



This document is the original author manuscript of a paper submitted to an IFIP conference proceedings or other IFIP publication by Springer Nature. As such, there may be some differences in the official published version of the paper. Such differences, if any, are usually due to reformatting during preparation for publication or minor corrections made by the author(s) during final proofreading of the publication manuscript.

# COVID-19 Discrepancies Rising from Population Density Political Polarization Exacerbates Policy Gap

Mouwafac Sidaoui, Nicholas Abrams and Abhishruti Adhikari

Menlo College, Atherton, CA 94027, USA

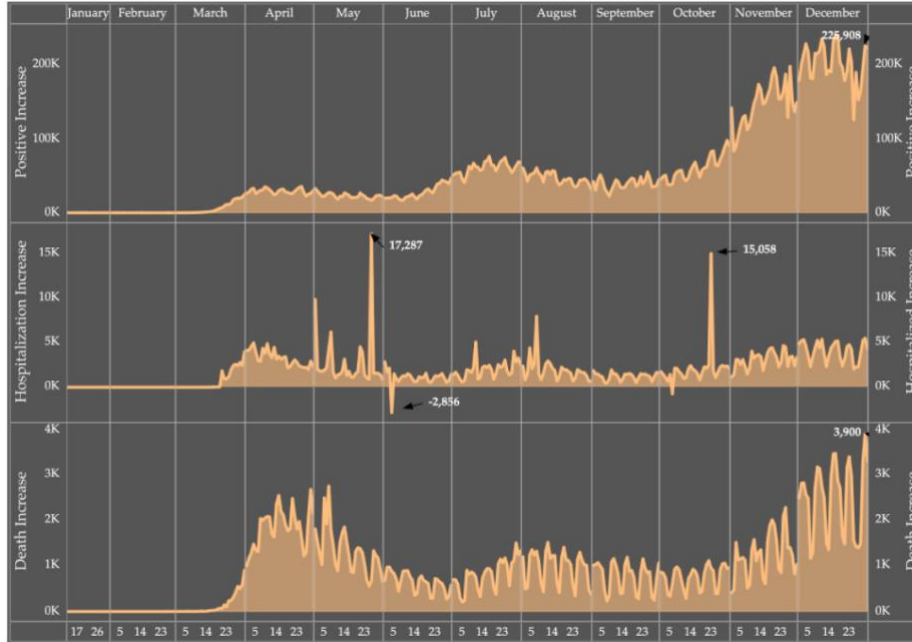
**Abstract.** The Coronavirus pandemic severely impacted certain areas of the USA more than others. The data-driven decision making at every level at CDC will aid government decision makers to reallocate medical resources while planning recovery and reopening businesses in the United States. In this paper, we use a data visualization approach combined with current secondary research to measure which areas of the USA are most severely impacted by the Coronavirus pandemic. We propose a novel methodology that is implementable by medical organizations that use informatics depending on the data initiative at hand.

**Keywords:** Data Visualization, Business Analytics, COVID-19, USA, Policy Gap, Political Polarization.

## 1 Introduction

Real data from [cdc.gov](https://www.cdc.gov) shed light on the states with the worst infection and death rates to better understand what states are most severely impacted by the Coronavirus. This insight will aid decision makers when allocating further medical resources while planning recovery and reopening of states. Along the way, important concerns regarding criteria and metrics are examined to provide greater clarity towards answering a further question. How does one measure impact and severity? The data within this research paper is first aggregated at the country level, then disaggregated to the state level. The data leads to two alternate conclusions for decisionmakers to ponder. Coastal states have experienced the greatest number of deaths related to the Coronavirus, while states situated in the interior of the country have experienced the greatest number of deaths related to the Coronavirus adjusted for population in given state. These metrics reveal contrasting conclusions that arise due to absolute and relative bases.

## 2 Research USA Time Series



**Fig. 1.** *COVID in Numbers.* Numbers on the left represent Total cases, Total Hospitalized, Total Deaths, and Fatality Rate of COVID in the US as of January 24, 2021. Graphs on the right represent the increase in Positive cases, Hospitalizations, and Deaths.

