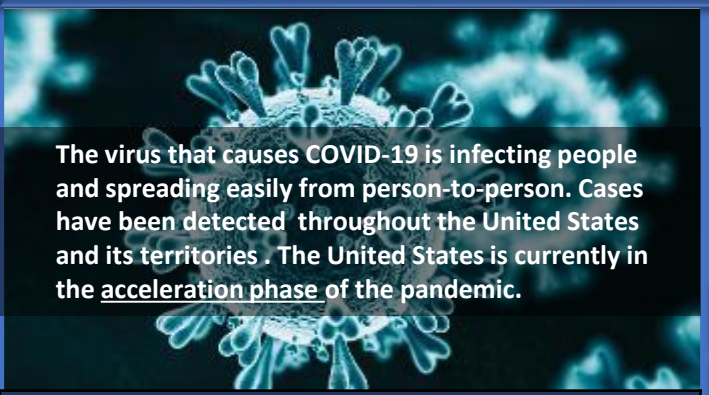
YALE-TULANE-SACRED HEART - ESF-8 SPECIAL US REPORT

CORONAVIRUS (COVID-19)



The virus that causes COVID-19 is infecting people and spreading easily from person-to-person. Cases have been detected throughout the United States and its territories . The United States is currently in the acceleration phase of the pandemic.

GLOBAL		
CONFIRMED CASES	DEATHS	RECOVERED
2, 628,527	183,424	784,986

UNITED STATES		
CONFIRMED CASES	DEATHS	RECOVERED
843,376	46,769	152,286

SOURCE: JOHNS HOPKINS COVID-19 DASHBOARD (AS OF 22 APRIL, 2339 HRS EDT)

RISK ASSESSMENT		
RISK TO GENERAL POPULATION	RISK TO ELDERLY POPULATION	RISK TO HEATHCARE SYSTEM CAPACITY
MODERATE	VERY HIGH	HIGH

ESF-8 MEDICAL AND PUBLIC HEALTH

Yale-Tulane-Sacred Heart

Planning and Response Network

AS OF 22 APRIL 2020
2339 HRS EDT

US FEDERAL GOVERMENT

- CORONAVIRUS.GOV
- USA.GOV

HHS
COVID-19

CDC
- CDC – COVID-19

NIH
- COVID-19

NIOSH
- NIOSH CORONAVISUS

FEMA
- FEMA

DOD
Coronavirus Response
USAF _ COVID-19

JOUNALS AND ONLINE LIBRARIES
- BMJ
- Cambridge University Press
- Cochrane
- Elsevier
- JAMA Network
- The Lancet 2019-nCoV Resource Centre
- New England Journal of Medicine
- Oxford University Press
- Wiley

INTERNATIONAL

WHO
- WHO –COVID-19
- ECHO
- PAHO AFRO
- EMRO
- Western Pacific

OCHA
- ReliefWeb

ECDC
- European Centre for Disease Prevention and Control

CCDC
- China Center for Disease Control and Prevention

NEWS SOURCES
- New York Times COVID-19 Coverage
- WASHINGTON POST
- Reuters
- CNN
- Xinhua

ASSOCIATION
- NACCHO
- AMERICAN HOSPITAL ASSOCIATION
- NRHA

PORTALS, BLOGS, AND RESOURCES
- YALE NEWHAVEN HEALTH – COVID-19
- YALE MEDICINE
- YALE NEWS _COVID 19
- JOHN HOPKINS UNIVERSITY COVID-19 GLOBAL CASES (CSSE)
- COVID-19 SURVEILLANCE DASHBOARD
- CIDRAP
- H5N1
- VIROLOGY DOWN UNDER BLOG
- CONTAGION LIVE
- WORLDOMETER
- 1POINT3ACRES

BACKGROUND

WHERE: WORLDWIDE

WHEN: DECEMBER 2019 - CURRENT

SITUATION PANDEMIC OUTBREAK – COVID-19

BACKGROUND:

At the end of December 2019, Chinese public health authorities reported several cases of acute respiratory syndrome in Wuhan City, Hubei province, China. Chinese scientists soon identified a novel coronavirus as the main causative agent. The disease is now referred to as coronavirus disease 2019 (COVID-19), and the causative virus is called severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). It is a new strain of coronavirus that has not been previously identified in humans. The initial outbreak in Wuhan spread rapidly, affecting other parts of China.

The International Health Regulations (IHR) (2005) Emergency Committee on the outbreak of COVID-19 was first convened on 22–23 January 2020, and subsequently reconvened on 30 January 2020.

PUBLIC HEALTH EMERGENCY OF INTERNATIONAL CONCERN (PHEIC)

The WHO Director General declared the COVID-19 outbreak to be a public health emergency of international concern (PHEIC) on 30 January 2020. The Emergency Committee provided recommendations to WHO, to China, to all countries and to the global community, on measures to control the outbreak.

PANDEMIC

On 11 March 2020. WHO declared COVID-19 a pandemic because of the "alarming levels of spread and severity, and by the alarming levels of inaction". At that time, there were large outbreaks of the virus in Italy, South Korea, and the United States. In the US, the slow rollout of testing and limited testing capacity has crippled response to the disease. The declaration came after a 13-fold rise in the number of cases outside China in the two weeks prior to the declaration.

COVID 19 IN THE UNITED STATES

The first known case of COVID-19 in the U.S. was confirmed on January 21, 2020, in a man in his 30s from Washington state, who traveled to Wuhan, is diagnosed with novel coronavirus.

On 29 January 2020 the White House Coronavirus Task Force was established. On 31 January 2020 , Secretary azar declares a Public Health Emergency for United States for COVID-19. Travel restriction were put into place for those traveling from China . Later restriction were added for Iran and Europe (29 February 2020).

On 26 February 2020 the Centers for Disease Control and Prevention (CDC) confirms the first case of COVID-19 in a patient in California with no travel history to an outbreak area, nor contact with anyone diagnosed with the virus. It's suspected to be the first instance of local transmission in the United States. Oregon, Washington and New York soon report their own cases of possible community transmission.

The first COVID-19 death is reported in Washington state, after a man with no travel history to China dies on 28 February 2020 at Evergreen Health Medical Center in Kirkland, Washington. Two deaths that occurred 26 February 2020 at a nearby nursing home would later be recorded as the first COVID-19 deaths to occur in the United States.

President Donald Trump declares a U.S. national emergency, which he says will open up $50 billion in federal funding to fight COVID-19 on 13 March 2020.

By 17 March 2020 COVID 19 was present in all 50 states. By 27 March, New York City **becomes epicenter of coronavirus pandemic in the US.**

SITUATION - UNITED STATES

JURISDICTIONS REPORTING CASES: 55 (Total jurisdictions includes 50 states, District of Columbia, Guam, the Northern Mariana Islands, Puerto Rico, and the U.S Virgin Islands.) (CDC)

NORTH AMERICA			
CONFIRMED CASES	DEATHS	CFR	RECOVERED
843,376	46,769	5.54%	152,286

SOURCE: JOHNS HOPKINS COVID-19 DASHBOARD (AS OF 22 APRIL, 2339 HRS EDT)

RISK ASSESSMENT		
RISK TO GENERAL POPULATION	**RISK TO ELDERLY POPULATION**	RISK **TO HEATHCARE SYSTEM CAPACITY**
MODERATE	**VERY HIGH**	**HIGH**

EMERGENCY AND MAJOR DISASTER DECLARATIONS AND WHITE HOUSE

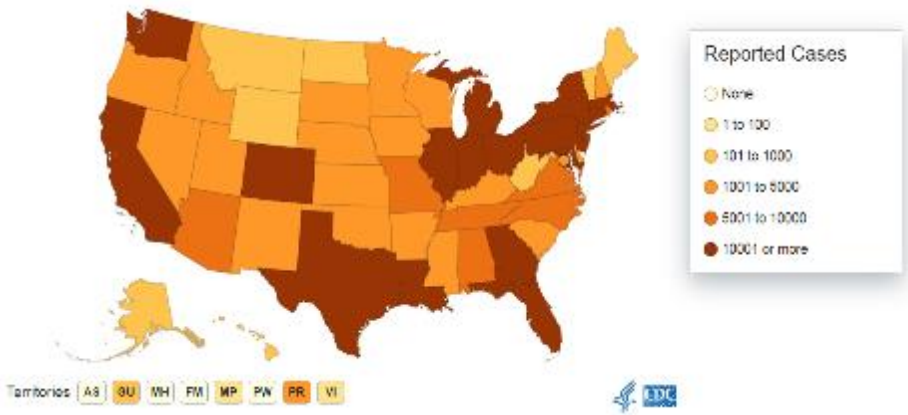
Several emergency declarations are in effect, including a Public Health Emergency under Section 319 of the Public Health Service Act, declared on January 31 (retroactively dated to January 27); nationwide emergency declarations on March 13 and subsequent major disaster declarations pursuant to the Stafford Act; and a National Emergency declaration pursuant to the National Emergencies Act on March 13, dated to March 1. Waivers are in effect under Section 1135 of the Social Security Act to aid the health care system with surge capacity

- President Trump invoked the Defense Production Act (DPA) on March 18 and delegated authority to the Secretary of Health and Human Services (HHS) to prioritize and allocate health and medical resources as needed.
- 30 Days to Slow the Spread - The White House has advised Americans to work and engage in schooling from home when possible and to avoid gatherings of 10 or more people, discretionary travel, and restaurants through April 30.
- The White House, in collaboration with the Centers for Disease Control and Prevention (CDC), has released guidelines for "OPENING UP AMERICA AGAIN" on April 16.

COVID-19 ACTIVITY

Different parts of the country are seeing different levels of COVID-19 activity. The United States nationally is in the acceleration phase of the pandemic. The duration and severity of each pandemic phase can vary depending on the characteristics of the virus and the public health response. (CDC)

- The greatest number of cases have been recorded in New York, New Jersey, Massachusetts, Pennsylvania, Michigan, Illinois, California, Florida, ,Louisiana., and Connecticut.
- There is early evidence that the epi curve is beginning to flatten
- Case numbers are expected to continue rise through the coming weeks, as more cases are identified through testing.



As of April 21, 2020 - This map shows confirmed and probable COVID-19 cases reported by U.S. states, U.S. territories, and the District of Columbia. Each state's health department reports how much the virus has spread in their community.

SITUATION - UNITED STATES

NIH Posts Updated COVID-19 Treatment Guidelines

These Treatment Guidelines have been developed to inform clinicians how to care for patients with COVID-19. Because clinical information about the optimal management of COVID-19 is evolving quickly, these Guidelines will be updated frequently as published data and other authoritative information becomes available.

Currently there are no Food and Drug Administration (FDA)-approved drugs for COVID-19. However, an array of drugs approved for other indications, as well as multiple investigational agents, are being studied for the treatment of COVID-19 in several hundred clinical trials around the globe. These trials can be accessed at *ClinicalTrials.gov*. In addition, providers can access and prescribe investigational drugs or agents approved or licensed for other indications through various mechanisms, including Emergency Use Authorizations (EUA), Emergency Investigational New Drug (EIND) applications, compassionate use or expanded access programs with drug manufacturers, and/or off-label use.

