# COVID-19 VACCINATION RATES DECLINE IN THE US:

## Strategies to improve

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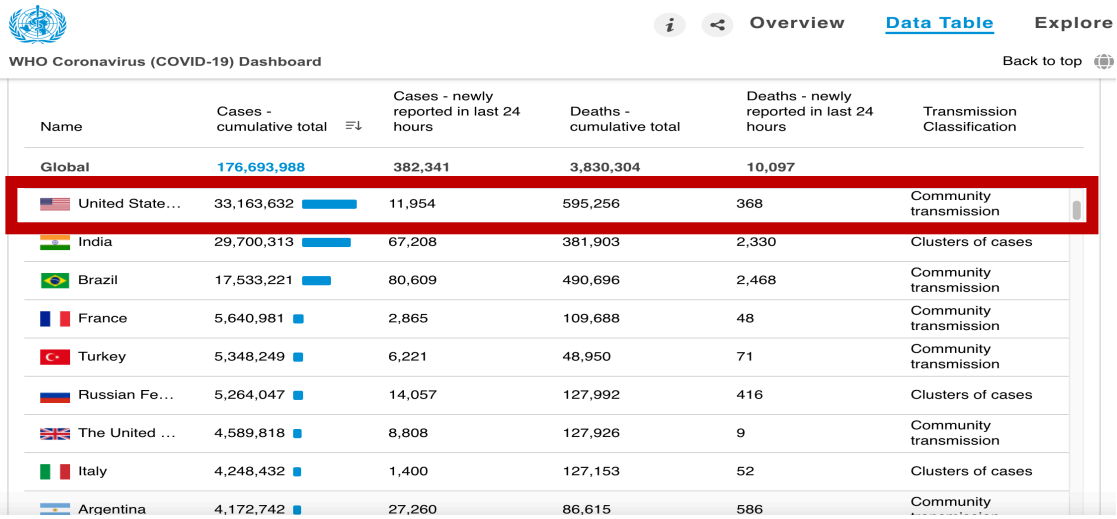
## Goal

The world is facing one of its greatest challenges in the recent history. The whole world is suffering from the brutality of COVID-19, which was first originated in Wuhan, China in 2019. The first case of COVID-19 in the US was reported in January 2020. Once, it was declared a pandemic, the world had one hope of fighting this disease, and it was an effective Vaccine. Now the US has at least 3 vaccines available and the roll out is quick the US is facing another challenge, that the vaccination rates are slowing down. Therefore, one of the biggest, or the biggest goal, of the Unites States (U.S.) government is to vaccinate all Americans for COVID-19. Towards that effort the U.S. aims to vaccinate 70% of the Americans by July 4$^{th}$ with at least one dose. However, the vaccination rates, for last seven-day average, has fallen below 1 million per day, which is down from 3.4 million per day during mid-April. With this reduced rate of vaccination U.S. is unlikely to achieve its goal to vaccinate 70% of the Americans by July 4$^{th}$. The biggest challenge/question the U.S. faces is how to increase the vaccination rate for COVID-19. Therefore, this report would analyze the question that **what strategy should the U.S. adopt to increase the vaccination rates?**

## The Problem


## Strategic Goals

The U.S. has various strategic interest in this mass vaccination program as described under. Presently the US is ranking number one in the world in total number of infections and the number of deaths. Therefore, the US has three major strategic goals.



