

Analysis of COVID-19 Effects and Responses in the United States for Future Prevention

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Introduction to COVID-19 and Epidemiology (Camilla and entire team)

Across the world, there have been 2.5 million confirmed cases of COVID-19, with 15-21% of cases rooted in global hotspots, such as New York City. 100 times more deadly than chickenpox, COVID-19 is primarily responsible for the death toll of approximately 2,000 individuals each day. The unique characteristics of the virus and ongoing mutations have proven more difficult to mitigate than previously considered.

COVID-19 spreads from an infected person through respiratory droplets. It can be transmitted through close contact, coughs, sneezes, and from animals or inanimate objects to humans. The symptoms of COVID-19 include a runny nose, headache, cough, sore throat, and/or fever. It can cause further infections like kidney failure and pneumonia. After 2-14 days of exposure, COVID-19 symptoms will appear. The diagnosis of COVID-19 involves blood samples or respiratory lab tests and treatments are limited to caring for patient's symptoms. COVID-19 infections can, however, be prevented by washing hands effectively, wearing masks, and maintaining distance and quarantine from others.¹

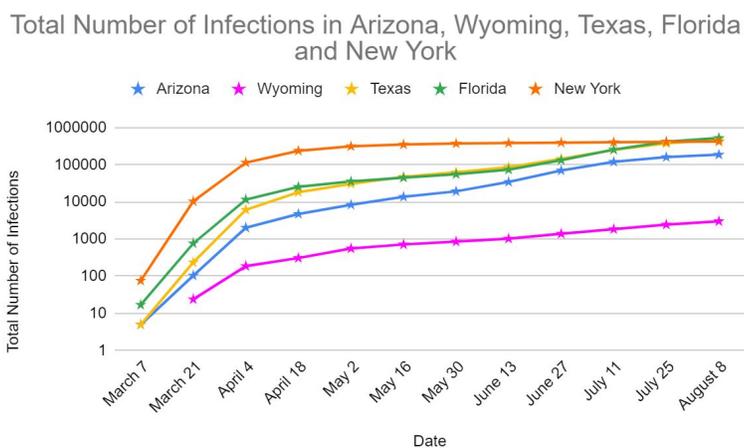
The COVID-19 family was named for its spiked surfaces. It includes four main groups: alpha, beta, gamma, and delta. There are 7 different types of the virus with the common human COVID-19es: 229E (alpha COVID-19) NL63 (alpha COVID-19) OC43 (beta COVID-19) HKU1 (beta COVID-19), MERS-CoV (beta) which causes Middle East Respiratory syndrome, SARS-CoV (beta) which causes severe acute respiratory syndrome, and SARS-CoV-2 which causes COVID-19 (novel.) COVID-19 is a large family of viruses which causes mild to moderate upper respiratory tract illnesses.

To date, COVID-19 has caused widespread infection rates, economic downturn, and stressed hospital systems despite various government and hospital efforts of mitigation.

Infections and fatality rates (Brenden, Yi, and Gina)

Analysis of infections by covid-19:

Throughout the United States, COVID-19 infections vary greatly between states as a result of each state employing different methods they found best to balance the safety of the community and the economy. Through early March of 2020, the COVID-19 had largely spared the US of infections, however, by March 20th New York was declared the epicenter of the COVID-19 with 7,102 people confirmed to have the illness.² The state



¹<https://COVID-19.jhu.edu/from-our-experts/early-herd-immunity-against-COVID-19-a-dangerous-misconception>

²<https://www.cnbc.com/2020/03/20/new-york-city-is-the-new-COVID-19-epicenter-with-one-third-of-all-us-cases-mayor-de-blasio-says.html>

hit an all-time high of a 71.3% positivity rate on March 28th. Many states imposed statewide stay at home orders and travel restrictions which led to a flattening of cases and a decrease in positivity rate in the hardest-hit states including New York which dropped to a 19.2% positivity rate by May 2nd and a 1.0% positivity rate by August 1st despite reopening plans taking place during June.³

