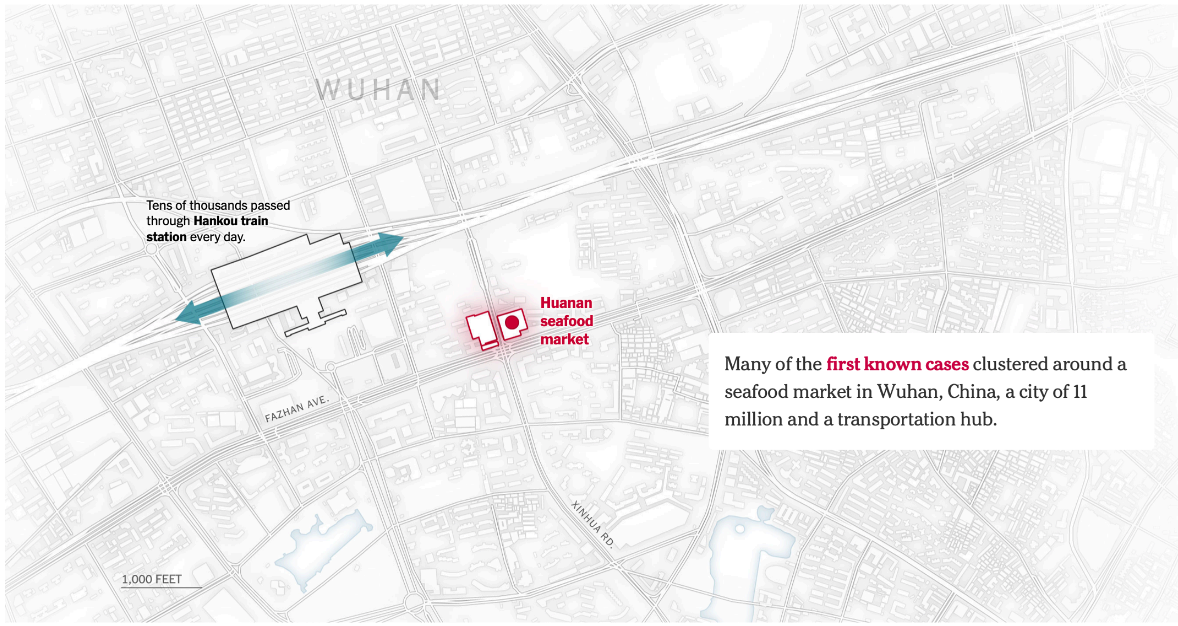
Covid-19: Why did it occur and what is the future?

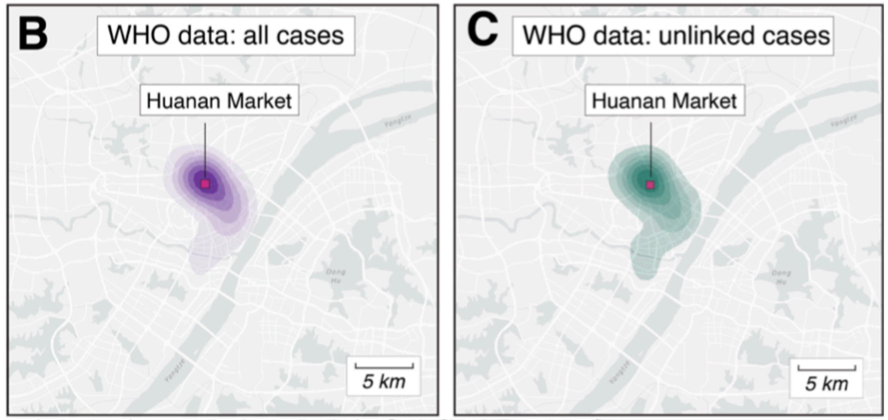
Jeremy Samuel Faust, MD MS FACEP, March 26, 2022

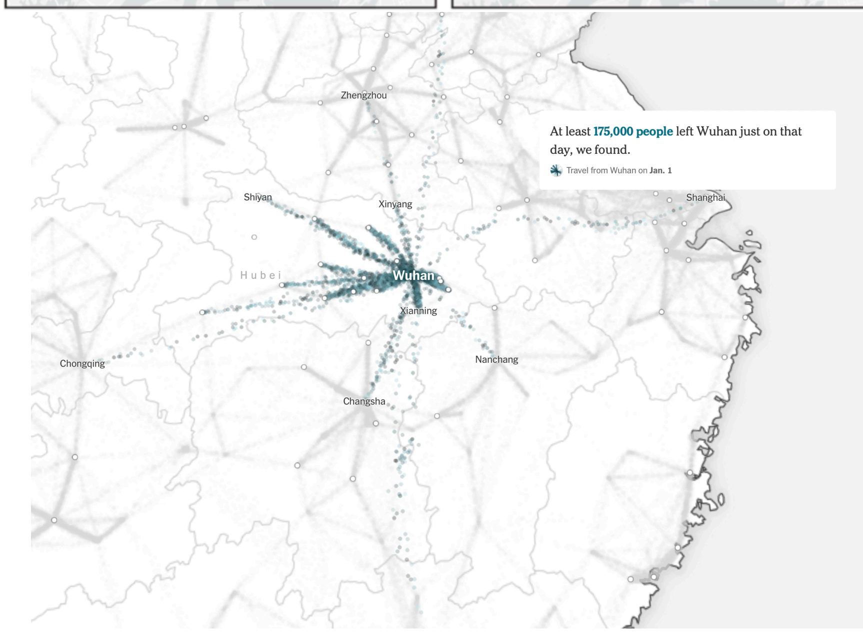
Objectives

1. Describe the early Covid-19 outbreak.
2. Describe early response in the US and elsewhere.
3. Lessons learned from Covid-19 so far.
4. Applying those lessons to Covid-19 and future outbreaks.

Part 1.


WUHAN
Tens of thousands passed through **Hankou train station** every day.
Huanan seafood market
FAZHAN AVE.
XINHUA RD.
1,000 FEET
Many of the **first known cases** clustered around a seafood market in Wuhan, China, a city of 11 million and a transportation hub.





https://zenodo.org/record/6299600#.YjeSNS9h1dA

Table 2. Live mammals traded at the Huanan market, November and December 2019

Species (Susceptibility*)	Family (Susceptibility*)	Order (Susceptibility*)	Observed at Huanan market, November 2019	Observed at Huanan market, December 2019**
Raccoon dog *(Nyctereutes procyonoides)* (**Y**)	Canidae (**Y**)	Carnivora (**Y**)	Y	Y
Amur hedgehog *(Erinaceus amurensis)*	Erinaceidae	Eulipotyphla	Y	ND***
Hog badger *(Arctonyx albogularis)* (**Y**)	Mustelidae (**Y**)	Carnivora (**Y**)	Y	ND
Asian badger *(Meles leucurus)*	Mustelidae (**Y**)	Carnivora (**Y**)	Y	ND
Chinese hare *(Lepus sinensis)*	Leporidae (Y)	Lagomorpha (Y)	Y	ND
Chinese bamboo rat *(Rhizomys sinensis)* (**Y**)	Spalacidae (**Y**)	Rodentia (**Y**)	Y	ND
Malayan porcupine *(Hystrix brachyura)*	Hystricidae	Rodentia (**Y**)	Y	Y
Chinese muntjac *(Muntiacus reevesi)*	Cervidae (**Y**)	Artiodactyla (**Y**)	Y	Y
Marmot *(Marmota himalayana)*	Sciuridae	Rodentia (**Y**)	Y	Y
Red fox *(Vulpes vulpes)* (**Y**)	Canidae (**Y**)	Carnivora (**Y**)	Y	Y
Siberian weasel *(Mustela sibirica)*	Mustelidae (**Y**)	Carnivora (**Y**)	N****	ND
Pallas's squirrel *(Callosciurus erythraeus)*	Sciuridae	Rodentia (**Y**)	N	ND
Masked palm civet *(Paguma larvata)* (**Y**)	Viverridae (**Y**)	Carnivora (**Y**)	N	ND
Coypu *(Myocastor coypus)*	Echimyidae	Rodentia (**Y**)	N	ND
Mink *(Neovison vison)* (**Y**)	Mustelidae (**Y**)	Carnivora (**Y**)	N	ND
Red squirrel *(Sciurus vulgaris)*	Sciuridae	Rodentia (**Y**)	N	ND
Wild boar *(Sus scrofa)* (**Y**)	Suidae (**Y**)	Artiodactyla (**Y**)	N	ND
Complex-toothed flying squirrel *(Trogopterus xanthipes)*	Sciuridae	Rodentia (**Y**)	N	ND

*Based on live susceptibility findings, serological findings, or ACE2 binding assays. See Table S3 for details and associated references.

**From photographic evidence from 3 December, 2019. (See Supplemental Materials.)

***ND = no data.

****Animals listed as "No" were, however, present at Wuhan markets during the 2017-2019 study period (*11*)v

https://zenodo.org/record/6299600#.YjeSNS9h1dA

Figure 3. Photographs from inside the Huanan market. **A-C**: photographs taken by a concerned citizen on 3 December, 2019, posted on Weibo and reported by CNN (*37*). **D, E**: photographs taken by one of us (E.C.H.) in the western section of the Huanan market on 29 October, 2014. Note that the raccoon dogs appear to be local, wild-caught common raccoon dogs rather than farmed raccoon dogs and that their plush coats are consistent with those observed in the winter. Note the red fox in the top right of panel **B**.

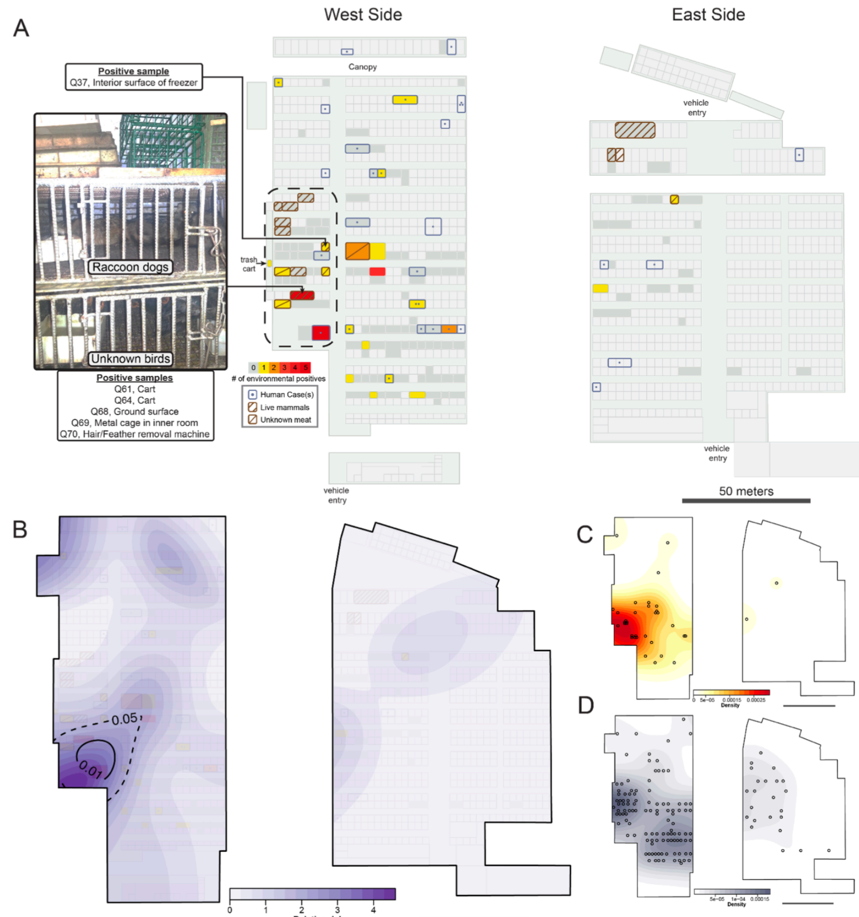


Figure 4. Map of the Huanan Wholesale Seafood Market. A. Aggregated environmental sampling and human case data from Huanan Market. Captions (left) describe the types of SARS-CoV-2 positive environmental samples obtained from known live animal vendors. Image (left) of raccoon dogs in a metal cage, on top of caged birds, taken in business with five positive environmental samples. Rectangle with dashed outline is used to denote the 'wildlife' section of the market. **B.** Relative risk analysis of positive environmental samples. Tolerance contours enclose regions with statistically significant elevation in density of positive environmental samples relative to the distribution of sampled stalls. **C.** Distribution of positive environmental samples. Sample locations (centroid of corresponding business) and quantity are shown as black circles. **D.** Distribution of businesses investigated with environmental sampling, with sampling locations shown as black circles. See Table S6 for details on environmental samples that were SARS-CoV-2-negative.

https://zenodo.org/record/6299600#.YjeSNS9h1dA


Why?

