
Consumer and Investment Management Division

Re-Opening of the Economy and Managing Risks of Additional Waves

(Eleventh in a Series)

April 30, 2020

Investment Strategy Group

- **Taking Stock of COVID-19**

Luciana Borio, Vice President, In-Q-Tel

- Former Director for Medical and Biodefense Preparedness Policy, National Security Council
- Former Acting Chief Scientist of the Food and Drug Administration
- Adjunct Assistant Professor of Medicine at Johns Hopkins University

- **Roadmap to Re-Opening**

Mark McClellan, Director, Duke-Margolis Center for Health Policy at Duke University

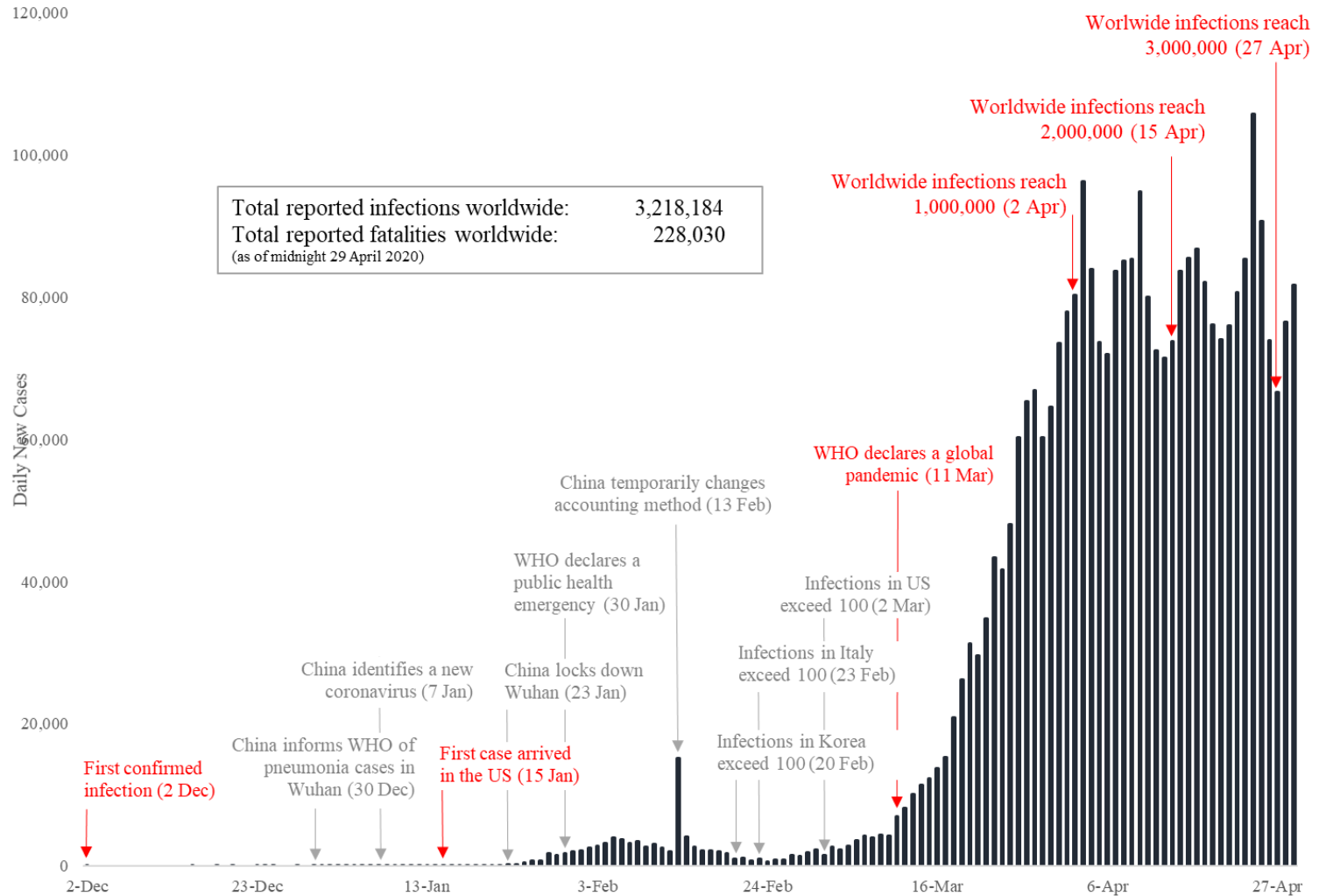
- Former Administrator of the Centers for Medicare & Medicaid Services
- Former Commissioner of the Food and Drug Administration
- Former member of the President's Council of Economic Advisers

- **Role of Serological Testing**

Florian Krammer, Professor of Vaccinology, Icahn School of Medicine at Mount Sinai

- First in the nation to develop a COVID-19 antibody test
- Previously focused on the design of a universal influenza vaccine
- Principal Investigator of the Sinai-Emory Multi-Institutional Collaborative Influenza Vaccine Innovation Center that aims to develop improved seasonal and universal influenza vaccines

