

Effects of Practicing Social Distancing on COVID-19 Infections and Deaths: A Retrospective Study

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Abstract

Background: The study aimed to investigate whether the implementation of social distancing as a mitigation strategy earlier as opposed to in late March would have made an impact on the number of COVID-19 cases and related mortality in the United States.

Methods: A Decision tree (Markov Modeling) was performed utilizing the Treeage Software®. The data, which was analyzed via Markov Modeling, was collected from Johns Hopkins Coronavirus Resource Center (CRC) and the CDC from February 1st through March 31st.

Results: The results showed that earlier use of social distancing would have saved lives, prevented infections, and restricted the exponential spread of infections later in the pandemic. Had social distancing been instituted on March 1st, 307,237 infections would have been prevented, and 9,130 lives would have been saved by March 31st. This study points to the missed opportunity of earlier initiation of the mitigation strategy of social distancing use, with March 1st being a critical breakpoint.

Conclusion: Analysis of the data concludes social distancing use must be strictly adhered to address the spread of infections and deaths due to Coronavirus. The findings of this study would be relevant for future research in formulating public health policy.

Keywords: Social distancing; COVID-19; Infections; Deaths.

Introduction

COVID-19, formerly known as 2019 novel coronavirus or 2019-nCoV, is a contagious respiratory virus, and as such, it is mainly transmitted through respiratory droplets when coughing or sneezing. It made its initial appearance in Wuhan, China back in

December of 2019. Since then, it has rapidly spread worldwide, taking the lives of over 433,000 people. As of June 2020, there are over 8.08 million reported cases [1]. France became the epicenter in March of 2020 and it aggressively started making its way to the

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Received Date: 12-30-2020

Published Date: 01-25-2021

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United States shortly after. It was only a matter of months before it went from an epidemic to a pandemic. According to the World Health Organization (WHO), there is no vaccine currently available, and the treatment is limited to supportive care. Common symptoms include fever, cough, shortness of breath, and fatigue. The best preventative measure recommended by WHO and the US Centers for Disease Control and Prevention (CDC) is social distancing and the use of face masks. By the end of March 2020, the United States became the new epicenter for COVID-19. To date, the United States has had 2,242,910 reported cases and 120,075 reported deaths [2]. Had we known about this virus earlier and taken precautionary measures early on, would the death toll still be over 118,000? If we had mandated the use of social distancing in mid-February or March, could we have prevented the loss of numerous lives? The purpose of this study is to investigate whether the implementation of mitigation measures, like wearing social distancing in the first week of February or mid-March, as opposed to in late March, would have made an impact on the number of COVID-19 cases and the rate of COVID-19-related mortality in the US.

According to the Center for Disease Control and Prevention (CDC), there were 8 active COVID-19 cases and zero deaths in the United States on February 1st, 2020. Within 62 days, the number of active cases and deaths surged exponentially to 818,662 and 38,325, respectively. The pace and magnitude of infections and deaths were unprecedented in recent history. The novel Coronavirus, which causes COVID-19 is thought to spread mainly from person to person, through respiratory droplets and

aerosols produced when an infected person coughs, sneezes, or talks [3]. This fact is amply demonstrated by the containment strategies of several countries.

The World Health Organization (WHO) declared Coronavirus as a pandemic on March 11th and the same day CDC recommended, not mandated, social distancing, as a preventive measure [4,5].

According to the CDC's website, there were 8 active COVID-19 cases and zero deaths in the United States on February 1, 2020. Within 58 days, the number of active cases and deaths surged exponentially. By March 30th, there were 163,539 positive cases in the United States, and the death toll rose to 4,073 deaths [3]. The United States was not prepared for this pandemic, despite the countless warning signs. On the contrary, several countries mandated the use of social distancing immediately. It was also recognized that societies who delayed implementing mitigation measures, such as social distancing experienced a longer time, as well as rapid spread of the virus compared to those who acted quicker. 2.4 days were added to the overall length of the epidemic for each day social distancing measures were delayed [6].

