

COVID-19 Mitigations in the U.S. September 2020 to April 2021





COVID-19 Mitigations in the U.S.

September 2020 to April 2021

AUTHORS David Ingram, CERA, FSA, MAAA
Daniel Ingram, MBA

Caveat and Disclaimer

The opinions expressed and conclusions reached by the authors are their own and do not represent any official position or opinion of the Society of Actuaries or its members. The Society of Actuaries makes no representation or warranty to the accuracy of the information.

Copyright © 2021 by the Society of Actuaries. All rights reserved.

COVID-19 Mitigations in the U.S.

September 2020 – April 2021

This report provides highlights of a weekly survey of practices regarding the mitigation of the spread of COVID-19 in the U.S. during the final four months of 2020 and the first four months of 2021. The survey asks about the degree to which the respondents perceive that people in their community are following 21 common mitigation practices. The responses are separated by state and compared to state level statistics regarding the level of COVID-19 infections from the Johns Hopkins COVID database for the same time period.

Executive Summary

Over the last four months of 2020 there was a small but steady decrease in community mitigation practices across the country from 64.8% in September to 64.4% in October, 62.9% in November and December. This trend took place as fall and winter weather forced much activity indoors where virus transmission is expected to be stronger than outdoors and as COVID-19 infection levels skyrocketed. In 2021 average mitigation level fell again in February through April, but the massive rollout of effective vaccines offset the looser compliance and a steep drop of infections resulted.

These observations of mitigation practices are based on over 10,000 surveys that were collected on a weekly basis. During that eight-month period, the monthly average level of active infections rose from 171 in September to 890 in January then fell to 274 in April. New COVID-19 infections for September were 1.2 million rising to 6.4 million in December before falling to 1.9 million in April. This is a more than 5-fold increase.

Additional findings from the four months:

- The monthly average daily New Infection Rate (NIR) rose and fell over the eight months, starting around 7% in September, reaching a peak of 8.6% in December before falling in the first months of 2021. The average NIR for January through April was only 6.6%, well below the No Growth level of 7.14%.
- Restaurant reduced seating and Senior facility restrictions were the two mitigations that had the largest drop in compliance, with Restaurants dropping by almost 20% and Senior facilities falling by over 10% over the eight months. Getting tested for antibodies and Enforcement by Police/Fines were the two mitigations with the largest increases in compliance (+16% and +10% respectively).
- At the state level, Massachusetts reported the highest average compliance over all mitigation practices at 70% while Georgia reported the lowest with 55.4% average compliance. Arizona led the nation with four months of improvement that were 2% or more. also reported the largest increase in average compliance over the four months with a 20% improvement, more than twice the second largest improvement in Missouri of 9%. Nevada reported an almost 20% decline in compliance, ending the four-month period with the third lowest average monthly compliance.
- COVID spread faster in New Jersey than in Texas over the four months, but both experienced a massive increase in infections that has put a huge strain on their healthcare facilities and caused tens of thousands of deaths. In Texas, most mitigations fell during this time, with a few key exceptions. In New Jersey, mitigations increased from their summertime lows when COVID was largely under control in that state.

- Adherence to two of the mitigation strategies is shown to be predictive of changes in one week ahead incident cases of COVID-19 as measured by the crowdsourcing approach.

The full set of mitigations surveyed are included in the appendix to this report.

Project Overview

This report follows the mitigations that are the practices in the U.S. to slow the spread of COVID-19 over the final four months of 2020 and the first four months of 2021. The information about the behavior of people in various states is captured through a crowdsourcing approach using an online survey instrument. Over this eight-month period, 10,168 surveys were collected from people in all 50 states and the District of Columbia. Throughout the eight-month period, we have collected observations about the degree of compliance with 21 specific mitigation practices on a weekly basis.

In addition, we look at the ups and downs of the course of the COVID-19 pandemic in the U.S. based upon data from the John Hopkins COVID-19 database. The focus has been on infections, rather than hospitalizations or deaths since the mitigation practices that we follow are intended to reduce infections.

The primary objective of this report and of the entire COVID Mitigation Monitoring Project is to produce information about actual community practices. Most information that was available at the outset of the project looked at whether or not officials in various jurisdictions were requiring or recommending particular mitigation practices. This report and the CMMP takes that one step further to pay attention to the degree to which people are actually following the requirements and recommendations, which we refer to as Compliance.

Over the four-month period aggregate compliance with the 21 practices has stayed fairly flat and in the range of 61.5% to 63%¹. However, there were significant variations in compliance across the 21 practices as well as by state.

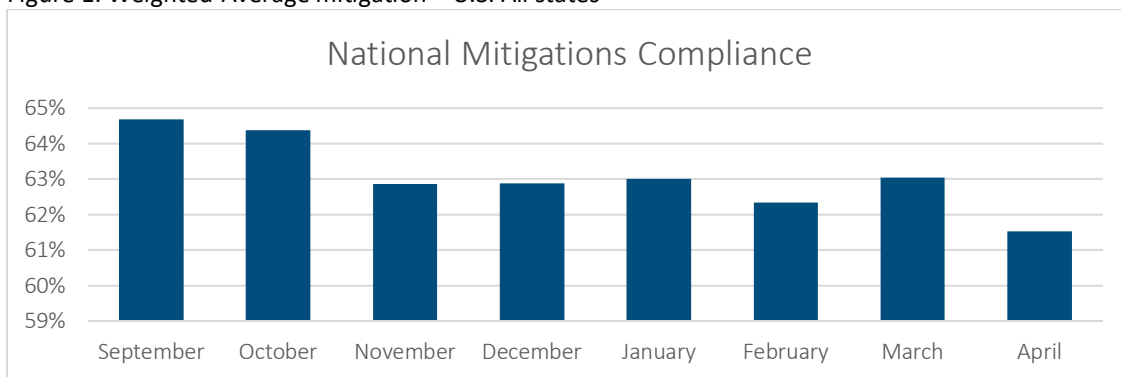
Survey Details

Collects information from volunteers on perceptions of community compliance with 21 COVID Mitigation strategies. Participants answer between 0% and 100% that they see the strategy in use in their area. Participants are asked to fill out survey every week.

U.S. Mitigation Practices

National average mitigation compliance fell slowly but steadily through the four-month period.

Figure 1. Weighted-Average mitigation – U.S. All states



The National Weighted Average Compliance stayed remarkably consistent from November to March falling at or very close to 63% in four of the five months. Anecdotal evidence suggests that many people had settled into a routine for their own personal practices and only made minor variations on that routine

¹ Mitigation compliance values for early April and all of March referenced here differ from some prior reports due to additional data cleansing that was performed for this report. The resulting national mitigation compliance values follow the same path of increases and decreases as previously reported.

until vaccination caused many people to relax that standard. This overall average, however, is a net result of larger and smaller changes in compliance levels both up and down for different mitigation practices. While the weighted average fell by 3.2% from January to April, compliance for many individual practices changed by much more and some by much less than that.

