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RESEARCH ARTICLE

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Impact of Retrospective Face Mask Usage on COVID-19 Infections and Deaths in the United States

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ABSTRACT

Background: The aim of the study was to investigate whether the implementation of face mask as a mitigation strategy earlier, as opposed to in April, would have made an impact on the number of COVID-19 cases and related mortality in the United States.

Material and Methods: A Decision tree (Markov Modeling) was performed utilizing the Tree age Software®. The data which was used for Markov Modeling was collected from Johns Hopkins Coronavirus Resource Center (CRC) and the CDC from February 1st through April 15th.

Results: Earlier use of face masks would have saved lives, prevented infections, and restricted the exponential spread of infections later in the pandemic. Had face masks been instituted on March 15th, 679,302 infections would have been prevented, and 31,863 lives would have been saved by April 15th. Similarly, had we instituted face masks on April 1, 527,123 infections would have been prevented, and 27,328 lives would have been saved by April 15th.

Conclusions: This study points to the missed opportunity of earlier initiation of the mitigation strategy of face mask use, with March 15th being a critical breakpoint. Face mask use must be strictly adhered to prevent the spread of infections and deaths due to Coronavirus.

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COVID-19, Face mask use, Deaths, Infection transmission.

Introduction

COVID-19, formerly known as 2019 novel coronavirus or 2019-nCoV, is a contagious respiratory virus, and as such, it is mainly transmitted between people to people through respiratory droplets when symptomatic people cough or sneeze. 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 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 it can only be treated symptomatically. 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 utilizing face masks. By the end of March 2020, the United States became the new epicenter for COVID-19. To date, the United States has 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 face masks in the mid of February or March, could we have prevented losing numerous innocent lives? The purpose of this study is to investigate whether the implementation of mitigation measures like wearing face masks in the first week of February or mid-March as opposed to in April 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 1, 2020. Within 62 days, the number of active cases and deaths surged exponentially to 818,662 infections and 38,325 deaths. 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]. The available evidence suggests that the use of non-medical face masks could successfully reduce the community spread of Coronavirus [4]. This fact is amply demonstrated by the containment strategies of several

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countries. The United States followed a different timeline when it came to mandating widespread use of face masks [5].

The World Health Organization (WHO) declared Coronavirus as a pandemic on March 11th and it was not until April 3rd when CDC recommended, not mandated, the masks to everyone as a preventive measure [6-7].

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 that were emerging right in front of us. On the contrary, there were several countries that mandated the use of face masks immediately. Approximately 99% of Hong Kong residents and citizens began wearing masks at an earlier stage which allowed them to control the virus sooner than the United States. Japan, like Hong Kong, also enforced mask-wearing at an earlier phase [5].

The United States followed a different timeline when it came to mandating widespread use of face masks. WHO declared COVID-19 as a pandemic on March 11, 2020.[6] Disregarding this crucial statement from WHO, on March 20th, 2020, CDC stated that it does not recommend that people that are well wearing a face mask protect themselves from COVID-19. The US Surgeon General also advised against purchasing masks for use by healthy individuals.[8] On the same day, WHO recommended that individuals that are caring for COVID-19 patients should wear face masks [8]. It was not until April 3rd when CDC recommended, not mandated, the masks to everyone as a preventative measure [7].

In the early phase of the pandemic, WHO recommended for healthy individuals to wear a mask only when taking care of suspected COVID patients [7]. China came out with recommendations for people at moderate or low-risk infection. People who were at moderate risk of infection had to wear disposable surgical masks, whereas people with low risk of infection could wear a disposable mask, cloth mask, or even not wear a mask [6-7]. Hong Kong mandated surgical face mask use in crowded places and also to people experiencing any mild symptoms of the coronavirus. Singapore made it mandatory to wear a face mask if a person is experiencing any respiratory symptoms [8]. Japan obligated the use of face masks most of the time in order to prevent transmission of the virus. Shortly after, the UK announced that face masks play a critical role in health care settings, but not so much in the community. The CDC in the United States did not recommend the use of face masks initially. At the same time, the US Surgeon General discouraged the use of face masks for healthy individuals [8]. Another study performing a model compartmental analysis to evaluate the community-wide impact of face mask use by the general population found that the use of face masks decreases the number of deaths and positive infection cases. For New York, they suggested 50% adoption of face masks could prevent 17-45% of deaths over the course of two months while reducing the daily death rate by 34-58% [7].