Notice {**Fig.1**} the first two months of the year present a minor increase in Positive Cases with zero hospitalization and few deaths. The month of March reveals positive cases, hospitalizations, and deaths increasing sharply. These indicators increase throughout the second half of the year. Hospitalizations, results of positive cases, and deaths related to the virus increase dramatically in the fall.

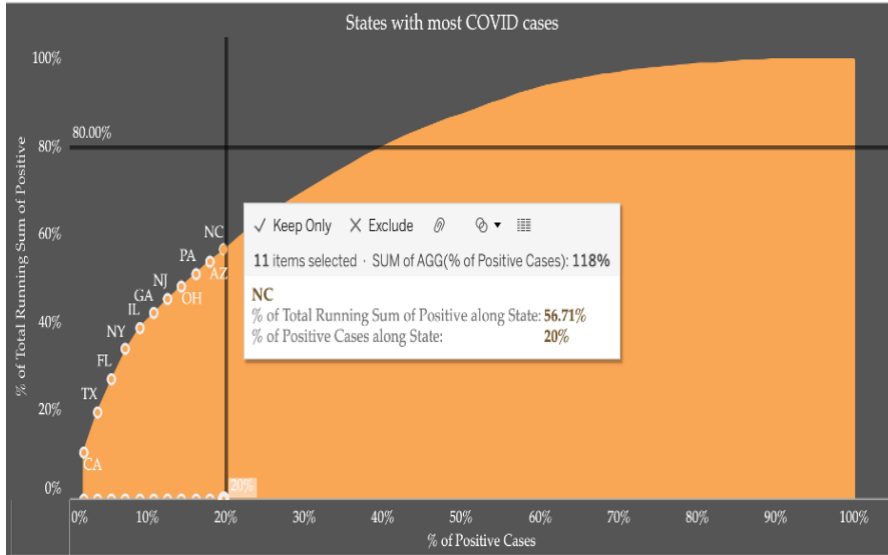
In the months leading up to March, there was not enough data or a robust set of data tools to gather and analyze the COVID-19 dataset. After the novel coronavirus was declared a national emergency on President Donald Trump on March 13, 2020, the White House urged its AI experts to develop tools to be applied to the COVID-19 dataset to help understand the transmission, risk, and other vital information of the virus. The “COVID-19 Open Research Dataset (*CORD-19*), representing the most extensive machine-readable coronavirus literature collection available for data mining to date, was put together by researchers from the Allen Institute for AI, the Chan Zuckerberg Initiative (CHI), Georgetown University’s Center for Security and Emerging Technology (CSET), Microsoft, and the National Library of Medicine (NLM) at NIH” as a result of the call-to-action by the White House soon after (Kent,

2020). Initiatives from Google Cloud to offer researchers free access to COVID-19 information through its COVID-19 Public Dataset Program helped the data be even more accessible to researchers paving the path for using AI tools in medicine.

While understanding the trends of the infection among various geographic regions and demographics, researchers identified very early on that the virus had disproportionately impacted not only the elderly and people with underlying conditions but also the people of lower socioeconomic status and other minority populations. Medical Home Network, an organization serving patients in the Chicago area, used Artificial Intelligence to identify high-risk individuals to prioritize care management outreach to patients at most risk to severe complications from the virus (Kent, 2020). Similar usage of the Artificial Intelligence algorithm helped an NYU team to accurately predict which patients diagnosed with COVID-19 will develop serious respiratory disease (NYU, 2020). Data scientists, Andrew Satz and Brett Averso founded a startup, EVQLV, that creates algorithms capable of generating, screening, and optimizing millions of therapeutic antibodies (EVQLV, 2020). Likewise, Definitive Healthcare, in partnership with Esri, launched an interactive data platform to predict where and when the resources such as ICU beds and ventilators need to be allocated by looking at the number of hospital beds, equipment, and other resources available in each county of each state in the country. Likewise, the Center for Systems Science and Engineering (CSSE) at Johns Hopkins released a web-based dashboard with real-time cases, recoveries, and deaths for all countries affected by the virus. These data gave the US federal and state governments a scientific guideline to implementing quarantine and social distancing measures.