A study, aiming to study effects of non-pharmacological interventions (NPIs), such as social distancing and their timings on Covid-19 cases, suggested that if NPIs in China were implemented earlier, COVID-19 cases would have been reduced by 67%. On the other hand, had the NPIs been imposed, 1 week, 2 weeks, or 3 weeks later, the number of COVID cases would have been increased by 3 times, 7 times, and 18 times, respectively [7].

A delay of the implementation of NPIs was not the only factor contributing to the rapid spread of the virus and the alarming rate of new infections. After the first case was reported, residents and travelers in Wuhan continued to participate in large gatherings, neglecting the seriousness of the situation and rapid transmission of the virus. Such acts further spread the virus within Wuhan and nearby cities. Traveling also played a significant role in advancing transmission [8]. Just before the lockdown was implemented in Wuhan, it was reported 5 million individuals had traveled out of Wuhan, days after holding large family gatherings.

This indicated that traveling led to the spread of the virus across the world and exposing millions of individuals. In addition to unregulated and unessential traveling, studies also show exposed individuals who are carriers of the virus freely interacting with their communities further exacerbate transmission [9].

To contain SARS-CoV-2, asymptomatic carriers had to be targeted and quarantined, as they were putting individuals who they were coming in contact with at risk of contracting the virus. Researchers also claim a myriad of cases is due to the movement of carriers who are unaware of their infection. On average, approximately 59% Covid-19 positive patients were asymptomatic and unaware thus were socially active unintentionally spreading the virus. It was also concluded in the same study that 90% of the future infections were prevented after social distancing was mandated [10]. Another study in China reported 85% of cases presenting with no symptoms or mild symptoms [11]. Ultimately, both studies illustrate a strong argument for the

intervention of social distancing to curtail or slow the progression of the disease. Therefore, to avoid situations where individuals are unaware whether they are infected or not, it is optimal to circumvent large gatherings and continue practicing social distancing is proven the best strategy to combat COVID-19 [11].

Additional studies suggest implementation must occur promptly to receive the complete advantage of social distancing [12]. Furthermore, a plethora of studies found analogous findings useful in mitigating the impacts of social distancing. A recent article discovered mandatory imposition of social distancing precautions “reduced daily growth rate by 5.4 percentage points after 1–5 days, 6.8 after 6–10 days, 8.2 after 11–15 days, and 9.1 after 16–20 days.” The effectiveness of social distancing according to studies is promising. Many studies agree with requiring social distancing and mitigation precautions to be continued throughout the remainder of this year voluntarily to reach a secure coverage against the virus and avoid premature lighting of restrictions risking an earlier second peak [13].

To prove the efficacy and significance of social distancing, researchers have discovered the risk of contracting the virus is 13% while staying 3 feet away from infected individuals. While the risk falls to 3% when social distancing at an approximate 6 feet distance [14]. It was also recognized that countries delaying implementing mitigation measures, such as social distancing, experienced a more rapid spread of the virus, compared to those who acted quicker. 2.4 days were added to the overall length of the epidemic for each day

social distancing measures were delayed [15].

It is important to note the implications of social distancing are valuable in stabilizing the rate of new cases, primarily stabilizing the curve. Furthermore, studies found that it took approximately 12 days for social distancing measures to be evident considering and respecting the time to receive test results back, as well as 5-6 days of the incubation period. After the implementation of these measures, a reduction in daily new cases was observed along with the time for the rate of growth doubling from 2 to 4 days [16]. Thus, social distancing must be implemented as an early mitigation method. The literature suggests that social distancing aids in diminishing the rate of daily new infections to “flatten the curve”. To emphasize the influence of social distancing, on average, cases decline by 3.059 percent a day after mitigation measures are implemented [17].

Methods

Data from the Johns Hopkins Coronavirus Resource Center (CRC) and the CDC was utilized to collect the number of infections and deaths by every 15 days from February 1st- March 31st. [1] A systematic review published in The Lancet journal, sponsored and endorsed by WHO, indicated that face mask use can result in a large reduction in risk of infection by one-sixth [14]. This research utilized the findings of the above-mentioned study as a reference factor. The current research study assumed that social distancing usage reduces the number of infections and deaths by six times based on WHO recommendations. Treeage Software® was used to create a Markov Model decision tree.