Meanwhile, other states including Texas, Florida, and Arizona were among the first to reopen in early May and at the time only had 5.9%, 5.4%, and 9.8% positivity rates respectively.⁴ As a result of the reopenings, lack of a mask mandate in either of the three states, and coincidence with Memorial Day and nationwide protests cases began to surge by mid-June. This supports the suggested incubation period of 2-14 days for COVID-19. On July 3rd Texas Governor Greg Abbott issued a mask mandate for the state and after a peak positivity rate of 17.9% on July 17th the state has been trending in the right direction with a positivity rate of 12.4% on August 1st.⁵ Meanwhile, Florida and Arizona have yet to see much improvement as neither governor has instituted a mask order and Florida has officially overtaken New York with total cases up to 480,028 compared to New York's 416,298 cases on August 1st. In rural parts of the US, the onset of the COVID-19 was slower as a result of a much smaller population, but even the least populated state, Wyoming, has seen a rise in cases going from 24 cases on March 21st to 2446 on July 25th with positivity rates averaging between 6-8%.⁶

Analysis of people currently getting infections: Individuals who are above the age of 65, have underlying health conditions that regard the heart and lungs, have diabetes or obesity, and have a weakened immune system overall have a higher susceptibility to COVID-19.⁷ Due to this, at the start of the pandemic cases were most prevalent among those aged 65 and older with a peak positivity rate of 26.9% out of all cases in the week beginning April 5th. While those who were most susceptible took the pandemic seriously by wearing masks and staying home, younger age groups particularly those between ages 18-49 saw a sharp rise in cases by June 7th with a peak positivity rate of 11% the week of July 12th. Throughout the spring COVID-19 infections and complications of the youngest ages ranging from 0-4 and 5-17 years old were thought to be very minimal, but that was in part due to a shutdown of schools and playgroups. Now by August 6th as schools are preparing to reopen children aged 5-17 have the highest positivity rate of 13.2% closely followed by kids aged 0-4 with a positivity rate of 10.3%.⁸

Fatality rates of select US states: The United States, as of recently, has the highest number of confirmed cases of COVID-19. As of August 4th, 2020, there are 18,387,725 confirmed total cases of COVID-19 in the world, of which 4,758,028 cases are from the United States.⁹ Due to the quick transmissions of COVID-19, all of the states in the US have seen devastating fatality

³ <https://www1.nyc.gov/site/doh/covid/covid-19-data.page>

⁴ <https://COVID-19.jhu.edu/testing>

⁵ <https://gov.texas.gov/news/post/governor-abbott-establishes-statewide-face-covering-requirement-issues-proclamation-to-limit-gatherings>

⁶ <https://COVID-19.jhu.edu/testing/individual-states/wyoming>

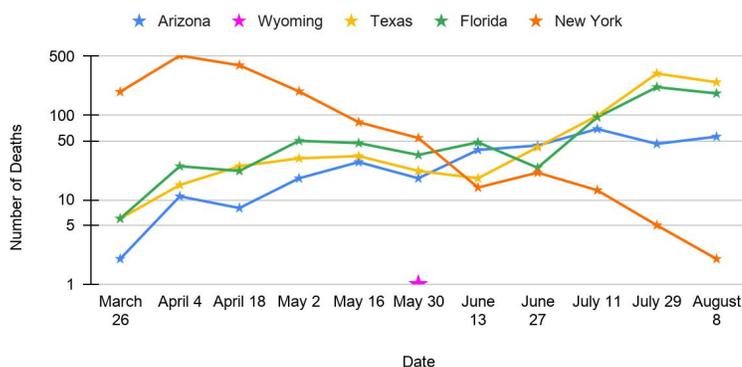
⁷ <https://www.cdc.gov/COVID-19/2019-ncov/covid-data/covidview/index.html>

⁸ <https://www.cdc.gov/COVID-19/2019-ncov/covid-data/covidview/08072020/public-health-lab.html>