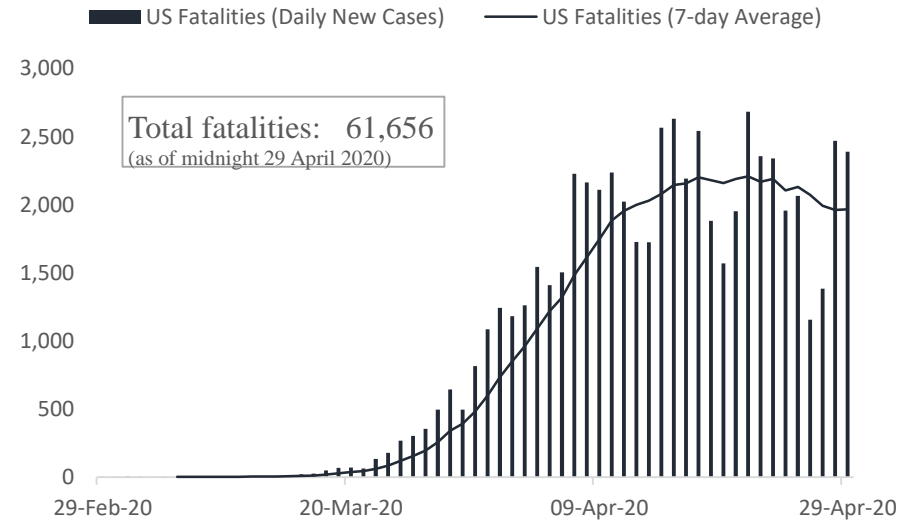
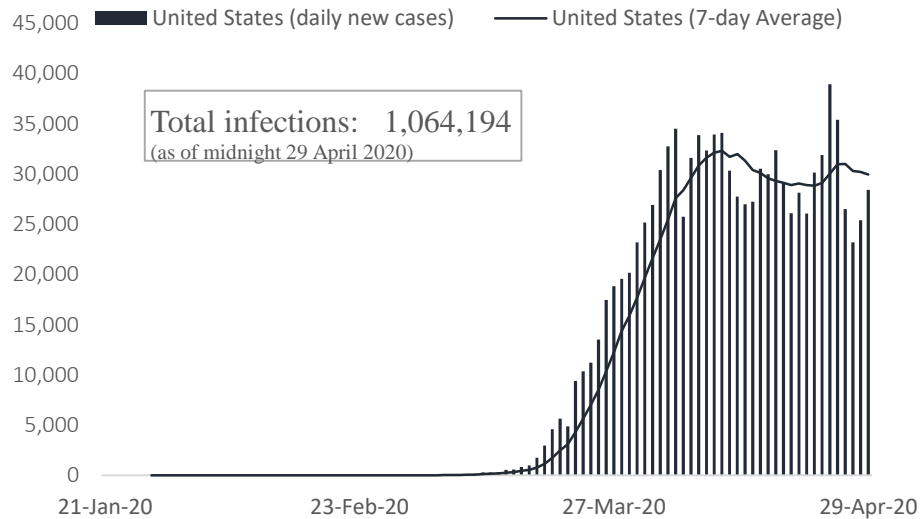
SARS-CoV-2 Pandemic Timeline



* As of April 29, 2020

Source: Investment Strategy Group, WHO, CDC, National Health Commission of People's Republic of China, John Hopkins University, Worldometers.

COVID-19 Infections and Fatalities in the United States

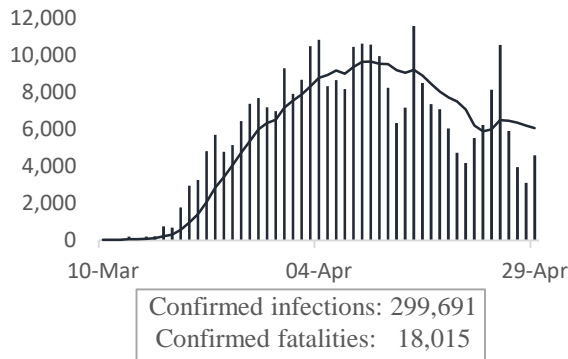


- While the number of new daily infections and fatalities remains high in the United States, the outbreak appears to have plateaued and may now be on a downward trajectory.

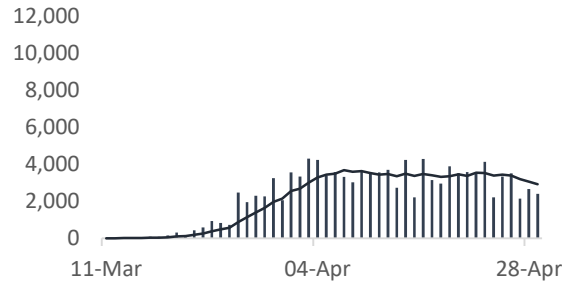
US States

1. Infections in Select US States (Daily New Cases and 7 Day Moving Average)

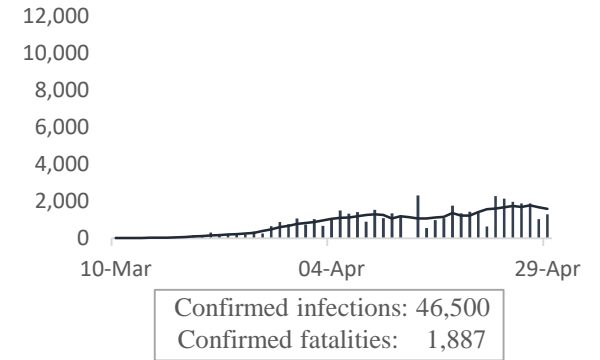
New York
(Population: 19.4mm)



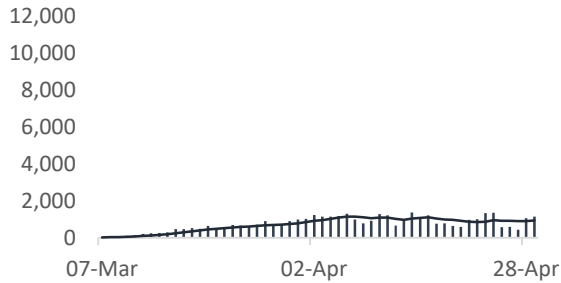
New Jersey
(Population: 8.9mm)