A review study filtering characteristics and efficacy of masks estimated population impacts of widespread community mask use, and sociological considerations for policies concerning mask-wearing recommended that public officials and governments should encourage the use of face masks in public and the adoption of public cloth mask-wearing in conjunction with existing hygiene and social distancing [4].

A systematic review and meta-analysis assessing the use of face masks and eye protection to prevent transmission of viruses concluded that physical distancing of at least 1m is strongly associated with protection, but distances of up to 6 ft. might be more effective. The use of face masks can protect both healthcare workers and the general public from the exposure to the infection [9].

A survey-based study investigating the knowledge, attitude, and practices of healthcare workers wearing surgical face masks to limit the spread of COVID-19 found that healthcare workers had a positive attitude, but the moderate-to-poor level of knowledge and practice regarding the use of face masks [10].

Material and Methods

Data from the Johns Hopkins Coronavirus Resource Center (CRC) and the CDC was utilized to collect the number of infections and deaths by each 15-day time period from February 1st- April 15th [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. [9] This research utilized the findings of the above-mentioned study as a reference factor. The current research study made the assumption that face mask usage reduces the number of infections and deaths by six times based on WHO recommendations. Tree age Software® was used to create a Markov Model decision tree.

A decision tree model is formed using a hierarchy of branches of flowchart-like tree structure, which classifies 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 April 15th when the face mask guidelines came into effect were the nodes. Whereas, the number of deaths and the number of infections were the branches of outcomes had the face mask intervention implemented from the specified date.

The retrospective data from February 1st to February 15th, March 1st to March 15th, and April 1st to April 15th 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 April 15 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 Tree age Software®.