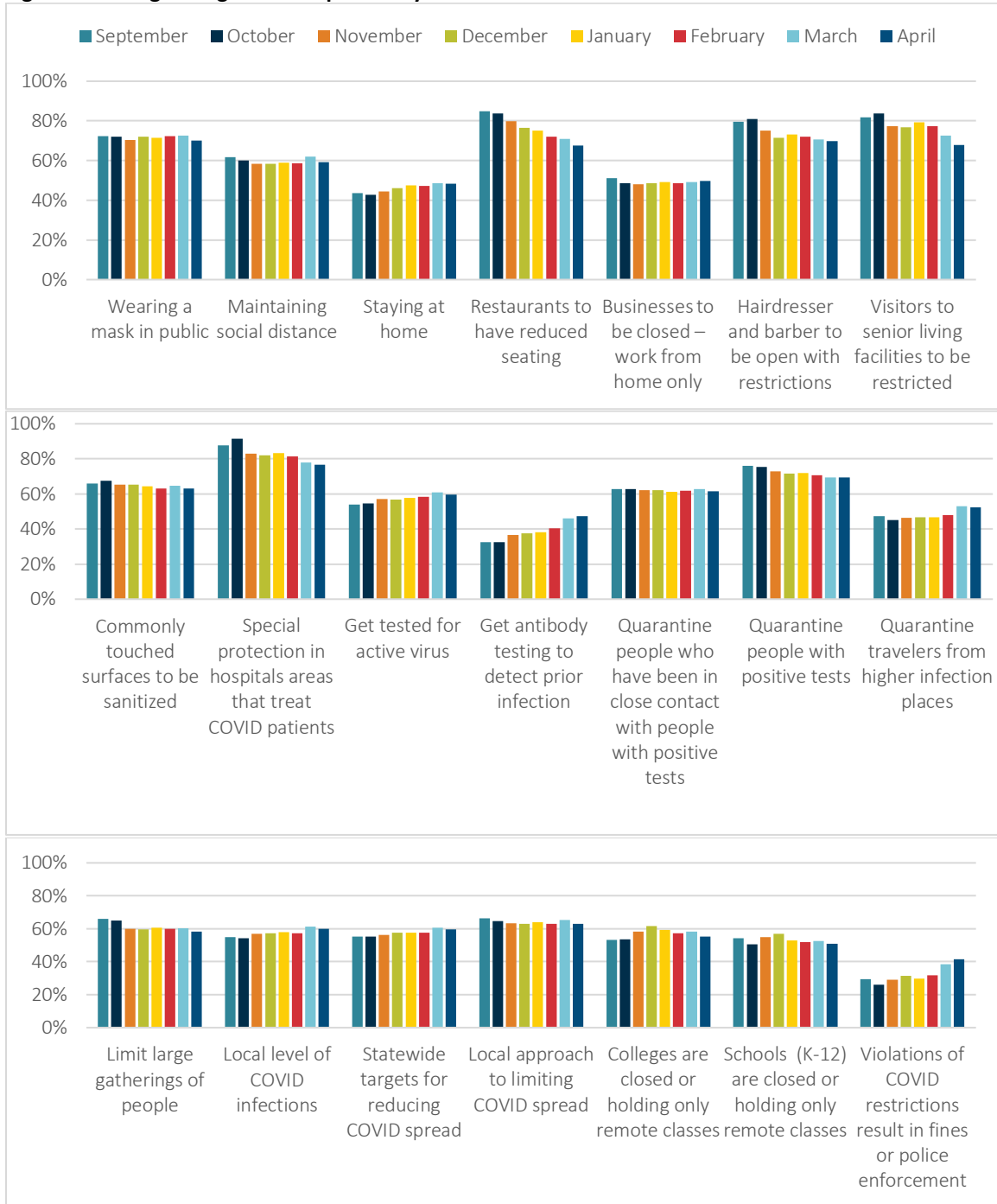
Table 1 Net change in percent compliance for 21 Mitigations from September 2020 to April 2021

	2020	2021	Total
Restaurants to have reduced seating	-10%	-9%	-19%
Visitors to senior living facilities to be restricted	-2%	-9%	-11%
Special protection in hospitals areas that treat COVID patients	-4%	-5%	-9%
Hairdresser and barber to be open with restrictions	-6%	-2%	-8%
Schools (K-12) are closed or holding only remote classes	-1%	-6%	-7%
Limit large gatherings of people	-5%	-1%	-6%
Quarantine people with positive tests	-4%	-2%	-6%
Commonly touched surfaces to be sanitized	-2%	-2%	-4%
Wearing a mask in public	-1%	-2%	-3%
Local approach to limiting COVID spread known	-2%	0%	-2%
Maintaining social distance	-3%	1%	-2%
Quarantine people who have been in close contact with people with positive tests	-1%	0%	-2%
Businesses to be closed – work from home only	-2%	1%	-1%
Colleges are closed or holding only remote classes	6%	-6%	0%
Statewide targets for reducing COVID spread known	2%	2%	4%
Quarantine travelers from higher infection places	-1%	6%	5%
Local level of COVID infections known	3%	3%	6%
Staying at home	4%	2%	6%
Get tested for active virus	4%	3%	7%
Violations of COVID restrictions result in fines or police enforcement	0%	10%	10%
Get antibody testing to detect prior infection	6%	10%	16%

This overall pattern, of decreasing compliance, indicates that in general, communities (or a significant minority of people within U.S. communities) have chosen to allow the spread of COVID-19 rather than continue with practices that may have been slowing the spread of COVID late last summer and early fall.

The following graphs show the path of compliance over the eight months and the level for each of the 21 mitigations.

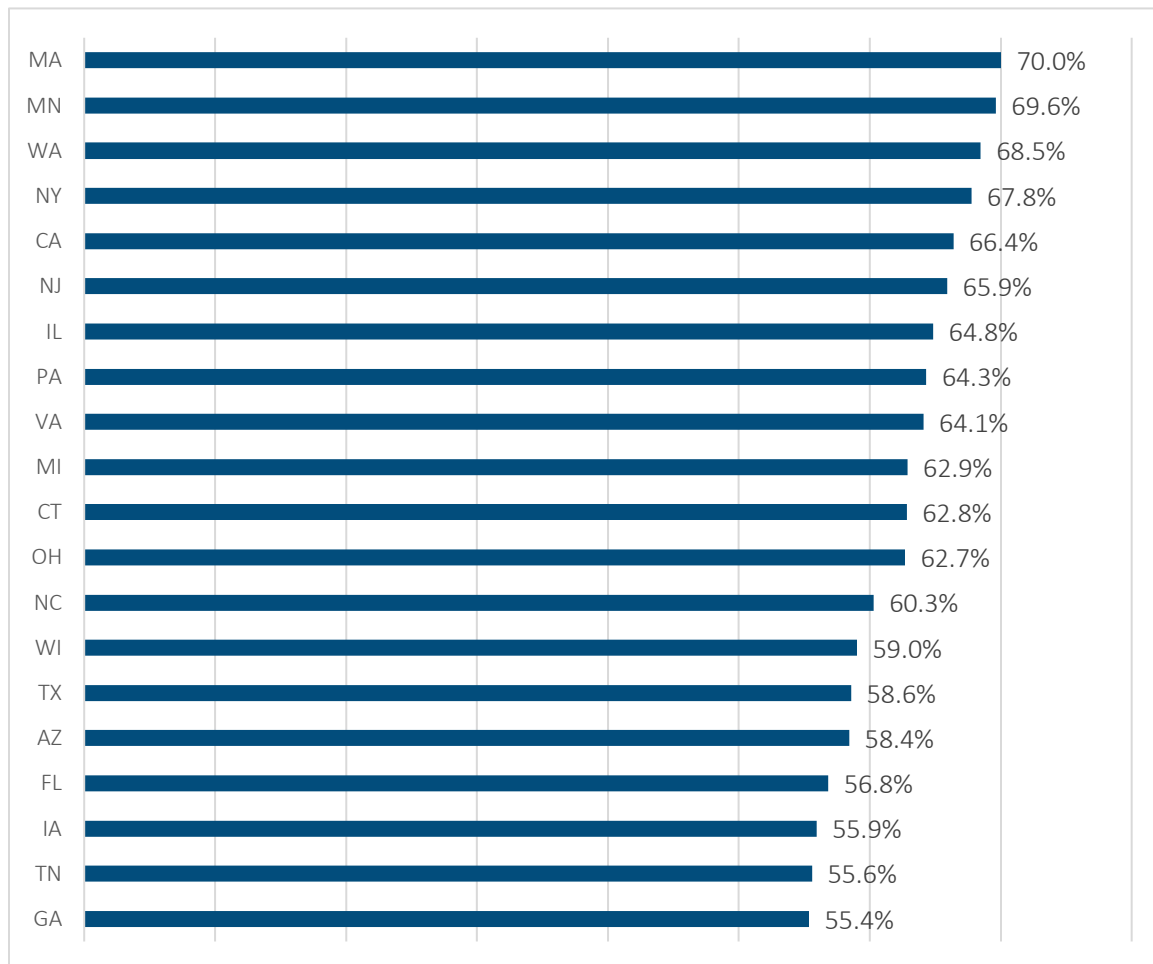
Figure 2. Average Mitigation Compliance by Month



Mitigation Practices – State Level

There were sufficient responses to calculate average mitigation compliance over the eight-month period for 20 states. This shows the highest average compliance for Massachusetts with 70% and the lowest for Georgia with 55.4%. For all 20 states, average compliance was over 50%.