Autopsies find first U.S. coronavirus death occurred in early February, weeks earlier than previously thought

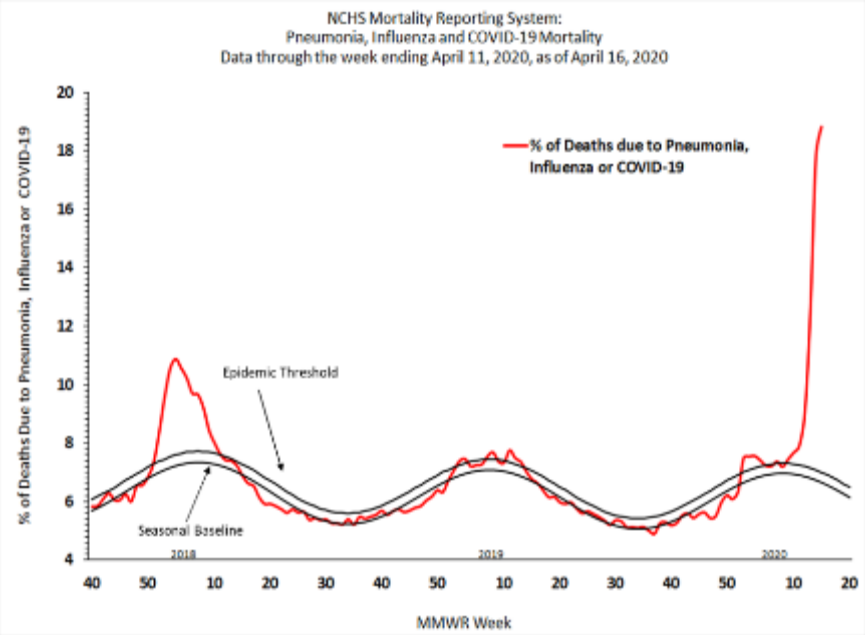
Tissue samples taken during autopsies of two people who died at home in Santa Clara County, Calif., tested positive for the virus, local health officials said in a statement. The victims died on Feb. 6 and Feb. 17, respectively.

HOSPITALIZATIONS

The overall cumulative hospitalization rate is 20.0 per 100,000, with the highest rates in persons 65 years and older (63.8 per 100,000) and 50-64 years (32.8 per 100,000). (CDC WEEK ENDING 11 APRIL 2020)

MORTALITY SURVEILLANCE

Based on death certificate data, the percentage of deaths attributed to COVID-19, pneumonia or influenza increased from 17.8% during week 14 to 18.8% during week 15.



The New York metro area continues to account for about one-third of the cases nationwide. New York City has recorded 14,064 deaths so far, and this number ranks 4th globally behind Italy, Spain, and the UK. Hospitalization and emergency room numbers are decreasing, but social distancing orders must be maintained for this trend to continue. Additionally, about 25% of deaths in the U.S. have been linked to long-term care facilities. (NYT)

Although many European countries have more coronavirus deaths per capita, the United States has the highest death toll in the world.

SITUATION - UNITED STATES

NORTHEAST

This region has been the hardest hit in the entire country. **New York State** has become the epicenter of the outbreak with 37 percent of all U.S. deaths. Even after adjusting for population size, the state still has the highest fatality rate for coronavirus in the nation.

The states in the Northeast account for nearly two-thirds of fatalities in the United States. Researchers suggest that the virus began spreading in this region in mid-February, weeks before the first confirmed case, and that a majority of cases have links to Europe, not Asia.

THE SOUTH

Most states in the South lagged behind the rest of the country in implementing stay-at-home orders, with many waiting until the end of March or early April to do so. These same states are now poised to be among the earliest to loosen those very restrictions, even though their populations have disproportionate rates of underlying conditions that put people at a higher risk of dying of the coronavirus.

In **Florida**, a beach festival held in early March was the source of dozens of infections. Nearly a month later — and after the official case count in Florida reached 7,000 — Gov. Ron DeSantis issued a stay-at-home order. A quarter of Florida's population is older than 60, the age group for whom the coronavirus is most deadly.

In **Georgia**, a funeral in the small city of Albany became a super-spreader event. Three counties near this city have some of the highest per capita rate of infections outside of the New York area.

Many point to New Orleans' failure to cancel Mardi Gras as a precipitating factor in **Louisiana**'s outbreak and the state ranks fifth in the country in deaths and is home to numerous hot spot counties.

SOURCE: NYT

THE MIDWEST

Several governors in the Midwest, which is home to multiple hot spots, have announced that they will coordinate plans to reopen their economies. Protesters in some of these states have taken to the streets to demand that governors loosen restrictions, even though public health experts warn that relaxing stay-at-home rules too soon could lead to new waves of outbreaks.

In **Illinois**, the Chicago area has emerged as a hot spot. The Cook County Jail — one of the nation's largest — is among the largest single sources of infection in the country.

Michigan has some of the highest rates of infection and fatality in the country, ranking third in coronavirus deaths and seventh in total cases among the 50 states and Washington, D.C. Racial disparities are also stark in Michigan, where black residents make up just 14 percent of the population, but 40 percent of virus deaths.

WEST

Some of the earliest cases in the country were diagnosed in this region, which has also been the most successful in mitigating the virus. California, Oregon and Washington have in fact shipped ventilators to hot spots on the East Coast.

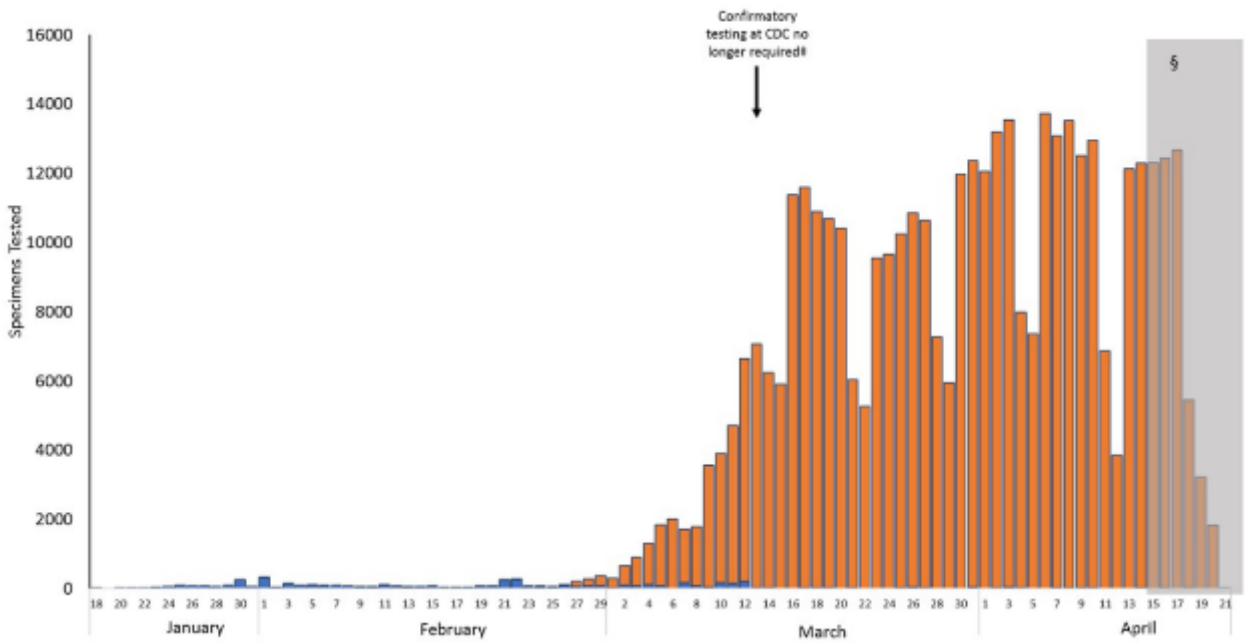
California, the most populous state in the country, had nearly 600 direct flights to China in January — more than twice as many as New York State — making it especially vulnerable to the spread of the virus.

Still, the state was the first to implement broad stay-at-home measures, and has managed to keep its death toll comparatively low, ranking 29th among all 50 states and Washington, D.C. in deaths per capita.

Late Tuesday, 21 April 2020, officials in Santa Clara County, Calif., announced that two residents there died of the coronavirus in early February, shifting the timeline of the virus's spread across the country much earlier than previously believed.

PROGRESS ON TESTING IN US

Number of specimens tested for SARS CoV-2 by CDC labs (N= 5,116) and U.S. public health laboratories* (N= 405,105)†



NOTE: Data during the gray period of graph are incomplete because of the lag in time between when specimens are accessioned, testing is performed, and results are reported. The range was extended from 4 days to 7 days on March 26.

CURRENT CDC TESTING PRIORITIES

PRIORITY 1: Hospitalized Patients and Symptomatic Healthcare Workers

PRIORITY 2: Patients in long-term care facilities with symptoms, patients 65+ with symptoms, patients with comorbidities with symptoms, first responders with symptoms

PRIORITY 3: critical infrastructure workers with symptoms, any other individual with symptoms, health care workers and first responders, individuals with mild symptoms in communities experiencing high COVID-19 hospitalizations

NON-PRIORITY: Individuals without symptoms

CDC; COVID TRACKING)

As of 4/22/2020, 2329 HRS EDT: 4,466,559 COVID-19 tests were administered in the United States.

California is the first state to open up testing to asymptomatic individuals in high risk settings

NY TO BEGIN COVID-19 TESTING/TRACING PROGRAM IN PARTNERSHIP WITH NJ AND CT

- New York's Contact Tracing Program Will Be Done in Coordination with Downstate Region as well as New Jersey and Connecticut
- Bloomberg School of Public Health at Johns Hopkins University to Build Online Curriculum and Training Program for Contact Tracers
- NYS DOH Will Work with Bloomberg Philanthropies Team to Identify and Recruit Contact Tracer Candidates, Including DOH Staff, Investigators from State Agencies, Hundreds of Downstate Tracers and SUNY and CUNY Students in Medical Fields
- Partnership with Vital Strategies' Resolve to Save Lives to Provide Operational and Technical Advising

(NY GOVERNOR)

CONTACT TRACING

KEY CONCEPTS OF CONTACT TRACING

Contact tracing is the identification and follow up of people who may have come into contact with an infectious disease. Steps include:

1. Contact Identification: a confirmed case is asked to identify any person they have come into contact with (family, friends, healthcare providers, coworkers)
2. Contact Listing: All contacts listed should be identified and contacted to inform them about their potential exposure to the disease. Contacts should be advised on actions they should take, what kind of follow up to expect, disease prevention, accessing early care, and quarantine or isolation procedures.
3. Contact Follow-Up: Regular follow-up should be conducted with all contacts to monitor for symptoms and test for signs of infection.

SOURCE: WHO

For COVID-19 Contact Tracing:

- Contacts are encouraged to stay home and maintain social distance from others (at least 6 feet) until 14 days after their last exposure, in case they also become ill. They should monitor themselves by checking their temperature 2x daily and watching for cough or shortness of breath. To the extent possible, public health staff should check in with contacts to make sure they are self-monitoring and have not developed symptoms. Contacts who develop symptoms should promptly isolate themselves and notify public health staff. They should be evaluated for infection and potential need for medical care.

Contact tracing is a specialized skill that requires:

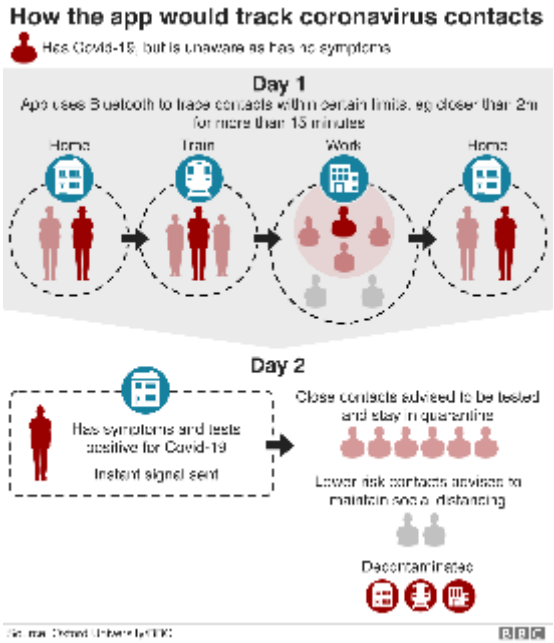
- An understanding of patient confidentiality
- Knowledge of the medical terms and principles of exposure, infection, infectious period, potentially infectious interactions, symptoms of disease, pre-symptomatic and asymptomatic infection
- Interpersonal, cultural sensitivity, and interviewing skills

SOURCE: CDC

TOOLS FOR CONTACT TRACING

Digital tools are used to:

1. Improve efficiency and accuracy of data management
2. Reduce the burden of data collection and risk of infection by allowing electronic self-reporting
3. Using location data to identify community contacts unknown to the case



In the United States, there have been 3 primary initiatives to develop mobile applications to assist with contact tracing.

