
<td>Imperial College London</td>
<td>✓</td>
</tr>
<tr>
<td>Iowa State</td>
<td>✓</td>
</tr>
<tr>
<td>Johns Hopkins</td>
<td>✓</td>
</tr>
<tr>
<td>London School of Hygiene &amp; Tropical Medicine</td>
<td>✓</td>
</tr>
<tr>
<td>MIT</td>
<td>✓</td>
</tr>
<tr>
<td>Northeastern</td>
<td>✓</td>
</tr>
<tr>
<td>Notre Dame</td>
<td>✓</td>
</tr>
<tr>
<td>UCLA</td>
<td>✓</td>
</tr>
<tr>
<td>University of Arizona</td>
<td>✓</td>
</tr>
<tr>
<td>University of Illinois</td>
<td>✓</td>
</tr>
<tr>
<td>University of Geneva / Swiss Data Center</td>
<td>✓</td>
</tr>
<tr>
<td>University of Massachusetts</td>
<td>✓</td>
</tr>
<tr>
<td>University of Texas – Austin</td>
<td>✓</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Research organizations</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Boston Medical Center</td>
<td>✓</td>
</tr>
<tr>
<td>Institute for Health Metrics and Evaluation</td>
<td>✓</td>
</tr>
<tr>
<td>Los Alamos National Labs</td>
<td>✓</td>
</tr>
<tr>
<td>Massachusetts General Hospital</td>
<td>✓</td>
</tr>
<tr>
<td>US Army Engineer R&amp;D Center</td>
<td>✓</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Companies/other</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Auquan Data Science</td>
<td>✓</td>
</tr>
<tr>
<td>COVID Act Now</td>
<td>✓</td>
</tr>
<tr>
<td>COVID-19 Simulator Consortium</td>
<td>✓</td>
</tr>
<tr>
<td><strong>Oliver Wyman</strong></td>
<td>✓</td>
</tr>
<tr>
<td>Predictive Science, Inc.</td>
<td>✓</td>
</tr>
<tr>
<td>Snyder Wilson Computing</td>
<td>✓</td>
</tr>
<tr>
<td>Youyang Gu</td>
<td>✓</td>
</tr>
</tbody>
</table>

Oliver Wyman forecasts are published on the CDC and Reich Lab websites for the US States. International forecasts are produced internally and can be made available.

1. Institutions shown contributed to a model submitted for the week of June 14. Some teams are formed by multiple institutions, and some institutions contribute to multiple teams.

© Oliver Wyman
THE PANDEMIC NAVIGATOR IS INFORMED BY A WIDE RANGE OF DATA SOURCES TO PRODUCE THE LATEST INSIGHTS FOR BUSINESS LEADERS & POLICYMAKERS

- **Reported case counts** by geography (90+ countries, US states and Canadian provinces, US zip codes) daily from Johns Hopkins
- **Google/Apple Mobility indices**
- **Undetected to Detected ratios**
- **Oxford Stringency Index** evaluates the robustness of worldwide government responses by country
- **Epidemiology expertise**, including the latest medical findings
- **# of tests conducted**
- **Health Risk Scorecard**

### Pandemic Navigator Capabilities:

1. **COVID-19 forecasts**
   - Detected and Undetected cases, recoveries, deaths, transmission rates

2. **What-if analysis**
   - ‘What if’ capabilities linking testing and mobility to COVID-19 case forecasts

3. **Scenarios**
   - Nine plausible scenario pathways, with latest vaccine developments

4. **Health risk score**
   - Proprietary risk score, calibrating forecasts and other leading indicators

5. **Gathering risk**
   - Probability score of active COVID-19 infection in a gathering

© Oliver Wyman
LEVERAGING PANDEMIC NAVIGATOR OUTPUT, WE HAVE IMPLEMENTED A RECOVERY INFORMATION SYSTEM THAT INTEGRATES WITH CORPORATE MIS AND ENABLES EFFECTIVE DECISION MAKING DURING THE LONG HAUL OF SUPPRESSION

**OW Pandemic Navigator**

Oliver Wyman has developed a powerful compass to support companies through uncharted waters: OW COVID-19 PANDEMIC NAVIGATOR.