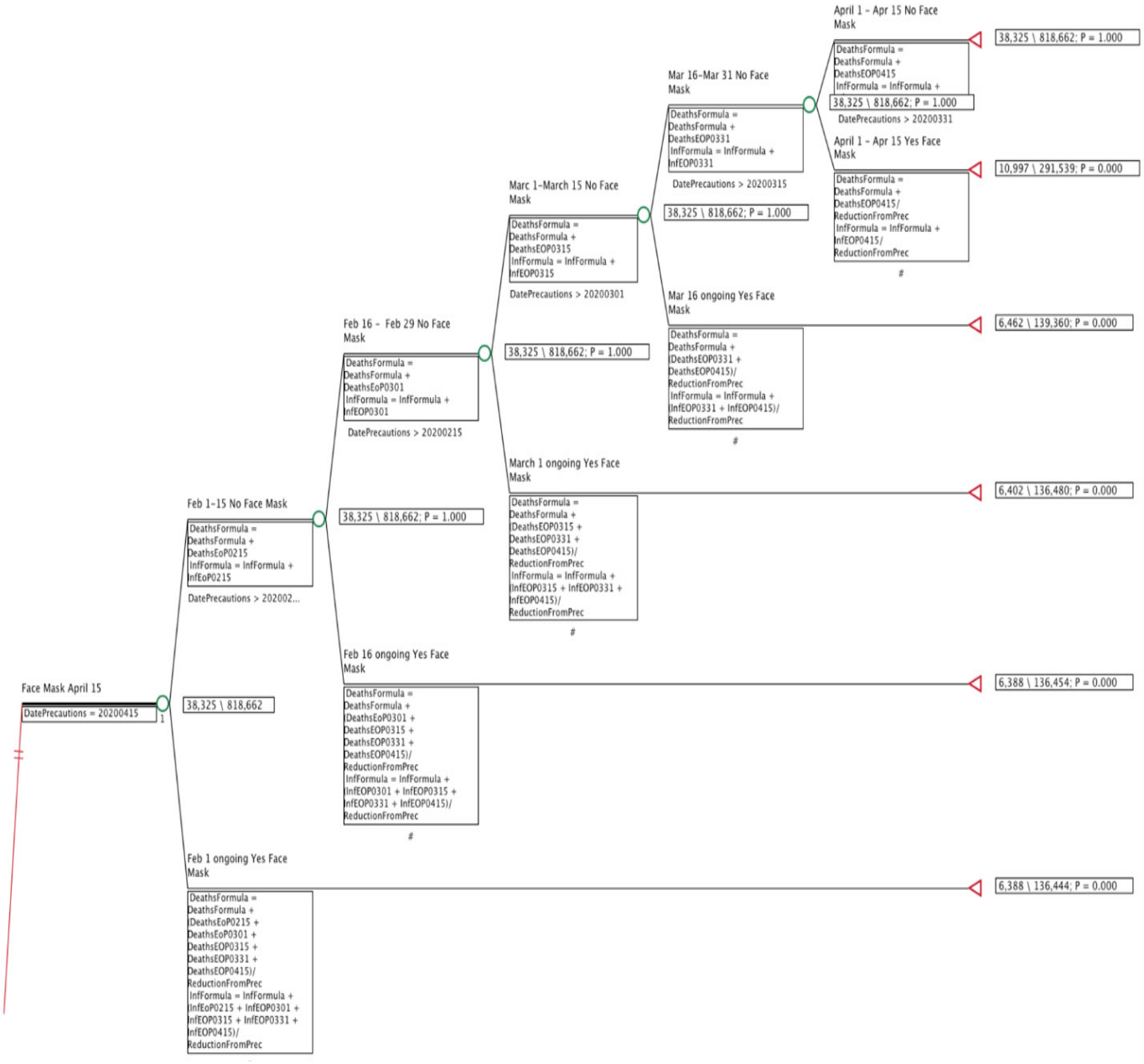

Figure 1: The Impact Of Face Maks Use on the Number of Deaths and Infections.

[A] Decision Tree Model Depicting the Impact of Face Mask Usage on the Number of Deaths and Infections.

The number of infections and deaths on April 15 were 818,662 and 38,325, respectively, according to the John Hopkins CRC (Table 1).

Table 1: Timeline of the Events that Could Have Been Prevented by Face Mask Use**.**

Date	Deaths as of April 15	Incremental deaths	Infections as of April 15	Incremental Infections
February 1	6,388		136,444	
February 15	6,388	0	136,455	11
March 1	6,402	14	136,480	25
March 15	6,462	60	139,360	2,880
March 30	10,997	4,5353	291,539	152,178
April 15	38,325	27,328	818,662	527,123

[A] Depicts the number of infections and deaths by the timeline if face masks use was implemented by the specified dates.

If face mask usage was mandated by the CDC on February 1st, the number of infections and deaths on April 15th would have been 136,444 and 6,388, respectively. (Table 1) If the face mask use was instituted on February 15th, the number of infections and deaths on April 15th would have been 136,455 and 6,388, respectively. Furthermore, if the face mask use was instituted on March 1st, the number of infections and deaths on April 15st would have been 136,480 and 6,402, respectively. If the recommendation to wear a face mask was initiated by the CDC on March 15st, the number of infections and deaths on April 15th would have been 139,360 and 6,462, respectively. Lastly, if the CDC were to mandate face mask usage on April 1st, the number of infections and deaths on April 15th would have been 291,539 and 10,997, respectively (Table 1).

The earlier implementation of face mask use could have saved thousands of lives and prevented hundreds of thousands of inactions. Initiating of Face masks on February 1 or February 15th would have saved 31, 937 lives by April 15th. Whereas, Initiation of Face masks on March 1 or March 15th would have saved 31, 923 and 31, 863 lives by April 15th. And lastly, 27, 328 lives would have been saved by April 15th, had the face mask guidelines were implemented on April, 1. The reduction of the number of infections would have followed the similar pattern by each time period. March 15th appears to be the crucial date for the implementation of this intervention with the maximum affect (Table 2).

Table 2: The Timeline of Infections Prevented and Lives Saved by the Implementation of Face Masks.

Dates	Infections Prevented	Lives Saved
February 1	682,218	31,937
February 15	682,208	31,937
March 1	682,182	31,923
March 15	679,302	31,863
April 1	527,123	27,328

Discussion

A significant number of infections could have been prevented, and lives would have been saved if face mask use was mandated earlier throughout the progression of the pandemic. Although face masks would not have made a significant difference in the number of infections and deaths in the time period of February 1st through March 1st, it would have made a drastic difference beyond March 15th.

At the beginning of the month 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. Worldwide spread is the third criteria were not yet met at the time according to the CDC [11]. 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 face mask use amongst the population. Although the CDC did indicate face mask use for healthcare workers and, ironically, they dissuaded the public usage of PPE and face masks in order to have enough supply for healthcare and essential workers.

The most important announcement in the crisis came from WHO on March 11, where in 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 travel ban on non-US citizens traveling from Europe who visited 26 European countries within 14 days of coming to the United States [12].

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 [13]. The US government even offered “large sums of money” for exclusive access to a COVID-19 vaccine to a German medical company CureVac. Face mask initiation at this time would have made the most difference. The present study indicates that had the face mask usage been implemented on March 15th, 679,302 infections would have been prevented, and 31,863 lives would have been saved by April 1st.