Figure 3. Eight Months Average Mitigations Compliance – All 21 mitigations



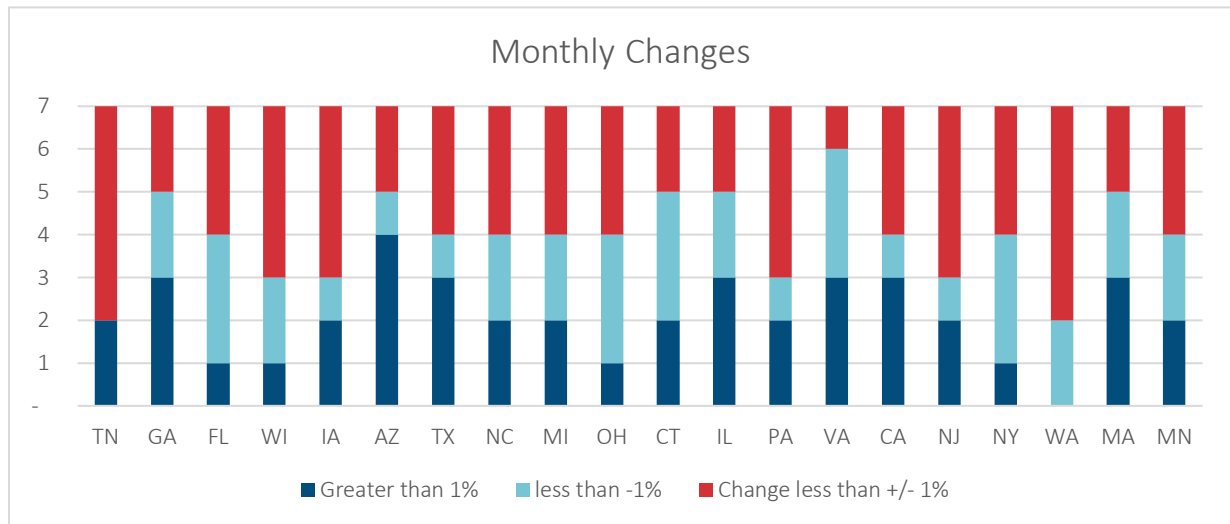
The average does not tell the whole story. For instance, some states had much greater variability of compliance level.

Table 2. Average Monthly Compliance Level vs. Consistency of Compliance

		Average Monthly Compliance Level		
		High	Medium	Low
Consistency of Compliance Level	High	New York	Pennsylvania North Carolina	Florida Georgia Texas Wisconsin
	Medium	New Jersey California Washington Massachusetts	Ohio	Tennessee
	Low	Minnesota	Illinois Virginia Connecticut Michigan	Iowa Arizona

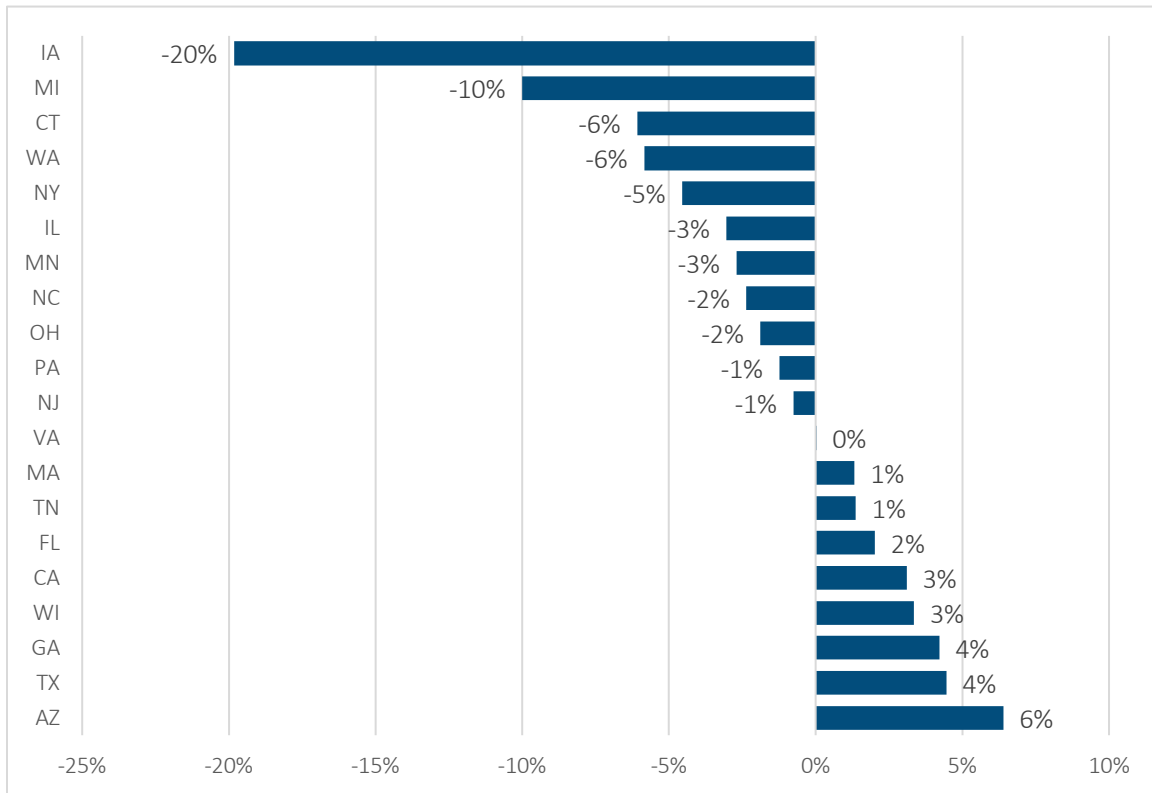
Iowa and Arizona had low Compliance Level (third and fifth worst on Figure 3) and their monthly compliance was highly variable (Low Consistency on Table 2). Four states, Florida, Georgia, Texas and Wisconsin, ranked low for eight-month compliance and also were consistent in that. New York, having suffered the most from the pandemic in the spring before the start of this project, was the only state to have high compliance and high consistency.

Figure 4. Distribution of Monthly Changes in Compliance Level



North Carolina was balanced with two months of increases in compliance by more than 1% and two months with decreases of more than 1% and two months of changes less than 1% up or down. Washington was stable, with only two months of changes of more than 1% and five months of smaller or no changes.

Figure 5. Change in Average Compliance September 2020 to April 2021

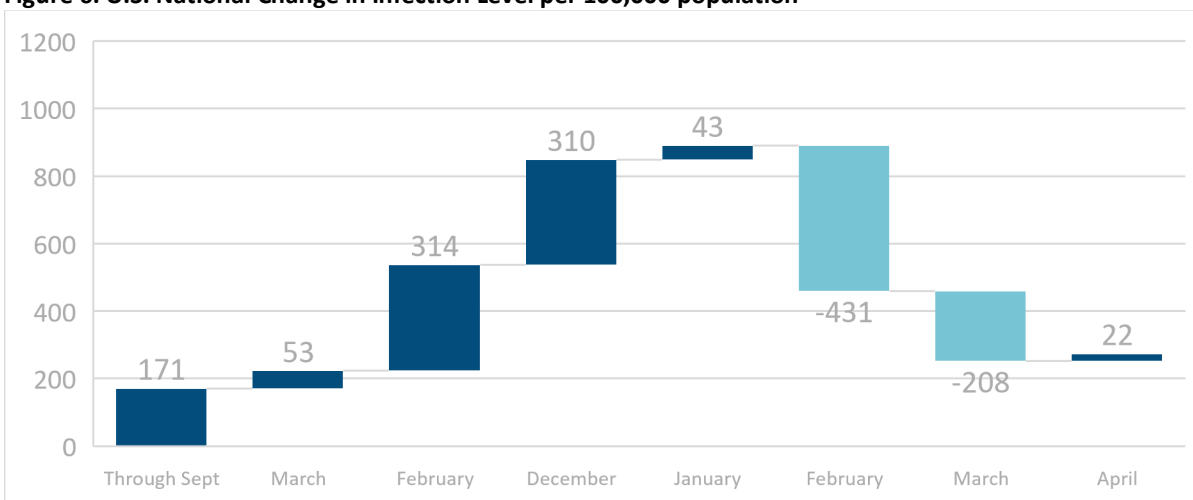


Georgia, Texas and Arizona showed the largest increases in average compliance, while Iowa and Michigan had the worst decrease in compliance.