Despite the efforts to make data transparent, much was still needed to learn about the coronavirus. All indicators of severity, including positive cases, hospitalizations, and deaths spike throughout the second half of the year. On May 28, total fatalities numbered 100,000. The daily death rate of the coronavirus hovered around 2,000 deaths per day. The Fatality Rate peaked on May 15 at 2.59% and subsequently decreased. The number of positive cases increased rapidly during Summer before subsiding towards Fall.

Fall experienced a more dramatic surge. Positive tests, hospitalizations, and fatalities increased. Nonetheless, the numbers so far represent the whole country and looking at data covering 50 states and 8 territories at the same time. Creating a Pareto chart to see where each state lies in relation to the running total of positive cases in the country provides further insight.



**Fig. 2. Pareto Chart.** A Pareto Chart with % of positive cases along with states and % total running sum of positive cases along states showing that 11 states contribute to 56.71% of total positive COVID cases in the US.

Notice that 11 states contribute to almost 60% of total cases in the US. The top 10 states with the most positive cases in the US are used for further analysis. The top 10 most-affected states were identified using the rank calculation, (RANK(SUM([POSITIVE])) and filtering the data by [\*Rank in Positive] <= [Top 10].

The cross tab below sorts those 10 states to create a chart that contains Positive Increase, Hospitalization Increase, Maximum Recovered, and Death Increase with % of the total sum as labels. The chart was then color-coded, where light to bright orange indicated low to high percentages.

### 3 Research Absolute vs. Relative Basis

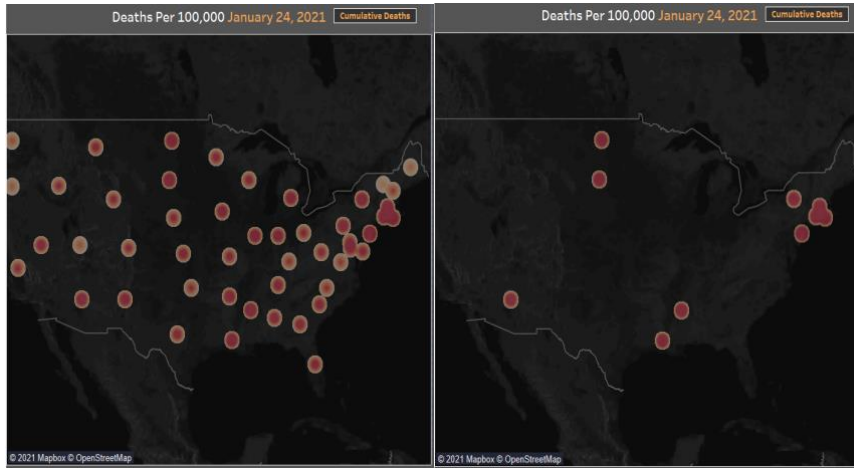
{Fig.3} illustrates Total Deaths related to the Coronavirus in each state across a heat map of the United States. The number of deaths associated with individual states are illustrated with a density chart that increases in size and varying degrees of color. The states which experience a greater number of deaths related to the Coronavirus are illustrated in red, while states which experience a lesser number of deaths related to the Coronavirus are illustrated in more pale color.



**Fig. 3. Heat Map: Total Deaths.** A map of the United States illustrating the number of deaths associated with each state. On the right-hand side, the data is filtered to narrow down on the top-10 states with the most deaths.