Similarly, had we instituted face masks on April 1st, 527,123 infections would have been prevented, and 27,328 lives would have been saved by April 15th. 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 numbers of US deaths were over 4,000 on April 1st [14]. Florida issued a statewide stay-at-home order, joining 36 other states and the District of Columbia in directing residents to remain at home [15]. A number of 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 [16]. 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 [17].

With infection cases rising and death tolls surging, face mask use could have been a crucial step in preventing the progression of the pandemic and saving lives at any point before April 15th. 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 rise of the 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 over fitting and under fitting, particularly when using a small data set. This problem can limit the generalizability and robustness of the model.

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 face mask usage cannot be underestimated in the light of so many infection cases and deaths. In retrospect, earlier use of face masks 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 face mask use, with March 15th being a critical breakpoint. Face mask use must be strictly adhered to in order 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.

References

[1] John Hopkins University of Medicine and Science (COVID-19) United States Cases. Published online 2020. https://coronavirus.jhu.edu/us-map

[2] https://www.worldometers.info/coronavirus/country/us/

[3] Corona Disease 2019 (COVID-19) Cases in the US. Published online 2020. https://www.cdc.gov/coronavirus/2019-ncov/cases-updates/cases-in-us.

[4] Howard J, Huang A, Li Z, et al. Face Masks Against COVID-19: An Evidence Review. Published online April 12, 2020.

[5] Frankford DM. Sick at Heart: A Fundamental Reason the United States Was Unprepared for the COVID-19 Emergency. SSRN. 72(5). https://ssrn.com/abstract=3623432

[6] Cheng VC, Wong SC, Chuang VW, et al. The role of community-wide wearing of face masks for control of coronavirus disease 2019 (COVID-19) epidemic due to SARS-CoV-2. JINF. 2020; 16: 13.

[7] Eikenberry SE, Mancuso M, Iboi E, et al. To mask or not to mask: Modeling the potential for face mask use by the general public to curtail the COVID-19 pandemic. Infect Dis Model. 2020; 5:293-308. doi:10.1016/j.idm.2020.04.001

[8] Feng S, Shen C, Xia N, Song W, Fan M, Cowling BJ. Rational use of face masks in the COVID-19 pandemic. Lancet Respir Med. 2020; 8(5):434-436. doi:10.1016/S2213-2600(20)30134-X

[9] Chu DK, Akl EA, Duda S, et al. Physical distancing, face masks, and eye protection to prevent person-to-person transmission of SARS-CoV-2 and COVID-19: a systematic review and meta-analysis. Lancet. Published online 2020: 1973-1987. doi:10.1016/S0140-6736(20)31142-9

[10] Kumar J, Katto MS, Siddiqui AA, et al. Knowledge, Attitude, and Practices of Healthcare Workers Regarding the Use of Face Mask to Limit the Spread of the New Coronavirus Disease (COVID-19). Cureus. 2020; 12(4). doi:10.7759/cureus.7737

[11] Timeline of WHO's response to COVID-19.https://www.who.int/emergencies/diseases/novel-coronavirus 2019/interactive. Accessed September 19, 2020.

[12] WHO | Pneumonia of unknown cause – China. WHO. 2020. http://www.who.int/csr/don/05-january-2020-pneumonia-of-unkown-cause-china/en. Accessed September 19, 2020.

[13] March 15 coronavirus news. https://www.cnn.com/world/live-news/coronavirus-outbreak-2-03-15-20-intl-hnk/index.html. Accessed September 11, 2020.

[14] COVID-19 Update: Global Confirmed Cases as of April 1, 2020. https://www.patientcareonline.com/view/covid-19-update-global-confirmed-cases-april-1-2020. Accessed September 11, 2020.

[15] Coronavirus updates from April 1, 2020. https://www.cbsnews.com/live-updates/coronavirus-pandemic-covid-19-latest-news-2020-04-01/. Accessed September 11, 2020.

[16] Zhou X, Snoswell CL, Harding LE, et al. The Role of Telehealth in Reducing the Mental Health Burden from COVID-19. Telemed e-Health. 2020;26(4):377-379. doi:10.1089/tmj.2020.0068

[17] April 15 Coronavirus news. https://www.cnn.com/asia/live-news/coronavirus-pandemic-intl-04-15-20/index.html. Accessed September 11, 2020.