Overview Data Table Explore

WHO Coronavirus (COVID-19) Dashboard

Back to top

| Name | Cases - cumulative total | Cases - newly reported in last 24 hours | Deaths - cumulative total | Deaths - newly reported in last 24 hours | Transmission Classification |
|---|---|---|---|---|---|
| Global | 176,693,988 | 382,341 | 3,830,304 | 10,097 | |
| United State… | 33,163,632 | 11,954 | 595,256 | 368 | Community transmission |
| India | 29,700,313 | 67,208 | 381,903 | 2,330 | Clusters of cases |
| Brazil | 17,533,221 | 80,609 | 490,696 | 2,468 | Community transmission |
| France | 5,640,981 | 2,865 | 109,688 | 48 | Community transmission |
| Turkey | 5,348,249 | 6,221 | 48,950 | 71 | Community transmission |
| Russian Fe… | 5,264,047 | 14,057 | 127,992 | 416 | Clusters of cases |
| The United … | 4,589,818 | 8,808 | 127,926 | 9 | Community transmission |
| Italy | 4,248,432 | 1,400 | 127,153 | 52 | Clusters of cases |
| Argentina | 4,172,742 | 27,260 | 86,615 | 586 | Community |

**2.1 Healthcare & Economic Burden**: Increased infection rate has led to an increased stress on the healthcare infrastructure of the nation. The availability of healthcare resources was lesser than the number of people requiring care. In addition, not everyone was able to access the best healthcare due to shortage in critical medicine and support equipment such as ventilators. Increased vaccination would reduce the number of infections, which in turn will provide access to the healthcare infrastructure for the ones in critical need. This would also increase the overall health and wellness of the nation.

**2.3 Quality of Life:** The pandemic has limited the social interaction between people, which has increased crime and other health issues. It has also led to job loss and an overall decline in the economy which has affected the quality of life of the people. Therefore, a mass vaccination program to better the quality of life of the U.S. citizens is a major goal of the government.

**2.4 Global Leadership:** The U.S. has been questioned on its strategy to handle the pandemic and some Americans would have lost trust in the government. According to past report the US was one of the worst countries in handling the pandemic. Vaccination is an opportunity for the U.S. to become a global leader by first gaining trust of its own citizens and then providing a model to the world of a successful strategy.

## Alternatives

After a thorough research, the following alternatives, or strategies, were identified which the US could adopt to increase the vaccination rates in the U.S.

**3.1 Incentives:** Various states, such as Ohio, have implemented to give certain financial incentives for people getting vaccinated. Similarly, various other states are giving some or the other incentive such as free Beer to those who come for vaccination. However, is it a good strategy in long-run? Would it impact the booster doses, would it make the early vaccine takers feel left out? Incentives in the form of financial support or other could be an encouragement to increase vaccination to some extent.

**3.2 Mandating:** This is essentially forcing people to take vaccination by mandating in the workplace, schools, colleges etc. Recently, various employers and Universities have mandated it to have vaccination to be able to return to work or to the college. This has created mixed feelings among the people. For some, it was good move to increase vaccination and to others it is a breach in their freedom of choice. It could be a good alternative as it has been adopted by certain institutions, but it could backfire too in a long run.

**3.3 Outreach:** There a certain group of individuals for whom the positives and negatives of the vaccination aren't clear. The information on vaccination has become more confusing due to some ambiguity in statements by the scientific/political leaders and the unclarity in the data. Therefore, it becomes important that public to have access to the correct data with clarity and not hand waving. Whatever is known so far about the vaccine and the COVID-19 should be transmitted to the public with clarity, transparency and truthfulness. Therefore, a robust outreach program to educate people and answer their questions, honestly, is a good alternative, which could create an intrinsic drive-in people to get vaccinated. This strategy would require the collaboration of various government and private agencies to reach out to public. Also, under this program a research could be done that how other countries have performed their outreach programs to learn the positives from other countries. In addition, vaccination could also be promoted as a social norm to encourage people to get vaccinated.

## The BOCR Model

1. **Benefits (B)**

Three control criteria are defined under benefits considering the most likely short-term benefits if the vaccination program is successful. Each has its alternatives. Such as, the Health Benefits can be incurred via positive approach and encouragement, clear communication and improved access to vaccination.

| ***Control Criteria*** | **B.1 Health** | **B.1 Social** | **B.2 Financial** |
|---|---|---|---|
| ***Alt*** | comorbidity | Mask | Business |
| ***Alt*** | Infection Rate | Crime rate | Employment |
| ***Alt*** | Mortality | Activities | Savings |
| ***Alt*** | Herd effect | | Labor supply |

**Definition of selected alternates under Benefits:**

*Health – Herd effect*

Herd effect is considered as one of the alternates under health benefits because heard effect would slower the infection rates and that's one of the objective of a mass vaccination program.