**PUBLIC SECTOR**
- More targeted policy response
- Design-led and data-driven approach
- Assessing hospital capacity
- Initial use case

**PRIVATE SECTOR**
- Monitoring key metrics
- Understanding the impact of decisions

**OW COVID-19 NAVIGATOR**
- Epidemiology (by country)
- Industry Earnings (by sector)
- Fiscal/Monetary Stimulus
- Risk/Loss Transmission

**Lockdown Patterns**
- Social media listening tool
- Governance and oversight team

**The hub**
- Corporate MIS
- Internal programs

**Mobile app**
- Covid companion

**Containment measures by geo**

**John Hopkins/External sources**
OUR MODEL IS RECOGNIZED AS ONE OF THE TOP COVID-19 MODELS BY INDEPENDENT MODEL COMPARISONS

Recent tweet: Oliver Wyman third in COVID-19 “Power Rankings”

Forecast comparisons: Oliver Wyman beat baseline 100% of weeks, one of 4 models to do so, compared to other CDC listed deaths forecasts

** Rating the COVID19 models **

What’s the "best" (= most accurate) of the COVID19 models out there? How can we make consistent comparisons over time?

This thread discuses a (new) framework for comparing the models on the @reichlab and @CDCgov sites. 1/

Zoom in on Oliver Wyman row:

<table>
<thead>
<tr>
<th>Model</th>
<th>Power_Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>NYU-ParamSearch</td>
<td>31.82</td>
</tr>
<tr>
<td>Columbia-Emory</td>
<td>32.81</td>
</tr>
<tr>
<td>OliverWyman-Navigator</td>
<td>78.69</td>
</tr>
<tr>
<td>JohnsHopkins</td>
<td>59.99</td>
</tr>
<tr>
<td>LANN-GrowthRate</td>
<td>66.18</td>
</tr>
<tr>
<td>UCLA-SEIR</td>
<td>66.31</td>
</tr>
<tr>
<td>UT-Mobility</td>
<td>54.76</td>
</tr>
<tr>
<td>USC-VIR</td>
<td>51.53</td>
</tr>
<tr>
<td>IHME-CovFor</td>
<td>49.97</td>
</tr>
</tbody>
</table>

Mean Mean Abs Error 487 390 268 311 230 136 134 127 147 206 259 258 208 191
FULL RECOVERY DEPENDS ON A SUCCESSFUL VACCINE, BUT TIMELINE IS UNCERTAIN
A successful vaccine manufactured and deployed at scale is the only certain path to eradication

How long could that take?
• The optimistic timeline suggests a vaccine could be commercially available in mid to late 2021
• The best comparison we have is the development of H1N1 vaccines under similar circumstances, though we are already past the 6mo it took for a vaccine to be approved in that scenario

<table>
<thead>
<tr>
<th>H1N1¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 months until vaccine approval; 12 months critical conditions; 18 months until end of pandemic</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>First world-wide case emerges</td>
<td>US Gov declares state of emergency</td>
<td>Source region possibly under control</td>
<td>Vaccine clinical trials begin</td>
<td>FDA approves four H1N1 vaccines</td>
<td>Vaccine available broadly</td>
<td>WHO declares end of pandemic</td>
</tr>
</tbody>
</table>

What is the current status?
• As of 9/15, there are 157 vaccine programs in pre-clinical stage and 41 in a clinical stage
• Two broad categories of vaccine are under development:
  – **Traditional, protein-based:**
    - Inactivated vaccine or proteins from it are grown in animal cells and then injected into the human body
    - Category has been proven to work and will rely on existing infrastructure, however will take longer to develop
    - Efforts of note: Partnership between GSK and Sanofi, Novavax
    - Potential timeline – Phase I trials to start later this year, vaccine wouldn’t be approved and available until 2021
  – **Modern, nucleotide-based:**
    - mRNA, DNA or inactivated virus is injected into the human body, so that its cells can make viral proteins
    - Category has not been proven, but has a much more rapid timeline to development
    - Efforts of note: Moderna, Pfizer, AstraZeneca – J&J – Oxford University partnership, Innovio
    - Potential timeline – Phase II and III trials have started or planned to start by summer with limited availability of doses potentially available this fall for high risk individuals and frontline workers assuming safety and efficacy in large trials

Sources: H1N1 timeline [link], Credit Suisse Equity Research, Nature [link], Artis Ventures [link], Biocentury [link] and DowJones
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IF NATURAL INFECTION CONFER IMMUNITY, THE HERD IMMUNITY THRESHOLD REQUIRED MAY BE LOWER THAN PREVIOUSLY THOUGHT

If herd immunity proves feasible, each region will be on a different path; while potential immunity is far off for most, heavily affected epicenters like NYC may begin to see a dampening effect on transmission.