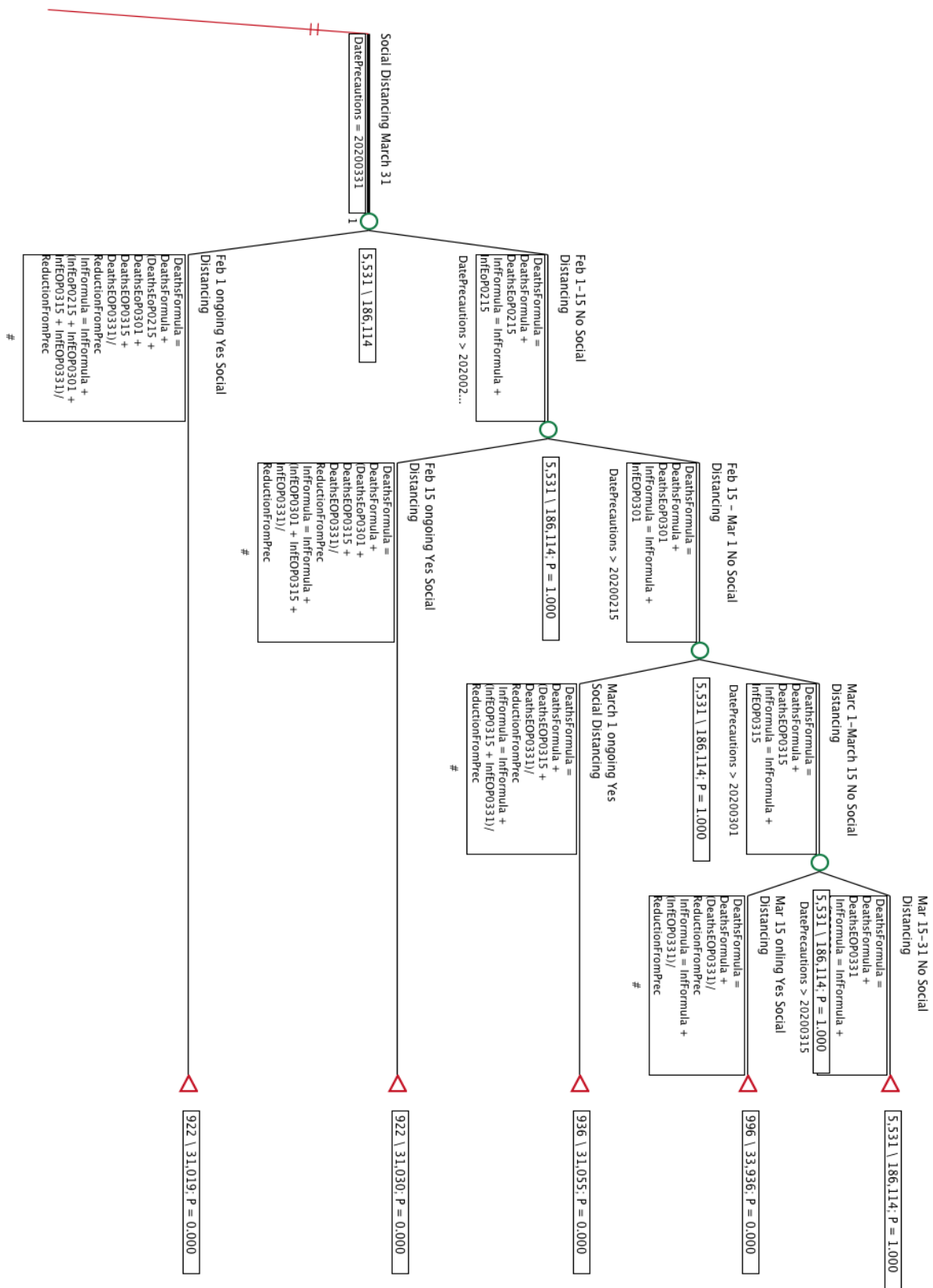
A decision tree model was formed using a hierarchy of branches of the flowchart-like tree structure, classifying options into branch-like segments that construct an inverted tree with a root node, internal nodes, and leaf nodes. A root node, also called a decision node, represents a choice that will result in the subdivision of all records into two or more mutually exclusive subsets. Branches represent chance outcomes or occurrences that emanate from root nodes and internal nodes. Each internal node represents a test on an attribute, each branch represents an outcome of the test. In this study, the dates of the period 15 days apart from February 1st till March 31st when the face mask guidelines came into effect were the nodes. Whereas, the number of deaths and the number of infections was the branches of outcomes that had the face mask intervention implemented from the specified date.