COVID-19 Spread of Infections – National

In September the national infection level per 100,000 of population averaged under 200. In October there was a small increase in average infection level which brought the national figure up to 224. Much larger increases were experienced in November and December with the infection level doubling in November and further increasing by over 50% in December. In January, further increases early in the month were mostly offset by decreases in the latter half of the month. February and March saw very large decreases driven largely by a surge in vaccinations. April had increases and decreases as faster spreading COVID variants came to the U.S. while a number of states were relaxing mitigation compliance worked against the continuing surge in vaccinations.

Figure 6. U.S. National Change in Infection Level per 100,000 population²



² The COVID figures per 100,000 of population are slightly different from earlier reports because this report uses the recently released 2020 Census results for the population values. Prior reports have used the 2019 census estimates.

Focusing in on the infection levels for the ten most populous states (Figure 7 below), a similar pattern emerges in many of those states. The U.S. nationally and nine of the ten large states peaked in January. California hit the highest monthly average in January but is April has the lowest infection level. Michigan peaked in April, several months later than other large states or the national average.

Figure 7. Eight months Infection Levels per 100,000 population in ten states with largest populations

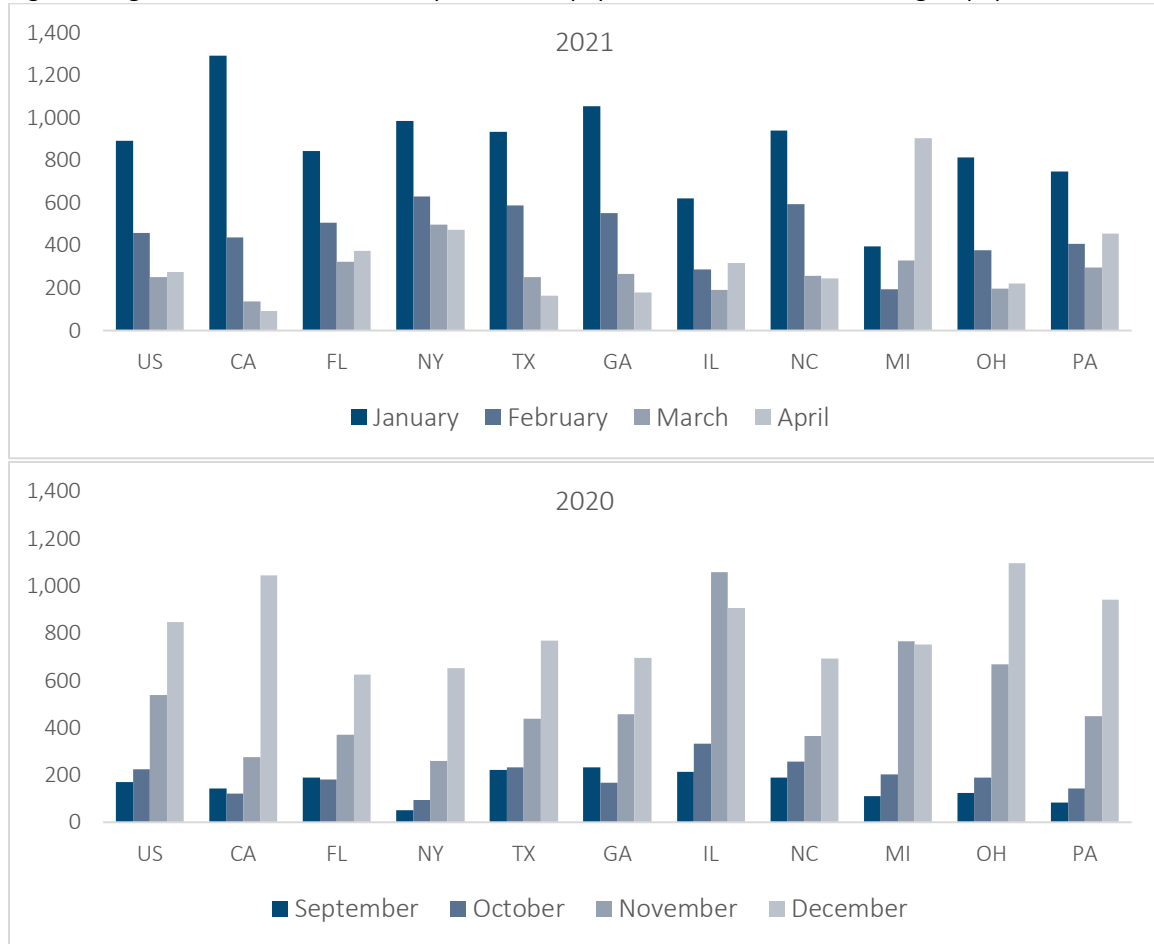
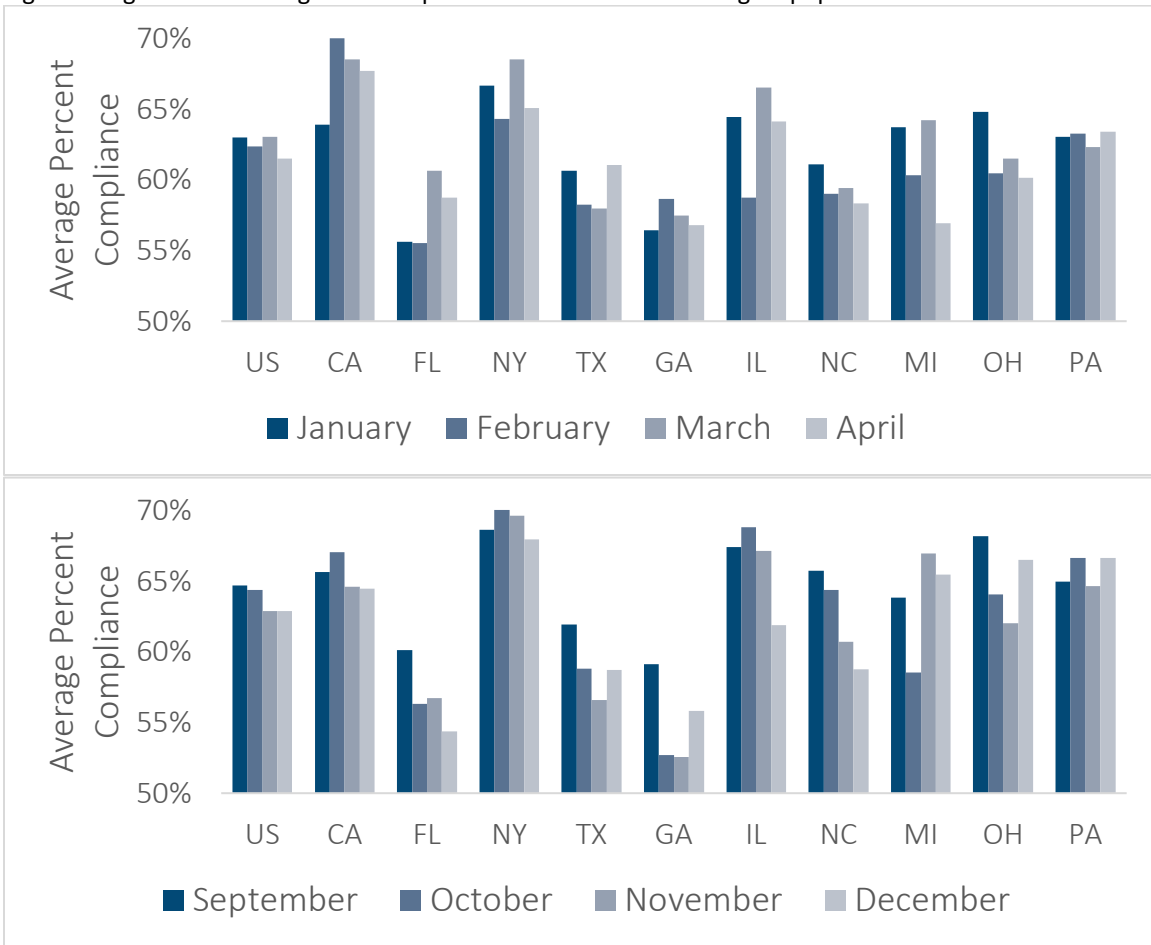


Figure 8. Eight months Mitigation Compliance for ten states with largest populations



The path and level of average mitigation compliance varies considerably by state as shown on Figure 8.