*Financial - Labor Supply*

A lot of business are facing short supply of labor due to increased infection rates. Which is causing financial losses. Therefore, a mass vaccination program would have financial benefits by getting back the labor supply needed for the businesses.

## 2. Opportunities (O)

The opportunities presented here are long term benefits of a successful vaccination program. In long term the U.S. would have two major wins in a increase in Economy by creating new jobs, investment and increased tourism. And Strategical Opportunity would come from an edge in Geopolitics, domestic political party gains and an increased Research funding to deal with such future infections.

| ***Control Criteria*** | **O.1 Financial** | **O.2 Strategic** | **O.3 Intangible** |
|---|---|---|---|
| ***Alt*** | GDP | Political | Caregiver burden |
| ***Alt*** | Investment | Research | Ageing quality |
| ***Alt*** | Tourism | Education | Cognitive |
| ***Alt*** | | | |

**Definition of selected alternates under Opportunities:**

*Intangible – Caregiver burden*

As more people get infected and sick the demand for caregiver would rise, while the available caregivers would go low therefore, a vaccination program provides an opportunity to level the caregiver burden.

*Intangible – Ageing quality*

All of us would like to age with good quality of life which would include access to regular checkups, availability of resources, and easy access. With increased infection rate the overall quality of ageing has decreased therefore, a vaccination program could provide an opportunity to better the ageing quality.

## 3. Costs (C)

Here we are looking at the factors which would help us decern in our model that which of the alternate strategy is more cost effective than the other. The Health Cost could be either a third wave, an increased mortality in non-vaccinated, and associated mental health problems due to COVID restrictions. Similarly, the Social costs could be either increased fear and crime in the society. Increased Hatred towards certain communities and also the dispersion of misinformation. Financial Cost would result in the form of loss of businesses or increased unemployment.

| ***Control Criteria*** | **C.1 Health** | **C.2 Social** | **B.3 Financial** |
|---|---|---|---|
| ***Alt*** | Third wave | Fear | Business |
| ***Alt*** | Mortality | Crime | Unemployment |
| ***Alt*** | Hospital access | Hatred | Savings |
| | | Education | |

4. **Risks (R)**

In the long run there are various risks associated with a slow vaccination program. Here we will analyze the factors which would help in our model to determine which alternate strategies are riskier in long term. One of the risk is would be the slower delivery of a booster dose leading to an increased risk of another outbreak (Pandemic 2) due to Variants, healthcare shortage and an economic fall. The CDC has already warned that the new variant could become dominant in the US, and it could hurt the low vaccinated communities harder. This could lead to Security Risks due to protests and domestic instability. Political risks could be due to the loss of elections, distrust towards a party and the financial incentives given now to get ta jab could backfire in long term because the early vaccine takers could feel cheated and would be reluctant to get a booster dose.

| ***Control Criteria*** | **R.1 Health** | **R.2 Social** | **R.3 Financial** |
|---|---|---|---|
| ***Alt*** | Variants | Protests | GDP |
| ***Alt*** | Treatment | Productivity | Investments |
| ***Alt*** | Infant mortality | Education | Labor |
| ***Alt*** | Fertility | | |

## Results of the BOCR model

Below are the priorities of the BOCR model. The Health and Opportunities are ranked bit higher than Cost and Risks.