The retrospective data from February 1st to February 15th, February 16th to March 1st, March 2nd to March 15th, March 16th to March 31st was analyzed for the number of infections and deaths. The decision tree was created, assuming face mask usage was started on each of the specific dates. The impact of face mask usage was compared to the number of infections and deaths by March 31st in 14-day increments.

Results

The results based on the decision tree are presented in Figure 1. Analysis of the data using the Markov Model (decision tree) was performed on Treeage Software®.

Figure 1: Decision Tree Model Depicting the Effects of Practicing Social Distancing on COVID-19 Infections and Deaths: A Retrospective Study.



*The number of infections and deaths on March 31st were 186,114 and 5,531, respectively, according to the John Hopkins CRC. (Table 1)

Table 1: The Timeline of Number of Infections and Deaths in the US.

Date	Deaths as of March 31	Incremental Saved Deaths	Infections as of March 31	Incremental Prevented Infections
1-Feb	922		31,019	
15-Feb	922	0	31,030	11
1-Mar	936	14	31,055	25
15-Mar	996	74	33,936	2,906
31-Mar	5,531	4,535	186,114	152,178

*Depicts the number of infections and deaths by the timeline if social distancing use was implemented by the specified dates.

The number of infections and deaths on March 31st was 186,114 and 5,531, according to the John Hopkins Clinical Research Center. If social distancing was initiated on February 1st by the CDC, the number of infections and deaths on March 31st would have been 31,019 and 922, respectively. If practicing social distancing was instituted on February 15th, per CDC's recommendation, the number of infections and deaths on March 31st would have been 31,030 and 922, respectively. If social distancing had been instituted on March 1st, the number of infections and deaths on March 31st would have been 31,055 and 936, respectively. Assuming guidelines of practicing social distancing were instituted

on March 15th, the number of infections and deaths on March 31st would have been 33,936 and 996, respectively.

Earlier implementation of social distancing use could have saved thousands of lives and prevented hundreds of thousands of infections. Initiating on February 1 or February 15th would have saved 4,609 lives by March 31st. Whereas, Initiation of social distancing on March 1 or March 15th would have saved 4,595 and 4,535 lives by March 31st. The reduction of the number of infections would have followed a similar pattern by each period. March 1st appears to be the crucial date for the implementation of this intervention with the maximum effect. (Table 2).

Table 2: The Timeline of Infections Prevented and Lives Saved by the Implementation of Social Distancing.

Dates	Infections Prevented	Lives Saved
February 1	152,095	4,609
February 15	155,084	4,609
March 1	155,059	4,595
March 15	152,178	4,535

Discussion

A significant number of infections could have been prevented, and lives would have

been saved if social distancing use was mandated earlier throughout the progression of the pandemic. Although social distancing would not have made a

significant difference in the number of infections and deaths from February 1st through February 28th, it would have made a drastic difference beyond March 1st.