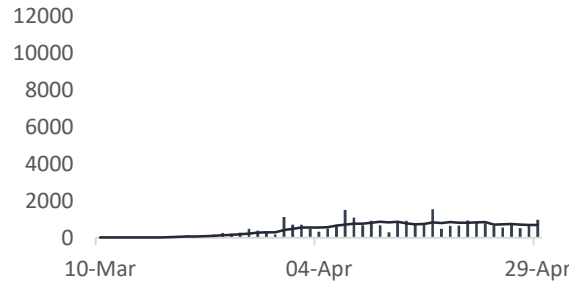
California
(Population: 39.5mm)



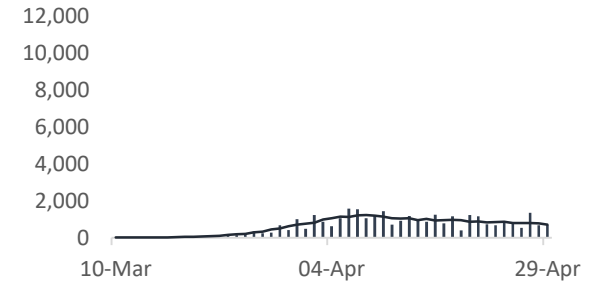
Michigan
(Population: 9.9m)



Georgia
(Population: 10.6mm)



Florida
(Population: 21.5mm)

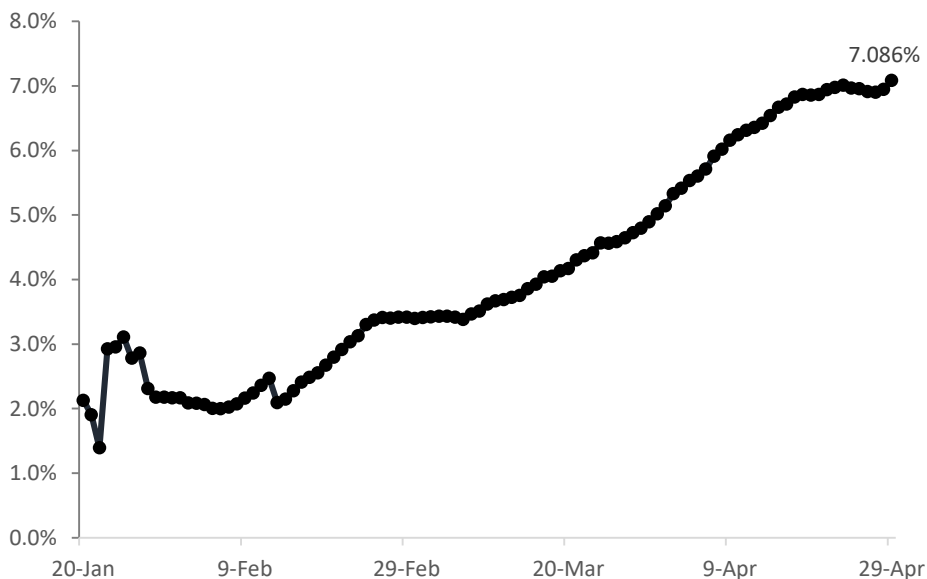


* As of April 29, 2020

Source: Investment Strategy Group, The COVID Tracking Project

Case Fatality Rate

1. Worldwide Case Fatality Rate (reported fatalities over confirmed infections)



2. Fatalities in Settings with Robust or Anti-Body Testing

	N	Tested	Infected	Fatalities	CFR
USS Theodore Roosevelt	4,845	All	940	1	0.11%
USS Kidd	380	239	64	0	0%
Gangelt (Germany)*	12,446	--	--	--	0.37%
Iceland	364,134	46,377	1,792	10	0.56%
Charles de Gaulle (ship)	1,800	All	1,081	0	0%
New York State**	19.4mm	3,000	417	--	0.5%

*For Gangelt, CFR was derived based on cluster study of 1,000 inhabitants.

**For New York state, CFR was derived based on results of a Phase I anti-body testing announced by Governor Cuomo on 23 April.

- The case fatality rate, based on confirmed infections and fatalities, has been increasing steadily since mid-February.
- However, in locations with robust or near universal testing, and now with anti-body testing, the case fatality rate is significantly lower.

* As of April 29, 2020

Source: Investment Strategy Group, WHO, Worldometers, LA Times, US Navy, Navy Times, University Hospital Bonn.

Reproduction Number (R0) – How Have Control Measures Impacted the Spread of the Virus

1. Reproduction Number (R0) (in the early days of the outbreak)

	SARS	MERS	SARS-CoV-2	H1N1	Seasonal Flu
R0 (reproduction number)*	2 - 4	<1**	2 - 4	1.33	0.9 to 2.1

*An epidemiologic metric used to describe how many persons, on average, can each infected person spread the virus to

**Overall, the reproduction number (R0) of MERS-CoV was <1, with significant heterogeneity in specific contexts.

2. Estimates of the Reproduction Number (R0)

	R0
Without controls	2.2 - 3.28
New York State	0.8
Seattle area*	0.75
Germany**	1
France	0.6
Wuhan	0.32
Italy	0.8

* The data for the Seattle area is from King, Snohomish, and Pierce Counties

**Germany had managed to reduce R0 to 0.7 earlier this month.

Note: These are most recent estimates available, except for Without Controls and Wuhan, which are from March.

- Social distancing and other control measures have reduced the reproduction number even in localities with some of the worst outbreaks.