Figure 9. State level Mitigation compliance for selected mitigations³



Looking at specific mitigations in two states with very different approach and results, Figure 9 shows:

- Two mitigations where California compliance was much higher (averaged +12% to +15%) than Texas – Quarantining Travelers and Businesses closed/Work from Home
- Three mitigations where California compliance was moderately higher (+5% to +9%) than Texas – Quarantining contacts, Knowing local approach to mitigation, Statewide Targets known
- Two mitigations where California compliance was similar (averaged +1% to +4%) than Texas – Maintaining Social Distance and Knowing local level of infections

³ Mitigations selected based upon correlations of mitigations with infection levels. The seven selected mitigations had the highest negative correlation to infections levels on a national level

Estimated Impact of Immunity

The vaccination programs started during the period under study here. An estimate of the potential impact of immunity gained from vaccinations and from recoveries from COVID infections shows that over the first four months of 2021, the impact of immunities on the spread of COVID is growing to a significant level.

Table 3. Impact of Immunities

	December	January	February	March	April
Reported Recovered Immune	16.4	23.2	27.0	28.7	30.9
Vaccinated Immune	2.0	16.9	37.7	77.0	125.2
Total Immune	18.4	40.1	64.7	105.8	156.1
Pct of Population	5.60%	12.3%	19.8%	32.4%	47.9%
Observed New Infection Rate ⁴	7.5%	6.8%	5.7%	7.0%	6.9%
Base New Infection Rate	7.9%	7.8%	7.1%	10.4%	13.3%

The base New Infection Rate above is the new infection rate that could apply to the part of the population that is not immune, where the observed New Infection Rate is a weighted average of 0% new infections for the immune part of the population and the Base New Infection Rate for the rest of the population.

While the national average total percent immune at the end of April is shown above to be 47.9%, at the state level, immune percentage ranges from a high of 57% in Massachusetts to a low of 38% in Mississippi. These differences are mostly driven by both differences in the levels of recovered immune people in the states as well as the range of vaccinated immune in each state.

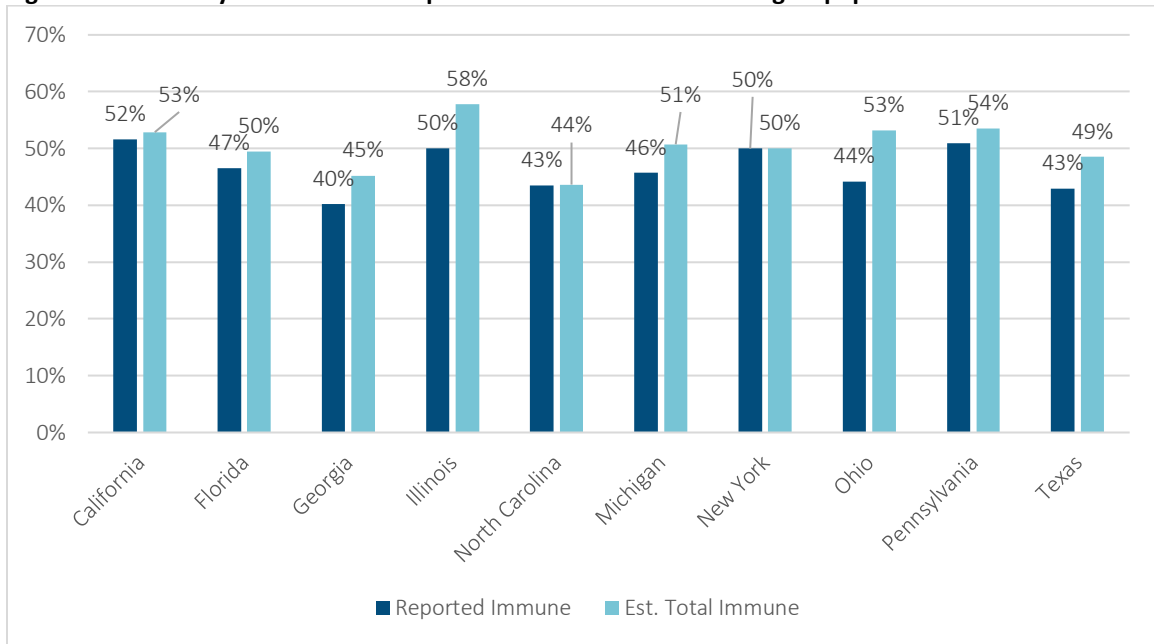
These calculations are estimates based upon average reported efficacy of the vaccines and an assumption that people with immunity would face an average level of exposure to COVID infection. In addition, no adjustments were made to these figures to reflect the exact timing of the onset of immunity from vaccinations which varies by type of vaccine or the fact that some recovered immune people are getting vaccinated.

In addition, these calculations are based upon Reported Infections. Because COVID infections result in a very wide range of individual responses from largely symptom free to severe respiratory distress leading to hospitalization and death, there are thought to be many cases that go unreported. The CDC conducts a study of the seroprevalence of COVID antibodies in blood drawn for a variety of medical tests by commercial labs⁵. Results from that study show that unreported infections may be as high as 105% of the reported infections. If that were true, the Total Immune level estimated above could be as much as 5% higher than the above estimate including an adjustment for vaccinated recovered immune people.

⁴ New Infection Rate is defined as the number of new infections for a day divided by the sum of the new infections for the prior 14 days. In this case, the average for the daily New Infection Rate over the entire month is used. Note that a New Infection Rate below 7.14% the number of active infections will shrink and above 7.14% active infections will grow.

⁵ This study can be found at https://covid.cdc.gov/covid-data-tracker/?CDC_AA_refVal=https%3A%2F%2Fwww.cdc.gov%2Fcoronavirus%2F2019-ncov%2Fcases-updates%2Fcommercial-labs-interactive-serology-dashboard.html#national-lab

Figure 10. Immunity levels at end of April 2021 for Ten states with largest populations