At the beginning of February, the WHO declared COVID-19 a public health emergency for just the sixth time in history. At that time, there were no deaths in the US, and the number of infections was also not significant. Around the same time, the United States started a 2-week home-based quarantine for people if they had been in Hubei province, and around the same time, the US declared a public health emergency due to the coronavirus outbreak. The announcement came 3 days after WHO declared a Global Health Emergency as more than 9800 cases of the virus and more than 200 deaths had been confirmed worldwide. By the last week of February, CDC declared that COVID-19 was Heading Toward Pandemic Status as COVID-19 met 2 of the 3 required factors: illness resulting in death and sustained person-to-person spread. The worldwide spread is the third criteria were not yet met at the time according to the CDC [9]. Until this point in the crisis, the US was still spared of any notable number of infections and deaths, as compared to other parts of the world. This would have been a good opportunity to initiate social distancing use amongst the population.

The most important announcement in the crisis came from WHO on March 11, wherein it Declared COVID-19 a Pandemic due to the alarming levels of spread and severity. Soon after, the US also declared the novel coronavirus a national emergency. The US also announced a travel ban on non-US citizens traveling from Europe who visited 26 European countries

within 14 days of coming to the United States [10].

Mid-March was the critical point. On March 15th, the US government declared a national emergency. During this time, Spain mandated self-quarantine, as the number of cases increased to 7,000. China, the early epicenter of the outbreak still had more cases than any other country [18]. The US government even offered “large sums of money” for exclusive access to a COVID-19 vaccine to a German medical company CureVac. Social Distancing initiation at this time would have made the most difference. The present study indicates that had the Social Distancing usage been implemented on March 1st, 152,178 infections would have been prevented, and 4,535 lives would have been saved by March 15th.

The social distancing between February 1st and February 15th appears to have minimal effect as no new infection cases or deaths were reported during that time. The social distancing between Feb 16th and March 1st appears to have a limited impact, as only 14 deaths and 25 infections were reported during this period. There was a significant increase in infections (2906) and deaths (74) during the 15 days between March 2nd and March 15th. Instituting social distancing at this stage could have prevented a large number of infections and deaths. Furthermore, social distancing could have prevented additional 4535 deaths and 152,178 infections by March 31st.

The CDC announced social distancing as mandatory by March 11th. For this study, March 15th was assumed as the date of the recommendation. This was done to be consistent with the 15-day increments of

the current study. This could be one of the limitations.

Worldwide, there were about 883,000 confirmed cases and over 40,000 deaths on April 1st. The US continued to lead the most confirmed cases of COVID-19 with 189,753 cases, followed by Italy with 105,792 cases and Spain with 102,136 cases. The number of US deaths were over 4,000 on April 1st [11]. Florida issued a state-wide stay-at-home order, joining 36 other states and the District of Columbia in directing residents to remain at home [12]. Several countries imposed a national lockdown, which was later extended to April 13th and, subsequently, mid-May. The lockdown was essential given the exponential rise in COVID cases [19]. As for Mid-April, the number of infection cases worldwide had expanded to over 2 million people, with about 134,000 deaths, according to Johns Hopkins University [14].

With infection cases rising and death tolls surging, social distancing use could have been a crucial step in preventing the progression of the pandemic and saving lives at any point before March 31st. The earlier the intervention, the more effective the outcomes would have been in terms of infections and deaths. The spread of the pandemic not only resulted in the rise of infections and deaths causing a sense of fear, paranoia and anxiety amongst the public. The fear of contracting the virus forced lockdown in many countries resulting in unemployment, economic

hardships and immense suffering across the world. Like any other public health crisis, the worst sufferers were the poor, the elderly and people with comorbidities. There are also limitations of the decision tree method utilized in this study as it can be subject to overfitting and underfitting, particularly when using a small data set. This problem can limit the generalizability and robustness of the model.

Conclusion

The present study provides a retrospective prediction model of the course of the progression of the pandemic. The importance of a vital mitigation strategy of social distancing usage cannot be underestimated in the light of so many infection cases and deaths. In retrospect, earlier use of social distancing would have saved lives, prevented infections, and restricted the exponential spread of the infection later in the pandemic. This study emphasizes the necessity of earlier initiation of the mitigation strategy of social distancing, with March 1st being a critical breakpoint. Social Distancing use must be strictly adhered to address the spread of infections and Coronavirus-related deaths. The findings of this study can be valuable for the research community, public health officials, and policymakers for future crises and a potential second wave.

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