Therapies and Vaccines: Recent Developments

1. Potential Therapies

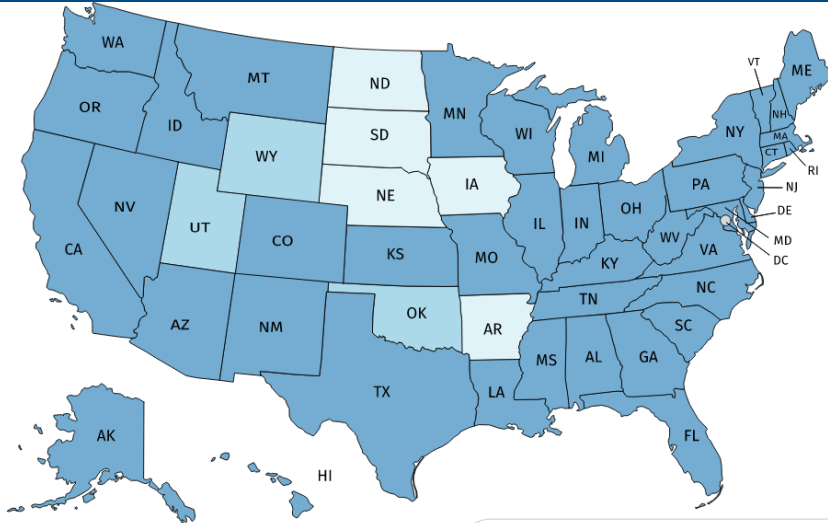
Product	Developer	Anticipated Next Steps
Remdesivir	Gilead	FDA's Emergency Authorization Use
Favilavir	Fujifilm	Phase 2 trial in US started April 2020
Chloroquine or hydroxychloroquine		RECOVERY trial results expected by June 2020
Lenzilumab	Humanigen, Inc.	Phase 3 recruitment expected
REGN3048-3051, Antibodies from mice	Regeneron	Phase 1 expected to start June 2020

2. Potential Vaccines

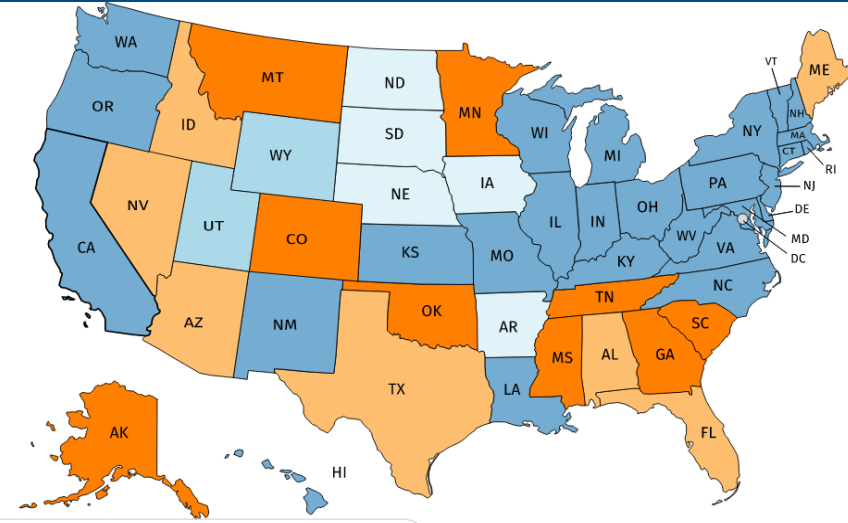
Product	Developer	Anticipated Next Steps
mRNA	Moderna	Phase 1 started March 2020, study ends June 2021; Phase 2 to start Q2 2020; Phase 3 to start fall 2020
Non-replicating viral vector; Ad26 (alone or with MVA boost)	Johnson&Johnson	FIH study starts in Sep 2020; First batches available in Q1 2021
Non-replicating viral vector; ChAdOx1	Jenner Institute, Oxford University	Phase 1/2 began April 2020
BCG Vaccine	Texas A&M University	Recruiting volunteers

Some US States Are Moving to Lift Restrictions

1. US states with restrictions in effect (week of 20 April 2020)

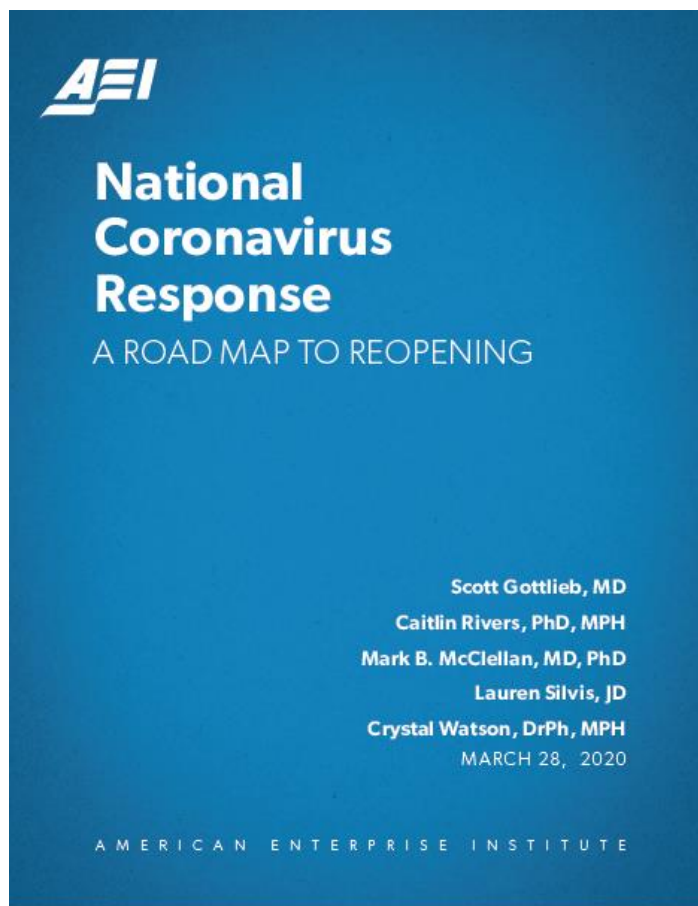


2. US states with restrictions in effect (week of 27 April)



- During the height of the pandemic from March to mid-April, the majority of US states imposed some level of temporary restrictions on socio-economic activities.
- Some governors are now moving to lift elements of these restrictions and more are expected to modify theirs as they approach the expiration date on their orders.