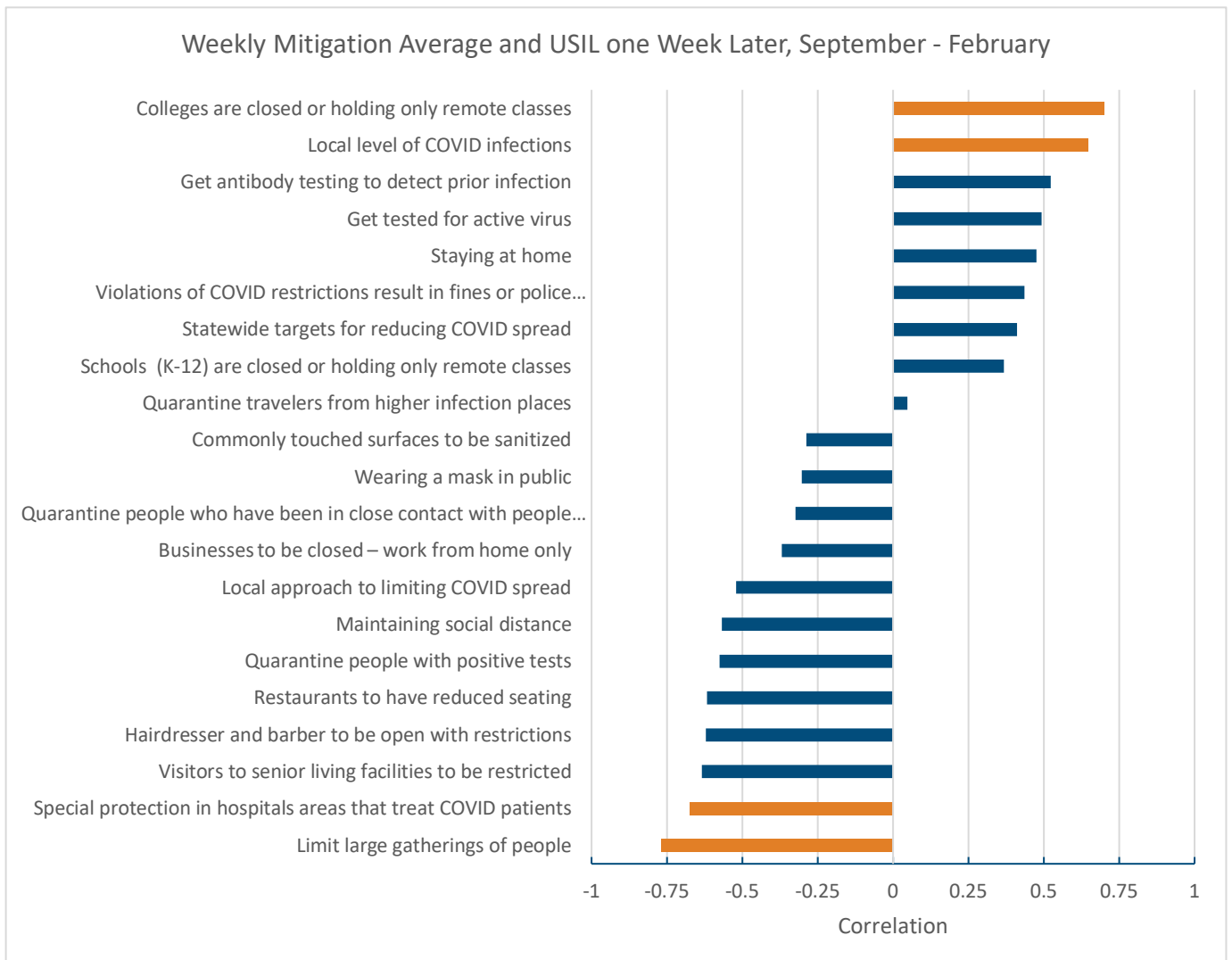
Looking again at the top ten states, there is a range of reported immunities from 43% in Texas and North Carolina to 52% for California. Including estimated unreported infections the high is 58% for Illinois and the low is 44% for North Carolina.

Correlations between Mitigations and Infection Levels

Throughout the course of the pandemic, communities across the country and world have engaged in a near infinite combination of mitigation methods. The multitude of unique combinations of mitigations, both mandated and truly occurring on the ground make it very difficult to assess the effectiveness of individual mitigations or combinations. No communities live in total isolation from others, and the few countries such as New Zealand which have been able to put in place and rigorously enforce their own combination of mitigation methods show that in isolation it is possible to manage the spread of COVID-19 very effectively through mitigation methods.

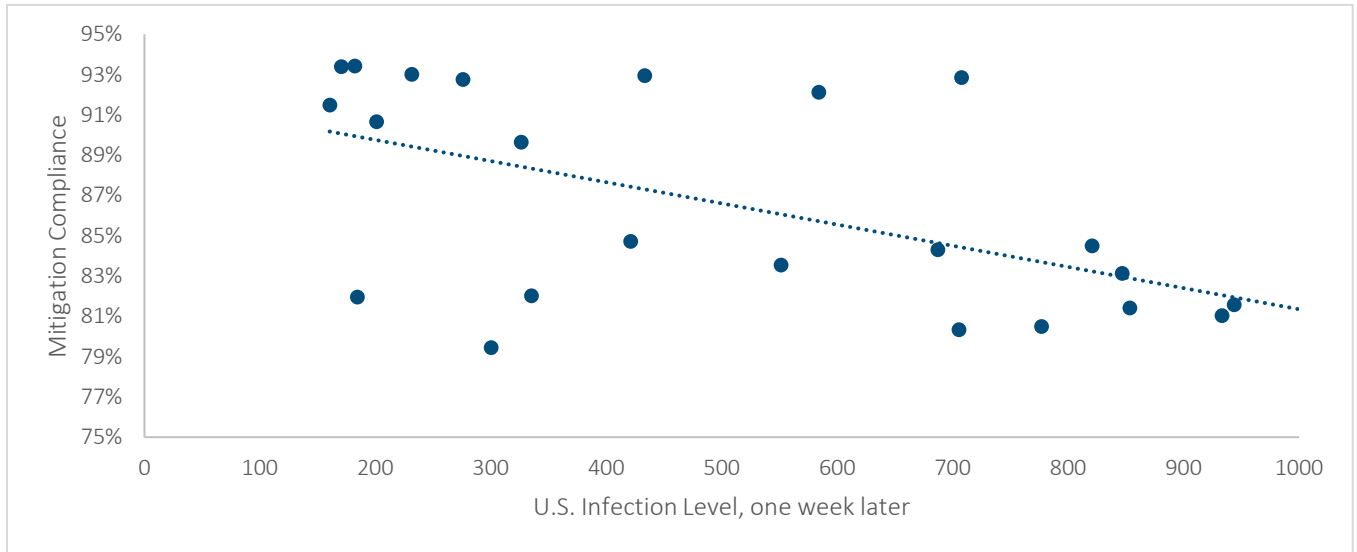
However, the fragmented and federalist nature of COVID-19 response in the United States has meant that we have not had the ability to create isolated areas of COVID-19 mitigations in the lower 48 states. One state’s mitigation methods and existing infected population has a large effect on its neighbors. Despite this inherent complexity, we are able to identify some very interesting correlations between mitigation practices and the U.S. Infection Level. In the following pages we will discuss the two highest and two lowest correlated mitigation methods and what insights we might draw from those correlations.

Figure 11. Correlation between Mitigations and U.S. Infection Level



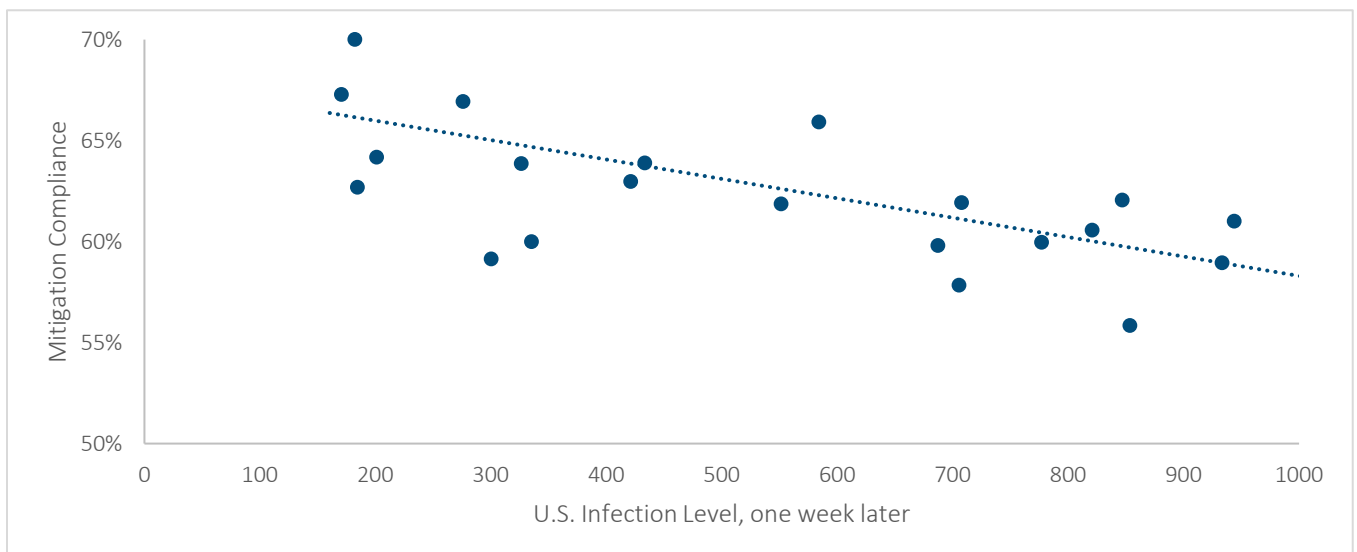
The two mitigations with the most negative correlation to the U.S. Infection Level show us that there are things that we can do collectively that are both logically related to the spread of COVID and accomplishable. The most negatively correlated mitigation method was Limiting Large Gatherings of People. This makes total sense with what we know about how the virus spreads. When someone is infected but before they are showing symptoms, they are able to spread the virus to people around them. If we limit the number of large gatherings of people, we should expect each infection vector to decrease commensurately, and we do.