Most remarkable is the contrast between the interior and coastal regions of the country. The states experiencing the most deaths related to the Coronavirus are California, Texas, New York, Florida, New Jersey, Illinois, Pennsylvania, Michigan, Massachusetts, and Georgia. The paler, less impacted States are situated more in the interior of the USA, while the redder, more impacted States are situated in coastal areas of the USA. This analysis illustrates that the interior of the country is less impacted by the Coronavirus than the coastal regions of the country. More precisely, the states most impacted by the Coronavirus are situated on the coastal regions of the country.

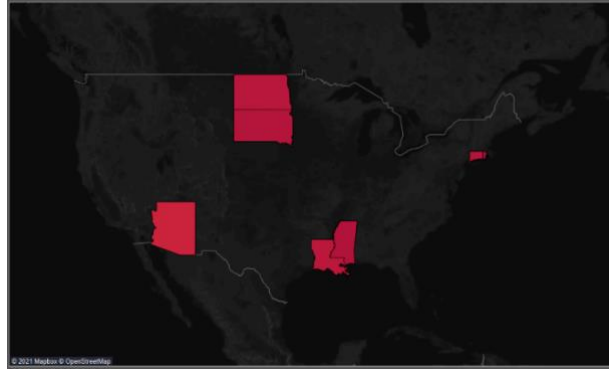
A different analysis provides the opposite conclusion. **{Fig.4}** below illustrates the severity of the Coronavirus by first taking the total number of deaths related to the Coronavirus within each state, then adjusted by the state's population size. This provides a relative number of deaths related to the Coronavirus "per 100,000" citizens. Notice that most states across the country experience a similar intensity of the Coronavirus. While the intensity of the Coronavirus is similar across the country, ten states stand out as the most severely impacted on this metric of "per 100,000" citizens. Those are Arizona, North Dakota, South Dakota, Missouri, Louisiana, New Jersey, New York, Rhode Island, Massachusetts, and Connecticut. This relative basis reveals that states within the interior of the country have greatly suffered from the Coronavirus pandemic, albeit relative to their population size.



**Fig. 4. Heat Map: Deaths Per 100,000.** A map of the United States illustrating the number of deaths associated with each state, then divided by the population size of the given state. On the right-hand side, the data is filtered to narrow down on the top-10 states with the most deaths relative to their population size.

Contrast the conclusion of both density charts. The first metric of “Total Deaths” within a given state concludes that coastal regions of the country suffer the greatest impact from the Coronavirus pandemic. Those states include California, New York, New Jersey, Texas, and Florida, among others. “Deaths per 100,000” of the state’s population concludes that states in the interior of the country suffer the greatest. Those states include North Dakota, South Dakota, Louisiana, Missouri, and Arizona.

Some states show themselves to be affected only on a relative basis. These states do not hold a top ten position with Total Deaths related to the Coronavirus but do hold a top ten position within “Deaths per 100,000” citizens. These states include Rhode Island, Missouri, South Dakota, Connecticut, North Dakota, Louisiana, and Arizona {Fig. 5}.



{Fig. 5} States Rhode Island, Missouri, South Dakota, Connecticut, North Dakota, Louisiana, and Arizona experience the greatest impact of the Coronavirus only relative to their population size.

More precisely, the impact of the Coronavirus in these states is found in the number of deaths relative to their population size. The number of deaths relative to the Coronavirus in each state is small compared to other states, but when this metric is normalized on a common basis, population size, the severity of the situation becomes apparent.

#### 4 Discussion Policy Gap

States in the interior of the country experienced a disproportionately high number of deaths related to the Coronavirus relative to their population size. Most striking are the states of North Dakota, South Dakota, Arizona, Missouri, and Louisiana. Why did such states become so severely impacted by the Coronavirus? Initial reports hint that bad policy was to blame.

A policy gap is a concept where the implementation of policy fails to achieve the intended results. The most salient factor contributing to policy gap throughout the response to the Coronavirus was the challenge of policy implementation across dispersed governance (Hudson et al., 2019). Three levels of governance make policy implementation challenging. First, federal recommendations lead to state regulation. Then state regulation leads to municipal implementation. This layering of bureaucratic decision-making highlights “the need for policymakers to confront the messy engagement of multiple players with diverse sources of knowledge” (Hudson et al., 2019). The increasing layers of bureaucracy produce implementation limitations at each level that become exacerbated when these layers of policymakers fail to establish common ground on core facts at hand. This is greatest highlighted in North and South Dakota’s bleak response when faced with the Coronavirus.