A Roadmap to Reopening

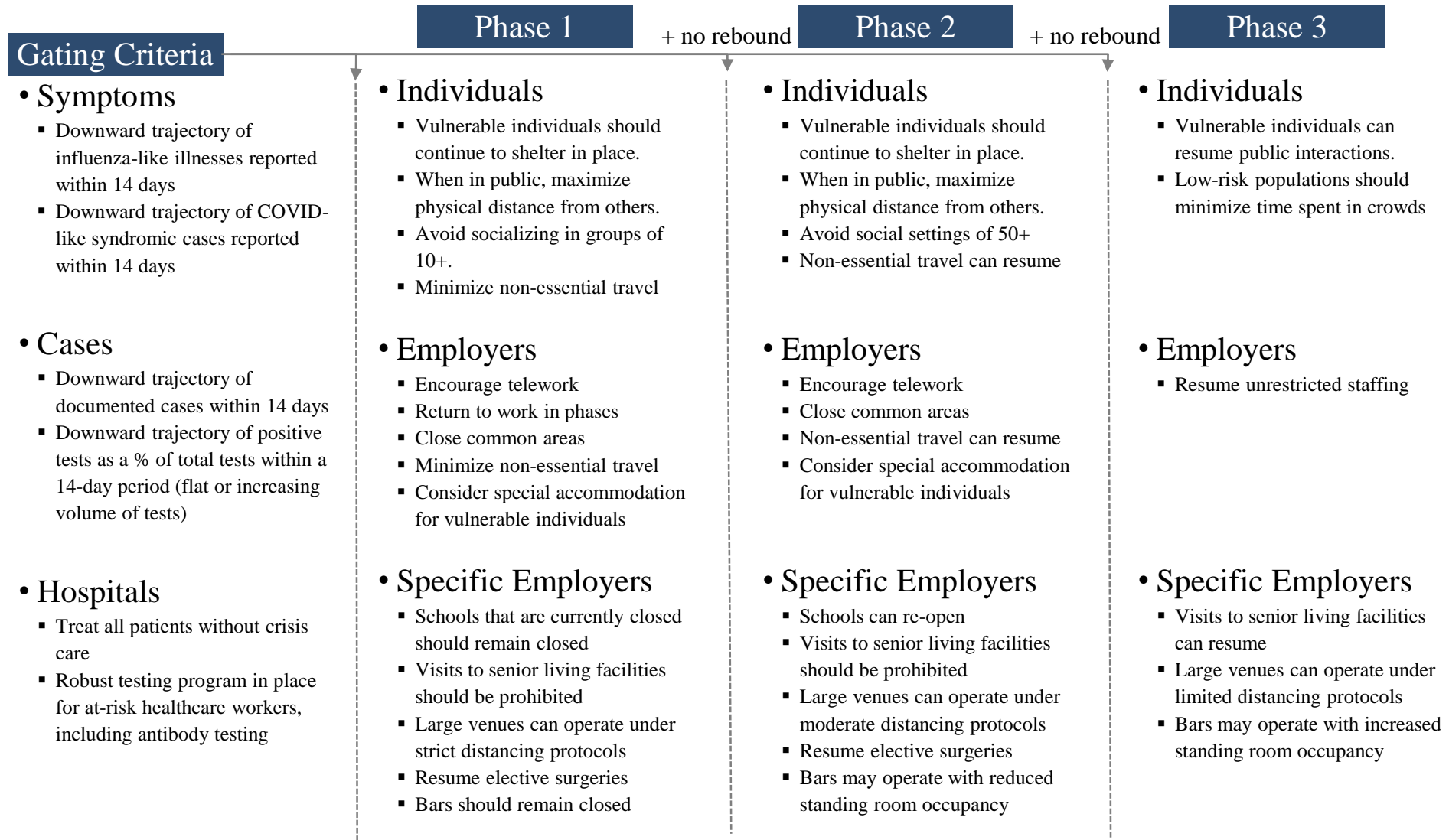


“

This report provides a road map for navigating through the current COVID-19 pandemic in the United States. It outlines specific directions for adapting our public-health strategy as we limit the epidemic spread of COVID-19 and are able to transition to new tools and approaches to prevent further spread of the disease. We outline the steps that can be taken as epidemic transmission is brought under control in different regions. These steps can transition to tools and approaches that target those with infection rather than mitigation tactics that target entire populations in regions where transmission is widespread and not controlled. We suggest measurable milestones for identifying when we can make these transitions and start reopening America for businesses and families.

”

White House Guidelines to Reopening



A Roadmap to Reopening

American Enterprise Institute National Coronavirus Response: A Roadmap to Reopening¹

Phase 1

Slow the Spread

- Maintain physical distancing
- Increase testing capacity, build data sharing infrastructure
- Ensure functioning of health care system
- Increase supply of PPE
- Implement surveillance systems
- Scale contact tracing, isolation and quarantine
- Encourage public to wear masks

Phase 2

State by State Re-opening

- Implement case-based interventions
- Begin to relax physical distancing measures
- Special care for vulnerable populations
- Accelerate development of therapeutics
- Identify those who are immune

Phase 3

Establish Immune Protection; Lift Physical Distancing

- Mass vaccination or therapeutic distribution when supply is abundant
- Global vaccine scale-up and vaccination
- Serological surveys to determine population immunity

Phase 4

Rebuild Readiness for Next Pandemic

- Develop vaccines for novel viruses in months, not years
- Modernize & fortify the health care system
- Establish a national infectious disease forecasting center
- Move to coordinated governance system