Figure 12. Weekly Special protection in hospitals areas that treat COVID patients and U.S. Infection Level one week later



The second most negatively correlated mitigation method is Special protections in hospitals in areas that treat COVID-19 patients.

Figure 13. Weekly Special protection in hospitals areas that treat COVID patients and U.S. Infection Level one week later



Looking at the impact of higher compliance at the state level, and isolating the infection level for the five states with the highest compliance for the mitigations with over 50% negative correlation to the five states with the lowest compliance, there is a persistent difference. (Figure 9 below)

Figure 14. Five States with High Compliance Compared to Five States with Low Compliance

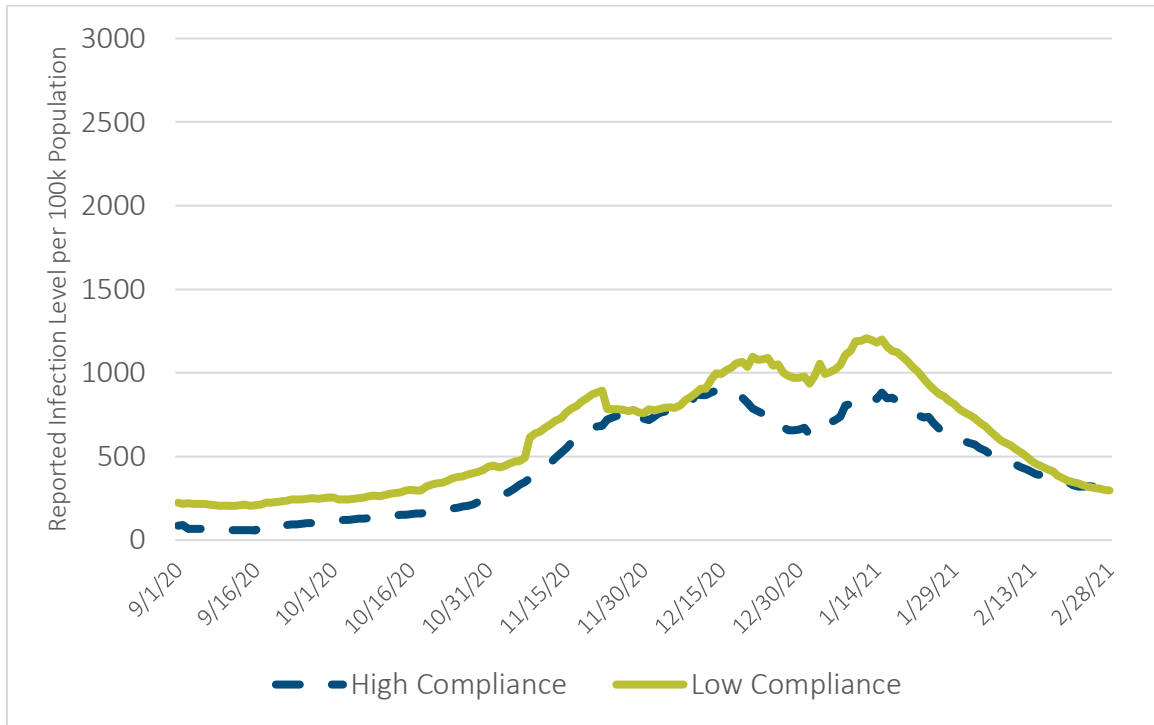
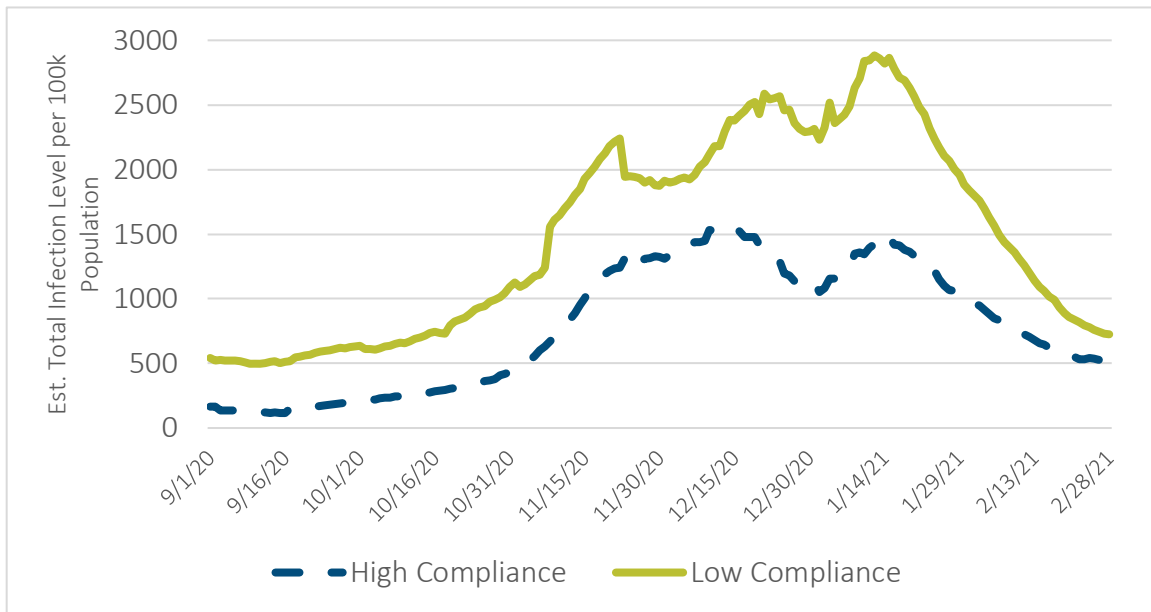


Figure 14 shows a small difference in infection level over the six months. But there is a large difference between the estimated unreported COVID cases in high compliance states (on average unreported cases are 68% of reported cases) compared to the low compliance states (on average unreported cases are 143% of reported cases). When the unreported cases are included, a more stark difference emerges.

Figure 15. Five States with High Compliance Compared to Five States with Low Compliance with Adj for Underreporting



Extending this analysis through April shows the two lines crossing (Figure 16), meaning that the Infection Level in the Low Compliance group of states is lower than the Infection Level in the High Compliance group.