South Dakota Governor Kristi Noem refrained from mandating policy that other states found appropriate. Masks were not mandated nor were large gatherings limited.



The decision sought to respect personal freedom (Levin & Lebeau, 2021). The impact is obvious. This *laissez faire* approach resulted in South Dakota experiencing one of the highest numbers of deaths relative to their population size (Levin & Lebeau, 2021). Similarly, North Dakota's enforcement of mask mandates was short lived, and the result was a dramatic spike in cases and subsequent deaths during the spring and summer months (Turley & Springer, 2020). This dismissive response to federal and public health official recommendations is not unique to these two states, but indicative of a political polarization that further exacerbates the policy gap.

North and South Dakota highlight the political polarization that increased the challenge of policy implementation across dispersed governance. Trust between policymakers and public health officials was very low and predominantly split between political party lines (Milosh, 2020). Take for example the situation surrounding face masks. Face coverings have been a staple policy to mitigate the spread of the Coronavirus across the country with impressive efficacy, however particular states were not interested in implementing the measure (Leung, 2020). During the pandemic, all 24 of the Democratic Governors required citizens within their state to wear a face mask indoors (Reimann, 2020). Only 8 of the 26 Republican Governors require citizens within their state to wear a face mask indoors (Reimann, 2020). Further research revealed areas that strongly supported democratic candidates in the 2016 election were more willing to comply with mask mandates while the opposite is true with areas that supported Republican candidates (Milosh, 2020). Republican led states were generally distrustful, or otherwise dismissive, of federal and public health official recommendations.

The Coronavirus pandemic exposes decision making mistakes across state and municipalities whose responsibility is to protect their population from such disasters. To avoid similar exacerbations of policy gap in future pandemics, trust between policymakers and health officials needs to be restored. Public health officials need to persuade policymakers across the various layers of governance and their subsequent constituency to make behavior changes and follow public health policies.

Public health officials' relationship with policymakers can be improved with transparency of the scientific modeling process that leads to recommendation of policy. The decision-making process of the Coronavirus pandemic involved interpreting scientific evidence in the form of quantitative models, abstract representations of reality that provide a logically consistent way to organize thinking about the relationship among variables of interest (Berger, 2021). Should differing scientific conclusions exist, public health officials need to clarify with the skeptical policy makers the scientific process to establish common ground on core facts at hand.

Public health officials' relationship with policymakers' constituencies can be improved through enlisting favored voices. Public health officials can follow a similar strategy as West Africa during the Ebola Crisis in 2014. West Africa officials enlisted local voices to build engagement and trust between the individuals and health officials (Bavel, 2020). This phenomenon is further validated by study by Ajzenman et al, who

noticed shortly after Donald Trump's endorsement of masks in July of 2020, social media engagement of mask mandates was significantly positive. Support from prominent figures can improve the impression of public health officials.

Further, public health officials can make a moral case for behavioral change. The pandemic revealed Americans are more willing to abide by stringent lockdown measures if they are convinced doing so would risk infecting a coworker of a serious illness (Bavel, 2020). Clear understanding of the implication of individuals' actions improves their ability to discern the impact of their choices. The result being public health recommendations are more appreciated.

## **5 Conclusion**

When decision makers attempt to craft policy regarding the Coronavirus and aid areas of the country that are most severely impacted, they must account for population size in their considerations. Further, decision makers must keep in mind that while coastal regions of the country suffer the greatest in the number of deaths related to the Coronavirus on a cumulative basis, a relative basis provides a different conclusion. On a relative basis, the interior of the country experiences a significant impact from the Coronavirus.