⁹ <https://COVID-19.jhu.edu/map.html>

rates. The number of deaths have kept on increasing, seen in certain states, such as Texas, Arizona, and Florida. During the month of July, these states experienced a severe increase in the number of daily deaths. As Texas began to reopen, the number of deaths due to COVID-19 rose to three hundred and thirteen deaths on July 29th from fifteen recorded deaths on April 4th.¹⁰ Texas recorded a 106% increase on July 9th in daily deaths related to COVID-19 compared to the previous week. Florida had similar statistics when the state started to open again. On April 4th, there were twenty-five deaths and it escalated to two hundred and sixteen deaths on July 29th. Florida reported a 35% increase on July 9th in the daily death tolls more than the past week.¹¹ Though Arizona did not have as many deaths as Texas or Florida, the state still encountered an increase in death rates. Arizona had reported eleven deaths on April 4th, but reported forty-six deaths on July 29th.¹² However, states in the rural area were not as affected by deaths from COVID-19, such as Wyoming who only reported one death on May 30th.¹³ New York, on the other hand, quickly became the epicenter for COVID-19, but as they set up guidelines to control the spread of COVID-19 the number of daily deaths decreased significantly. There were five hundred and ten deaths reported on April 4th to only three deaths reported on July 29th in New York.¹⁴

Number of Deaths In Arizona, Wyoming, Texas, Florida and New York



Hospital Resources and Future Models (Yi, Gina, and Connie)

Ventilator and hospital resources: As the COVID-19 virus rapidly spread, there was an increased demand for Personal Protective Equipment. The shortage of PPE supply at the beginning of the COVID-19 pandemic led to Non-NIOSH-approved N95 Respirators to be imported and utilized due to the severity of the situation.¹⁵ The cost of certain PPE also experienced inflation, in which gowns have doubled in price, N95 respirators have tripled, and the prices of surgical masks have increased by six times. The healthcare workers faced many risks working during this supply shortage. The immense lack of supplies left many of the healthcare workers underprepared to

¹⁰ <https://txdshs.maps.arcgis.com/apps/opsdashboard/index.html#/ed483ecd702b4298ab01e8b9cafc8b83>

¹¹ <https://www.cnbc.com/2020/07/10/COVID-19-deaths-tick-up-in-florida-texas-california-arizona.html>

¹² <https://www.azdhs.gov/preparedness/epidemiology-disease-control/infectious-disease-epidemiology/covid-19/dashboards/index.php>

¹³ <https://health.wyo.gov/publichealth/infectious-disease-epidemiology-unit/disease/novel-COVID-19/covid-19-map-and-statistics/>

¹⁴ <https://www1.nyc.gov/site/doh/covid/covid-19-data.page>

¹⁵ <https://www.fda.gov/medical-devices/personal-protective-equipment-infection-control/faqs-shortages-surgical-masks-and-gowns-during-COVID-19-pandemic>

take care of the COVID-19 patients.¹⁶ A vital medical tool, the ventilators, were also experiencing shortages. On March 25th, it was estimated that over hundreds of thousands to one million ventilators would be needed for COVID-19 patients. One way that there could be more ventilators would be if the Defense Production Act (DPA) permits the President of the United States to regulate the production of necessary equipment by private companies during a national emergency.¹⁷

As a vital part of the health care system, healthcare workers are essential hospital resources. From the nurses to the doctors, every employee performs a certain task that allows them to help the patients. While New York was the epicenter of the COVID-19 pandemic earlier in the spring, many medics from the Air Force Reserve were mobilized and deployed within two days to help with the cases in New York City. These extra medical professionals were designed to help with the surge of COVID-19 patients since there was a strain on healthcare workers.¹⁸

Compare countries' responses to availability to resources: Daegu, South Korea, was the location of the first outbreak of COVID-19. It faced PPE, beds, and health care workers shortages. However, the health care workers and patients experienced low rates of infections comparatively to other large cities. This was due to the Daegu health officials and leaders of public health progress to mobilizing reorganization of the health system, interventions in hospitals, managing resources and equipment, relieving shortages, and eventually effectively protecting healthcare workers and patients. On the other hand, unfortunately, the United States' response to the COVID-19 pandemic was fairly slow. The US government overall was hesitant to utilize strict public policies compared to other countries. Data as shown in the graphs below shows that school closures, cancellation of events, monetary measures, and healthcare investment were implemented by the United States but still by July of 2020, the United States became one of the leading countries of the most cases and deaths. Although now, the United States is one of the global leaders in the creation of the COVID-19 vaccine, it is inevitable to wonder about the number of lives that could have been saved if the US were to initiate change and progress like South Korea.¹⁹

Future models of infection of COVID-19 (and others)

¹⁶<https://www.who.int/news-room/detail/03-03-2020-shortage-of-personal-protective-equipment-endangering-health-workers-worldwide>

¹⁷ <https://www.nejm.org/doi/full/10.1056/NEJMp2006141>

¹⁸<https://www.af.mil/News/Article-Display/Article/2138332/air-force-reserve-mobilizes-medics-to-new-york-for-covid-19-response/>

¹⁹ <https://catalyst.nejm.org/doi/full/10.1056/CAT.20.0159>

Figure 1.