Spectrum of disease

Research Letter

February 21, 2020

FREE

Presumed Asymptomatic Carrier Transmission of COVID-19

Yan Bai, MD[1]; Lingsheng Yao, MD[2]; Tao Wei, MD[3]; et al

Author Affiliations | Article Information

JAMA. 2020;323(14):1406-1407. doi:10.1001/jama.2020.2565

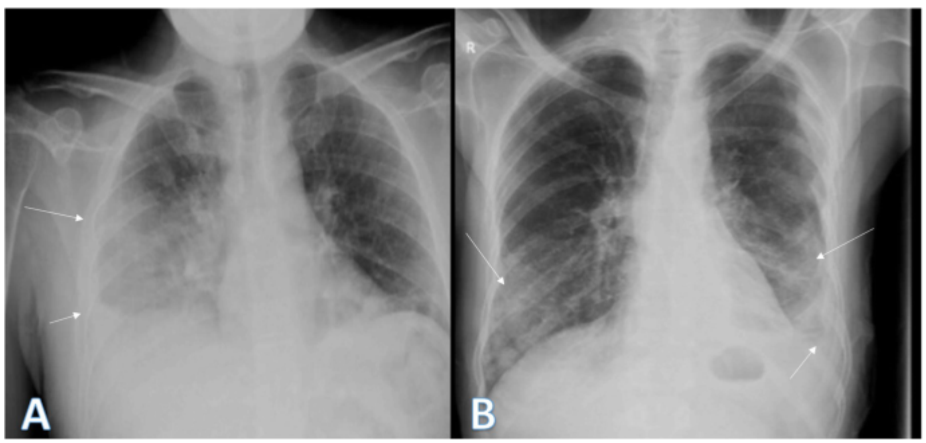
COVID-19 Resource Center

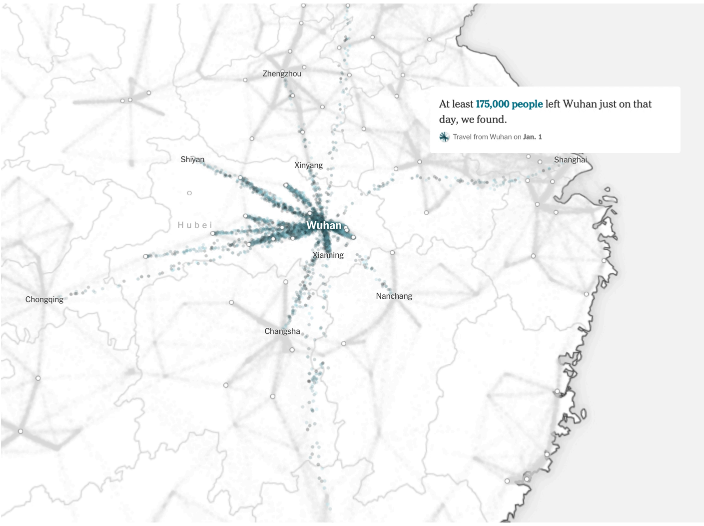
Editorial Comment | Related Articles | Interviews

The NEW ENGLAND JOURNAL of MEDICINE

CORRESPONDENCE

Transmission of 2019-nCoV Infection from an Asymptomatic Contact in Germany




At least 175,000 people left Wuhan just on that day, we found.
Travel from Wuhan on Jan. 1
Zhengzhou
Shiyan
Xinyang
Shanghai
Hubei
Wuhan
Xianning
Chongqing
Nanchang
Changsha


77
85
%SpO2
PRbpm

COVID-19 pandemic on board *Diamond Princess*

Diamond Princess, off Toba, Mie Prefecture, Japan, December 2019

Disease	COVID-19
Virus strain	SARS-CoV-2
Location	Pacific Ocean
First outbreak	Wuhan, Hubei, China
Index case	*Diamond Princess*
Arrival date	5 February 2020
Confirmed cases	712
Deaths	7 to 14

Clinical Infectious Diseases

MAJOR ARTICLE

Serologic Testing of US Blood Donations to Identify Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2)–Reactive Antibodies: December 2019–January 2020

Sridhar V. Basavaraju,[1] Monica E. Patton,[1] Kacie Grimm,[2] Mohammed Ata Ur Rasheed,[2] Sandra Lester,[2] Lisa Mills,[3] Megan Stumpf,[3] Brandi Freeman,[1] Azaibi Tamin,[1] Jennifer Harcourt,[1] Jarad Schiffer,[1] Vera Semenova,[1] Han Li,[1] Bailey Alston,[4] Muyiwa Ategbole,[5] Shanna Bolcen,[1] Darbi Boulay,[1] Peter Browning,[1] Li Cronin,[1] Ebenezer David,[6] Rita Desai,[1] Monica Epperson,[1] Yamini Gorantla,[5] Tao Jia,[1] Panagiotis Maniatis,[1] Kimberly Moss,[4] Kristina Ortiz,[4] So Hee Park,[4] Palak Patel,[6] Yunlong Qin,[4] Evelene Steward-Clark,[1] Heather Tatum,[5] Andrew Vogan,[4] Briana Zellner,[7] Jan Drobeniuc,[1] Matthew R. P. Sapiano,[1] Fiona Havers,[1] Carrie Reed,[1] Susan Gerber,[1] Natalie J. Thornburg,[1] and Susan L. Stramer[2]

[1]Centers for Disease Control and Prevention, Atlanta, Georgia, USA, [2]American Red Cross, Scientific Affairs, Gaithersburg, Maryland, USA, [3]Synergy America, Inc, Atlanta, Georgia, USA, [4]Eagle Global Scientific, Atlanta, Georgia, USA, [5]IHRC, Atlanta, Georgia, USA, [6]CFD Research Corporation, Huntsville, Alabama, USA, and [7]Oak Ridge Institute for Science and Education, Oak Ridge, Tennessee, USA

(See the Major Article by Reed et al on pages e1010–7 and the Editorial Commentary by Rosenberg and Bradley on pages e1018–20)

Background. Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), the virus that causes coronavirus disease 2019 (COVID-19), was first identified in Wuhan, China, in December 2019, with subsequent worldwide spread. The first US cases were identified in January 2020.

Methods. To determine if SARS-CoV-2–reactive antibodies were present in sera prior to the first identified case in the United States on 19 January 2020, residual archived samples from 7389 routine blood donations collected by the American Red Cross from 13 December 2019 to 17 January 2020 from donors resident in 9 states (California, Connecticut, Iowa, Massachusetts, Michigan, Oregon, Rhode Island, Washington, and Wisconsin) were tested at the Centers for Disease Control and Prevention for anti–SARS-CoV-2 antibodies. Specimens reactive by pan-immunoglobulin (pan-Ig) enzyme-linked immunosorbent assay (ELISA) against the full spike protein were tested by IgG and IgM ELISAs, microneutralization test, Ortho total Ig S1 ELISA, and receptor-binding domain/ACE2 blocking activity assay.

Results. Of the 7389 samples, 106 were reactive by pan-Ig. Of these 106 specimens, 90 were available for further testing. Eighty-four of 90 had neutralizing activity, 1 had S1 binding activity, and 1 had receptor-binding domain/ACE2 blocking activity >50%, suggesting the presence of anti–SARS-CoV-2–reactive antibodies. Donations with reactivity occurred in all 9 states.

Conclusions. These findings suggest that SARS-CoV-2 may have been introduced into the United States prior to 19 January 2020.

Keywords. SARS-CoV-2; blood donors; antibody.

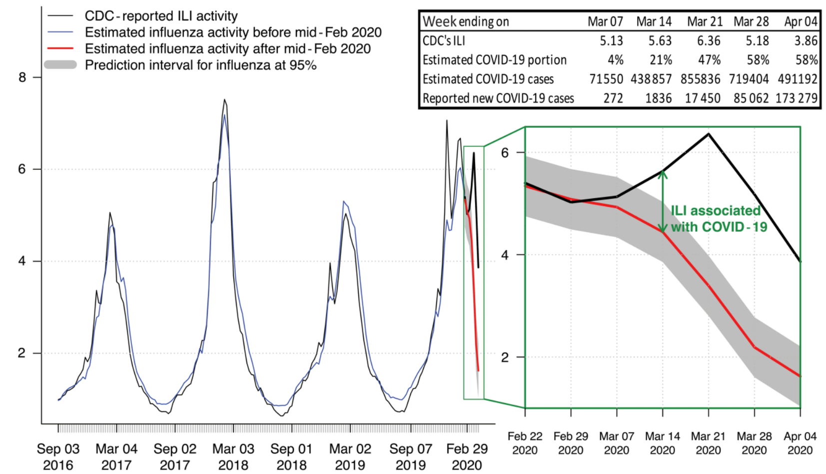
Clinical Infectious Diseases

BRIEF REPORT

Unmasking the Actual COVID-19 Case Count

Samuel C. Kou,[1] Shihao Yang,[2] Chia-Jung Chang,[3] Teck-Hua Ho,[4] and Lisa Graver[5]

[1]Department of Statistics, Science Center, Harvard University, Cambridge, Massachusetts, USA, [2]Harvard Medical School, Boston, Massachusetts, USA, [3]State Street Corporation, Boston, Massachusetts, USA, [4]National University of Singapore, Singapore, and [5]Alvogen Inc, Pine Brook, New Jersey, USA



Week ending on	Mar 07	Mar 14	Mar 21	Mar 28	Apr 04
CDC's ILI	5.13	5.63	6.36	5.18	3.86
Estimated COVID-19 portion	4%	21%	47%	58%	58%
Estimated COVID-19 cases	71550	438857	855836	719404	491192
Reported new COVID-19 cases	272	1836	17 450	85 062	173 279

Figure 1. The estimated influenza level before and after mid-February 2020. Prior to mid-February 2020, our estimated influenza level (blue line) closely matches the Centers for Disease Control and Prevention (CDC)–reported influenza-like illness (ILI) level (black line), but significant gaps between the 2 levels (red and black lines) emerge after mid-February, which can be attributed to COVID-19. To estimate the COVID-19 weekly case counts shown in the figure, we used the ILI total counts reported in ILINet, the reported 8.5% sampling rate of ILINet, and the reported 50% ± 8% rate of persons with symptomatic ILI seeking medical care for their illness. For the reported rates, see https://www.cdc.gov/flu/about/burden/preliminary-in-season-estimates.htm and https://www.cdc.gov/flu/about/burden/how-cdc-estimates.htm.

Clinical Infectious Diseases

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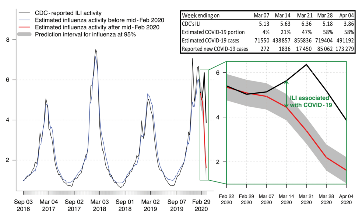

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Toward a Better Case Fatality Estimate for Severe Acute Respiratory Syndrome Coronavirus 2 During the Early Phase of the United States Outbreak FREE

Jeremy Samuel Faust

Clinical Infectious Diseases, Volume 71, Issue 11, 1 December 2020, Pages 2952–2954, https://doi.org/10.1093/cid/ciaa639

Table 1. Case Fatality Rates Derived From Denominators Suggested by the Model of Kou et al

Date	CFR-Symptomatic (Cumulative, 14 d After Case Count)	CFR Including Adjustment for Presymptomatic and/or Asymptomatic Cases (All Deaths Since Outbreak as of 14 d After Case Count)
7 March 2020	0.52	0.29
14 March 2020	0.54	0.30
21 March 2020	0.76	0.43
28 March 2020	1.15	0.65

Numerators are derived from death count from an online coronavirus disease 2019 tracker [7].

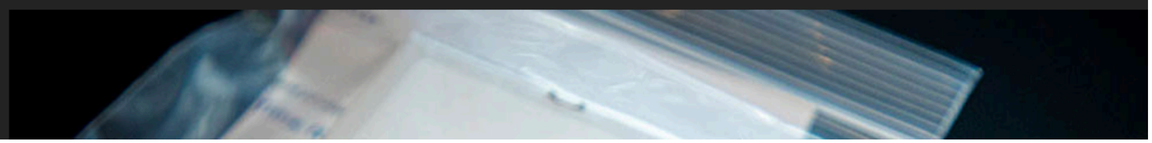
Abbreviation: CFR, case fatality rate.