Triggers to Move to Next Phase

- Sustained reduction in cases for 14 days
- Safe hospital care without crisis standards
- Able to test all people with symptoms
- Active monitoring of confirmed cases and their contacts

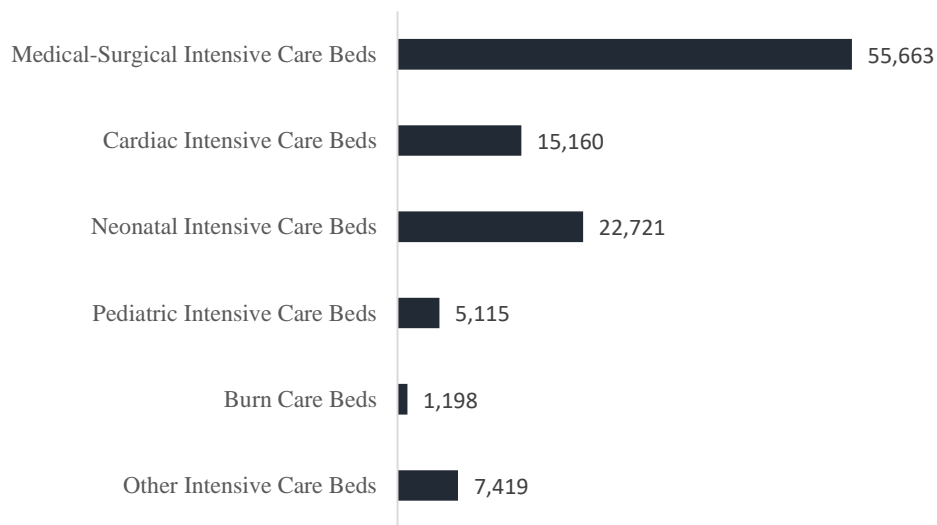


- Once a vaccine has been developed, has been tested for safety and efficacy, and receives FDA emergency use authorization, states can move to Phase III



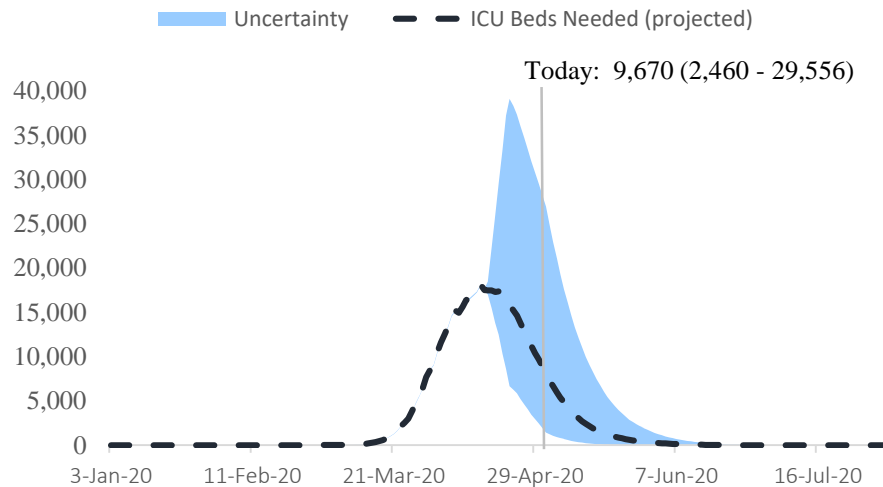
ICUs Appear to Have Withstood the High Demands of this Wave of the Outbreak

1. Total Intensive Care Beds Capacity in US Community Hospitals



Note: Intensive care bed counts as reported to the American Hospital Associations. Total intensive care beds are not summed because the care provided is specialized.