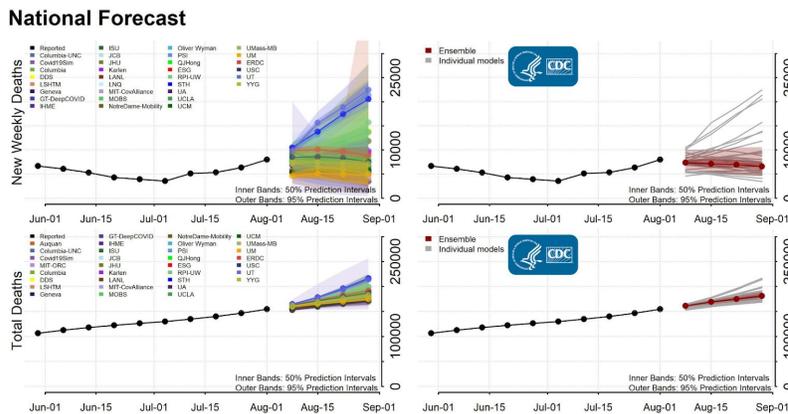
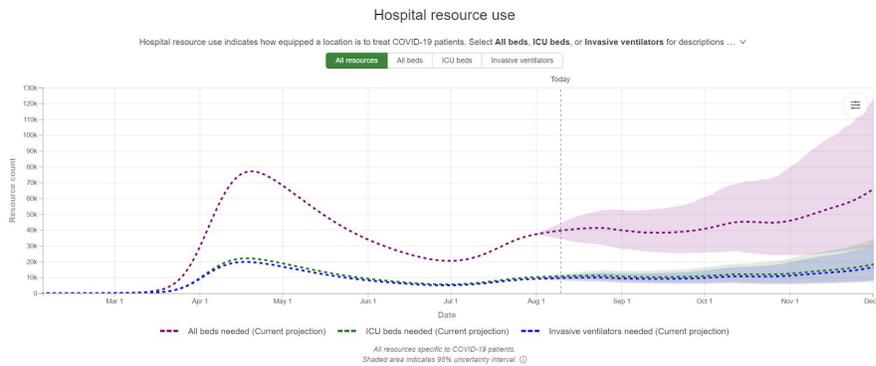


Figure 2.



The Centers for Disease Control and Prevention (CDC) gathered data to predict the national forecast for new COVID-19 deaths in the United States from August 1 to August 29. The top row of Figure 1. displays the weekly number of new COVID-19 deaths, while the bottom row shows the total number of COVID-19 deaths. The weekly national ensemble forecast predicted that the number of new COVID-19 deaths would potentially decrease and range from 4,500 to 10,600 during the week ending August 29. In addition, they anticipated that there would be between 175,00 and 190,000 total COVID-19 deaths by August 29. It is predicted by state-level ensemble forecasts that the weekly number of reported new deaths will increase in the following weeks in Hawaii and Puerto Rico and possibly decrease in Florida, Mississippi, Vermont, the Northern Mariana Islands, Ohio, New Mexico, Texas, and the Virgin Islands.

Figure 2. exhibits the predicted amount of hospital resources, such as all beds, ICU beds, and invasive ventilators, that will be necessary from August 10 until December 1. Based on the trend, it is expected that the necessary amount of hospital resources will increase from the August 10 projection, which is 40,081.1 (33,594.07 - 46,077.38) beds, 10,904.91 (8,983.12 - 12,648.77) ICU beds, and 9,729.6 (7,953.94 - 11,330.18) invasive ventilators. On December 1, the predicted projection is 69,905.93 (31,933.98 - 129,292) beds, 19,473.55 (8,846.89 - 36,231) ICU beds, and 17,483.67 (7,936.59 - 32,526.75) invasive ventilators²⁰.