SCIENCEINSIDER | SCIENTIFIC COMMUNITY

The United States badly bungled coronavirus testing—but things may soon improve

A faulty reagent in a test kit and bureaucratic hurdles have slowed testing for the virus that causes COVID-19

28 FEB 2020 • BY JON COHEN



459

35,000

1.6 million

Opinion: For useful covid-19 testing, we need to think outside the box — and outside the ER

By Jeremy Samuel Faust

March 11, 2020

A health worker on Wednesday at a community testing tent set up in Denver by the Colorado Department of Public Health and Environment. (Rj Sangosti/AP)

“Hospitals around the country are scrambling to meet the demand for identifying SARS-nCoV-2, the virus that causes covid-19. The need is clear: We need enough tests for every single American.”

Part 2.

Received: 23 April 2020 | Revised: 17 May 2020 | Accepted: 26 May 2020
DOI: 10.1002/emp2.12155

JACEP OPEN WILEY

LETTER TO THE EDITOR
Correspondence

Why the United States failed to contain COVID-19

Armin Nowroozpoor MD[1]
Esther K. Choo MD, MPH[2]
Jeremy S. Faust MD, MS[3]

- Lack of a recent historical precedent in the united states
- The varying reports on the characteristics of the disease
- The presumption that only elderly and patients with comorbidities at risk
- Fear of economic consequences
- *Fear of over-responding*

VIEWPOINT

Suicide Mortality and Coronavirus Disease 2019—A Perfect Storm?

Mark A. Reger, PhD
VA Puget Sound Health Care System, Seattle, Washington; and Department of Psychiatry and Behavioral Sciences, University of Washington, Seattle.

Ian H. Stanley, MS
VA Puget Sound Health Care System, Seattle, Washington; and Department of Psychology, Florida State University, Tallahassee.

Thomas E. Joiner, PhD
Department of Psychology, Florida State University, Tallahassee.

Suicide rates have been rising in the US over the last 2 decades. The latest data available (2018) show the highest age-adjusted suicide rate in the US since 1941.[1] It is within this context that coronavirus disease 2019 (COVID-19) struck the US. Concerning disease models have led to historic and unprecedented public health actions to curb the spread of the virus. Remarkable social distancing interventions have been implemented to fundamentally reduce human contact. While these steps are expected to reduce the rate of new infections, the potential for adverse outcomes on suicide risk is high. Actions could be taken to mitigate potential unintended consequences on suicide prevention efforts, which also represent a national public health priority.

COVID-19 Public Health Interventions and Suicide Risk

Secondary consequences of social distancing may increase the risk of suicide. It is important to consider changes in a variety of economic, psychosocial, and health-associated risk factors.

Decreased Access to Community and Religious Support

Many Americans attend various community or religious activities. Weekly attendance at religious services has been associated with a 5-fold lower suicide rate compared with those who do not attend.[4] The effects of closing churches and community centers may further contribute to social isolation and hence suicide.

Barriers to Mental Health Treatment

Health care facilities are adding COVID-19 screening questions at entry points. At some facilities, children and other family members (without an appointment) are not permitted entry. Such actions may create barriers to mental health treatment (eg, canceled appointments associated with child restrictions while school is canceled). Information in the media may also imply that mental health services are not prioritized at this time (eg, portrayals of overwhelmed health care settings, canceled elective surgeries). Moreover, overcrowded emergency departments may negatively affect services for survivors of suicide attempts. Reduced access to mental health care could negatively affect patients with suicidal ideation.

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JAMA Network Open

Research Letter | Public Health

Suicide Deaths During the COVID-19 Stay-at-Home Advisory in Massachusetts, March to May 2020

Jeremy Samuel Faust, MD, MS; Sejal B. Shah, MD; Chengan Du, PhD; Shu-Xia Li, PhD; Zhenqiu Lin, PhD; Harlan M. Krumholz, MD, SM

Introduction

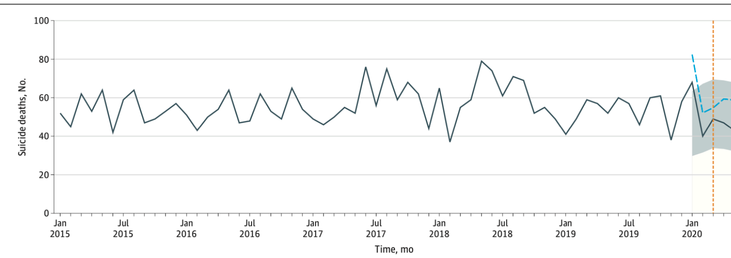
Many policy makers believe that shelter-in-place or stay-at-home policies could cause an increase in what are known as deaths of despair. While increases in psychiatric stressors during the coronavirus disease 2019 (COVID-19) pandemic have been reported, it is presently unknown whether suicide rates similarly changed during stay-at-home periods.[1,2]

Author affiliations and article information are listed at the end of this article.

Methods

In this cohort study, we assembled suicide death data for persons aged 10 years and older from the Massachusetts Department of Health Registry of Vital Records and Statistics from January 2015 through May 2020. This study was not subject to institutional review board approval or the requirement for informed consent because it used public data. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) reporting guideline was followed.

Figure. Suicide Deaths in Massachusetts From January 2015 Through May 2020



The solid line indicates raw suicide death counts; the dashed blue line, raw suicide deaths plus deaths pending investigation by the state medical examiner that are in excess of monthly averages of active pending investigations during the corresponding months from 2015 to 2019; gray shaded area, projected range of suicide deaths expected to occur during 2020 using the seasonal adjusted model; vertical orange line, the start of the stay-at-home period.

Table. Age and Sex Demographic Characteristics Among Individuals Who Died by Suicide in Massachusetts

	Deaths, No./total No. (%)		Mean age, y		
Year	Women	Men	Women	Men	All
2015	44/180 (24.4)	136/180 (75.6)	47.6	47.5	47.6
2016	39/169 (23.1)	130/169 (76.9)	47.5	44.7	45.3
2017	38/157 (24.2)	119/157 (75.8)	49.7	44.2	45.5
2018	45/193 (23.3)	148/193 (76.7)	46.3	46.3	46.3
2019	37/166 (22.3)	129/166 (77.7)	44.4	50.0	48.8
2020	34/139 (24.5)	105/139 (75.5)	44.7	49.9	48.6

VIEWPOINT

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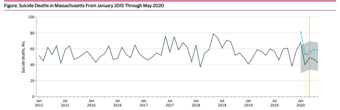

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Research Letter

FREE

May 21, 2021

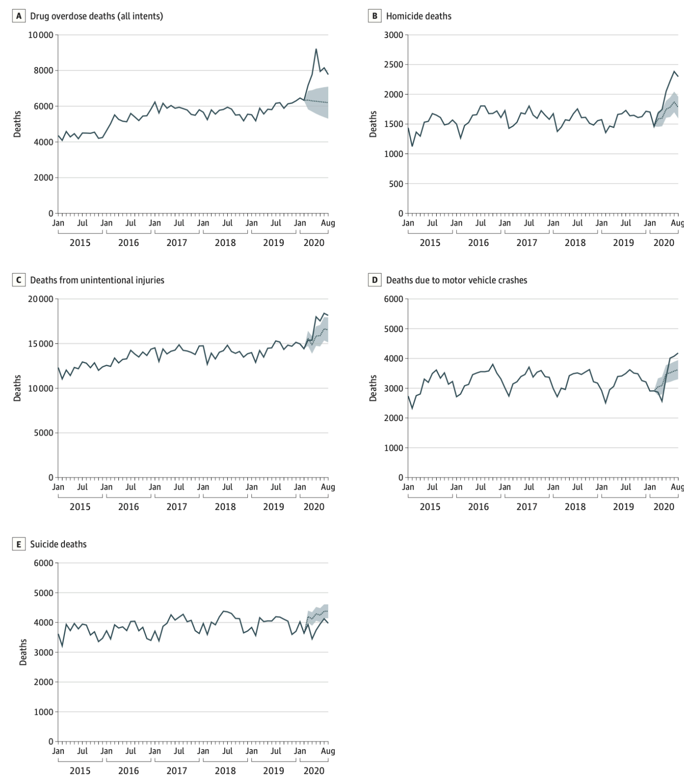
Mortality From Drug Overdoses, Homicides, Unintentional Injuries, Motor Vehicle Crashes, and Suicides During the Pandemic, March-August 2020

Jeremy S. Faust, MD, MS[1]; Chengan Du, PhD[2]; Katherine Dickerson Mayes, MD, PhD[3]; et al

Author Affiliations | Article Information

JAMA. 2021;326(1):84-86. doi:10.1001/jama.2021.8012

Figure. Cause-Specific Mortality Due to Select External Causes in the US, January 2015 to August 2020



The solid line indicates raw cause-specific death counts from January 2015 to August 2020; the dotted line and shading represent the point estimate and projected 95% CI for cause-specific expected deaths from March to August 2020 using the seasonal adjusted model. The y-axes are raw death counts.

RECOVERY
Randomised Evaluation of COVID-19 Therapy

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UNIVERSITY OF OXFORD

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This international clinical trial aims to identify treatments that may be beneficial for people hospitalised with suspected or confirmed COVID-19

GLOBAL CUMULATIVE TOTALS

47337 Participants

194 Active sites

U.S. FOOD & DRUG
ADMINISTRATION

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FDA NEWS RELEASE

Coronavirus (COVID-19) Update: FDA Revokes Emergency Use Authorization for Chloroquine and Hydroxychloroquine

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GAO U.S. Government Accountability Office

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Operation Warp Speed:
Accelerated COVID-19 Vaccine Development Status and Efforts to Address Manufacturing Challenges

GAO-21-319

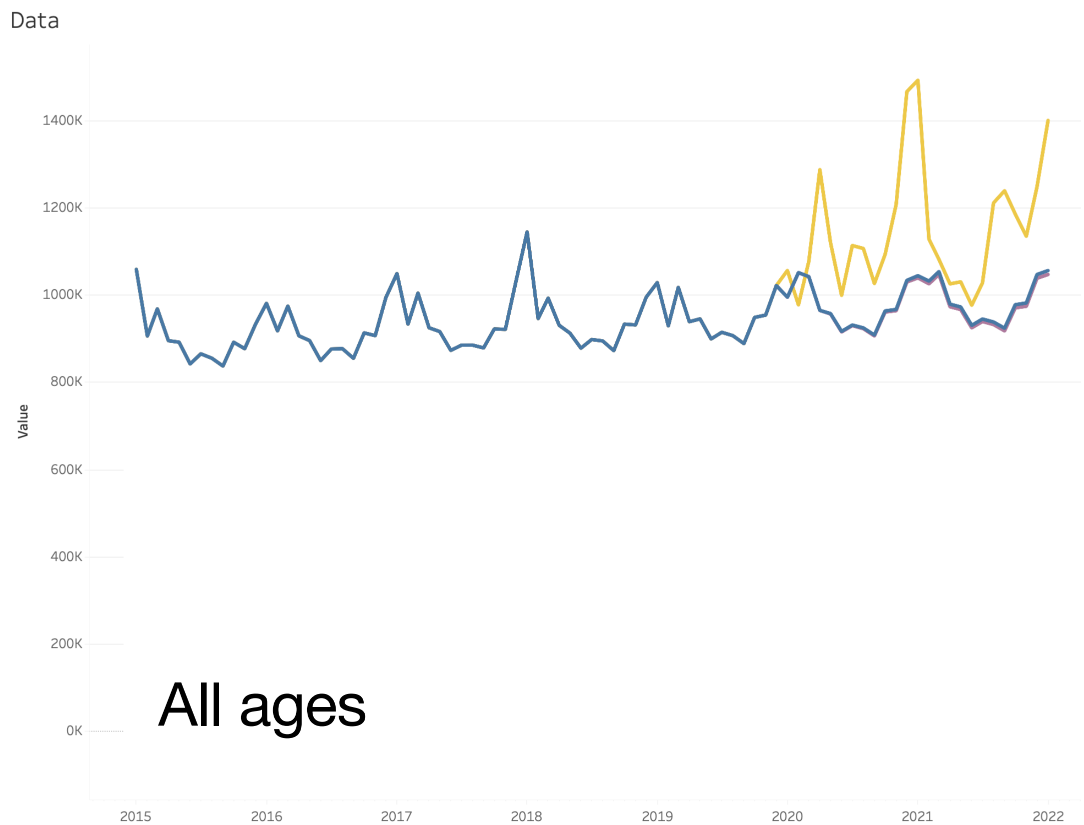
Published: Feb 11, 2021. Publicly Released: Feb 11, 2021.