| Alternatives | Priorities | Totals | 1.Health&Econom... (0.4742) | 2.QualityOfLife (0.1494) | 3.GlobalLeadership (0.3764) |
|---|---|---|---|---|---|
| 1.Benefits | 0.3929 | 1.0000 | Posiive | Excellent | Good |
| 2.Opportunities | 0.3929 | 1.0000 | Posiive | Excellent | Good |
| 3.Costs | 0.1103 | 0.2808 | Neutral | Moderate | Average |
| 4.Risks | 0.1038 | 0.2642 | Negative | Good | Average |

## Benefits Subnet

**Benefits**

**Health** **52.8%**

| Name | Ideals | Normals | Raw |
|---|---|---|---|
| A1_Incentives | 0.196 | 0.126 | 0.063 |
| A2_Mandating | 0.358 | 0.231 | 0.115 |
| A3_Outreach | 1.000 | 0.643 | 0.322 |

**Social** **14%**

| Name | Ideals | Normals | Raw |
|---|---|---|---|
| A1_Incentives | 0.465 | 0.222 | 0.111 |
| A2_Mandating | 0.625 | 0.299 | 0.150 |
| A3_Outreach | 1.000 | 0.478 | 0.239 |

**Financial** **33%**

| Name | Ideals | Normals | Raw |
|---|---|---|---|
| A1_Incentives | 1.000 | 0.381 | 0.191 |
| A2_Mandating | 0.703 | 0.268 | 0.134 |
| A3_Outreach | 0.919 | 0.351 | 0.175 |

**Control Criteria Priorities**

| Name | Normalized | Idealized |
|---|---|---|
| Health | 53% | 1.000 |
| Social | 14% | 0.265 |
| Financial | 33% | 0.630 |

**Overall**

| Name | Ideals | Normals | Raw |
|---|---|---|---|
| A1_Incentives | 0.515 | 0.252404 | 0.501 |
| A2_Mandating | 0.524 | 0.257112 | 0.510 |
| A3_Outreach | 1 | 0.490484 | 0.973 |

Under benefits, the model suggests that Outreach has the highest social and health benefits, while the alternate Incentives has higher financial benefits. Overall, an outreach program would have the highest benefits to increase the vaccination rate in the US.

## Opportunities Subnet

| Opportunities | | | |
|---|---|---|---|
| **Financial** | **45.8%** | | |
| **Name** | **Ideals** | **Normals** | **Raw** |
| **A1_Incentives** | 0.982 | 0.445 | 0.222 |
| **A2_Mandating** | 0.225 | 0.102 | 0.051 |
| **A3_Outreach** | 1.000 | 0.453 | 0.227 |

| **Strategic** | **41.6%** | | |
|---|---|---|---|
| **Name** | **Ideals** | **Normals** | **Raw** |
| A1_Incentives | 0.503 | 0.265 | 0.133 |
| A2_Mandating | 0.395 | 0.208 | 0.104 |
| A3_Outreach | 1.000 | 0.527 | 0.263 |

| **Intangible** | **12.6%** | | |
|---|---|---|---|
| **Name** | **Ideals** | **Normals** | **Raw** |
| A1_Incentives | 0.321655 | 0.178908 | 0.089454 |
| A2_Mandating | 0.476226 | 0.264882 | 0.132441 |
| A3_Outreach | 1 | 0.55621 | 0.278105 |

| **Control Criteria Priorities** | | |
|---|---|---|
| **Name** | **Normalized** | **Idealized** |
| **1.Financial** | **46%** | **1** |
| 2.Strategic | 42% | 0.9085603 |
| 3.Intangible | 13% | 0.2751606 |

| **Overall** | | | |
|---|---|---|---|
| **Name** | **Ideals** | **Normals** | **Raw** |
| A1_Incentives | 0.699 | 0.345066 | 0.699 |
| A2_Mandating | 0.327 | 0.161545 | 0.327 |
| A3_Outreach | 1.000 | 0.493389 | 1.000 |

In a long-term assessment of benefits/opportunities, the model suggests that an Outreach strategy has highest financial, strategic as well intangible benefits compared to the other

alternatives namely Incentives and Mandating. Overall, the model recommends that an Outreach program would be the most effective strategy to increase the vaccination program in the US.