- Covid-19 Watch
- CoEpi: Community Epidemiology in Action
- Private Kit: Safe Paths

CONTACT TRACING CAPACITY

- The CDC is calling for "very aggressive" contact tracing
- Much of the burden falls on state/local health departments who lack the personnel to do extensive tracing
- In an effort to expand the workforce, CDC is funding 650 health workers at state health departments to increase contact tracing and testing capacity
- Digital technology can act as a force multiplier allowing one worker to reach more people within the community than would normally be possible.
- Other federal agencies, like the Census Bureau, Peace Corps and AmeriCorps may be called in to assist with contact tracing

SOURCE: NPR

EMERGING TREND – NEW POTENTIAL RISK FACTORS

Table 1. Characteristics of the Patients.*

Characteristic	All Patients (N=393)	Invasive Mechanical Ventilation (N=130)	No Invasive Mechanical Ventilation (N=263)
Baseline and demographic			
Median age (IQR) — yr	62.2 (48.6–73.7)	64.5 (51.7–73.6)	61.5 (47.0–75.0)
Male — no. (%)	238 (60.6)	92 (70.8)	146 (55.5)
White race — no. (%)†	147 (37.4)	46 (35.4)	101 (38.4)
Current smoker — no. (%)	20 (5.1)	6 (4.6)	14 (5.3)
Obesity — no./total no. (%)‡	136/380 (35.8)	56/129 (43.4)	80/251 (31.9)
Diabetes — no. (%)	99 (25.2)	36 (27.7)	63 (24.0)
Hypertension — no. (%)	197 (50.1)	70 (53.8)	127 (48.3)
Chronic obstructive pulmonary disease — no. (%)	20 (5.1)	7 (5.4)	13 (4.9)
Asthma — no. (%)	49 (12.5)	17 (13.1)	32 (12.2)
Coronary artery disease — no. (%)	54 (13.7)	25 (19.2)	29 (11.0)
On arrival in ED			
Fever — no./total no. (%)	100/392 (25.5)	45/130 (34.6)	55/262 (21.0)
Highest level of supplemental oxygen within first 3 hr — no. (%)			
None	244 (62.1)	40 (30.8)	204 (77.6)
Invasive mechanical ventilation	19 (4.8)	19 (14.6)	0
Infiltrates on initial chest radiograph — no. (%)	296 (75.3)	114 (87.7)	182 (69.2)
During hospital stay			
Arrhythmia — no. (%)	29 (7.4)	24 (18.5)	5 (1.9)
Vasopressor support — no. (%)	128 (32.6)	124 (95.4)	4 (1.5)
Bacteremia — no./total no. (%)	19/338 (5.6)	15/126 (11.9)	4/222 (1.8)
New renal replacement therapy — no./total no. (%)	18/375 (4.8)	17/128 (13.3)	1/247 (0.4)
Death — no. (%)	40 (10.2)	19 (14.6)	21 (8.0)
Discharge from hospital — no. (%)	260 (66.2)	23 (17.7)	237 (90.1)

* ED denotes emergency department, and IQR interquartile range.
† Race was determined by the clinical team.
‡ Obesity was defined as a body-mass index (the weight in kilograms divided by the square of the height in meters) of 30 or higher.

SOURCE: *The New England Journal of Medicine*

A recent retrospective case series on the first 393 consecutive patients with COVID-19 admitted to two New York hospitals between March 3rd and March 27th has revealed new potential risk factors for the illness. Among the patients, **60.6% were male** and **35.8% had obesity.**

Additionally, patients who required **invasive mechanical ventilation** were more often male and obese, with signs of **compromised liver function and inflammation** (elevated liver-function values and inflammatory markers, e.g., ferritin, D-dimer, C-reactive protein, and procalcitonin).

This data indicates that having obesity and being male are risk factors for both acquiring COVID-19, as well as for developing severe disease that requires invasive mechanical ventilation.

RECOMMENDED ACTION

Given the global shortage of machine ventilators, it is critical that prevention efforts and campaigns target individuals with these risk factors in order to limit future demand for invasive machine ventilators. Likewise, hospitals should prioritize these patients for early therapeutic interventions upon admission, even if they don't present urgent or life-threatening symptoms, given their heightened risk for developing serious infections later on.

HEALTH CARE PERSONNEL - COVID-19

CHARACTERISTICS OF HEALTH CARE PERSONNEL WITH COVID-19 — UNITED STATES, FEBRUARY 12–APRIL 9, 2020

Of 9,282 U.S. COVID-19 cases reported among health care personnel (HCP), median age was 42 years, and 73% were female, reflecting these distributions among the HCP workforce. HCP patients reported contact with COVID-19 patients in health care, household, and community settings. Most HCP patients were not hospitalized; however, severe outcomes, including death, were reported among all age groups.

WHAT ARE THE IMPLICATIONS FOR PUBLIC HEALTH PRACTICE?
It is critical to ensure the health and safety of HCP, both at work and in the community. Improving surveillance through routine reporting of occupation and industry not only benefits HCP, but all workers during the COVID-19 pandemic.

Hospitalizations,* intensive care unit (ICU) admissions,† and deaths,§ by age group among health care personnel with COVID-19 — United States, February 12–April 9, 2020

	Outcome, no. (%)**		
Age group¶ (yrs) (no. of cases)	Hospitalization††	ICU admission	Death
16–44 (4,898)	260 (5.3–6.4)	44 (0.9–2.2)	6 (0.1–0.3)
45–54 (1,919)	178 (9.3–11.1)	51 (2.7–6.3)	3 (0.2–0.3)
55–64 (1,620)	188 (11.6–13.8)	54 (3.3–7.5)	8 (0.5–1.0)
≥65 (508)	97 (19.1–22.3)	35 (6.9–16.0)	10 (2.0–4.2)
Total (8,945)	**723 (8.1–9.7)**	**184 (2.1–4.9)**	**27 (0.3–0.6)**

It is critical to make every effort to ensure the health and safety of this essential national workforce of approximately 18 million HCP, both at work and in the community. Surveillance is necessary for monitoring the impact of COVID-19-associated illness and better informing the implementation of infection prevention and control measures. Improving surveillance through routine reporting of occupation and industry not only benefits HCP, but all workers during the COVID-19 pandemic. (MMWR-17 APRIL 2020)

RESEARCH/STUDIES

Los Angeles, California study backs Stanford researchers' conclusion about high prevalence of COVID-19 – Palo Alto Online
USC researchers, who collaborated with Stanford, concluded that about 4% of Los Angeles County residents were infected with virus [Related Stanford Pre-Pub Study] [Related NYT Article]

Antibody surveys suggesting vast undercount of coronavirus infections may be unreliable – Science
Surveying large swaths of the public for antibodies to the new coronavirus promises to show how widespread undiagnosed infections are, how deadly the virus really is, and whether enough of the population has become immune for social distancing measures to be eased. But the first batch of results has generated more controversy than clarity.[Related pre-pub study]

Outcomes of hydroxychloroquine usage in United States veterans hospitalized with Covid-19 – MedRxiv
In this study, researchers found no evidence that use of hydroxychloroquine, either with or without azithromycin, reduced the risk of mechanical ventilation in patients hospitalized with Covid-19. An association of increased overall mortality was identified in patients treated with hydroxychloroquine alone. These findings highlight the importance of awaiting the results of ongoing prospective, randomized, controlled studies before widespread adoption of these drugs.(Not peered reviewed, pre-print)

Convalescent Plasma Therapy Clinical Guidebook
A team of Johns Hopkins experts has created a clinical guidebook to help hospitals and medical centers rapidly scale up their ability to deliver so-called convalescent plasma therapy, which leverages immune system components found in the plasma portion of blood from people who have recovered from COVID-19 illness. The guidebook was published online April 7 in the *Journal of Clinical Investigation*.

Mayo Clinic named national site for Convalescent Plasma Expanded Access Program

Mayo Clinic will be the lead institution providing coordinated access to investigational convalescent plasma for hospitalized patients with severe or life-threatening COVID-19, or those at high risk of progression to severe or life-threatening disease.

The Food and Drug Administration (FDA) announced the designation on Friday3 April 2020. Convalescent plasma refers to blood plasma collected from people who have recovered from COVID-19. That plasma is then used to treat others with advanced illness. The plasma donor must have recovered from, and tested negative for, COVID-19 and be otherwise healthy. The patient is transfused with the donor's plasma, which contains antibodies that can attack the virus and may help patients recover more rapidly.

GUIDELINES

OPENING UP AMERICA AGAIN

PROPOSED STATE OR REGIONAL GATING CRITERIA

- A downward trajectory of influenza-like illnesses and COVID-19 syndromic cases reported within a 14-day period.
- A downward trajectory of documented cases or positive tests as a percent of total tests, within a 14-day period.
- Hospitals are treating patients without crisis care and have a robust testing program in place for at-risk healthcare workers, including emerging antibody testing.
- Once states meet these criteria, Trump recommends that they begin the first stage of lifting the lockdown.

https://www.whitehouse.gov/openingamerica/#criteria

PHASE ONE OF THE OPENING UP AMERICA AGAIN GUIDELINES

When a state enters phase one, according to the guidelines, individuals should continue to social distance when in public, and social settings of more than 10 people should be avoided. Individuals should minimize non-essential travel, and follow the Centers for Disease Control and Prevention (CDC) guidelines regarding self-isolating following travel.

- Vulnerable individuals should continue to stay at home and members of their households should be aware that returning to work where distancing isn't practical risks passing on the coronavirus to the vulnerable person.
- Employers should continue to encourage their employees to work remotely, when possible, and return to work in phases. Additionally, employers should close common areas, minimize non-essential travel, and consider special accommodations for vulnerable employees.

PHASE TWO OF THE OPENING UP AMERICA AGAIN GUIDELINES

During phase two, vulnerable individuals should continue to stay at home. Individuals should continue to social distance, but social settings of more than 50 should be avoided. Non-essential travel can resume.

Employers should continue to encourage their employees to work remotely, should keep common areas closed, and should continue to consider special accommodations for the vulnerable population.

In phase two, schools, daycare centers, and camps can reopen, and bars can open with reduced standing-room occupancy.

PHASE THREE OF THE OPENING UP AMERICA AGAIN GUIDELINES

Vulnerable individuals no longer have to stay at home but should practice social distancing and minimize their exposure to social settings where distancing may not be practical. Low-risk populations should minimize their time spent in crowded environments.

Employers can allow their workers to return to work in phase three. Visits to senior care facilities and hospitals can resume, but those who interact with residents and patients must maintain high standards of hygiene. Large venues, like movie theaters and sports venues, can operate under limited physical distancing protocols. Bars can operate with increased standing room occupancy.

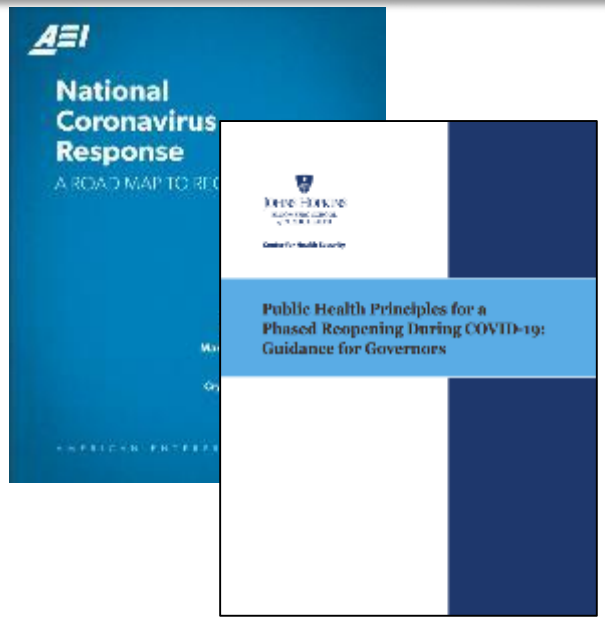
PHASING REOPENING

As the COVID-19 pandemic continues to progress, most jurisdictions have implemented physical distancing measures to reduce further transmission, which have contributed to reductions in numbers of new cases.

As chains of transmission begin to decline, along with new COVID-19 cases, there will need to be decisions at the state level about how to transition out of strict physical distancing measures and into a phased reopening.