The states impacted by the Coronavirus on a relative basis reveal remarkable policy gaps through the Coronavirus response. These policy gaps were primarily caused by challenges in implementing policy through several layers of governance, though was further exacerbated by political polarization that impacted individuals trust in federal and public health mandates. Trust between policymakers and public health officials, and trust between policymakers' constituency and public health officials must be improved to avoid repeat outcomes of North and South Dakota.

## References

1. Ajzenman, N. (2020, February 5). *Leaders' speech and risky behaviour during a pandemic*. VOX, CEPR Policy Portal. <https://voxeu.org/article/leaders-speech-and-risky-behaviour-during-pandemic>
2. Bavel, J. J. (2020, April 30). *Using social and behavioural science to support COVID-19 pandemic response*. Nature Human Behaviour. [https://www.nature.com/articles/s41562-020-0884-z?error=cookies\\_not\\_supported&code=f6599321-3df6-4797-934f-bd3dabeb5293](https://www.nature.com/articles/s41562-020-0884-z?error=cookies_not_supported&code=f6599321-3df6-4797-934f-bd3dabeb5293)
3. Berger, L. (2021, January 26). *Rational policymaking during a pandemic*. PNAS. <https://www.pnas.org/content/118/4/e2012704118>
4. Cohen, J., & Rodgers, Y. V. D. M. (2020). Contributing factors to personal protective equipment shortages during the COVID-19 pandemic. *Preventive Medicine*, 141, 162-163. <https://doi.org/10.1016/j.ypmed.2020.106263>
5. Hudson, B., Hunter, D., & Peckham, S. (2019). Policy failure and the policy-implementation gap: can policy support programs help? *Policy Design and Practice*, 2(1), 1–14. <https://doi.org/10.1080/25741292.2018.1540378>
6. Leung, N. H. L. (2020, May 27). *Respiratory virus shedding in exhaled breath and efficacy of face masks*. Nature Medicine. [https://www.nature.com/articles/s41591-020-0843-2?fbclid=IwAR0Q3-WhHv1F9dmZSr2iLNQ-F6ioAIfOYACh7PPtHib9EsuVyhs-mYZlXcg&error=cookies\\_not\\_supported&code=a9b92dd0-6150-4811-ae2c-86db898e6933](https://www.nature.com/articles/s41591-020-0843-2?fbclid=IwAR0Q3-WhHv1F9dmZSr2iLNQ-F6ioAIfOYACh7PPtHib9EsuVyhs-mYZlXcg&error=cookies_not_supported&code=a9b92dd0-6150-4811-ae2c-86db898e6933)
7. Levin, J., & Lebeau, D. (2021, February 3). *Covid's South Dakota Rampage Created a Failed Experiment in Herd Immunity*. Bloomberg.
8. Milosh, M. (2020, December 23). *Political polarisation impedes the public policy response to COVID-19*. VOX, CEPR Policy Portal. <https://voxeu.org/article/political-polarisation-impedes-public-policy-response-covid-19>
9. Reimann, N. (2020, July 30). *All States With Democratic Governors Now Have Mask Mandates, But Most With Republicans Don't*. Forbes. <https://www.forbes.com/sites/nicholasreimann/2020/07/30/all-states-with-democratic-governors-now-have-mask-mandates-but-most-with-republicans-dont/?sh=24622de27e25>
10. Silverstein, J. (2020, December 1). *U.S. reported more COVID-19 cases in November than most countries had all year*. CBS News. <https://www.cbsnews.com/news/covid-november-cases-united-states/>
11. Times, T. N. Y. (2020, July 24). *Spike in U.S. Cases Far Outpaces Testing Expansion*. The
12. New York Times. <https://www.nytimes.com/2020/07/22/world/Coronavirus-covid-19.html>
13. Turley, J., & Springer, P. (2020, November 16). *How did North Dakota's COVID-19 outbreak become the worst in the country?* Twin Cities. <https://www.twincities.com/2020/11/15/how-did-north-dakotas-covid-19-outbreak-become-the-worst-in-the-country/>