## Costs subnet

| Costs | | | |
|---|---|---|---|
| **Health** | **44%** | | |
| **Name** | **Ideals** | **Normals** | **Raw** |
| A1_Incentives | 0.746 | 0.361 | 0.180 |
| A2_Mandating | 0.322 | 0.156 | 0.078 |
| A3_Outreach | 1.000 | 0.483 | 0.242 |
| **Social** | **39%** | | |
| **Name** | **Ideals** | **Normals** | **Raw** |
| A1_Incentives | 0.496 | 0.296 | 0.148 |
| A2_Mandating | 0.177 | 0.106 | 0.053 |
| A3_Outreach | 1 | 0.598 | 0.298966 |
| **Financial** | **17%** | | |
| **Name** | **Ideals** | **Normals** | **Raw** |
| A1_Incentives | 0.561 | 0.301 | 0.151 |
| A2_Mandating | 0.302 | 0.162 | 0.081 |
| A3_Outreach | 1.000 | 0.537 | 0.268 |

| Control criteria | | |
|---|---|---|
| **Name** | **Normalized** | **Idealized** |
| 1.Health | 0.443429114 | 1 |
| 2.Social | 0.387371012 | 0.87358046 |
| 3.Financial | 0.169199874 | 0.38157141 |

| Overall | | | |
|---|---|---|---|
| **Name** | **Ideals** | **Normals** | **Raw** |
| **A1_Incentives** | 0.618 | **0.329** | 0.618 |
| **A2_Mandating** | 0.262 | **0.140** | 0.262 |
| **A3_Outreach** | 1.000 | **0.532** | 1.000 |

The models suggest that while and Outreach strategy out competes the other two alternates in short term and long-term benefits, but it is also having the highest health, social and financial

cost associated with it. Making this alternate as the costliest. Let's analyze, that why Outreach came out as the costlier and what could be implications. If we look at the control criteria under Costs (health, social and financial) and the associated alternatives, we will realize that the pandemic is time sensitive situation. Any delays in response to COVID-19 pandemic could lead to consequences, which we have already observed last year. Currently, the government has not implemented an outreach program at full scale therefore, it is likely that there is a time investment factor associated with outreach, including but not limited to; 1) finalizing a plan/proposal for a comprehensive outreach program, 2) allocating dedicated funding, 3) final implementation on the ground.

On the other hand, the Incentives and Mandating are less costly than outreach because such measures could be implemented at a rapid pace and hence the model suggests that incentives and mandating are less costly.

Considering the above, why did we rate Costs with low to moderate rating in our ratings model? Because the incentives and mandating has already been ongoing but didn't really increase the vaccination rates as it was expected to do therefore, an outreach program is an alternate which could boost the vaccination rates effectively. Hence, looking at the overall scenario, in the ratings model the Costs are rated as low to moderate.

## Risks Subnet

| **Risks** | | | |
|---|---|---|---|
| **Health** | **53%** | | |
| **Name** | **Ideals** | **Normals** | **Raw** |
| A1_Incentives | 0.957 | 0.407 | 0.204 |
| A2_Mandating | 0.394 | 0.167 | 0.084 |
| A3_Outreach | 1.000 | 0.425 | 0.213 |
| **Social** | **33%** | | |
| **Name** | **Ideals** | **Normals** | **Raw** |
| A1_Incentives | 0.693 | 0.342 | 0.171 |
| A2_Mandating | 1.000 | 0.493 | 0.247 |
| A3_Outreach | 0.335 | 0.165 | 0.083 |
| **Financial** | **14%** | | |
| **Name** | **Ideals** | **Normals** | **Raw** |
| A1_Incentives | 0.642 | 0.257 | 0.129 |
| A2_Mandating | 1.000 | 0.401 | 0.200 |
| A3_Outreach | 0.855 | 0.342 | 0.171 |