²⁰ <https://www.cdc.gov/COVID-19/2019-ncov/covid-data/forecasting-us.html>
<https://covid19.healthdata.org/united-states-of-america>

Mitigation Efforts (Connie, Camilla, and Gina)

Hospital mitigation efforts:

Currently in hospitals around the United States, mitigation efforts include increasing rooms, intensive care unit beds, special equipment, and personnel to assist patients throughout the facilities. In response to overloaded hospital capacity, places like Detroit have allocated hotels, empty arenas, and others for additional care sites. In order to ensure mitigation efforts within hospitals, hospitals should confirm that the emergency operations plans (EOP) are reviewed, updated, and adapted to fit the components of mitigation, response, and preparedness. The EOP must fit with the local, regional, and state programs and plans as well to ensure collaboration and evaluation. Lastly, EOPs must be evaluated to fit correctly with the hazards vulnerability analysis (HVA.)

Types of Laboratories	Week 26 percentage of respiratory specimen testing positive	Week 27 percentage of respiratory specimen testing positive
Public health	6.4%	6.0%
Clinical	5.7%	8.0%
Commercial	9.9%	9.4%

*Overall, the percentage of respiratory specimens testing positive for COVID-19 decreased from 9.2% in week 26 to 8.8% in week 27 nationally but increased in five other regions.*²¹

According to the data above, research in public health, clinical, and commercial laboratories show varying results in the percentage of positive results of COVID-19.

Community mitigation efforts: In order to decrease the risk of illness for susceptible hosts, such as elderly above 65 years of age, underlying medical conditions, prisoners, refugees, first responders, and others, areas such as churches, schools, government, and marketplaces must focus on protecting the susceptible hosts and implementing strategies to keep everyone safe while minimizing daily life disruptions. However, when balancing the priorities between daily life activities and protection of everyone's safety, safety should be the first priority at all times. Furthermore, public health programs interventions must be supported by the places mentioned prior in order to support community mitigation efforts overall.²²

Without a vaccine available to control the number of COVID-19 cases, many countries, including the United States, have implemented community mitigation measures, which are essential actions to slow the spread of COVID-19 and other infectious diseases. Depending on the size and characteristics of a district or region, communities in the U.S. have imposed certain mitigation strategies, such as enforcing personal protective measures (handwashing, wearing masks, and cough etiquette), applying safety actions for cleaning and disinfection, and social

²¹ <https://www.cdc.gov/COVID-19/2019-ncov/covid-data/covidview/index.html>

²² <https://www.cdc.gov/COVID-19/2019-ncov/global-COVID-19/community-mitigation-measures.html>

distancing. Wearing masks has been proven to be an effective mitigation measure. According to the Alaska Department of Health and Social Services, from April 8th to May 15th, 15 U.S. states and the District of Columbia required individuals to use face masks. It was concluded that states that mandated the use of facial coverings "... experienced a significant decline in case rates for every five days the mandate was set in place". Many states that opened their states too early experienced a major influx of COVID-19 cases and deaths. Arizona, Texas, California, and Florida were the four states that suffered the most when the state reopened too soon. To keep the COVID-19 virus from spreading, individuals must take appropriate measures during this time.

The state government should be accountable for their actions of opening the state too soon instead of issuing the correct guidelines to ensure the citizens safety.²³

On a broader scale, communities have closed schools, restricted traveling, and banned public gatherings, limited business operations, and placed stay at home orders to maintain social distancing. Seattle, San Francisco, New Orleans, and 5 boroughs in New York City had a large number of COVID-19 cases in positive correlation to their large population and size. In these cities, implementation of policies, COVID-19 cases, changes in set periods, and community mobilization were analyzed. All of these large cities and locations had utilized state of emergency issues, limits on gatherings, school closures, and quarantine orders in March. Altogether, the policies implemented were able to decrease community mobility. Because community mobility is strongly correlated with a decline in COVID-19 case growth rates, according to the Lancet Journals, it can be deduced that the mitigation measures mentioned above are effective in reducing the number of COVID-19 cases in the U.S. In the midst of this pandemic, communities have also taken extra precaution towards ensuring that the healthcare system capacity is not overwhelmed by keeping track of adequate staffing, hospital beds, and crucial medical equipment. Although community mitigation efforts alone play a large role in slowing the spread of COVID-19, it is crucial for individuals to recognize their responsibilities to follow recommended actions and procedures as well.