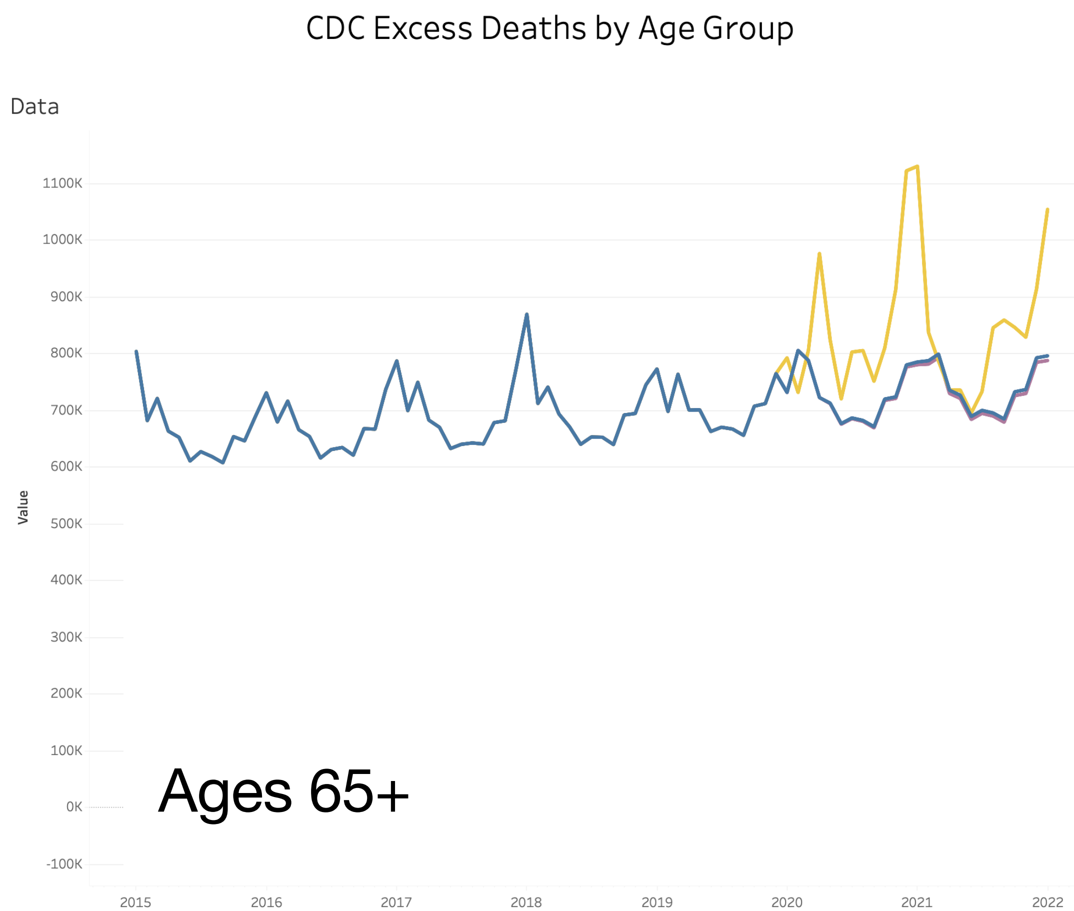
Part 3.

Some epidemiological findings.

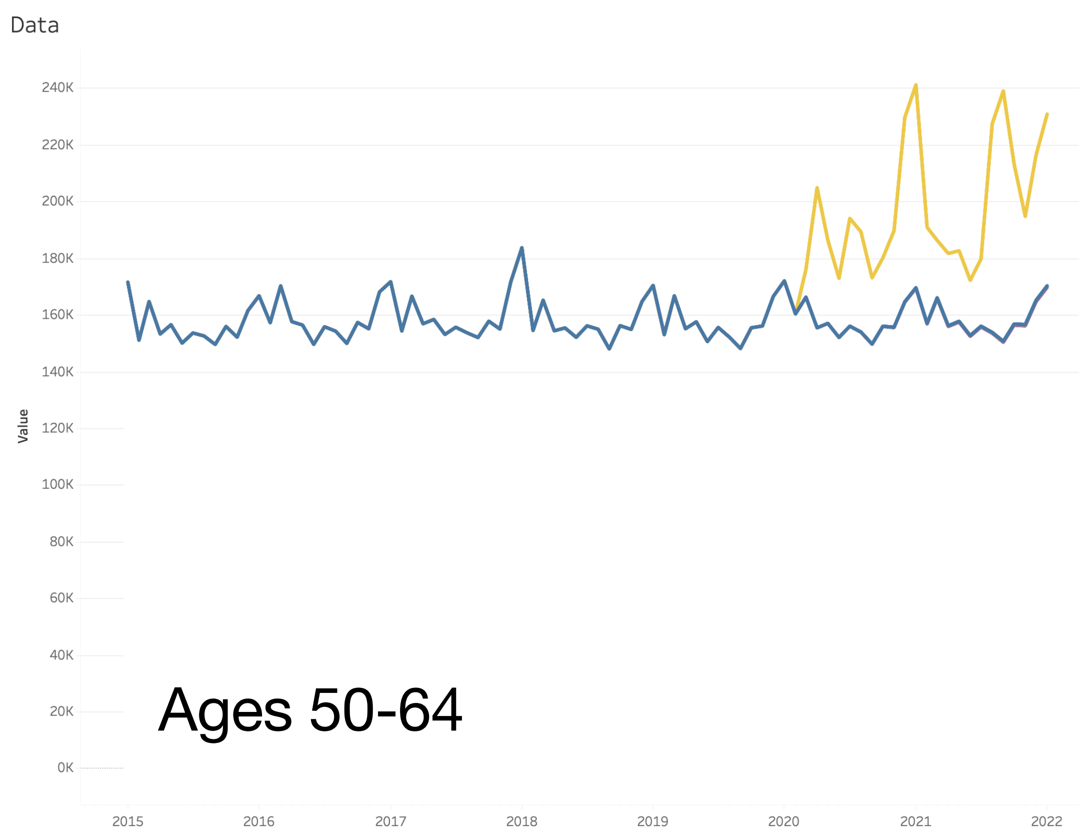
1. Excess mortality across ALL ages.
2. What we do matters.

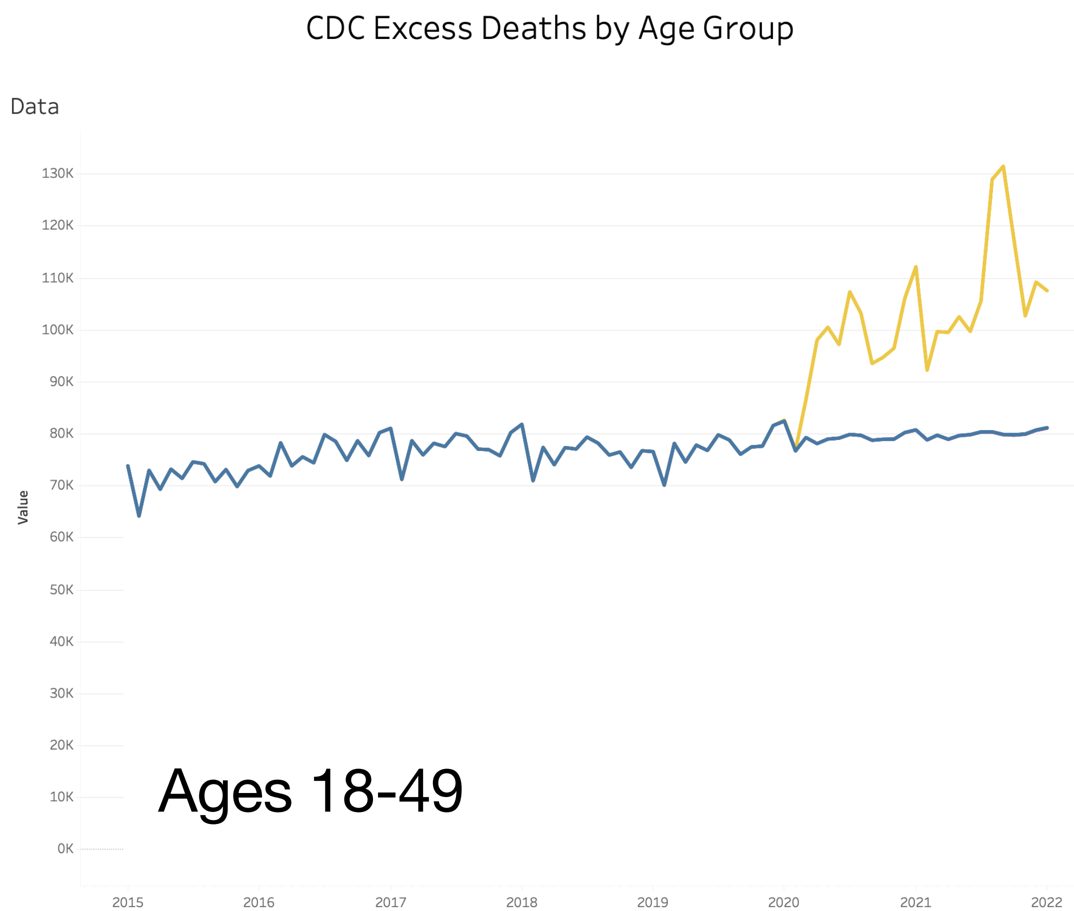
CDC Excess Deaths by Age Group



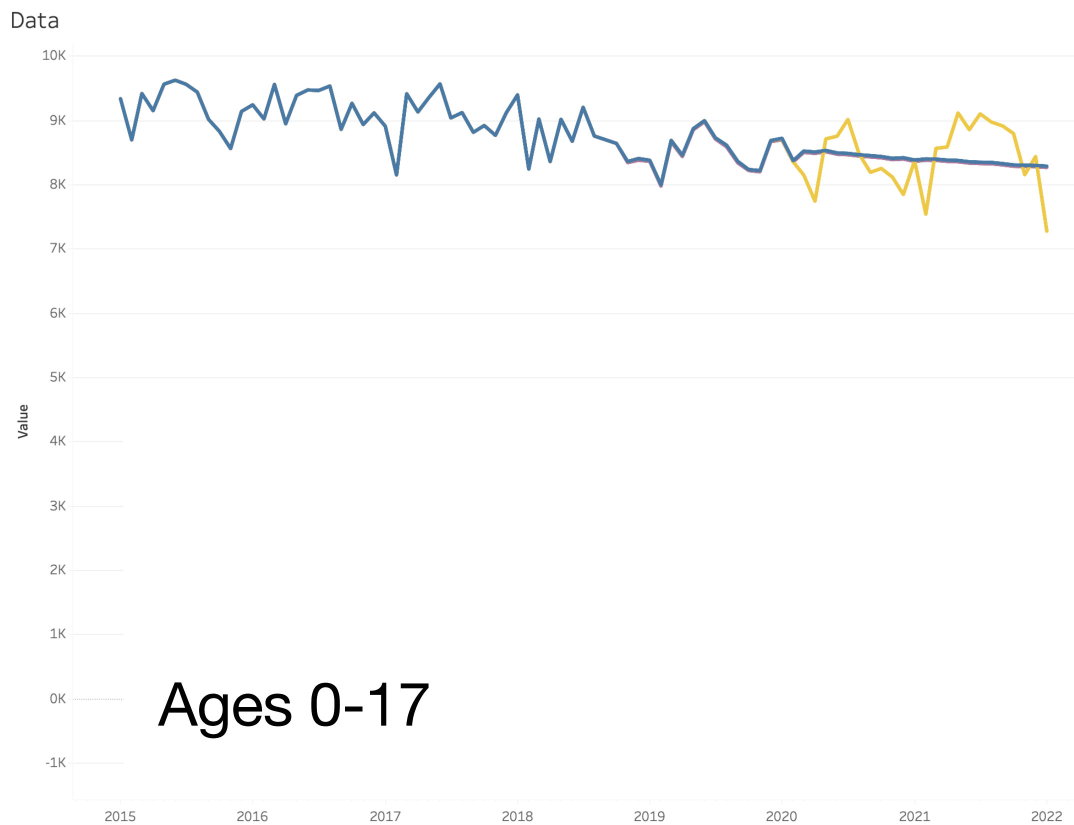

CDC Excess Deaths by Age Group
Data
Value
1100K
1000K
900K
800K
700K
600K
500K
400K
300K
200K
100K
0K
-100K
2015
2016
2017
2018
2019
2020
2021
2022
Ages 65+