The Johns Hopkins Center for Health Security's Public Health Principles for a Phased Reopening During COVID-19: Guidance for Governors provides an assessment of the risk of SARS-CoV-2 transmission in a variety of organizations and settings that have been closed. We outline steps to reduce potential transmission during the reopening of these organizations and settings, building on the proposed phased approach from American Enterprise Institute's National Coronavirus Response: A Road Map to Reopening.

Reopening businesses and other sectors represents one of many steps that will need to be taken to revitalize communities recovering from the pandemic, restore economic activity, and mitigate the unintended public health impact of the distancing measures that were necessary to confront the epidemic of COVID-19. A discussion of larger community-wide considerations for holistically enhancing recovery can be found in the Appendix. https://www.centerforhealthsecurity.org/our-work/pubs_archive/pubs-pdfs/2020/reopening-guidance-governors.pdf



IDSA hivma

Policy and Public Health Recommendations for Easing COVID-19 Distancing Restrictions

The Infectious Diseases Society of America and its HIV Medicine Association warned today that prematurely easing social distancing measures put in place to curtail the spread of COVID-19 will risk increased infections and deaths, incapacitated health care facilities, and prolonged economic hardships. Stressing that physical distancing policy changes must be based on relevant data and adequate public health resources and capacities, IDSA and HIVMA released recommendations calling for a rolling and incremental approach to lifting these restrictions.

https://www.idsociety.org/contentassets/9ba35522e0964d51a47ae3b22e59fb47/idsa-recommendations-for-reducing-covid-19-distancing_16apr2020_final-.pdf

This rolling approach must reflect state and regional capacities for diagnosing, isolating and treating people with the virus, tracing their contacts, protecting health care workers, and addressing the needs of populations disproportionately affected by COVID-19.

The recommendations stress that changes to current physical distancing policies should only begin when widespread testing allows accurate surveillance of the coronavirus spread. A significant expansion of tests, testing, personal protective equipment (PPE) and other medical supplies, and public health workers is still needed to reach the level of testing and surveillance necessary to safely reopen the country. Some continued measures will be necessary pending the development and availability of proven treatments and a vaccine, the recommendations note.

The recommendations, which will be updated in response to developments, also call for specific steps to build nationwide capacities and supply chains to detect, prevent, and respond to the spread of COVID-19.

BEST PRACTICES FOR RETURNING TO WORK

On 4/21/2020, the Minnesota Chamber of Commerce released guidelines and recommendations for businesses to return to work without risking employee or customer health safety. The recommendations are divided by:

PERSONAL PROTECTION AND FACILITIES CLEANING, SANITIZING

CUSTOMER ENGAGEMENT

EMPLOYEE AND CUSTOMER COMMUNICATIONS / INSTRUCTION / SIGNAGE

SOCIAL DISTANCING

TRAVEL POLICIES

COMMUNICATIONS / EDUCATION / RESPONSIBILITIES

VENDOR ENGAGEMENT

MONITORING EMPLOYEE HEALTH

https://www.mnchamber.com/blog/covid-19-prevention-best-practices

https://www.cdc.gov/coronavirus/2019-ncov/community/guidance-business-response.html

https://www.mnchamber.com/sites/default/files/MN%20Chamber%20Best%20Practices%20edition%201.pdf

https://www.osha.gov/Publications/OSHA3990.pdf

EMERGING ISSUES - CONGREGATE CARE FACILITIES

IMPACT ON GROUP HOMES & CARE FACILITIES FOR THE DEVELOPMENTALLY DISABLED

Across the U.S., group homes and care facilities for the developmentally disabled are experiencing disproportionately high numbers of COVID-19 cases and deaths compared to the general population. Additionally, exposure to infected patients has resulted in many staff/caregivers—the "direct care work force"—also contracting the virus, making it difficult for facilities to maintain adequate staffing levels.

Developmentally delayed residents of these facilities are a particularly vulnerable group because, in addition to living in a congregate residential setting, many have underlying health conditions that make them exponentially more likely to contract and die from COVID-19.

In New York York state, 1,100 of the 140,000 developmentally disabled people monitored by the state have tested positive, as well as 314 group home staff. As of April 10th, 156 of the 1100 have died. In New York City, residents of group homes and similar care facilities are 5.34 times more likely than the general population to develop the virus and 4.86 times more likely to die from it.

Staff/caregivers have expressed concerns about facilities' capacity to contain and control infection control and containment, including:

- Staff lacking training on how to minimize infection transmission when providing patient care
- Shortage of staff (due to infection or fear of getting infected)
- Difficulty enforcing recommended prevention measures like hand-washing and social distancing among residents
- Difficulty obtaining tests
- Shortage of PPE and other critical supplies (e.g. oxygen)

The widespread challenge of overwhelmed hospitals has also contributed to the increased toll of COVID-19 on group homes, with many facilities reporting that their residents who displayed symptoms were turned away by the hospital if their symptoms weren't life threatening. As a result, these individuals returned to their group homes, likely infecting other residents and staff.

SOURCE: NEW YORK TIMES
SOURCE: NBC NEW YORK

PROTECTING COVID-19 PATIENTS WITH DEVELOPMENTAL DISABILITIES FROM DISCIRIMINATORY HEALTH CARE

There is growing concern being expressed by caregivers, advocates and policymakers about the potential deprioritization of developmentally delayed COVID-19 patients for life saving treatments, namely ventilators.

On April 4th, Disability Rights New York, an oversight organization, filed a federal complaint against Governor Cuomo's administration, claiming that state policies treat the developmentally disabled as second-class citizens who will be deprioritized for access to ventilators, should there be a shortage. Similar complaints were also filed by advocacy groups in Alabama, Kansas, Tennessee, and Washington State.

In order to prevent discriminatory care of COVID-19 patients in healthcare settings, leading advocates have proposed that [state] policy prohibiting discriminatory allocation of ventilators, and healthcare at large, be enacted immediately.

As the COVID-19 pandemic moves into its next phase, some of the attention is shifting from shortages to the horrific death tolls and apparent neglect in densely populated nursing homes for the elderly and disabled, group homes and institutions for people with intellectual and developmental disabilities, and mental institutions. When so much of the battle against the virus depends on isolation, these kinds of congregate care facilities seem uniquely and inherently unsafe. (Forbes)

SOURCE: NEW YORK TIMES

IMPACT ON PEOPLE OF COLOR

Due to underlying social and economic disparities, COVID-19 has disproportionately affected communities of color.

The CDC began reporting national data on confirmed coronavirus cases by race and ethnicity as of April 17, 2020. However, race and ethnicity is missing or unspecified for 65% of CDC-reported cases, limiting ability to interpret data.

As of April 15, 2020, 33 states, including DC were reporting data on distribution of confirmed cases and/or deaths by race/ethnicity

According to the Kaiser Family Foundation, in the majority of states reporting data, Black people accounted for a higher share of confirmed cases (in 20 of 31 states) and deaths (in 19 of 24 states) compared to their share of the total population.

In some states, disparate impacts were observed for Hispanic and Asian individuals. In 6 of 26 states reporting data, Hispanic individuals made up a greater share of confirmed cases.

In Chicago, more than 50% of COVID-19 cases and nearly 70% of COVID-19 deaths involve black individuals, although blacks make up only 30% of the population. Moreover, these deaths are concentrated mostly in just 5 neighborhoods on the city's South Side.

In Louisiana, 70.5% of deaths have occurred among black persons, who represent 32.2% of the state's population.

In Michigan, 33% of COVID-19 cases and 40% of deaths have occurred among black individuals, who represent 14% of the population.

If New York City has become the epicenter, this disproportionate burden is validated again in underrepresented minorities, especially blacks and now Hispanics, who have accounted for 28% and 34% of deaths, respectively (population representation: 22% and 29%, respectively).

THE OTHER COVID RISKS: HOW RACE, INCOME, ZIP CODE INFLUENCE WHO LIVES OR DIES

Doctors know that people with underlying health conditions — such as the 40% of Americans who live with diabetes, hypertension, asthma and other chronic diseases — are more vulnerable to COVID-19. So are patients without access to intensive care or mechanical ventilators.

Yet some public health experts contend that social and economic conditions — long overlooked by government leaders, policymakers and the public — are even more powerful indicators of who will survive the pandemic.

Federal health officials have known for nearly a decade which communities are most likely to suffer devastating losses — both in lives and jobs — during a disease outbreak or other major disaster. In 2011, the CDC created the Social Vulnerability Index to rate all the nation's counties on factors such as poverty, housing and access to vehicles that predict their ability to prepare, cope and recover from disasters.

Yet the country has neglected to respond to warning signs that these communities — where people already live sicker and die younger than those in more affluent areas — could be devastated by a pandemic. (Kaiser Health News)

The Johns Hopkins University and American Community Survey indicate that to date, of 131 predominantly black counties in the US, the infection rate is 137.5/100 000 and the death rate is 6.3/100 000. This infection rate is more than 3-fold higher than that in predominantly white counties. Moreover, this death rate for predominantly black counties is 6-fold higher than in predominantly white counties. Even though these data are preliminary and further study is warranted, the pattern is irrefutable: underrepresented minorities are developing COVID-19 infection more frequently and dying disproportionately.

Sources:
Growing Data Underscore that Communities of Color are Being Harder Hit by COVID-19

Hospitalization Rates and Characteristics of Patients Hospitalized with Laboratory-Confirmed Coronavirus Disease 2019 — COVID-NET, 14 States, March 1–30, 2020

The other COVID risks: how race, income, zip code influence who lives or dies

COVID-19 and African Americans

COVID-19 AND INCARCERATION

Mass testing at a state prison in Ohio has provided more evidence of just how quickly and easily the novel coronavirus can spread in correctional facilities. 1,828 people — or 73% of all inmates — have tested positive for COVID-19 at the Marion Correctional Institute in Marion County, Ohio, according to the Ohio Department of Rehabilitation & Corrections.

At least 2,400 inmates across Ohio state prison facilities have received positive diagnoses for COVID-19 since Ohio Department of Rehabilitation & Correction began testing on April 11, including large numbers at the state's Pickaway Correctional Institution and Franklin Medical Center. As of April 22, incarcerated people make up 20% of the state's entire coronavirus cases. 12 inmates have died.

This percentage is largely believed to be because mass testing has been implemented at the three facilities, based on the demographics of their populations (which skew towards elderly inmates and those with pre-existing conditions).

Mass testing at the Cummins Unit correctional facility in Lincoln County, Ark. has similarly found 731 inmates testing positive for COVID-19, according to the Arkansas Department of Corrections. (Over 1,000 inmates there have been tested, the *Associated Press* reported.) Most of the Cummins inmates have been asymptomatic, but three have been hospitalized.

In Cook County Jail in Chicago As of 22 April 2020, 448 inmates have tested positive, six have died, 18 are hospitalized, 231 inmates have now recovered from COVID-19. A total of 321 Cook County Sheriff's employees have tested positive for the virus to date — with 185 being corrections officers. 129 have recovered and returned to work. Two correction officers have died.

As of 04/22/2020, there are 566 federal inmates and 342 Bureau of Prisons (BOP) staff who have confirmed positive test results for COVID-19 nationwide. Currently, 248 inmates and 52 staff have recovered. There have been 24 federal inmate deaths and 0 BOP staff member deaths attributed to COVID-19 disease.

Mass incarceration could almost double its number of deaths from coronavirus, with jails acting as incubators of the disease and spreading a further 100,000 fatalities across the US.

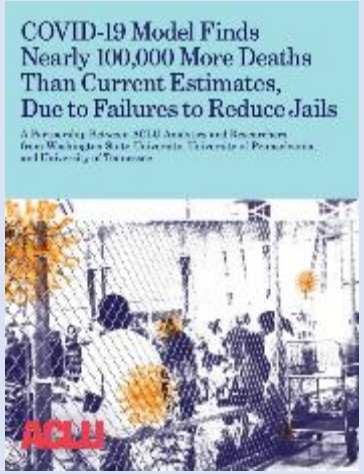
The warning comes from groundbreaking modeling by the American Civil Liberties Union (ACLU) and academic researchers, released on Wednesday.