Nationwide mitigation efforts:

In a collective effort to reduce the impact of COVID-19, each department of the US government has prepared their own response to the pandemic. These departments are: enforcing travel restrictions, alerting citizens of any travel updates, creating guidelines for workers, running the White House Covid-19 task force, and bringing citizens stuck in other countries home.

Department/Agency	Demonstrated Mitigation Effort(s)
Department of Defense (DOD)	Designated over 3 billion dollars for the safety of military and federal employees and had 14 aeromedical evacuation missions carried out to help COVID-19 patients from areas without adequate resources.
Defense Logistics Agency (DLA)	Over 5.9 million N95 masks, 118 million

²³<https://www.healthline.com/health-news/covid19-cases-rising-states-reopened#Individual-behavior-is-crucial>

	examination gloves, 14.2 million nonmedical surgical masks, 2.7 million isolation and surgical gowns, 8,000 ventilators, and 13 million cloth face coverings were distributed to armed forces and government employees ²⁴
DLA and Defense Contracting Management Agency (DCMA)	Monitoring the impact of COVID-19 on the defense industrial base
Center for Disease Control and Prevention (CDC)	Monitors studying and publishing information on COVID-19 for the local communities and general public
Department of Energy	Studies on energy linked to COVID-19
Department of Homeland Security	Set new travel restrictions for American citizens and individuals across the world, due to the spread of COVID-19 being linked to international and domestic travel.
Department of Labor and OSHA	Initiated guidelines to help “essential workers” as well as those who are currently unemployed, since the COVID-19 pandemic has affected jobs and the economy.
The Internal Revenue Service (IRS) and	Released new tax policies for compensation and was involved in delivering the spring stimulus checks to all U.S. citizens.
Consumer Financial Protection Bureau	Develops action plans for individuals to better manage their finances during this stressful time.
The Federal Communications Commission	Ensures that various service providers keep Americans connected, as a mitigation effort of helping individuals transition to a virtual reality either for schooling purposes or work.
Food and Drug Administration (FDA)	Responsible for the progress of vaccine developments, drug treatments, and COVID-19 diagnostic tests

²⁴ <https://www.defense.gov/Explore/News/Article/Article/2228330/dod-official-details-covid-19-mitigation-efforts/>

National Institutes of Health (NIH)	responsible for the continual research on vaccinations and other treatment methods for COVID-19. ²⁵
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Socioeconomic Impacts (Frida, Meghan, and Gina)

Social impact: Systemic health and social inequalities, discriminations, and other social deterrents in health have prevented minority groups from fair opportunities in health care. Unfortunately, this tradition has been long-standing and continues to impact the COVID-19 situation today. Circumstances such as poverty and health care access, risks, and other barriers have caused minority groups to be at an unfair disadvantage in health care.

Discrimination unfortunately also exists in health care systems meant to promote health and wellbeing. These systems include education, finance, health care, and housing, and thus branch out from health care. As a result, this causes chronic stress, toxicity, and socioeconomic factors that can put racial and ethnic minority groups in increased risk of contracting COVID-19.

Furthermore, health care opportunities are lacking of those who are limited in transportation, work, communication, cultural differences, and historical discrimination that exists in health care systems. As a result, people from racial and ethnic minority groups may distrust the healthcare systems due to the inequities in treatment that have been historically proven through events such as the Tuskegee Study of Untreated Syphilis.

Economic Impact: In terms of occupations and work settings, people from racial and ethnic minority groups may work in settings that have a higher chance of getting exposed to the virus. This includes close contact with other people, not having paid sick days, and not having days off. People who work in essential work settings and minority groups who are disproportionately represented in these settings like public transportation, farms, and factories, can have a higher chance of infection as a result as well.

Additionally, inequities that stand to cause some minority groups to have low high school completion rates and college entrances have also been seen to relate to limited job options and lower paying jobs. As a result of the low flexibility, educational, and financial gaps, these people often cannot afford to miss work and end up having increased risk of exposure to the virus. Lastly, those who live in crowded conditions can have a higher risk for infection as following prevention strategies become significantly harder. As a result, disproportionate unemployment rates and lack of financial stability can lead to greater risk of eviction, homelessness, and COVID-19 infection.