CDC Excess Deaths by Age Group

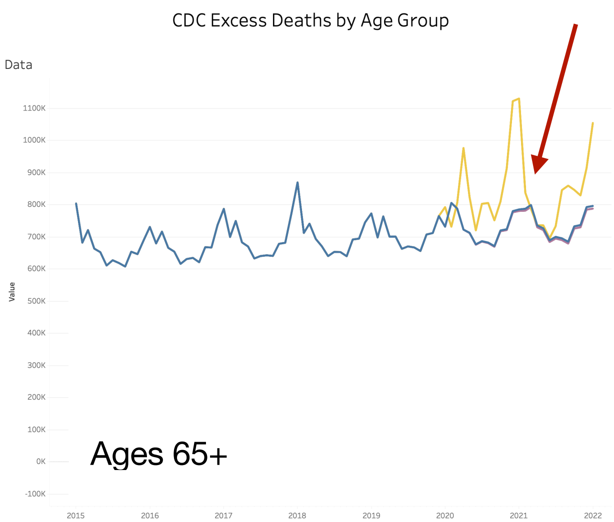


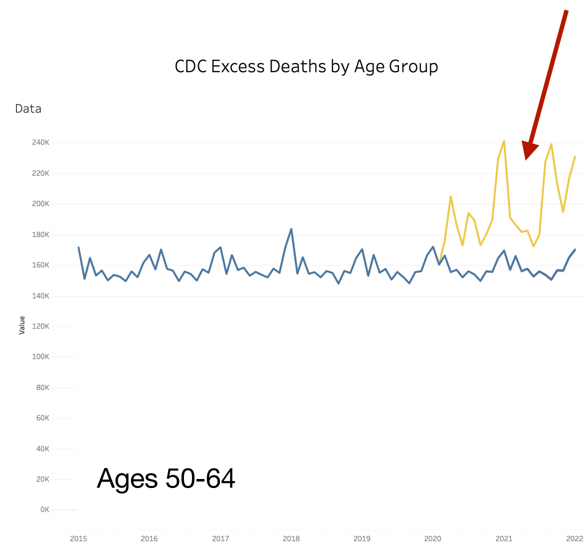

CDC Excess Deaths by Age Group
Data
Value
130K
120K
110K
100K
90K
80K
70K
60K
50K
40K
30K
20K
10K
0K
2015
2016
2017
2018
2019
2020
2021
2022
Ages 18-49

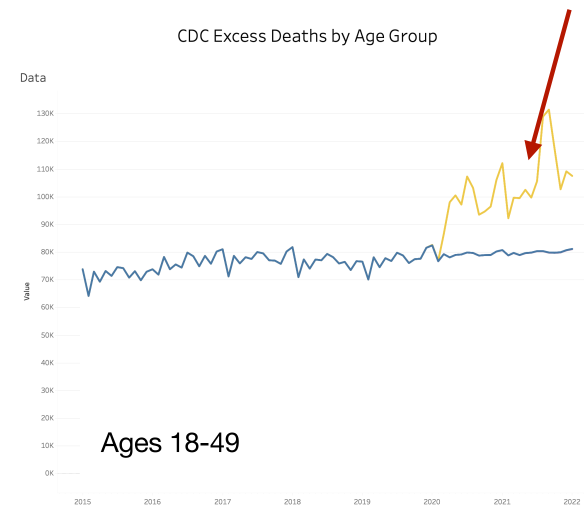
CDC Excess Deaths by Age Group

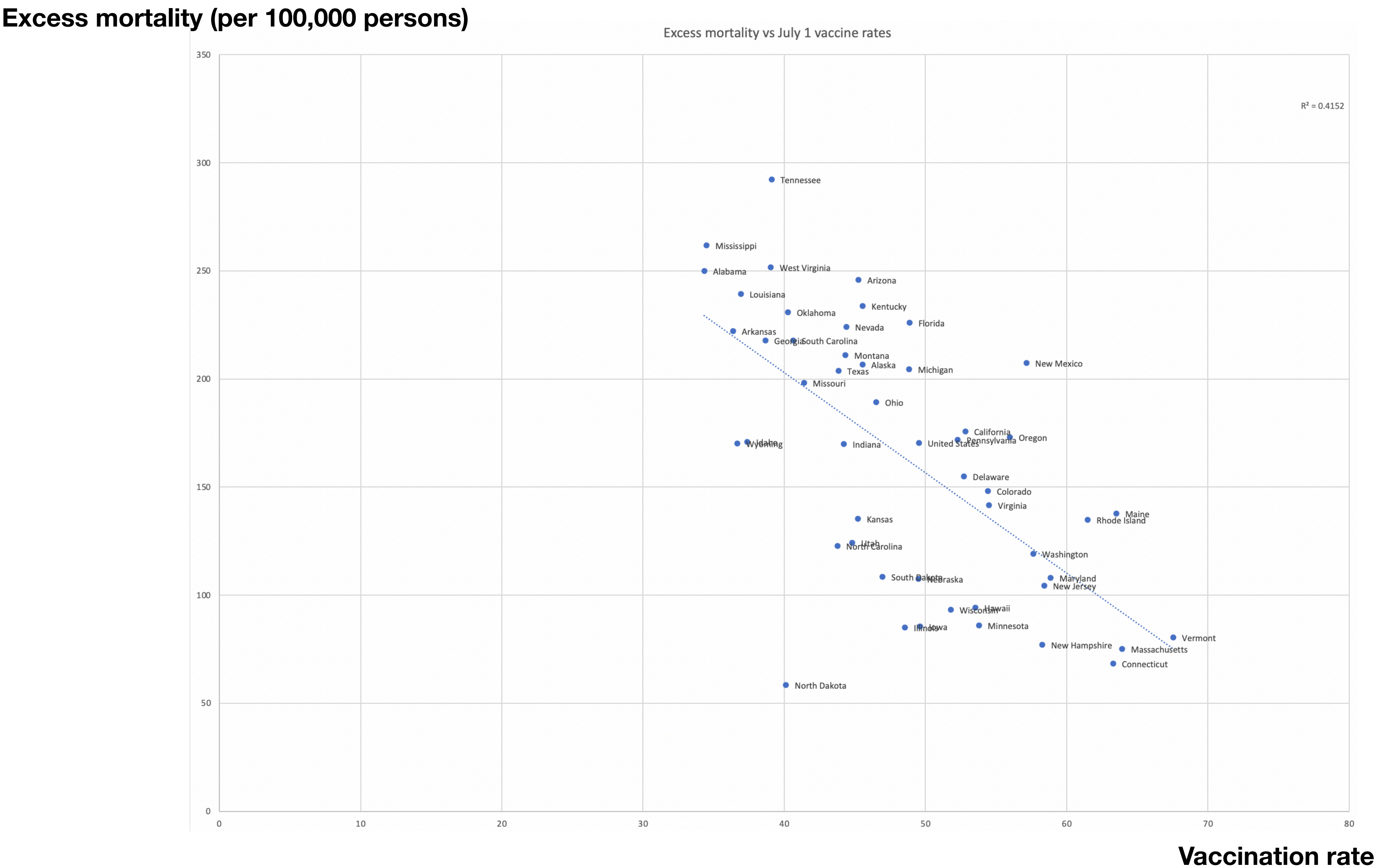


What we do matters









Excess mortality (per 100,000 persons)
Excess mortality vs July 1 vaccine rates
R² = 0.4152
Tennessee
Mississippi
West Virginia
Alabama
Arizona
Louisiana
Oklahoma
Kentucky
Nevada
Florida
Arkansas
Georgia
South Carolina
Montana
Alaska
Texas
Michigan
New Mexico
Missouri
Ohio
California
Pennsylvania
Oregon
Idaho
Wyoming
Indiana
United States
Delaware
Colorado
Virginia
Maine
Rhode Island
Kansas
Utah
North Carolina
Washington
South Dakota
Nebraska
Maryland
New Jersey
Wisconsin
Hawaii
Illinois
Iowa
Minnesota
Vermont
New Hampshire
Massachusetts
Connecticut
North Dakota
0
50
100
150
200
250
300
350
0
10
20
30
40
50
60
70
80
Vaccination rate

What we do matters.

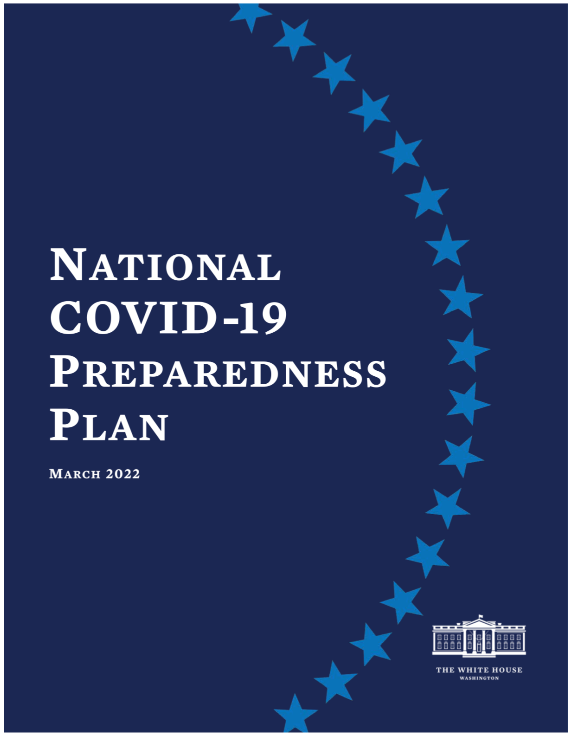
CORRESPONDENCE | VOLUME 397, ISSUE 10268, P25, JANUARY 02, 2021

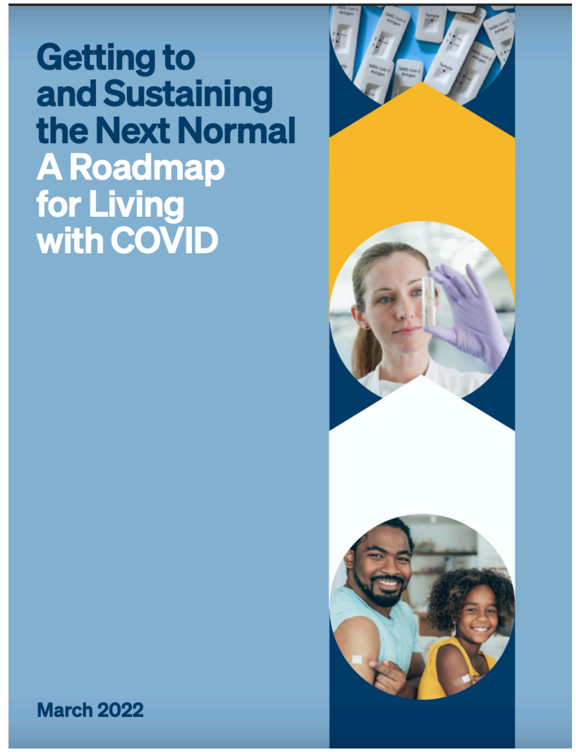
PDF [136 KB]

Reduced mortality in New Zealand during the COVID-19 pandemic

Stacey Kung • Marjan Doppen • Melissa Black • Tom Hills • Nethmi Kearns

Published: December 14, 2020 • DOI: https://doi.org/10.1016/S0140-6736(20)32647-7


National
COVID-19
Preparedness
Plan
March 2022
THE WHITE HOUSE


Getting to
and Sustaining
the Next Normal
A Roadmap
for Living
with COVID
March 2022

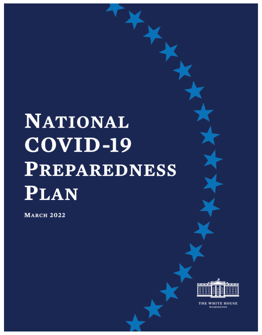
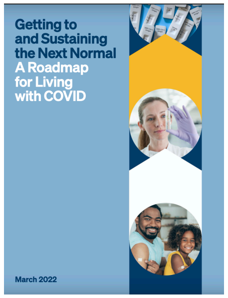


Table of Contents

- Protect Against and Treat COVID-19: Create a stable vaccine supply and implementing a "Test to Treat" initiative that would provide immediate treatments after a positive test result at the same place.
- Prepare for New Variants: Increase monitoring and test vaccines and therapeutics on new variants quickly to determine whether modifications need to be made, with a goal of updated vaccines within 100 days.
- Prevent Economic and Educational Shutdowns: Provide safe environments, access to tests, increased sick leave, funding to keep schools safely open, expand access to federal programs.
- Continue to Lead the Effort to Vaccinate the World and Save Lives: Increase not just vaccine doses, but other global needs like oxygen and PPE.