The analysis found that unless instant action is taken to reduce jail populations, a terrible price will be paid. Jails, which house men and women not yet convicted, will act as mass vectors of the contagion.

As many as 100,000 more people could die in the US as a result of the virus being contracted behind jail walls, the study predicts.

The US accounts for 4% of the world's population, but 21% of its incarcerated population. The ACLU modeling, developed with epidemiologists from Washington state and the Universities of Tennessee and Pennsylvania, focuses on the 740,000 people held in US jails. Conditions inside such institutions are often even worse than in the notorious prison system and amount to a Covid-19 perfect storm.

COVID-19 Model Finds Nearly 100,000 More Deaths Than Current Estimates, Due to Failures to Reduce Jails



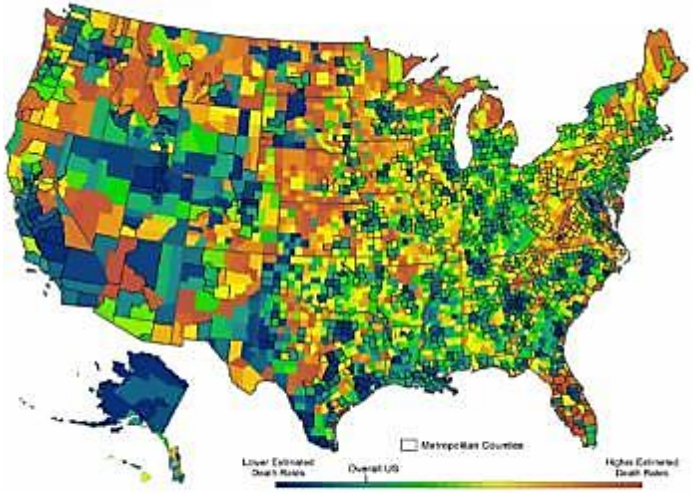
RURAL RESPONSE TO CORONAVIRUS (COVID-19)

Why rural America could be a 'tinderbox' for Covid-19

Apr 22, 2020 While national media outlets cover the novel coronavirus outbreak in urban hotspots, rural America is bracing for its own wave of the epidemic. Several mostly-rural states have not mandated statewide stay-at-home orders, including Arkansas, Iowa, Nebraska, North Dakota, South Dakota, Utah, and Wyoming. Experts say it's only a matter of time before the virus hits these areas—and hard.

In fact, research suggests these communities are poised to face especially poor outcomes. A study from the **University of New Hampshire** found that more than half of rural counties experience Covid-19 mortality rates that are higher than the national average due to their older populations. Rural residents also experience more chronic conditions, leaving them at a higher risk for complications.
Rural residents are more likely to be considered essential workers—like those in the meatpacking plants in Sioux Falls and Louisa County—leaving them at greater risk for exposure. Source: Advisory Board View details

OLDER NONMETROPOLITAN POPULATION INCREASES ESTIMATED DEATH RATES AMONG THOSE INFECTED BY SARS-COV-2



Note: Death rates estimated using age-specific mortality rates among those infected with the coronavirus. Several other factors known to influence coronavirus mortality are not included in estimates.
Source: Census Bureau Estimates; R. Verity, et al., 2020. Lancet.
Analysis: K.M. Johnson, Carsey School of Public Policy, University of New Hampshire

An Older Population Increases Estimated COVID-19 Death Rates in Rural America

- KEY TAKEAWAYS
- Rural residents on average are older, experience elevated clinical challenges, and are less able to access and afford care.
- Rural patients of color experience even more acute health inequities, with few social safety net programs to alleviate social determinants of health.
- Rural hospitals are increasingly shuttering, while nearly half of remaining hospitals operate in the red, threatening the livelihood of their surrounding communities.

Lessons from the Field: How Rural Clinics, FQHCs Can Use Telehealth, eConsults During the COVID-19 Emergency

Apr 20, 2020 - Highlights Shasta Cascade Health Centers in rural Northern California, who in response to the COVID-19 pandemic, created a hotline and utilized patient screening through teleconferencing for residents who may have been exposed to coronavirus. Describes how FQHCs and rural clinics can utilize telehealth and eConsults to provide medical and mental health services and mitigate the effects of the disease.
Source: Medical Group Management Association. view details

New COVID-19 Risk Assessment Could Help Rural Mitigation Strategies

Apr 20, 2020 - Presents an overview of a report that states the absence of widespread testing for the coronavirus may cause rural counties to appear "statistically invisible," putting them at risk of lowering their guard to the disease. Researchers propose not basing decisions and response measures on the absolute count of cases, but rather relative risk scores assessed through various indicators.
Source: The Daily Yonder view details

CMS Issues Recommendations to Re-Open Health Care Systems in Areas with Low Incidence of COVID-19

Apr 19, 2020 - The Centers for Medicare and Medicaid Services (CMS) issued guidance to areas with low COVID-19 incidence recommending healthcare providers coordinate with public health officials and review the availability of resources before reopening non-essential healthcare services. This is part of Phase 1 in the Trump Administration's Guidelines for Opening Up America Again.
Source: Centers for Medicare and Medicaid Services view details

SOURCE: RHIhub

CORONAVIRUS AT MEATPACKING PLANTS

Meat packing and COVID-19

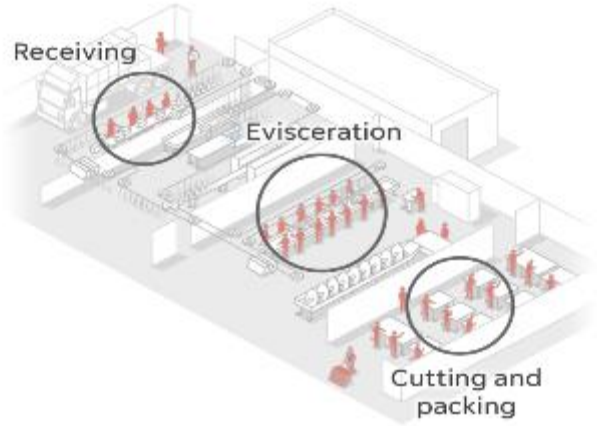
The map shows large meat packing factories in U.S. counties with an infection rate greater than 104 per 100,000 residents – a higher COVID-19 infection rate than 75 percent of US counties.

SOURCE: USDA; Johns Hopkins University; WHO; CDC; USA TODAY Analysis

CARLIE PROCELL/USA TODAY

Close quarters in meat packing plants

Workers can stand too close together in certain areas of a meat packing facilities, enabling the spread of corona. This is a look inside a chicken processing plant, but the process is similar no matter what type of meat is being processed.



SOURCE USA TODAY research: Al Mahomud Ibne Jamal, student at Chittagong Veterinary & Animal Sciences University

Karl Gelles/USA TODAY

*As of **April 22**, there have been at least about **2,700** reported positive cases tied to meatpacking facilities at 60 plants in 23 states, and at least **17** reported worker deaths at 8 plants in 8 states.*

The Smithfield pork processing plant in Sioux Falls, South Dakota, is now home to the largest cluster of COVID-19 cases in the country, with 761 employees and 1433 non employees who tested positive after interacting with plant workers. As of . That's more than half of the state's COVID-19 total, which is 1,168. So far, at least one Smithfield plant employee has died from the disease.

As of 21 April 2020 coronavirus infections had spread in at least 48 U.S. meatpacking plants, sickening more than 2,200 people and killing 17.

The outbreaks also have prompted the closure of at least 17 facilities, including that of the JBS pork plant in Worthington, Minnesota, on Monday, 20 April 3020.

The Worthington JBS is among the 153 meat processing plants that USA TODAY and the Midwest Center for Investigative Reporting identified as operating in counties with a high rate of coronavirus infection. Any rate above one infection per 1,000 people puts a county in the top 25% of U.S. counties reporting COVID-19 infection rates.

Other plants on the list include the Tyson pork-processing facility in Columbus Junction, Iowa, where 186 workers fell ill and two died after COVID-19 swept through the factory.

The Tyson plant is located in Louisa County, where 19 out of every 1,000 people have tested positive for the novel coronavirus. It’s the highest rate of any county with a large meat processor.

Tyson also has a poultry processing facility in Mitchell County, Georgia, where at least four workers have tested positive for coronavirus. The facility remains open, despite more than 9 out of every 1,000 county residents testing positive for COVID-19.

A JBS facility in Grand Island, Nebraska remains open after 237 workers tested positive there. The plant is located in Hall County, where 7.5 of every 1,000 people has tested positive.

IDSA
Infectious Diseases Society of America

IDSA COVID-19 Antibody Testing Primer

Updated: April 20, 2020

SOURCE: www.idsociety.org/globalassets/idsa/public-health/covid-19/idsa-covid-19-antibody-testing-primer.pdf

BACKGROUND ON ANTIBODY TESTING FOR SARS-CoV-2 INFECTION

The antibody response in infected patients remains largely unknown, and the clinical values of antibody testing have not been fully demonstrated. Seroprevalence data will be important in understanding the scale of the pandemic and future vaccine utility. Potential utility of serology in SARS-CoV-2:

- Detection of PCR-negative cases, especially for patients who present late with a very low viral load below the detection limit of RT-PCR assays, or when lower respiratory tract sampling is not possible;
- Identification of convalescent plasma donors;
- Epidemiologic studies of disease prevalence in the community;
- Verification of vaccine response once antibody correlate(s) of protection identified.
- Potential drawbacks if serological assays are not well-validated:
- False negative risks if performed early in disease course, especially in mild disease;
- False positive risks, particularly with tests for Immunoglobulin M (IgM) and potential cross reactivity +with common cold coronaviruses (e.g. HKU1, NL63, OC43, 229E).

TEST QUALITY & INTERPRETATION

- There are a multitude of different antibody tests for COVID-19 with variable performance. Tests vary in the viral antigen(s) they target, e.g., nucleoprotein (N protein) or spike protein (S protein). It is not yet clear which antibody responses, if any, are protective or sustained.
- The Foundation for Innovative New Diagnostics (FIND), a global non-profit organization driving innovation in the development and delivery of diagnostics, is conducting an independent evaluation of performance data for SARS-CoV-2 immunoassays to help inform procurement and implementation decisions for countries and health programs. The dataset could also help inform clinical validation studies for these tests.
- A "positive" test is exceptionally difficult to interpret because the performance of these tests is not well known. For some assays both sensitivity and specificity may be poor, or at the very least undefined.
- Clinical laboratories will need to perform validation studies of commercial reagents.
- **Some FDA-authorized COVID-19 antibody tests are estimated to have 96-98% specificity, which would mean that a positive test result is more likely a false-positive result than a true positive result if the prevalence or pretest probability is 5% or less.**

ADDITIONAL CONSIDERATIONS

- No universal standard for reporting is available and test detection limits are variable. Some assays provide semi-quantitative results and others are designed to be qualitative (i.e. antibody detected or not).
- Several tests are combination IgG/IgM, which provide unclear value given the poor specificity of IgM.
- Currently available commercial assays do not have titers, and without this information it is unclear how to identify "qualified" individuals for plasma donation.
- Nucleic acid amplification tests (NAATs) perform differently than antibody testing, and this has implications for interpretation. The NAATs that were developed for SARS-CoV-2 are very specific. Inpatients with signs and symptoms of infection, a positive NAAT result has a very high positive predictive value (PPV) for true infection. Conversely, both the negative and PPV of antibody testing are likely to be lower, given the low prevalence of prior exposure to SARS CoV-2 in the U.S. population and imperfect sensitivity and specificity of the test.
- As a result, antibody tests will be most useful as surveillance tools to estimate (with surrounding confidence intervals) relative proportions of different populations that have been exposed to SARS CoV-2. They will have less utility as diagnostic tools for individual patient assessment.
- Privacy concerns: As we roll out antibody tests, the federal government should clarify several key questions regarding privacy: Who will collect antibody samples? How might they be saved and used in the future (i.e. by government, by law enforcement)? Will there be federal privacy protections for patient samples? What type(s) of applications are intended?
    - Applications must mitigate concerns about privacy violations and hacking; advertiser tracking; potential test error; and faulty phone/wireless signals.