2. Projected COVID-19 Related ICU Needs (per day)*

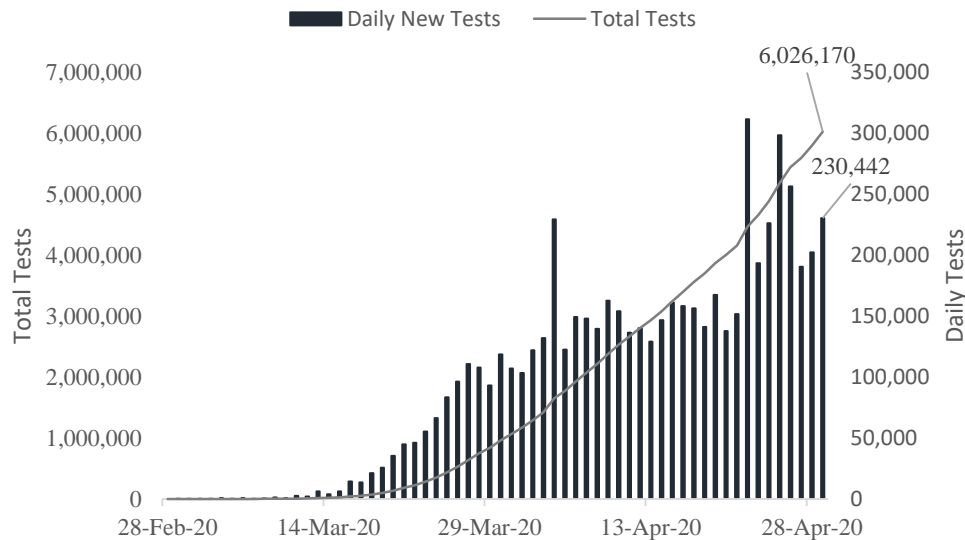


*Based on modeling done by the Institute for Health Metrics and Evaluation

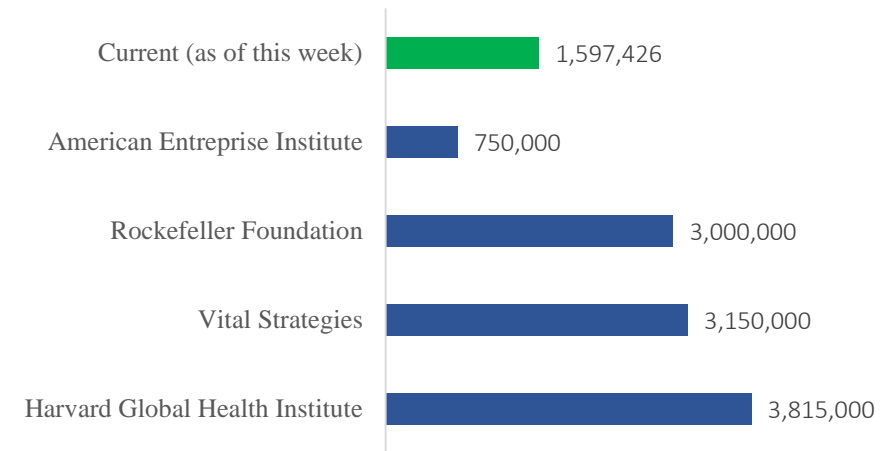
- The expansion of ICU capacity in places like New York and California and efforts by doctors, nurses, and other healthcare professionals avoided overwhelming the healthcare system during the peak of this wave of the outbreak.

Diagnostic Testing – Key to Re-opening the Economy

1. Diagnostic Testing in the United States



2. Current and Recommend Diagnostic Testing Levels (per week)



*Note: Rockefeller Foundation's recommendation above is the minimum. The recommended maximum is 30,000,000 tests per week.

- After initial struggles, diagnostic testing for COVID-19 in the United States has improved considerably.
- As more states move to lift their restrictions and businesses prepare to re-start their activities, demand for both diagnostic and anti-body testing is likely to increase further.

Contact Tracing Through Apps

- CDC deems contact tracing a key strategy for preventing further spread of COVID-19.
- However, contact tracing is a labor-intensive process.
 - During the high of the outbreak in Wuhan, Chinese authorities dispatched more than 1,800 teams, with a minimum of 5 people per team to trace tens of thousands of contacts a day.
 - In the US, the CDC has indicated that a substantial expansion of public health fieldworkers will be needed to undertake contact tracing. Independent assessments have suggested that some 300,000 fieldworkers may be needed in order to effectively conduct contact tracing.
- A number of countries are turning to smartphone apps to help with contact tracing.
- In the US, Apple and Google are expected to release by mid-May a mobile software tool that will let iPhones and Android devices talk to each other and enable future digital contact tracing.

1. Select Contact Tracing Apps And Developers Around the World



Australia



Norway



China



Czechia



Israel



Iceland



North Macedonia



TraceTogether

Singapore



STOPP
CORONA

Austria



Mount Sinai Laboratory's COVID-19 Antibody Test

1. COVID-19 ELISA IgG Antibody Test

- On March 17, a team led by virologist Florian Krammer, PhD, at Mount Sinai, managed to develop the first in the nation serological enzyme-linked immunosorbent assay (ELISA) test
- There are three main advantages to this test:
 - Providing an accurate picture of how many people have been infected;
 - Identifying people with new immunity to SARS-CoV-2 who could care for COVID-19 patients at zero or minimal risk; and
 - Identifying newly recovered patients with high antibody levels who can donate their antibody-rich blood, known as convalescent plasma, to potentially save patients with severe COVID-19.
- On April 15, the US Food and Drug Administration authorized the emergency use of Mount Sinai's test.



US Serological Tests

1. List of FDA Authorized Serological Test (as of 27 April)

Date of EUA	Manufacturer	Technology
4/1/2020	Cellex Inc.	Serology IgM and IgG
4/14/2020	Ortho Clinical Diagnostics, Inc.	Serology Total Antibody
4/14/2020	Chembio Diagnostic System, Inc	Serology IgM and IgG
4/15/2020	Mount Sinai Laboratory	Serology IgG
4/24/2020	Autobio Diagnostics Co. Ltd.	Serology IgM and IgG
4/24/2020	DiaSorin Inc.	Serology IgG only
4/24/2020	Ortho-Clinical Diagnostics, Inc.	Serology IgG only
4/26/2020	Abbott Laboratories Inc.	Serology IgG only

- Anti-body tests are proliferating in the United States and internationally, but their quality is uneven.