Executive Summary

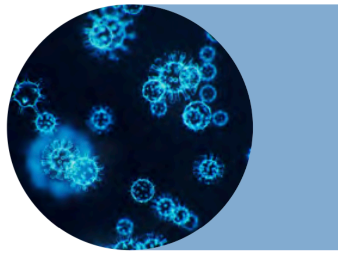
Covid has been raging for 2 years. Multiple variants have emerged. Worldwide, hundreds of millions of people have been infected, millions have died, and untold numbers have developed long Covid. Covid has disproportionately affected communities of color, those living in poverty, and those in less developed countries. Covid has disrupted education and led to significant learning loss. And, there has been tremendous economic dislocation, millions of people thrust into poverty, and the loss of tens of trillions of dollars from the world economy. Importantly, effective vaccines and therapeutics have helped make progress combatting the virus, but cases and deaths still remain high.

As the pandemic enters its third year, two factors have become critical. One is fatigue. People are tired of restrictions used to fight Covid. Simultaneously, the virus continues to surprise experts and make it challenging to anticipate what lies ahead. In all cases, the world must be better prepared.

In 2022, it is possible for a new variant of concern to emerge. But greater population immunity increases the probability of a lower disease burden, lower strain on the health system, and fewer deaths, if waning immunity or immune evasion do not become significant factors.

The United States' pandemic phase—with restrictive public health measures—can end when average daily deaths due to Covid and other major respiratory illnesses decline below 0.5 per 1 million Americans, or 165 deaths a day at a national level. At that point, the United States can transition into the next normal, although individual regions may be able to make earlier transitions, depending on local Covid metrics.

But on March 1, 2022, the nation is not yet at the next normal. The shift to the next normal should not induce complacency, inaction, or premature triumphalism. To rapidly reach and sustain the next normal, the country must implement a comprehensive and coordinated roadmap to both address this pandemic and develop the capacity to confront future biosecurity threats.



The following 12 elements constitute the fundamental core of this Roadmap and are elaborated in this report.

1. **Major Respiratory Viral Illnesses**
   Shift the focus from Covid to major respiratory viral illnesses like flu and RSV infection, with the interim goal of reducing annual deaths below the worst influenza season in the last decade. Even in a pessimistic scenario, the next 12 months are likely to see about half the deaths from Covid compared to 2020 or 2021. But this should not lead to complacency, as unexpected viral changes may occur. There are concrete steps the U.S. can take to increase the chances of this outcome. *(Chapter 2: Possible Scenarios)*

2. **Dashboard**
   Create, maintain, and disseminate a transparent infectious diseases dashboard to guide both the public and policymakers at the national, state, and local levels on the introduction, modification, and lifting of public health measures. The dashboard should also provide guidance on the distribution of therapeutics and other special protections for the immunocompromised, elderly, and other vulnerable populations. *(Chapter 1: Next Normal)*

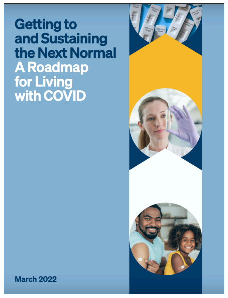
3. **Testing, Surveillance, and Data Infrastructure Increase**
   Increase surge production capacity for at-home rapid tests to 1 billion per month. Establish a test-to-treat infrastructure that links all testing with high sensitivity and specificity to immediate medical consults and appropriate treatment, clinical trial enrollment, and public health guidance. Invest in a substantial upgrade of the data collection and analysis infrastructure for pathogen surveillance at the local, state, and national levels. Implement standardization and timely collection, analysis, and public sharing of data from expanded and enhanced environmental, genetic, and zoonotic monitoring systems, including those involving wastewater and deer. In addition, establish and sustain infrastructure to rapidly collect and analyze population immunity data. *(Chapter 3: Testing and Surveillance; Chapter 9: Health Data Infrastructure)*.

4. **Indoor Air Quality**
   Direct the Environmental Protection Agency (EPA) and Occupational Safety and Health Administration (OSHA) to develop standards to improve indoor air quality and protect workers from inhalation exposure. Direct states and localities to use American Rescue Plan and other appropriated funds to upgrade ventilation and air filtration in schools, childcare facilities, and public buildings. *(Chapter 4: Cleaner, Safer Indoor Air)*

5. **Vaccines and Therapeutics**
   Support the development of new, more effective therapeutics, especially multi-drug oral antivirals, and next generation vaccines, especially mucosal and pancoronavirus designs. Develop a test-to-treat platform to ensure rapid and equitable access to treatments for the most vulnerable populations and reduce disparities. *(Chapter 6: Vaccines; Chapter 7: Therapeutics)*

6. **Global Investment**
   Shift the goal of U.S. contributions to the global vaccination effort from stopping infections through population vaccination coverage alone to improving the distribution and administration infrastructure necessary to fully vaccinate the most vulnerable people in low- and middle-income countries. *(Chapter 6: Vaccines)*

7. **Long Covid**
   Rapidly coordinate and expand research on long Covid, to produce data and biospecimens available through open science, with specific emphases on the INSPIRE and RECOVER studies. Aim to generate definitive answers to fundamental questions on frequency, risk factors, prognosis, and the benefits of vaccines and therapies for long Covid, within the next year. Augment social, financial, and health supports for individuals affected by long Covid. *(Chapter 8: Long Covid)*



8. Equity

Better address health disparities by creating a permanent cadre of community health workers to support vulnerable populations highly susceptible to adverse outcomes from viral respiratory illnesses and leveraging trusted community groups such as faith-based organizations. *(Chapter 10: Public Health Infrastructure)*

9. Workforce

Expand and support the public health and health care workforces through improved wages, health benefits (including mental health), tuition assistance, loan forgiveness, and safe working conditions. Incentivize the accelerated adoption of automation for routine chores and paperwork. To institutionalize both virtual care and various forms of home care, extend and expand regulatory policies and reimbursement flexibilities. Ensure that a flexible pool of workers is available in emergencies. *(Chapter 10: Public Health Infrastructure; Chapter 11: Healthcare Workforce; Chapter 14: Worker Safety)*

10. Biosecurity and Pandemic Leadership

Create the post of Deputy Assistant to the President for Biosecurity (within the National Security Council), responsible for preparing for, monitoring, addressing, and coordinating responses to and communications about any biosecurity and pandemic threats. This post should coordinate efforts to counter foreign and domestic sources of anti-science misinformation on vaccines and drugs. *(Chapter 12: Communications and Education)*

11. Communication

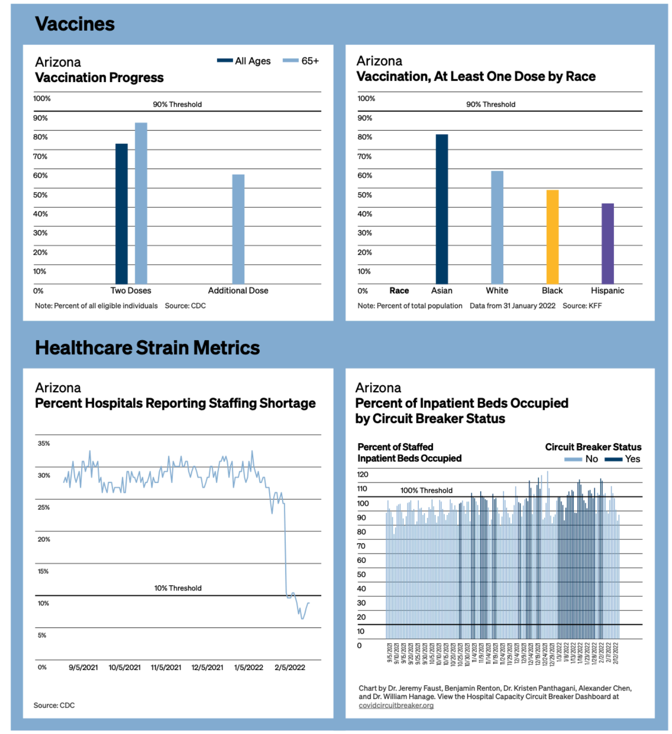
Implement a comprehensive, scientifically-tested communication and behavioral intervention infrastructure to increase vaccination, testing, and treatment, especially among vulnerable groups. *(Chapter 12: Communication and Education)*

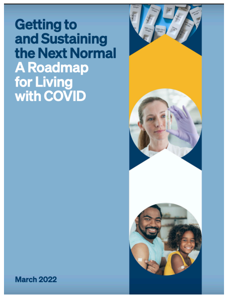
12. Schools and Childcare

Governments should not close schools and childcare facilities unless all other community mitigation measures fail. Implement policies and programs, such as improved air filtration and expanded school nurse programs, that enable schools and childcare facilities to remain open and safe for in-person instruction and care without the need for special public health mitigation measures. Target program implementation assistance to schools in communities with the greatest need. *(Chapter 13: Schools and Childcare)*

Figure 1

Illustrative Respiratory Virus Dashboard For Policy Makers





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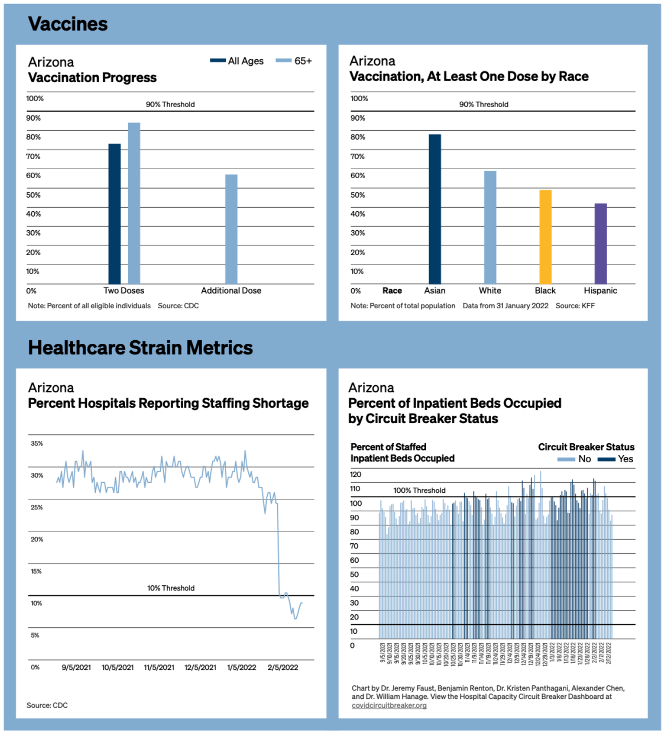


The U.S. Hospital Capacity Circuit Breaker dashboard (by Faust and colleagues) leverages public health data to determine when any jurisdiction is at high risk of exceeding hospital capacity in the following 1-14 days. On the included graph, dark blue bars indicate when hospital capacity is forecast to soon be exceeded (note: any capacity threshold can be chosen; 100% capacity is shown). With this warning, hospital systems can act to increase capacity by limiting or cancelling elective procedures, increasing staffing and physical care space, and carefully triaging admissions and discharge decisions; local governments can act by encouraging or requiring indoor mask use (and providing high-quality masks to the public), temporarily limiting capacity in crowded indoor environments, requiring proof of vaccination, and taking any other actions that slow the spread of Covid during surges, including delivering free rapid tests to all places of residence and businesses.

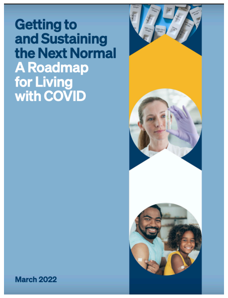
Each metric has a threshold to indicate when the country is sustainably at a tolerable respiratory viral illness level without the need for significant public health interventions like closing businesses or requiring masks in schools.