OUSTANDING RESEARCH NEEDS

- While extrapolation from other coronavirus infections allows us to be optimistic that detection of an IgG response will likely confer at least some protection to most people, we have no direct evidence of this for SARS-CoV-2.
- Understanding which antibodies (if any) are protective is required for vaccine development. There are many different SARS CoV-2 IgG antibodies that may be produced, and each may have a different role.
- This should also be a consideration in assessing the clinical utility of tests designed to target specific antibodies.
- Determine limits of protective immunity (e.g., antibody amount, duration, and efficacy) and correlations with disease severity.
- Address concerns about potentiation of cytokine release syndrome (CRS) by a vaccine or hyperimmune plasma administration: Patients with COVID-19 infection can develop CRS about day 7-10 of illness, which often leads to death. There is some concern that a vaccine against the "wrong" antigens or infusion of hyperimmune plasma from COVID-19 survivors could worsen the inflammatory immune response in patients with COVID-19 infection. This immune enhancement is seen for some flaviviruses such as dengue.
- Development of accurate serologic tests that can be used with fingerstick capillary blood would be ideal for seroprevalence field studies. Most commercial assays require venipuncture blood draw to obtain serum or plasma.

HEALTHCARE INNOVATIONS TO FIGHT COVID-19

04.21.20

FIGHT THE PANDEMIC

DIAGNOSTICS

78 **79** 80

Regulatory authorized diagnostic tests

DIAGNOSTICS

Diagnostic Test Type

Scientific assay/technology used for detection

68 Polymerase chain reaction (PCR)

3 PCR – Point-of- care

2 Next-generation sequencing (NGS)

2 Isothermal amplification

4 Serological

Diagnostics Approval Status*

FDA-Emergency Use Authorization	CE mark (approval to sell in Europe)	Lab developed test (LDT)	LDT-EUA	Discontinued
42	17	1	16	~~3~~

Result Time

Based on time for assay to run

< 1 hr	2-8 hr	12+ hr
12	58	8

*Approval status not double counted

SOURCE : https://www.av.co/covid-diagnostics

@vasudevbailey
@zoeguttendorf

DIAGNOSTICS

Vasudev Bailey, PhD @vasudevbailey
Zoe Guttendorf @zoeguttendorf

	Product	Company	Test Type	Result Time (hr)	Approval Status
1.	RealTime SARS-CoV-2	Abbott	PCR	4-6	FDA - EUA
2.	ID NOW COVID-19 test	Abbott	Isothermal amp. - PoC	<1	FDA - EUA
3.	iAMP COVID-19 Detection Kit	Atila BioSystems	Isothermal amp. - PoC	1	FDA - EUA
4.	AvellinoCoV2	Avellino Labs	PCR	24-48	FDA - EUA
5.	BD SARS-CoV-2Reagents	BD	PCR	2-3	FDA - EUA
6.	BioGX SARS-CoV-2 Reagents	BioGx, BD	PCR	2-3	FDA - EUA
7.	Real-Time Fluorescent RT-PCR kit	BGI	PCR	3	FDA - EUA
8.	BIOFIRE COVID-19 test	BioMérieux - BioFire Defense	PCR	<1	FDA - EUA
9.	2019-nCoV Real-Time RT-PCR Dx Panel	CDC	PCR	24-72	FDA - EUA
10.	qSARS-CoV-2 IgG/IgM Rapid Test Kit	Cellex	Serological	<1	FDA - EUA
11.	Xpert Xpress SARS-CoV-2 test	Cepheid	PCR-PoC	<1	FDA - EUA
12.	DPP COVID-19 IgM/IgG System	ChemBio Dx Systems	Serological	<1	FDA - EUA
13.	Logix Smart Coronavirus COVID-19 Test	Co-Diagnostics	PCR	1-2	FDA - EUA
14.	QuantiVirus SARS-CoV-2 test	DiaCarta	PCR	2	FDA - EUA
15.	Simplexa COVID-19 Direct	DiaSorin Molecular	PCR	1	FDA - EUA
16.	Fosun COVID-19 RT-PCR Detection Kit	Fosun Pharma USA	PCR	2	FDA - EUA
17.	ePlex SARS-CoV-2 Test	GenMark Diagnostics	PCR	2	FDA - EUA
18.	GS™ COVID-19 RT-PCR KIT	GenoSensor	PCR	4-6	FDA - EUA
19.	COVID-19 RT-Digital PCR Detection Kit	Gnomegen	PCR	4-6	FDA - EUA
20.	Panther Fusion SARS-CoV-2 Assay	Hologic	PCR	3	FDA - EUA
21.	Smart Detect SARS-CoV-2 rRT-PCR Kit	InBios International	PCR	4-6	FDA - EUA
22.	COV-19 IDx assay	Ipsum Diagnostics	PCR	24	FDA - EUA
23.	Curative-Korva SARS-Cov-2 Assay	KorvaLabs	PCR	4-6	FDA - EUA
24.	Covid-19 RT-PCR test	LabCorp	PCR	24	FDA - EUA
25.	ARIES SARS-CoV-2 Assay	Luminex Corporation	PCR	2	FDA - EUA
26.	NxTAG CoV Extended Panel Assay	Luminex Corporation	PCR	4	FDA - EUA
27.	SARS-CoV-2 Fluorescent PCR Kit	Maccura Biotech	PCR	2	FDA - EUA
28.	Accula SARS-CoV-2 test	Mesa Biotech	PCR-PoC	<1	FDA - EUA
29.	COVID-19 ELISA IgG Antibody Test	Mount Sinai	Serological	<1	FDA - EUA
30.	SARS-CoV-2 Assay, 288/96 Molecular Systems	NeuMoDx	PCR	1-2	FDA - EUA
31.	VITROS Immunodiagnostic Products Anti-SARS-CoV-2 Total Reagent Pack	Ortho Clinical Diagnostics	Serological	<1	FDA - EUA
32.	GeneFinder COVID-19 Plus RealAmp Kit	OsangHealthcare	PCR	4-6	FDA - EUA
33.	New Coronavirus RT-PCR Test	PerkinElmer	PCR	4-6	FDA - EUA
34.	COVID-19 genesig Real-Time PCR assay	Primerdesign	PCR	2	FDA - EUA
35.	QIAstat-Dx Respiratory SARS-CoV-2 Panel	Qiagen (acq. by Thermo Fisher)	PCR	1	FDA - EUA
36.	Quest SARS-CoV-2 rRT-PCR	Quest	PCR	96-120	FDA - EUA
37.	Lyra SARS-CoV-2 Assay	Quidel	PCR	4-6	FDA - EUA
38.	cobas SARS-CoV-2 Test	Roche	PCR	3-8	FDA - EUA
39.	SARS-CoV-2 RTqPCR Detection Kit	ScienCell Research Labs	PCR	4-6	FDA - EUA
40.	TaqPath COVID-19 Combo Kit	Thermo Fisher	PCR	4	FDA - EUA
41.	PhoenixDx 2019-CoV	Trax Managment Services	PCR	4-6	FDA - EUA
42.	NY SARS-CoV-2 Real-time RT-PCR	Wadsworth Center, NY State Dept of Public Health (CDC)	PCR	24-72	FDA - EUA
43.	SARS-CoV-2 + Influenza A & B RT-qPCR Kit	3D Medicines	PCR	4-6	CE Mark
44.	REALQUALITY RQ-2019-nCoV	AB ANALITICA	PCR	4-6	CE Mark
45.	Bosphore 2019-nCoV Detection Kit	Anatolia Geneworks	PCR	2	CE Mark
46.	SARS-CoV-2, influenza, RSV panel	AusDiagnostics	PCR	4-6	CE Mark
47.	AccuPower COVID-19 Real-Time RT-PCR Kit	Bioneer	PCR	8	CE Mark
48.	Q-Sens 2019-nCoV Detection Kit	CancerRop	PCR	2	CE Mark
49.	VIASURE SARS-CoV-2 Real Time PCR	CerTest Biotec, BD	PCR	3	CE Mark
50.	VitaPCR SARS-CoV2 Assay	Credo Diagnostics Biomedical	PCR-PoC	<1	CE Mark
51.	EasyScreen SARS-CoV-2 Detection Kit	Genetic Signatures	PCR	4-5	CE Mark
52.	Detection Kit for SARS-CoV-2	Genetron Health	PCR	4	CE Mark
53.	qCOVID-19, CLART COVID-19	Genomica/PharmMar Group	PCR	5	CE Mark
54.	2019 Real-time PCR Kit	Kogene Biotech	PCR	4-6	CE Mark
55.	RealAccurate Quadruplex Corona-plus PCR Kit	PathoFinder	PCR	2	CE Mark
56.	Allplex 2019-nCoV Assay	Seegene	PCR	4	CE Mark
57.	DiaPlexQ 2019-nCoV Detection kit	SolGent	PCR	2	CE Mark
58.	SARS-CoV-2 Clinical Sequencing assay	Vision Medicals	NGS	>12	CE Mark
59.	Multiple Real-Time PCR Kit	Beijing Applied Biological Technologies (XABT)	PCR	4-6	CE Mark
60.	COVID-19 RT-PCR Test	Baptist Hospital Miami	PCR	4-6	LDT (EUA)
61.	Childrens-Altona-SARS-CoV-2 Assay	Boston Children's Hospital	PCR	4-6	LDT (EUA)
62.	SARS-CoV-2 RT-PCR test	Children's Hospital of Philadelphia (CHOP)	PCR	4-6	LDT (EUA)
63.	CirrusDx SARS-CoV-2 Assay	CirrusDx Laboratories	PCR	4-6	LDT (EUA)
64.	SARS-CoV-2 Test	Exact Sciences	PCR	4-6	LDT (EUA)
65.	CDI Enhanced COVID-19 Test	Hackensack University	PCR	3-5	LDT (EUA)
66.	SARS-CoV-2 Assay	Integrity Laboratories	PCR	4-6	LDT (EUA)
67.	MGH COVID-19 qPCR assay	Massachusetts General Hospital	PCR	4-6	LDT (EUA)
68.	SARS-Cov-2 Assay	Northwestern Medicine	PCR	4-6	LDT (EUA)
69.	Origin 2019 nCoR (COVID-19) Test	Origin	PCR	4-6	
70.	ThermoFisher - Applied Biosystems TaqPath COVID-19 Combo Kit	Rutgers University	PCR	4	LDT (EUA)
71.	SD1 SARS-CoV-2 Assay	SD1 Labs	PCR	4-6	LDT (EUA)
72.	Stanford SARS-CoVo2 Assay	Stanford Clinical Virology Lab	PCR	4-6	LDT (EUA)
73.	SARS-CoV-2 real-time RT-PCR test	UNC Medical Center	PCR	4-6	LDT (EUA)
74.	Viracor SARS-CoV-2 assay	Viracor Eurofins Clinical Diagnostics	PCR	4-6	LDT (EUA)
					LDT (EUA)
75.	SARS-CoV-2 PCR test	Yale New Haven Hospital	PCR	4-6	LDT (EUA)
76.	Explify Respiratory	IDbyDNA	NGS	24-48	LDT
77.	COVID-19 Home Test Kits	Carbon Health	PCR	-	discontinued
78.	At-home Covid-19 test	Everlywell	PCR	-	discontinued
79.	Covid-19 Home Test Kit	Nurx, Molecular Testing Labs	PCR	-	discontinued

Design by: @IlianaMarksCA

Source: FDA, WHO, company websites, news. Available upon request.