| Control criteria | | |
|---|---|---|
| **Name** | **Normalized** | **Idealized** |
| 1.Health | 53% | 1 |
| 2.Social | 33% | 0.62996052 |
| 3.Financial | 14% | 0.26456684 |

| **Name** | Ideals | **Normals** | **Raw** |
|---|---|---|---|
| A1_Incentives | 1.000 | 0.365 | 0.82537 |
| A2_Mandating | 0.824 | 0.300 | 0.679989 |
| A3_Outreach | 0.919 | 0.335 | 0.758531 |

According to our model, overall, incentives is the riskiest strategy of all. But why would it be the most risky or costly in long-term? Because, if we look at carrot and stick ways of motivation, where incentives being carrot and mandating is stick, these are external stimuli. While the external stimulus works well for certain situations, but a Pandemic is a situation where a collective conscious is needed, we need to come together to fight COVID-19. Therefore, in a long-term incentives could be risky. If we look at the values (Ideals and Normals), we would realize that all three alternates are more or less equally risky, this is because there are still many unknowns associated with this disease; we are still not sure on the overall effectiveness of the Vaccines against variants and in different populations; the data on the long term side effects of vaccines is still not available, especially for the mRNA based Vaccines (as these are developed on a new platform). Hence, in terms of risks all three alternatives rank close to each other.

## Overall Model

| | Benefits | Opportunities | Costs | Risks |
|---|---|---|---|---|
| **A1_Incentives** | 0.252404 | 0.345 | 0.329 | 0.365 |
| **A2_Mandating** | 0.257112 | 0.162 | 0.140 | 0.300 |
| **A3_Outreach** | 0.490484 | 0.493 | 0.532 | 0.335 |

| **Strategic Criteria** | | | |
|---|---|---|---|
| **Inconsistency** | **0.05156** | | |
| **Name** | **Normalized** | **Idealized** | **Rank** |
| **1.Health&Economic Burden** | 0.474 | 1.000 | 1 |
| **2.QualityOfLife** | 0.149 | 0.315 | 3 |

| | | | |
|---|---|---|---|
| **3.GlobalLeadership** | 0.376 | 0.794 | 2 |

In the overall model output, Outreach has the highest short-term and long-term benefits but is the costliest of another alternative. Incentives came out as the Riskiest of all other alternative.

The model also suggests that of the three strategic goals, Health & Economic Burden is the first priority, Global Leadership is second while Quality of Life is third.

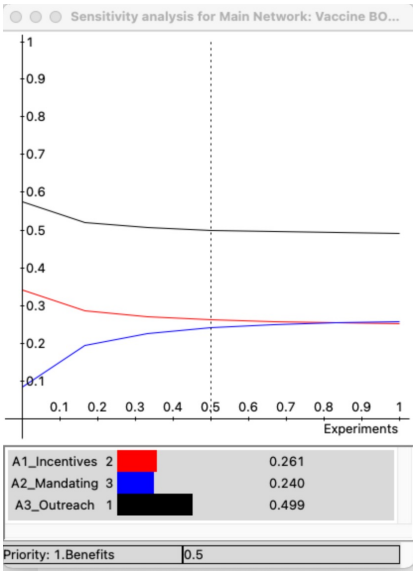
## Long-term *vs* Short-term analysis

| **Additive - Long Term** | | | |
|---|---|---|---|
| **Name** | **Ideals** | **Normals** | **Raw** |
| **A1_Incentives** | 0.542005 | 28% | 0.317755 |
| **A2_Mandating** | 0.391557 | 20% | 0.229554 |
| **A3_Outreach** | 1 | 52% | 0.586259 |
| | | | |
| **Multiplicative - Short Term** | | | |
| **Name** | **Ideals** | **Normals** | **Raw** |
| **A1_Incentives** | 0.535441 | 24% | 0.68696 |
| **A2_Mandating** | 0.729404 | 32% | 0.93581 |
| **A3_Outreach** | 1 | 44% | 1.282979 |