Importantly, each metric in this dashboard can be measured and utilized to inform policy at the national, state, and local levels.

Two important caveats: The United States does not presently have real time data for each of these metrics, and appropriate thresholds for some metrics have not been set at the national level, which hinders regional comparisons. For instance, wastewater surveillance is not yet standardized or timely enough to provide a comprehensive country-level snapshot across the whole United States. Given the lack of standardized data and differences in sampling technologies in local sewersheds, thresholds today must be set at the local level. Comparisons will only be possible if differences in data formats and reporting at local centers are standardized and accounted for using a consistent methodology for determining pathogen thresholds. Similarly, data on hospital bed occupancy is not reliably reported daily by all hospitals. To ensure accuracy and utility of such a dashboard, the data inputs for these critical metrics need rapid upgrading (see *Chapter 9: Health Data Infrastructure*).

Unfortunately, the United States has yet to arrive at the next normal.

Unfortunately, the United States has yet to arrive at the next normal. Going into March 2022, the country is currently experiencing about 5 deaths per million people per day from Covid. That is about 10-fold higher than was normal for major respiratory diseases prior to the Covid pandemic. And while wastewater surveillance testing indicates declining Covid infections, hospital bed occupancy still appears strained in several parts of the country.



US Hospital Circuit Breaker Dashboard

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Unfortunately, the United States has yet to arrive at the next normal.

US Hospital Circuit Breaker Dashboard

05:51

2 Boston researchers urge CDC to encourage short-term restrictions in areas of high omicron spread

December 20, 2021 | By Lisa Mullins and Lynn Jolicoeur

Two Harvard-affiliated researchers are calling for faster, more targeted action against the omicron variant of the coronavirus.

They've sent a memorandum to CDC Director Dr. Rochelle Walensky, asking her to give states and municipalities guidance on how to implement what they're calling "circuit breakers." Those are short-term restrictions on high-risk activities, meant to disrupt and slow down the transmission of the virus. That, in turn, would allow hospitals to continue taking care of not only COVID patients, but people with other acute conditions, they argue.

US Hospital Circuit Breaker Dashboard

Home // Local Coverage // Health

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1. Hospital actions.
2. Community actions.

US Hospital Circuit Breaker Dashboard

Home // Local Coverage // Health

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1. Hospital actions.

- Cancel elective procedures.
- Open surge space.
- Increase staffing.
- Change disposition parameters.

US Hospital Circuit Breaker Dashboard

Home // Local Coverage // Health

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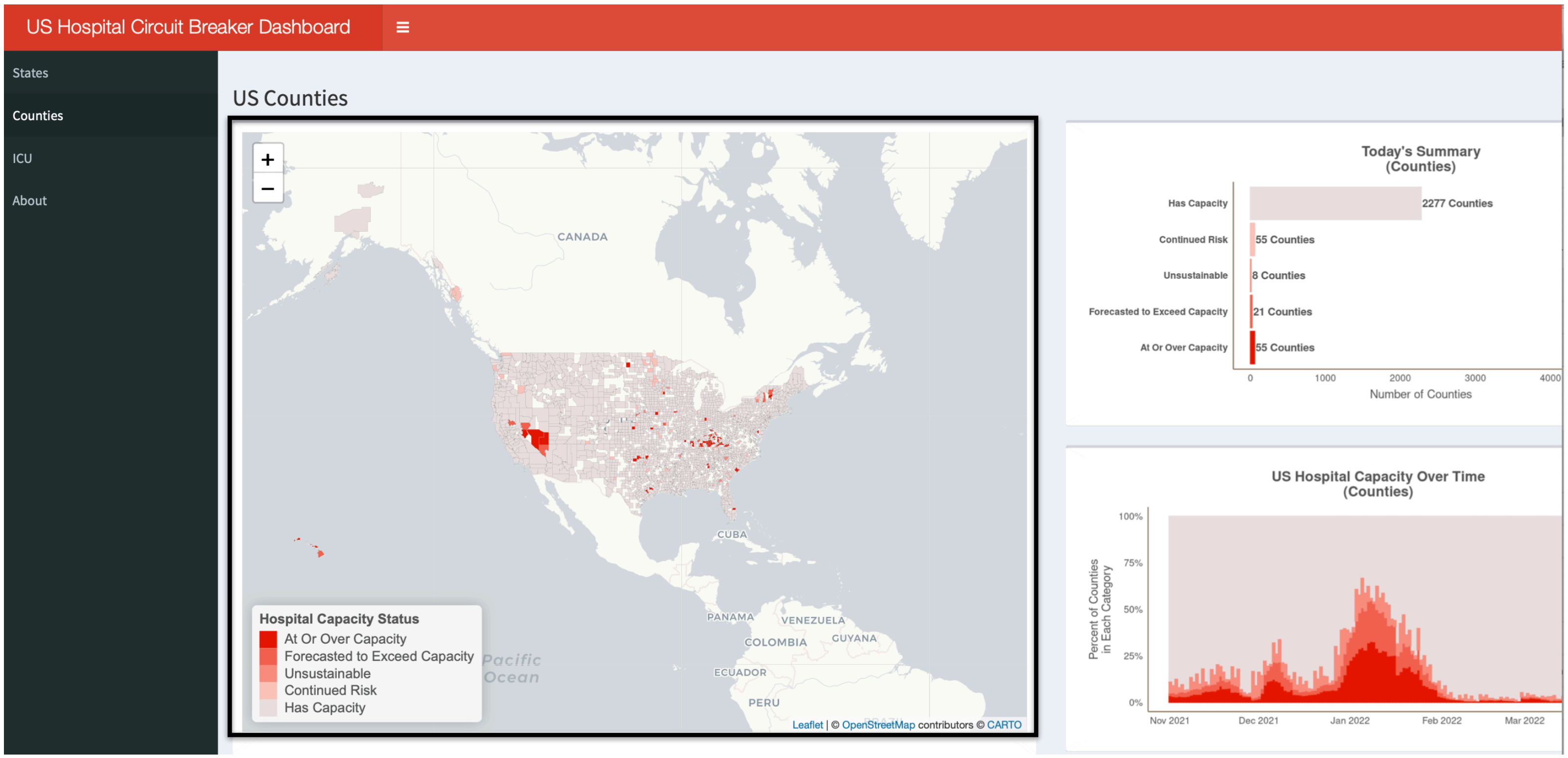
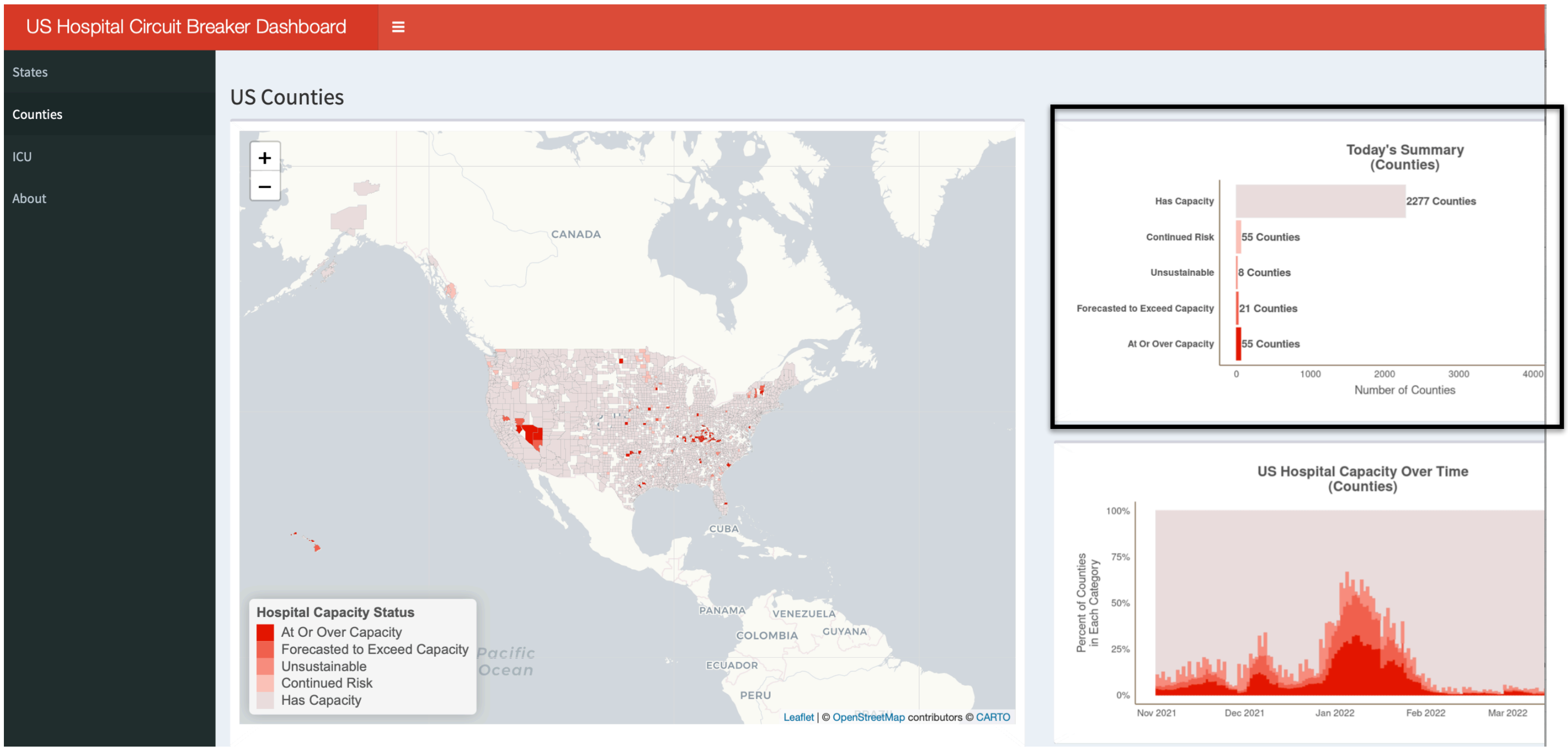
1. Community actions.

- Decrease capacity in large spaces.
- Reduce indoor dining.
- Mask mandates.
- Vaccine requirements.