Figure 16. Five States with High Compliance Compared to Five States with Low Compliance

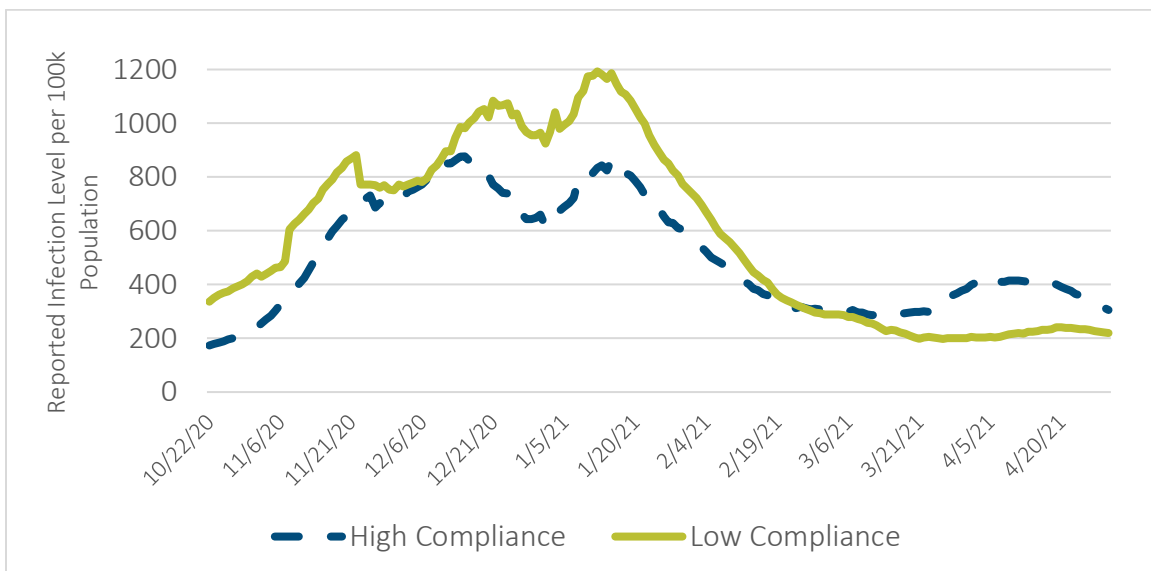
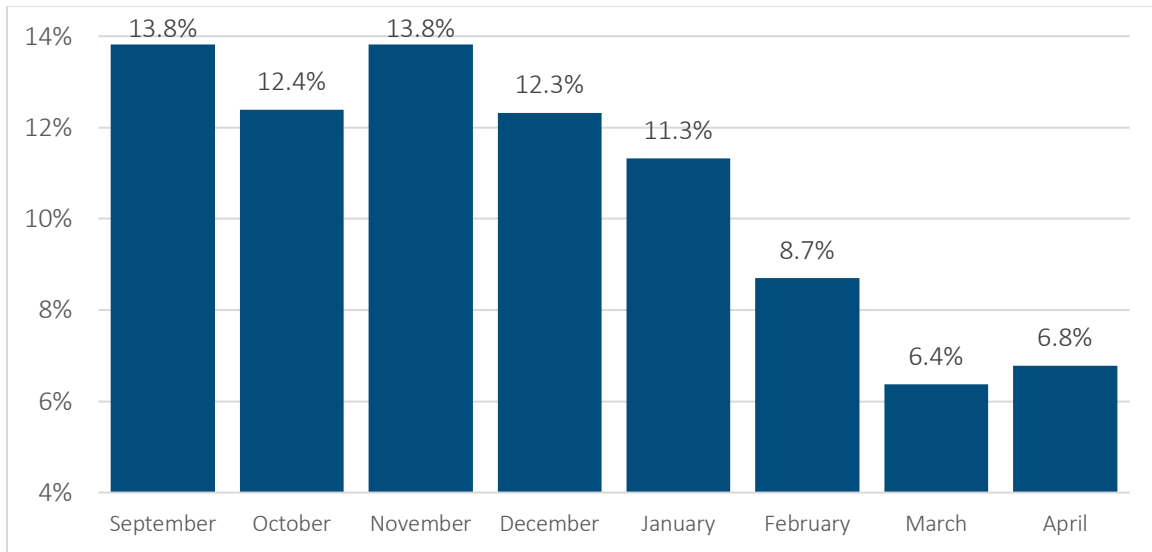


Figure 16 uses the same two sets of five states that were used for Figures 14 and 15. They were chosen based upon their average compliance over the September to February time period. However, when we look at March and April, the difference in compliance decreases sharply.

Figure 17. Difference in Average Compliance between High and Low Compliance Groups of States



This then shows that there is a strong relationship between compliance with these mitigations and infection levels in March and April as well and in addition, that the crowdsourcing survey method of gathering the mitigation information is sensitive to changes in mitigation levels in both states that were in the past both higher and lower compliance.

Acknowledgments

The researchers' gratitude goes to those without whose efforts this project could not have come to fruition: the Project Working Group and others for their diligent work overseeing questionnaire development, analyzing and discussing respondent answers, and reviewing and editing this report for accuracy and relevance.

Project Working Group members:

Max Rudolph, FSA, CFA, CERA
Kailan Shang, FSA, CFA, PRM, SCJP
Robert Wolf, FCAS, CERA
John Stark, FSA, CERA

At the Society of Actuaries:

R. Dale Hall, FSA, MAAA, CFA, CERA

Note on Mitigation Compliance Observations

The COVID mitigation information is collected via a SurveyMonkey survey. In that survey, observers are asked to say what they are seeing in their community regarding the percentage compliance with 21 specific mitigation activities. The observers are volunteers who were either recruited personally by the project team or who responded to a variety of solicitations for observers via Twitter, Facebook, LinkedIn, and SurveyMonkey. This data is subject to self-selection and other biases. No adjustments have been made to the data that we have collected in order to respond to possible biases. Responses are aggregated and the average of multiple views are treated as true information about the mitigation activity in a state. The variance of the responses in a state has been examined and targets are set for a higher number of responses in states where there is a higher variance of responses.

Appendix List of Mitigations under Study

- Wearing a mask in public
- Maintaining social distance
- Staying at home
- Restaurants to have reduced seating
- Businesses to be closed – work from home only
- Hairdresser and barber to be open with restrictions
- Visitors to senior living facilities to be restricted
- Commonly touched surfaces to be sanitized
- Special protection in hospitals areas that treat COVID patients
- Get tested for active virus
- Get antibody testing to detect prior infection
- Quarantine people who have been in close contact with people with positive tests
- Quarantine people with positive tests
- Quarantine travelers from higher infection places
- Limit large gatherings of people
- Local level of COVID infections
- Statewide targets for reducing COVID spread
- Local approach to limiting COVID spread
- Colleges are closed or holding only remote classes
- Schools (K-12) are closed or holding only remote classes
- Violations of COVID restrictions result in fines or police enforcement

About The Society of Actuaries

With roots dating back to 1889, the [Society of Actuaries](#) (SOA) is the world's largest actuarial professional organization with more than 31,000 members. Through research and education, the SOA's mission is to advance actuarial knowledge and to enhance the ability of actuaries to provide expert advice and relevant solutions for financial, business and societal challenges. The SOA's vision is for actuaries to be the leading professionals in the measurement and management of risk.

The SOA supports actuaries and advances knowledge through research and education. As part of its work, the SOA seeks to inform public policy development and public understanding through research. The SOA aspires to be a trusted source of objective, data-driven research and analysis with an actuarial perspective for its members, industry, policymakers and the public. This distinct perspective comes from the SOA as an association of actuaries, who have a rigorous formal education and direct experience as practitioners as they perform applied research. The SOA also welcomes the opportunity to partner with other organizations in our work where appropriate.

The SOA has a history of working with public policymakers and regulators in developing historical experience studies and projection techniques as well as individual reports on health care, retirement and other topics. The SOA's research is intended to aid the work of policymakers and regulators and follow certain core principles:

Objectivity: The SOA's research informs and provides analysis that can be relied upon by other individuals or organizations involved in public policy discussions. The SOA does not take advocacy positions or lobby specific policy proposals.

Quality: The SOA aspires to the highest ethical and quality standards in all of its research and analysis. Our research process is overseen by experienced actuaries and nonactuaries from a range of industry sectors and organizations. A rigorous peer-review process ensures the quality and integrity of our work.

Relevance: The SOA provides timely research on public policy issues. Our research advances actuarial knowledge while providing critical insights on key policy issues, and thereby provides value to stakeholders and decision makers.

Quantification: The SOA leverages the diverse skill sets of actuaries to provide research and findings that are driven by the best available data and methods. Actuaries use detailed modeling to analyze financial risk and provide distinct insight and quantification. Further, actuarial standards require transparency and the disclosure of the assumptions and analytic approach underlying the work.

Society of Actuaries
475 N. Martingale Road, Suite 600
Schaumburg, Illinois 60173
www.SOA.org