Treatment and Vaccine Development (Gina, Frida, and Meghan)

Current treatments

Healthcare facilities around the world are treating moderate cases of infected COVID-19 patients most commonly with a technique known as prone positioning. Prone positioning, a technique

²⁵ <https://www.usa.gov/coronavirus>

involving flipping patients onto their ventral/belly side, quickly improves oxygenation levels. Another widely used treatment are ventilators and other support devices. Although this equipment carries a risk of infection with it, if prone positioning is ineffective, patients may go rely on the ventilators for additional oxygen.

US and countries' involvement in treatment plans and funding: Currently, more than 100 vaccines are in development by companies, academic institutions, and government agencies that are being tracked by the WHO. There are vaccine candidates in clinical trials in more than a dozen countries. However, with this immense effort, it is too early to determine the success of the vaccine. So in order to track the progress of the possible vaccine, each country's efforts need to be examined. In the United States, there are more than six candidates that are being considered. The first human trial took place in March at Seattle with Modern Inc, funded by the NIAID and NIH. Following that trial was the large-scale testing of thousands of participants in July along with other candidates by the Inovio Pharmaceuticals company, the Bill and Melinda Gates Foundation, Coalition for Epidemic Preparedness Innovations, and more. Alongside the US efforts would be China. For China, there are at least 6 other trial candidates. The Cansino Biologics and medical research section of the People's liberation army had trials that took place in march as well. These studies took place in collaboration with other biotech firms in China, like the Beijing and Wuhan Institutes.

Furthermore, in Brazil, there are vaccine trials by Sinovac that are taking place, along with several vaccines and trials in Australia. In terms of collaboration between the countries would be the cooperation of Clover Biopharmaceuticals from China, Novavax from the US, and others working on trials for the candidates.

For the UK, the University of Oxford began human trials in April with funding from the government.

Conclusion (Brenden and entire team)

Overview of COVID-19 and its effects in the US: The effects of COVID-19 reach far and wide across the US and the entire world. The disease has caused an unprecedented number of infections and fatalities, extreme economic hardship and severely limited hospital resources despite prevention efforts by local and national governments. However, researchers across the globe are working hard to develop a vaccine and find new treatments for the virus.

Herd Immunity: As of August 9th, there are over 5 million cases of COVID-19 in the US and experts were optimistic that herd immunity could develop over time as people become infected and develop antibodies against the virus. New studies, however, show that COVID-19 antibodies may only last up to a few months with one study concluding only 17% of participants had enough antibodies to quell the virus after roughly 2 months.²⁶ As a result, some people have already been infected with COVID-19 multiple times and the need for a vaccine greatly increases. Despite this even once a successful vaccine is developed history shows that at least 70-90% of the population will need to be vaccinated in order to eliminate high transmission rates.

Effects of Vitamin D: Vitamin D has long been known to provide benefits to a person's bone health, but recent studies suggest it could lower severity of influenza type illnesses including

²⁶<https://www.kens5.com/article/news/health/coronavirus/studies-show-coronavirus-antibodies-may-only-last-a-few-months/273-bbd3ad5a-7619-4f0b-bff5-4e1c4a242e4f>

COVID-19. Researchers in Indonesia found that over half of 780 COVID-19 deaths had Vitamin D deficiencies and researchers at Northwestern University in the US found that 17% of people who are Vitamin D deficient are likely to have severe COVID-19 complications. While the studies are only preliminary, experts have begun to recommend an increase of daily Vitamin D intake ranging from 1000-2000 IU compared to the normal 600-800 IU in preparation for the winter months and as a result of a decrease in the amount of time spent outside from quarantine.²⁷

Additionally, the US government has designated 1.5 billion towards the US Agency for International Development (USAID), in order to support the efforts being made globally to fight the pandemic. More specifically, these funds aid public health education, healthcare facilities, and research facilities across the globe. 490 million of those funds are going towards countries with limited resources, in order to reduce and/or prepare them for COVID-19.²⁸

Future outlook of where the US could be headed with COVID-19: In the end, the future of COVID-19 will be heavily dependent on the continued mitigation efforts that are taken by each individual every day. Together, with help from a vaccine, the world will be able to overcome COVID-19 and emerge as a stronger society that is better equipped to handle emerging viruses.

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²⁷ <https://www.webmd.com/lung/news/20200518/more-vitamin-d-lower-risk-of-severe-covid-19>

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