Infected proportion of population

Emerging perspective

- We do not currently know if protective immunity is conferred or for what length of time; If protective immunity does not last long (e.g., 6 months), we will not achieve herd immunity.

- Assuming immunity is conferred, progress towards herd immunity varies by region.
  - Key factors include how hard hit a region was and how effective suppression measures are/were.

- Additionally, it is likely that herd immunity thresholds differ from region to region or from population to population.
  - Heterogeneity of contagiousness (i.e., some patients may be “super-spreaders”, some may be naturally immune, some may have cross-reactivity from other infections / vaccinations) and of interaction (groups are differentiated in how they interact within and outside of the group) suggest variability in herd immunity thresholds.

- This heterogenous transmission means herd immunity may be more achievable than we first thought, as long as immunity lasts long enough.

Sources: Total confirmed cases by country as reported by Johns Hopkins University as of 8/13/2020; total confirmed cases by US county as reported by US facts as of 8/13/2020; world population as reported by link; total population for MSAs as reported by Claritas. 1. Estimates for herd immunity for COVID based on R0 of 2–5.7 and a target of R0<1 (link) and (link); 2. Based on heterogenous nature of COVID-19 transmission, some studies have indicated lower required threshold (link); 3. Estimated total infected based on Oliver Wyman Pandemic Navigator Model 4. NYC includes 5 boroughs only, not full MSA 5. Oliver Wyman Pandemic Database 6. HealthKnowledge; 7. The Atlantic.
THE US ECONOMY IS EXPERIENCING A SEVERE SHOCK: GDP

The escalation of the COVID-19 crisis has resulted in unprecedented volatility in forecasts

U.S. Real GDP Growth Forecasts – Q3 2020 to Q4 2021
QoQ annualized growth rate, by select economic analysts

Key observations from estimates

- Q2 2020 was the worst quarter on record
- Forecast updates for Q3 2020 have been moving lower (or flat) over the last month, but still with significant uncertainty in forecasts
- Key indicators to track include:
  - Cycle of opening and closing in regional economies
  - Reliance on “smart” mitigation strategies (e.g., mass testing, analytics)

1. JP Morgan (July 31), Goldman Sachs (July 12), Morgan Stanley (July 17), Toronto Dominion (June 17), UBS (July 29), Bank of America (July 31), Deutsche Bank (July 28), CBO (July 2)
2. JP Morgan (April 24), Goldman Sachs (April 29), Morgan Stanley (April 27), Toronto Dominion (April 20), UBS (April 29), Bank of America (April 17), Deutsche Bank (April 28), CBO (April 24)
3. JP Morgan (July 17), Goldman Sachs (July 12), Morgan Stanley (July 17), Toronto Dominion (June 17), UBS (July 29), Bank of America (July 24), Deutsche Bank (July 28), CBO (July 2)
THE US ECONOMY IS EXPERIENCING A SEVERE SHOCK: UNEMPLOYMENT
The escalation of the COVID-19 crisis has resulted in unprecedented volatility in forecasts

U.S. Unemployment Forecasts – Q1, Q2, Q3, and Q4
Quarterly unemployment rate, by select economic analysts

Key insights

- Unemployment claims filed since start of the COVID-19 lockdown have wiped out the last eleven years of job gains
- Most unemployment forecasts assume a steady recovery for 2H20 and 2021 and appear not (yet) to account for the possibility of subsequent waves of lockdown
- Unemployment estimates will likely be quite volatile for a while
- Congressional Budget Office forecasts a slower employment recovery than most major banks

1. Goldman Sachs (July 12), JP Morgan (July 31), UBS (July 29), Deutsche Bank (July 28), Toronto Dominion (June 17), CBO (July 2), Moody’s (June 22); U.S. Bureau of Labor Statistics. 2. U.S. Bureau of Labor Statistics. 3. Tracking unemployment forecasts against unemployment reports may be misleading – unemployment reports only record jobless workers actively searching for employment.
READ OUR LATEST INSIGHTS ABOUT COVID-19 AND ITS GLOBAL IMPACT ONLINE

Oliver Wyman and our parent company Marsh and 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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