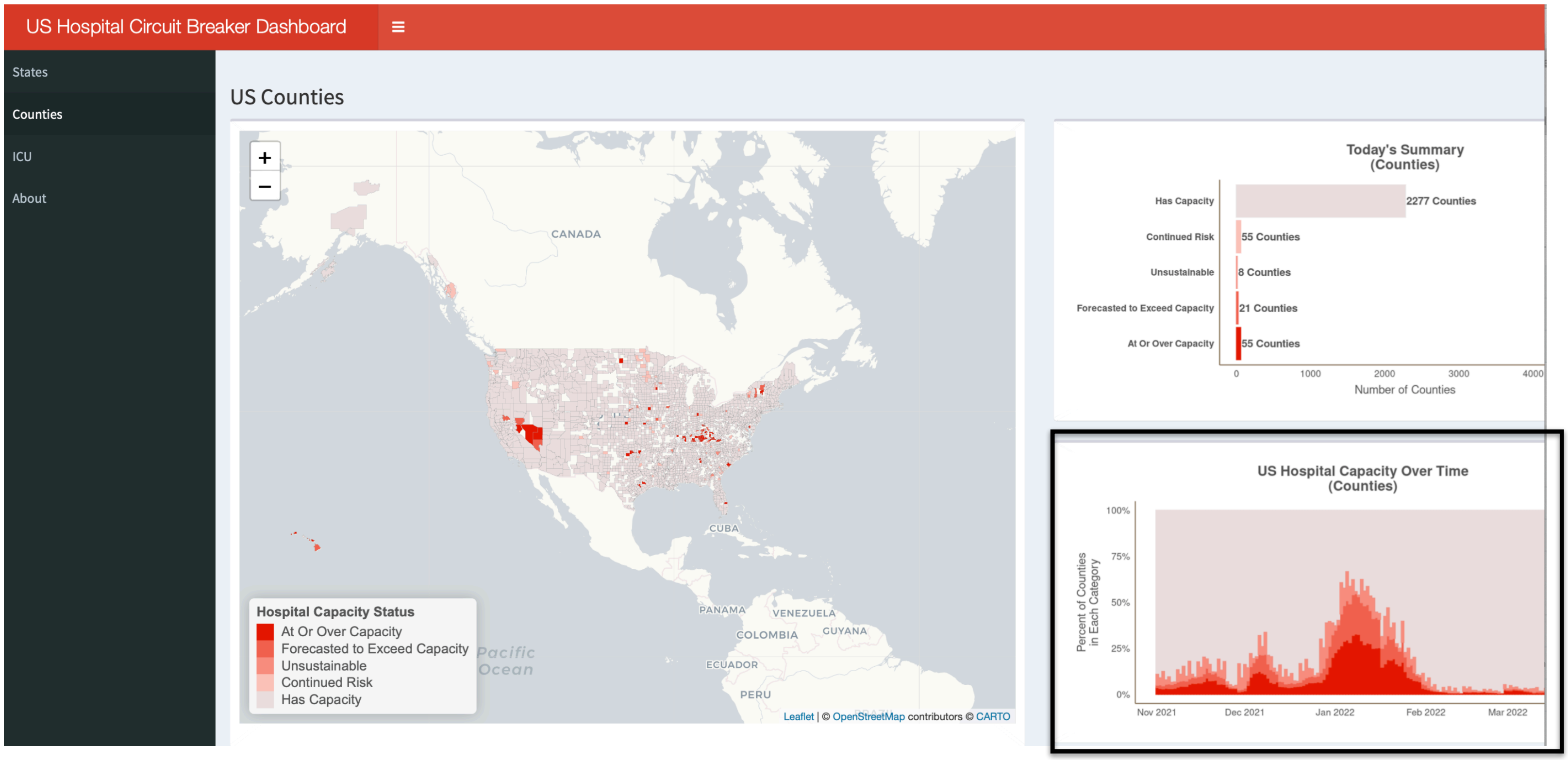
US Hospital Circuit Breaker Dashboard



US Hospital Circuit Breaker Dashboard

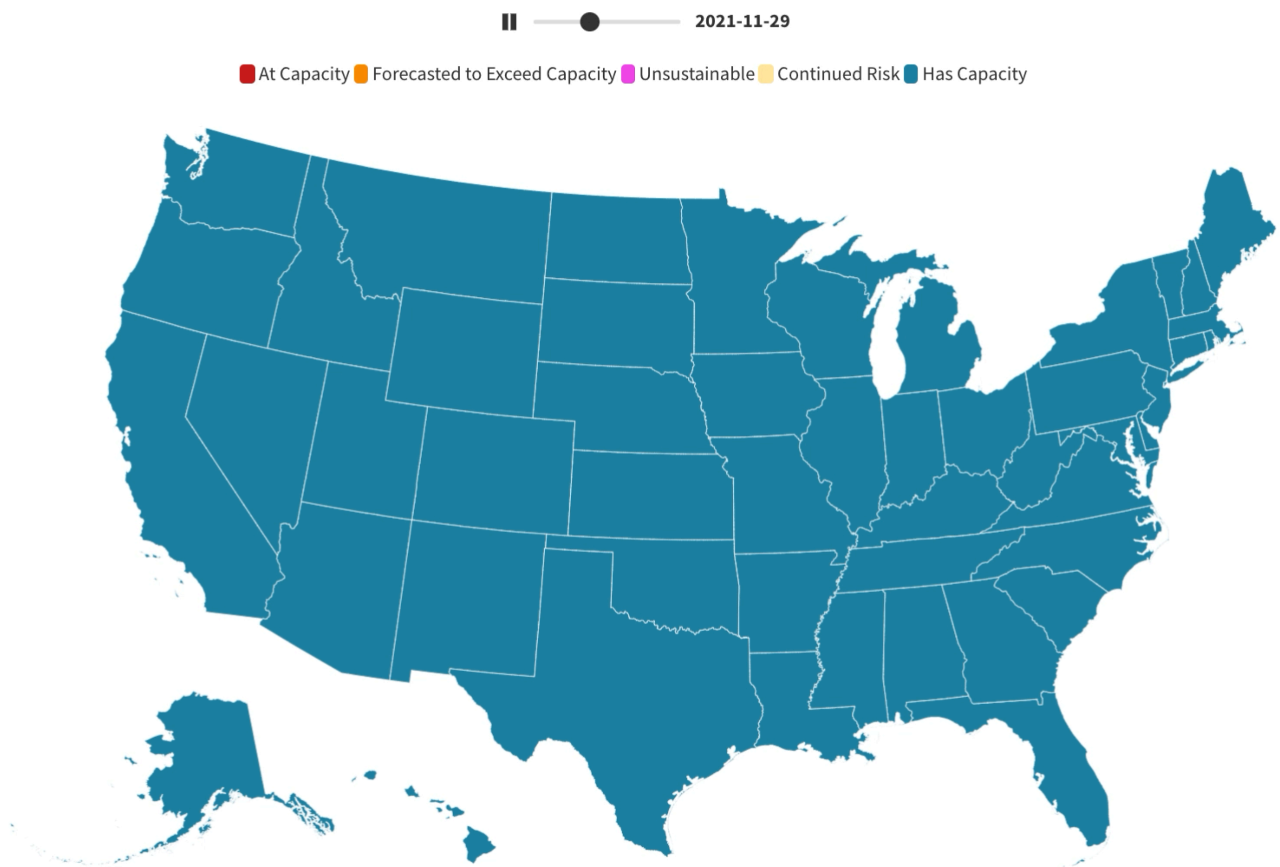


US Hospital Circuit Breaker Dashboard



US Hospital Circuit Breaker Dashboard

COVID-19 Hospital Capacity Circuit Breaker Dashboard — State Timeseries



Source: COVID-19 Hospital Capacity Circuit Breaker Dashboard • Map by Jeremy Faust, Bill Hanage, Benjy Renton

US Hospital Circuit Breaker Dashboard

Test case: Arizona

Percent of Inpatient Beds Occupied by Circuit Breaker Status — Arizona

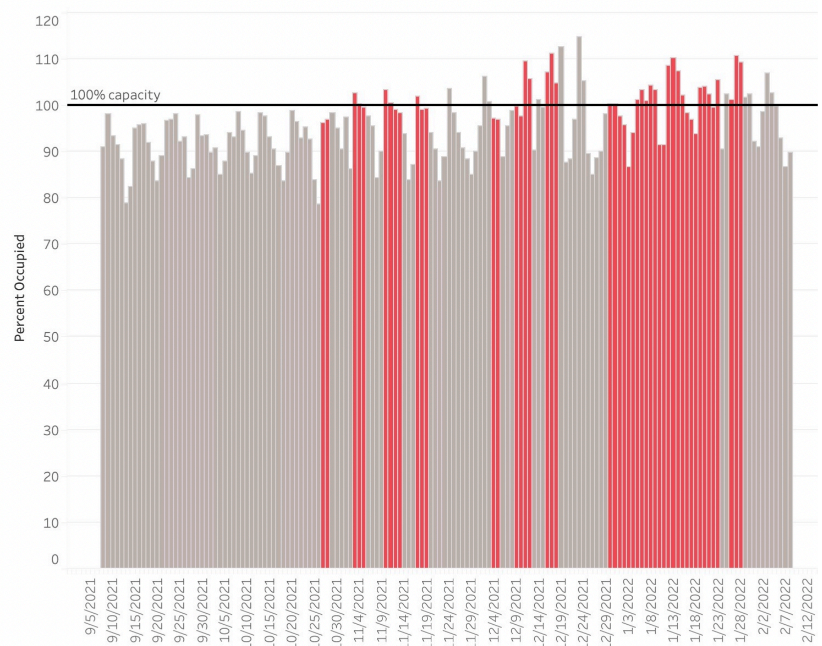


Chart by Jeremy Faust and Benjy Renton
View the Hospital Capacity Circuit Breaker Dashboard at covidcircuitbreaker.org

SARS-CoV-2 RNA Levels in Wastewater in the United States

Maps, charts, and data provided by CDC, updated by 8pm ET[†]. Represents all wastewater data submitted directly to CDC's National Wastewater Surveillance System's DCIPHER platform, subject to suppression criteria described in Footnotes.

For more information on wastewater surveillance, please visit the National Wastewater Surveillance System page.

View Footnotes and Download Data

State or territory: Select State or Territory

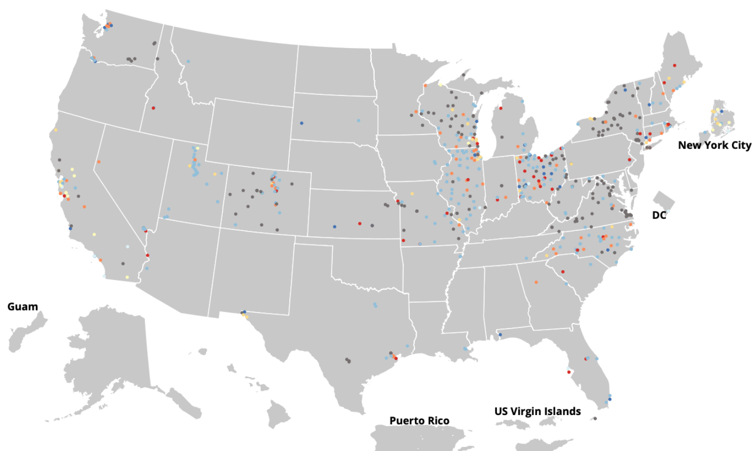
County: Select a state in order to enable county select

Reset Selections

Time Period: Mar 05, 2022 – Mar 19, 2022

Major Cities On | Major Cities Off

Map Metric: 15-day percent change



SARS-CoV-2 RNA wastewater levels, United States: 15-day percent change by sewershed

15-day % change category	Num. sites	% sites	Category change in last 7 days
-100%	28	6	22%
-99% to -10%	235	52	-8%
-9% to 0%	14	3	-33%
1% to 9%	18	4	-10%
10% to 99%	41	9	-29%
100% to 999%	71	16	11%
1000% or more	47	10	-16%

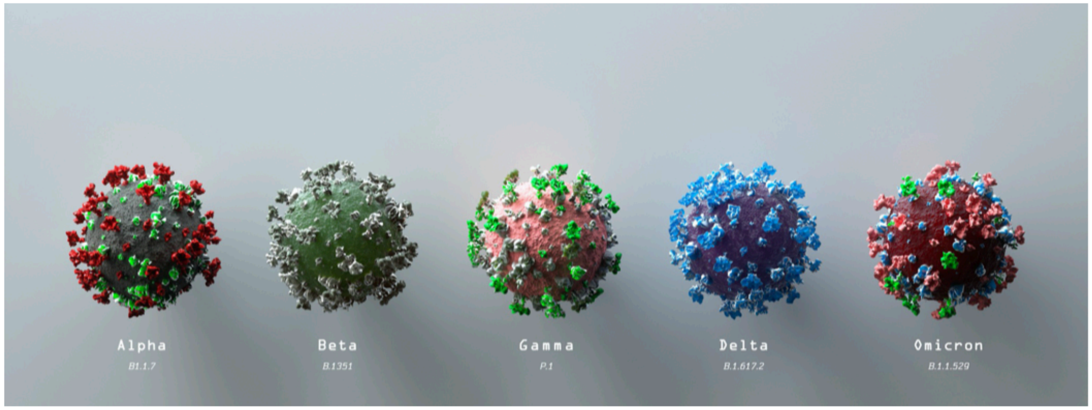
Total sites with current data: 454

Total number of wastewater sampling sites: 649

How is 15-day percent change calculated?

Select legend categories to filter points on the map.

-100% | -99% to -10% | -9% to 0% | 1% to 9% | 10% to 99% | 100% to 999% | 1000% or more | No recent data



Six crucial lessons from Omicron.

What we learned in the last wave can help us survive the next one.

- Local conditions matter.
- Surveillance tools work.
- Rapid testing works and can slow down the spread of disease.
- Small changes in behavior matter.
- Circuit breaker approaches.
- Boost our way out of surges?

The future of outbreaks:

- Early detection.
- Mobilize resources (masks, tests, treatments, specific vaccines)
- Test-to-treat.
- Test-to-return.
- Hospitals: flexible staffing models.
- Hospitals: use circuit breakers to address capacity.
- Small changes in public behavior.

Results:

- Sooner action, less drastic action.
- Avoid mass shutdown.
- Better outcomes.
- Enhance public trust/adherence.

Covid-19: Why did it occur and what is the future?

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