ARTIS VENTURES

HEALTHCARE INNOVATIONS TO FIGHT COVID-19

04.16.20

FIGHT THE PANDEMIC

DIAGNOSTICS: SEROLOGICAL

Vasudev Bailey, PhD @vasudevbailey
Zoe Guttendorf @zoeguttendorf

Product	Company*
1. Accu-Tell COVID-19 IgG/IgM Test	AccuBioTech
2. DrivenFlow COVID-19	Alfa Scientific Designs
3. COVID-19 IgM/IgG test kit	AmonMed Biotechnology
4. COVID-19 IgG/IgM Ab Test Kit	Anhui Deep Blue Medical Technology
5. COVID-19 IgG/IgM Test Device	Assure Tech
6. COVID-19 Antibody (IgG/IgM) Kit	Beijing Abace Biology
7. 2019-nCoV IgG/IgM Antibody Kit	Beijing Diagreat Biotech
8. COVID-19 Antibody Test	Beijing Hotgen Biotech
9. Kewei COVID-19 IgM ELISA Test Kit	Beijing Kewei Clinical
10. SARS-Cov-2 Antigen Fluorescence Rapid Detection Kit	Beijing Savant Biotech
11. Tigsun COVID-19 Combo IgM/IgG Rapid Test	Beijing Tigsun Diagnostics
12. SARS-CoV-2 IgG/IgM Ab Kit	Beroni Group
13. 2019-nCoV IgG/IgM Ab Kit	Biolidics
14. 2019-nCoV IgG/IgM Test	BIOMAXIMA
15. COVID-19 IgM-IgG Dual Ab Test	BioMedomics
16. CoreTest COVID-19 IgM/IgG	Core Technology
17. OnSite COVID-19 IgG/IgM Test	CTK Biotech
18. ELISA COVID 19 IgG	DIA PRO
19. COVID-19 IgMEIA-6147	DRG International
20. 2019 nCOV IgG/IgM Rapid Test	Dynamiker Biotech
21. 2019 nCoV Ab detection reagent	Edinburgh Genetics
22. ED COVID-19 IgG/ IgM ELISA Kit	Epitope Diagnostics
23. Anti-SARS-CoV-2-ELISAs	EUROIMMUN
24. GenBody COVID-19 IgM/IgG	GenBody
25. One Step Test for 2019-nCoV IgM/IgG antibody	Getein Biotech
26. SARS-CoV-2 IgG/IgM Kit	Goldsite Diagnostics
27. Finecare SARS-CoV-2 Ab Test	Guangzhou Wondfo Biotech
28. 2019-nCoV Antigen Rapid Test	Hanghzhou AllTest Biotech
29. COVID-19 IgG/IgM Rapid Test	Hangzhou Biotest Biotech
30. COVID-19 IgM Ab Rapid Test Kit	Hecin Scientific
31. COVID-19 IgG/IgM Test	Humasis
32. COVID-19 IgG/IgM Detection Kit	Hunan Lituo Biotech
33. Rapid SARS-CoV-2 Antibody	InTec Products
34. PerfectPOC SARS-CoV-2 Ag Test Kit	Jiangsu Bioperfectus Tech
35. Covid-19 IgG/IgM Rapid Test	KRISHGEN BioSystems
36. LYHER 2019-nCoV IgM/IgG Ab Kit	Laihe Biotech
37. SARS-CoV-2 Antibody Test	Lepu Medical Technology
38. COVID-19 Antigen Test Device	Liming Bio-Products
39. QuickProfile™ 2019-nCoV IgG/IgM	LumiQuick Diagnostics
40. SARS-CoV-2 IgM/IgG Quantum Dot	Mokobio Biotech R&D
41. MP Rapid 2019-nCoV IgG/IgM	MP Biomedicals
42. NADAL® COVID-19 IgG/IgM Test	nal von minden GmbH
43. COVID-19 IgG/IgM Duo	NanoEnTek
44. EGENS COVID-19 IgG/IgM Kit	Nantong Egens Biotech
45. OZO SARS-CoV-2 IgM + IgG Method	Ozo Life
46. PCL COVID19 IgG/IgM Rapid Gold	PCL Inc.
47. PEPperCHIP® SARS-CoV-2	PEPperPRINT
48. COVID-19 rapid test	PharmaAct/Vivera Pharma
49. SARS-CoV-2 IgG ELISA Kit	Pishtaz Teb
50. BIOCREDIT COVID-19 Ag	RapiGEN
51. SARS-CoV-2 IgM/IgG Test Kit	RayBiotech
52. COVID-19 IgM/IgG Rapid Test Kit	Ring Bio
53. STANDARD F COVID-19 Ag FIA	SD BIOSENSOR
54. EDR COVID 19 Rapid Kit (IgM/IgG)	SensingSelf
55. Cleartest Corona Covid-19	servoprax GmbH
56. SARS-CoV-2 Ab (IgM / IgG) Test	Shanghai Outdo Biotech
57. iFlash-SARS-CoV-2 IgM / IgG	Shenzhen Yhlo Biotech
58. SARS-CoV-2 Antibody Test Strip	Sinocare/PTS Diagnostics
59. Maglumi 2019-nCoV IgM/IgG kits	Snibe Diagnostics
60. SGTi-flex COVID-19 IgM/IgG	Sugentech
61. SARS-CoV-2 IgM Ab Rapid Test	Sure Bio-Tech (USA)
62. SARS-CoV-2 IgM/ IgG	Taizhou ZECEN Biotech
63. COVID-19 IgG Lateral Flow Assay	Tianjin Era Biology
64. VivaDiag COVID-19 IgM/IgG Test	VivaChek Lab
65. Covid-19 IgM/ IgG rapid test	Willi Fox
66. nCoV IgM antibody test kit	Wuhan EasyDiagnosis Biomedicine
67. Covid-19 IgG/IgM Ab Test Kit	Wuhan UNscience Biotech
68. Helix-19 COVID-19 IgM/IgG Test Kit	Xiamen AmonMed Biotech
69. SARS-CoV-2 IgG/IgM Test Kit	Xiamen Biotime Biotech
70. Rapid 2019-nCoV IgG/IgM Test	Xiamen Boson Biotech
71. COVID-19 IgG/IgM Rapid Test	Zhejiang Orient Gene Biotech/Aytu Bio (US)
72. qSARS-CoV-2 IgG/IgM Rapid Test	Cellex**
73. DPP COVID-19 IgM/IgG System	Chembio Dx Systems**
74. COVID-19 VITROS® Total Ab Test	Ortho Clinical Diagnostics**

Product	Company
75. SARS-CoV-2 IgG	Abbott Laboratories
76. NovaTest: 1 Step COVID-19 IgG/IgM rapid test	Atlas Link Technology
77. Anti-SARS-CoV-2 Rapid Test	Autobio Dx/Hardy Dx
78. 2019-nCoV IgG/IgM Rapid Test	Beijing Beier Bioeng.
79. nCoV IgM/IgG Combo Rapid Test	Beijing Decombio Biotech
80. COVID-19 Total Ab Rapid Test	Beijing O&D BIOTECH
81. SARS- COV-2 Ab Rapid Test Kit	Beijing Wantai Bio Pharma
82. SARS-CoV-2 IgM/IgG Ab Test Kit	Biobase Biodustry
83. Tell Me Fast COVID-19 IgG/IgM Ab Test	Biocan Diagnostics
84. COVID-19 IgG/IgM Rapid Test	Biomerica
85. COVID-19 IgM/IgG Rapid Test	BioSys Laboratories
86. COVID-19 Antibody Test	Boston Heart Diagnostics
87. Rapid Response™ COVID-19 IgG/IgM Test	BTNX
88. COVID-19 Ag Respi-Strip	Coris BioConcept
89. COVID-19 IgM/IgG Rapid Test	Coronacide
90. DZ-LITE SARS-CoV-2 IgG Kit	Diazyme Laboratories
91. AccuRapid™ SARS-CoV-2 IgM/IgG	Eachy Biopharmaceuticals
92. COVID-19 antibody test	EDP Biotech Corporation
93. COVID-19 antibody test	Emory Medical Laboratories
94. SeroFlash SARS-CoV-2 IgM/IgG Antibody Kit	EpiGentek
95. Pylon COVID-19 IgM/IgG Assay	ET Healthcare Inc
96. 2019-nCoV IgG/IgM Test Kit	Genrui Biotech
97. SARS-CoV-2 IgG/IgM Rapid Test	Guangzhou Fenghua Bioeng.
98. Clungene COVID-19 IgM/IgG	Hangzhou Clongene Biotech
99. 2019-nCOV IgG/IgM Rapid Test	Hangzhou Realy Tech
100. One Step COVID-19 IgG/IgM Test	Hangzhou Testsealabs Biotechnology
101. COVID-19 IgG/IgM Rapid Test	Healgen Scientific
102. SARS-CoV-2 IgM/IgG Test Kit	Hunan RunKun Pharma
103. Sars-Cov-2 Total Ab EIA Test	IMMYLabs
104. SARS-CoV-2 antibody assay	Innovita Biological Tech
105. SARS-CoV-2 IgM/IgG Assay Kit	Jiangsu Macro & Micro-Test Med-Tech
106. COVID-19 IgM/IgG Rapid Test	Jiangsu Medomics Medical Technologies
107. Test-it COVID-19 IgM/IgG Lateral Flow Assay	Lifeassay Diagnostics
108. SARS-CoV-2 IgM/IgG Antibody Assay Kit	Maccura Biotechnology
109. IgG Antibody Test	Mayo Clinic
110. Coronavirus Disease 2019 Ab (IgM/IgG) Combined Test Kit	MedicalSystem Biotech Co.
111. SARS-CoV-2 IgM/IgG Antibody Rapid Test Kit	Nanjing Limingbio
112. NanoMedicina™ SARS-COV-2 IgM/IgG Antibody Rapid Test	NanoResearch
113. (2019-nCoV) Antibody Test	Nantong Diagnos Biotech
114. SARS-CoV-2 IgM/IgG Ab Kit	Nirmidas Biotech
115. COVID19 IgG/IgM Rapid Test	Phamatech Inc.
116. SAFECARE COVID-19 IgG/IgM Rapid Test Device	Safecare Biotech (Hangzhou)
117. COVID-19 IgG/IgM Rapid Test	Shanghai Eugene Biotech
118. Liangrun COVID-19 IgM/IgG Antibody Test	Shanghai Liangrun Biomed Tech/Todos Medical
119. COVID-19 IgG/IgM Rapid Test	Shenzhen Landwind Medical
120. SARS-CoV-2 IgG/IgM Rapid Test	Shenzhen Watmind Medical
121. SARS-CoV-2 IgG/IgM Rapid Qualitative Test	Suzhou Kangheshun Medical Technology
122. SARS-CoV-2 IgG/IgM Ab Kit	Telepoint Medical Services
123. COVID-19 antibody test	United Biomedical/c19
124. COVID-19 antibody test	University of Minnesota
125. COVID-19 ImmuneCheck	Vibrant America
126. COVISURE™ COVID-19 IgM/IgG	W.H.P.M.
127. COVID-19 IgG/IgM Test Kit	Wuhu 3H Biotechnology
128. 2019-nCoV IgM/IgG and IgM Detection Kits	WuXi Diagnostics
129. COVID-19 IgG Ab Rapid Test Kit	Zhengzhou Fortune Bio
130. SARS-CoV-2 IgM/IgG (GICA)	Zhongshan Bio-Tech

*CE Mark **FDA-EUA

Source: FDA, WHO, company websites, news. Available upon request.