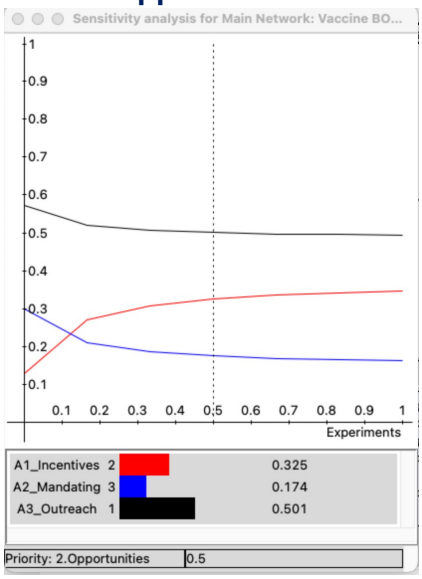
The BOCR model predicts that both in long-term and short-term the Outreach strategy would be the most useful compared to the other two alternatives.

## Sensitivity Analysis

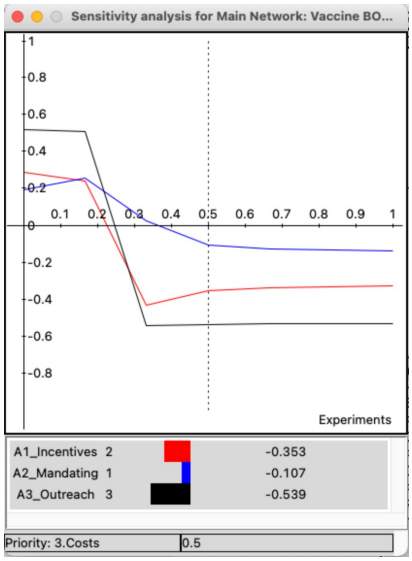
## Benefits



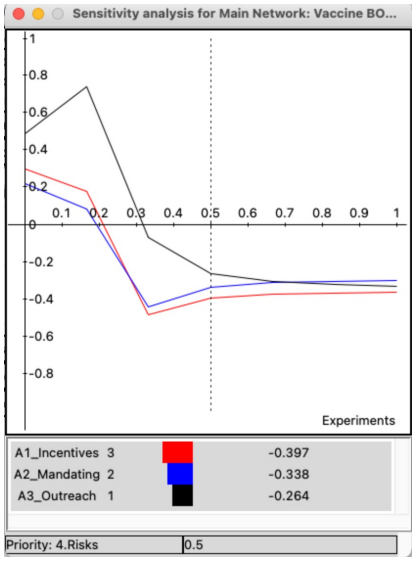

## Opportunities




## Costs




## Risks




The sensitivity analysis for benefits shows that outreach remains the top choice while the incentives and mandates could come close or may swap positions if weight is increased.

The sensitivity analysis for opportunities shows that outreach remains the top choice irrespective of the weightage. But if the weight is decreased close to 0.1 than the incentives and mandating could swap positions.

The sensitivity analysis for Costs suggests that all three alternatives would hold their position even if the weight is increased, with outreach being the costliest. But if the weight goes below 0.25 than outreach and incentives could swap positions.

The sensitivity analysis for Risks subnet suggests that incentives are the riskiest but would remain risky even if the weight is increased. But if the weight is decreased below 0.25 than it could swap places with the Mandating.

## Conclusion

The US vaccination rates are declining therefore, this report analyzes three alternate strategies (Incentives, Mandating, and Outreach) from the strategic perspective of the US government. The BOCR modeling was performed, using Super Decision software, to analyze each alternative against a number of criteria to find the best strategy. The BOCR model recommends that Outreach is the best strategy, both in short-term and long-term, for the US government to increase the rates of vaccination.