Testing the results of anti-body tests

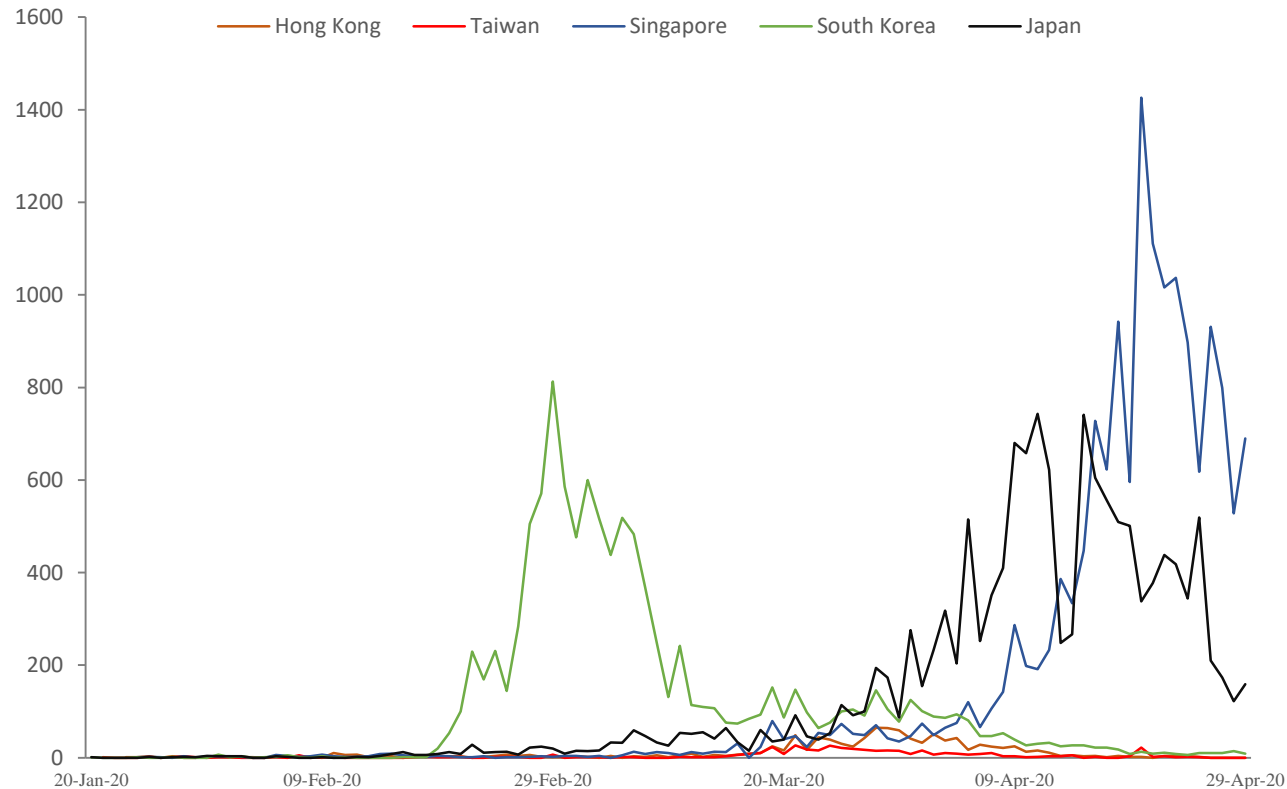
1. Specificity in blood donor plasma specimens collected before July 2018

	Total N	Positive	%	95% CI
Lateral Flow Assays (LFAs)				
BioMedomics (US)	107	14	86.92%	79.02-92.66
Bioperfectus (China)	104	5	95.19%	89.14-.98.42
DecomBio (China)	107	11	89.72%	82.35-94.76
DeepBlue (China)	108	17	84.26%	76.00-90.55
Innovita (China)	108	4	96.30%	90.79-98.98
Premier Biotech (US)	108	3	97.22%	92.10-99.42
Sure Biotech (US/HK)	108	0	100.00%	96.64-100.00
UCP (US)	107	2	98.13%	93.41-99.77
VivaChek (US)	99	5	94.95%	88.61-98.34
Wondfo Biotech (China)	106	1	99.06%	94.86-99.98
Enzyme-linked immunosorbent assays (ELISAs)				
Epitope	108	11	89.81%	82.51-94.80
Krammer Lab, Mount Sinai	108	1	99.07%	94.95-99.98

- A recent analysis of 10 rapid tests that deliver a yes-no signal for antibodies (LFAs) and two tests using a lab technique known as ELISA demonstrated specificity greater than >99% only for two LFAs (Sure Biotech, Wondfo) and one ELISA (Krammer Lab, Mount Sinai Hospital)
- False positives can become dangerous when making policy and personal decisions about who can go back to work.

A Second Wave or a Temporary Breakdown in Strategy?

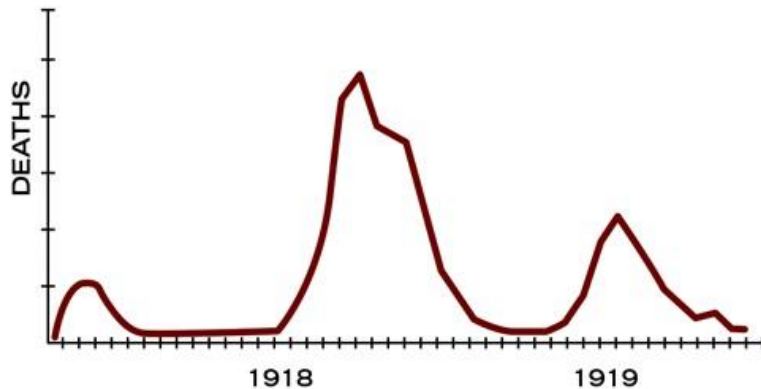
1. Daily New Infections



- After successfully containing the initial outbreak in January and February, Japan and Singapore have recently experienced an increase in the new number of infections.

Likelihood of Additional Waves

1. The 1918 Flu Pandemic (H1N1 Virus) – “Spanish Flu”



Note: There were 3 different waves of illness during the pandemic, starting in March 1918 and subsiding by summer of 1919. Pandemic peaked in the U.S. during the second wave, in the fall of 1918. This highly fatal second wave was responsible for most of the U.S. deaths attributed to the pandemic.

“There’s a possibility that the assault of the virus on our nation next winter will actually be even more difficult than the one we just went through... We’re going to have the flu epidemic and the coronavirus epidemic at the same time.

CDC Director Robert Redfield
Interview with The Washington Post
21 April 2020

2. China: Some Restrictions Re-Imposed Due to Imported Cases



“[A second round of the coronavirus] is inevitable... If by that time we have put into place all of the countermeasures that you need to address this, we should do reasonably well. If we don't do that successfully, we could be in for a bad fall and a bad winter.

NIAD Director Anthony Fauci
Interview with CNN
29 April 2020

Consumer and Investment Management Division

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Period	Gross Return	Net Return	Differential
1 year	6.17%	4.61%	1.56%
2 years	12.72%	9.43%	3.29%
10 years	81.94%	56.89%	25.05%

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