ARTIS VENTURES

HEALTHCARE INNOVATIONS TO FIGHT COVID-19

04.21.20

FIGHT THE PANDEMIC

TREATMENTS

61 **62** 63

Assets in human clinical trials or patients

TREATMENTS

End purpose of drug being developed

- 17 — Treat symptoms
- 23 — Anti-inflammation
- 20 — Anti-viral growth
- 2 — Prevention

In Development

Preclinical 30+

Phase of Development (Clinical Trials)

30+	3	6	20	9	16	3	2	~~3~~
Preclinical candidates *Innovations not yet in clinical trials*	**Ph I** *Safety, side-effects/ dose*	**Ph I/II**	**Ph II** *Effectiveness/ safety*	**Ph II/III**	**Ph III** *Confirm effectiveness*	**Ph IV** *Risk-benefit/ best use*	Compassion-ate Use	Failed Trial

SOURCE : https://www.av.co/covid-diagnostics

@vasudevbailey
@zoeguttendorf

TREATMENTS

Vasudev Bailey, PhD @vasudevbailey
Zoe Guttendorf @zoeguttendorf

Drug	Company	Target	Stage	Date~	Treatment Goal	Location
1. Kaletra	Abbvie	HIV protease inhibitor	Failed Trial	03/20	Anti-viral growth	
2. Arbidol	Pharmstandard	broad-spectrum antiviral	Failed Trial	04/20	Anti-viral growth	
3. Chloroquine/ Hydroxychloroquine	Multiple Locations	ACE-2 inhibitor	Failed/ongoing/EUA	02/20	Anti-viral growth	
4. Ganovo + Ritonavir	Ascletis	Hep C/HIV protease inhibitors	Phase IV	03/20	Treat pneumonia	
5. Leukine	Partner Therapeutics	recombinant humanized GM-CSF	Phase IV	10/20	Anti-inflammatory	
6. Diovan	Radboud University*	ATiR inhibitor	Phase IV	07/20	Reduce organ failure	
7. Actemra	Roche	IL-6 inhibitor	Phase III	05/20	Anti-inflammatory	
8. Lenzilumab	Humanigen	anti-GM-CSF	Phase III	09/20	Anti-inflammatory	
9. CD24Fc	OncoImmune	IL-6 inhibitor	Phase III	05/20	Anti-inflammatory	
10. Prezcobix	Shanghai Public Health Clinical Center*	HIV-1 protease inhibitor + CYP3A inhibitor	Phase III	08/20	Treat pneumonia	
11. Colchicine	Montreal Heart Institute*	tubulin disruption	Phase III	09/20	Anti-inflammatory	
12. Jakavi	Novartis, Incyte	JAK inhibitor	Phase III	08/20	Treat pneumonia	
13. DAS181	Ansun Biopharma	cleaves sialic acid	Phase III	04/21	Anti-viral growth	
14. Olumiant	Eli Lilly	JAK1/2 inhibitor	Phase III	04/20	Block viral entry into cells	
15. Tradipitant	Vanda Pharmaceuticals	NK1 inhibitor	Phase III	08/20	Anti-inflammatory	
16. Remdesivir	Gilead	adenosine analog	Phase III	05/20	Anti-viral growth	
17. Rebif	Merck KgaA, INSERM	interferon beta-1a	Phase III	03/23	Treat respiratory illness	
18. Sylvant	EUSA Pharma	IL-6 inhibitor	Phase III	05/20	Anti-inflammatory	
19. Kineret	Sobi	IL-1 inhibitor	Phase III	07/20	Anti-inflammatory	
20. Farxiga	Astrazeneca	SGLT2 inhibitor	Phase III	10/20	Reduce organ failure	
21. Avigan	Fujifilm	RNA polymerase inhibitor	Ph III (JPN), PhII (US)	05/20	Anti-viral growth	
22. Truvada	Gilead	Pre-exposure prophylaxis	Phase III	06/20	Prevention	
23. Kevzara	Regeneron, Sanofi	IL-6 inhibitor	Phase II/III	03/21	Anti-inflammatory	
24. Avastin	Roche	VEGF inhibitor	Phase II/III	04/20	Treat pneumonia	
25. IFX-1	InflaRx	C5a mAb	Phase II/III	10/20	Anti-inflammatory	
26. Gamifant	Sobi	IFNγ mAb	Phase II/III	07/20	Anti-inflammatory	
27. Amiodarone	Nicolaus Copernicus Univ*	ion channel blocker	Phase II/III	03/21	Anti-viral growth	
28. Verapamil	Nicolaus Copernicus Univ*	ion channel blocker	Phase II/III	03/21	Anti-viral growth	
29. Vazegepant	Biohaven Pharmaceuticals	CGRP receptor antagonist	Phase II/III	07/20	Anti-inflammatory	
30. Ivermectin	Tanta University	broad-spectrum antiparasitic	Phase II/III	12/20	Anti-viral growth	
31. Nafamostat	Univ Hospital Padova*	serine protease inhibitor	Phase II/III	12/21	Block viral entry into cells	
32. Leronlimab	CytoDyn	CCR5 antagonist	Phase II	12/20	Anti-inflammatory	
33. Aviptadil	NeuroRx, Relief Therapeutics	IL-6 inhibitor	Phase II	08/20	Anti-inflammatory	
34. SNG001	Synairgen	IFN-beta-1a	Phase II	06/20	Treat respiratory illness	
35. Gilenya	Novartis	sphingosine 1-phosphate receptor modulator	Phase II	07/20	Anti-inflammatory	
36. AiRuiKa	Southeast Univ, China*	PD-1 inhibitor	Phase II	04/20	Treat pneumonia/sepsis	
37. APN01	APEIRON Biologics	recombinant human ACE2	Phase II	09/20	Anti-viral growth, anti-inflammatory	
38. PUL-042	Pulmotect	TLR agonist	Phase II	09/20	Prevention, immunostimulant	
39. Alvesco	Institut Pasteur Korea*	inhaled corticosteroid	Phase II	06/20	Anti-viral growth	
40. Piclidenoson	Can-Fite Biopharma	A3 adenosine receptor agonist	Phase II	06/20	Anti-inflammatory	
41. Xeljanz	Pfizer	JAK1/3 inhibitor	Phase II	06/20	Treat pneumonia	
42. Xpovio	Karyopharm Therapeutics	XPO1 inhibitor	Phase II	08/20	Anti-inflammatory	
43. Calquence	Astrazeneca	BTK Inhibitor	Phase II	09/20	Anti-inflammatory	
44. Clazakizumab	Vitaeris	anti-IL-6 mAb	Phase II	07/20	Anti-inflammatory	
45. Brukinsa	BeiGene	BTK Inhibitor	Phase II	06/20	Anti-inflammatory	
46. Sirolimus	University of Cincinnati*	mTOR inhibitor	Phase II	07/20	Treat respiratory illness	
47. Fluvoxamine	Washington Univ School of Medicine*	SSRI	Phase II	06/20	Prevent shortness of breath	
48. Clevudine	Bukwang Pharmaceutical	pyrimidine analog	Phase II	09/20	Anti-viral	
49. Gimsilumab	Roivant, Altasciences	anti-GM-CSF	Phase II	07/20	Anti-inflammatory	
50. BIO-11006	Biomarck	MARCKS inhibitor	Phase II (ARDS)	08/19	Treat respiratory illness	
51. Mesenchymal Stem Cells	Multiple Companies	Tissue regeneration	Phase II	06/20	Anti-inflammatory, tissue regeneration	
52. CYNK-001	Celularity	NK cell therapy	Phase I/II	NS	Anti-viral growth, immunotherapy	
53. Desferal	Kermanshah Univ. of Medical Sci.*	Iron chelator	Phase I/II	09/20	Treat pneumonia	
54. Meplazumab	Tang-Du Hospital*	anti-CD147 antibody	Phase I/II	12/20	Treat pneumonia	
55. Camostat	University of Aarhus	serine protease inhibitor	Phase I/II	12/20	Block viral entry into cells	
56. Tlo03234	I-mab Biopharma	anti-GM-CSF mAb	Phase I/II	09/20	Anti-inflammatory	
57. Virazole	Bausch Health	guanosine analog	Ph I/II (unspecified)	NS	Anti-viral growth	
58. Losartan	Univ of Minnesota	ATiR inhibitor	Phase I	04/21	Reduce organ failure	
59. Galidesivir	BioCryst Pharmaceuticals	adenosine analog	Phase I	05/21	Anti-inflammatory	
60. Convalescent Plasma Therapy	Multiple Locations	antibodies from recovered patients	Ph I & Emergency Use	08/20	Anti-viral growth, anti-inflammatory	
61. Yeliva	RedHill	SK2 selective inhibitor	Compassionate Use	-	Anti-viral growth, anti-inflammatory	
62. PLX Cell Therapy	Pluristem Therapeutics	regenerative medicine	Compassionate Use	-	Treat respiratory illness	

Design by: @IlianaMarksCA

~Estimated Primary Completion Date *Trial sponsor **Emergency Use in Patients ‡International compassionate use

Source: FDA, WHO, company websites, news. Available upon request.

ARTIS VENTURES

HEALTHCARE INNOVATIONS TO FIGHT COVID-19

04.21.20

FIGHT THE PANDEMIC

VACCINES

9 **10** 11

Assets in human clinical trials

VACCINES

Phase of Development (Clinical Trials)

Preclinical candidates	Ph I	Ph I/II	Ph II	Ph II/III	Ph III	Ph IV
60+	5	2	1	1	1	–
Innovations not yet in clinical trials	*Safety, side-effects/ dose*		*Effectiveness/ safety*		*Confirm effectiveness*	*Risk-benefit/ best use*

Vaccine Platform

Mechanism being used for vaccine development

DNA	Inactivated	Live Attenuated	Non-replicating viral vector	Protein subunit	Replicating viral vector	RNA	Virus-like particle (VLP)	Unknown
7	2	3	9	25	7	10	4	3

SOURCE : https://www.av.co/covid-diagnostics

@vasudevbailey
@zoeguttendorf

ARTIS VENTURES

VACCINES

Vasudev Bailey, PhD @vasudevbailey
Zoe Guttendorf @zoeguttendorf

Vaccine	Company	Platform	Stage	Start Date	Description	Location
1. BCG Vaccine	Research Group, Netherlands	Live Attenuated	Phase III	3/25/20	Repurposing the BCG vaccine, orginally for TB, to fight SARS-CoV-2 in healthcare workers at high risk of infection. 1,000 individuals will be enrolled across 8 hospitals to receive the vaccine or placebo.	Netherlands
2. BCG Vaccine	Murdoch Children's Research Institute	Live Attenuated	Phase II/III	3/30/20	The BRACE trial will conduct a randomized, multi-center study of the TB vaccine in 4,000 healthcare workers across Australia.	Australia
3. Ad5-nCoV	CanSino Bio	Non-Replicating Viral Vector	Phase II	4/12/20	After 3 weeks, vaccine is advancing to phase 2 trials based on preliminary Ph 1 safety data. Virtual enrollment is open for interested individuals with Ph 2 to launch soon. The Vx uses viral vectors to deliver antigens to express SARS-CoV-2 spike protein.	China
4. ChAdOx1 nCoV-19	University of Oxford	Non-Replicating Viral Vector	Phase I/II	Est. start 4/20	Enrolling 500+ inviduals to test its vaccine candidate, which uses a non-replicating virus to deliver RNA into cells.	UK
5. LV-SMENP-DC	Shenzhen Geno-Immune Medical Institute	Lentiviral	Phase I/II	3/24/20	Begun early testing of its vaccine candidate. The vaccine uses a lentiviral vector to deliver COVID-19 minigenes to modify dendritic cells and activate T cells.	China
6. mRNA-1273	Moderna	RNA	Phase I	3/15/20	First to dose a human in the US. Vaccine consists of a synthetic strand of mRNA designed to elicit an immune response to produce antibodies against SARS-CoV-2.	USA
7. INO-4800	Inovio Pharmaceuticals	DNA	Phase I	4/6/20	The vaccine will be the second in humans in the US. It inserts small circles of double-stranded DNA, called plasmids, into cells to create antigens that elicit an immune response.	USA
8. aAPC Vaccine	Shenzhen Geno-Immune Medical Institute	Lentiviral	Phase I	2/15/20	The vaccine uses a lentiviral vector to deliver Covid-19 minigenes to modify artificial antigen presenting cells (aAPC) and activate T cells.	China
9. Inactived COVID-19 Vaccine	Wuhan Institute of Biological Products (Sinopharm)	Inactivated	Phase I	4/13/20	China approved the world's first vero-cell-derived inactivated COVID-19 vaccine for human trials. The virus is grown in vero-cell cultures and inactivated (killed), then used to induce an immune response.	China
10. Inactived COVID-19 Vaccine	Sinovac	Inactivated	Phase I	4/13/20	Sinovac's vaccine is inactivated by formalin and is combined with an alum-adjuvant.	China

*Trial sponsor

Source: FDA, WHO, company websites, news. Available upon request.

69 **70** 71

Early development (preclinical) candidates

DNA	Inactivated	Live Attenuated	Non-replicating viral vector	Protein subunit	Replicating viral vector	RNA	VLP	Unknown
7	2	3	9	25	7	10	4	3

Design by: @IlianaMarksCA