

# **COVID-19 Vaccination and the Daily Cases, Hospitalizations and Death Rates: a Case Study of Tennessee in the United States.**

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# COVID-19 Vaccination and the Daily Cases, Hospitalizations and Death Rates: a Case Study of Tennessee in the United States.

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## Abstract

The COVID-19 outbreak highlights the vulnerability to novel infections, and vaccination remains a foreseeable method to return to normal life. However, infrastructure is inadequate for the whole population to be vaccinated immediately. Therefore, policies have adopted a strategy to vaccinate the elderly and vulnerable population while delaying others. This study uses the Tennessee official statistic from the onset of COVID vaccination (17th of December 2021) to understand how age-specific vaccination strategies reduce daily cases, hospitalization, and death rate. The result shows that vaccination strategy can significantly influence the numbers of patients with COVID-19 in all age groups and lower hospitalization and death rates just in older age groups. The Elderly had a 95% lower death rate from December to March; however, and no change in the death rate in other age groups. The Hospitalization rate was reduced by 80% in this study cohort for people aged 80 or older, while people who were between 50 to 70 had almost the same hospitalization rate. The study indicates that vaccination targeting older age groups is the optimal way to avoid higher transmissions and reduce hospitalization and death rate for older groups.

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## Original Manuscript

# COVID-19 Vaccination and the Daily Cases, Hospitalizations and Death Rates: a Case Study of Tennessee in the United States.

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## **Background:**

The COVID-19 outbreak highlights the vulnerability to novel infections, and vaccination remains a foreseeable method to return to normal life. However, infrastructure is inadequate for the vaccination of the whole population immediately. Therefore, policies have adopted a strategy to vaccinate the elderly and vulnerable populations while delaying others.

## **Objective:**

This study uses the Tennessee official statistic to understand how age-specific vaccination strategies reduce daily cases, hospitalization, and death rate.

## **Method:**

The research used publicly available data of COVID-19, including vaccination rates, positive cases, hospitalizations, and death from the health department of Tennessee. This study targeted from the first date of vaccinations, December 17, 2020, to March 3, 2021. The rates were adjusted by data from U.S. Census Bureau (2019), and the age groups were stratified at ten-year intervals from the age of 21.

## Results:

The result shows that vaccination strategy can reduce the numbers of patients with COVID-19 in all age groups with lower hospitalization and death rates in older. The elderly had a 95% lower death rate from December to March, while no change in the death rate in other age groups. The hospitalization rate was reduced by 80% for people aged 80 or older, while people who were between 50 to 70 had almost the same hospitalization rate.

## Conclusions:

The study indicates that targeting older age groups for vaccination is the optimal way to avoid higher transmissions, reduce hospitalization and death rates.

## Introduction

In December 2019, the severe respiratory coronavirus in Wuhan, China, has caused a coronavirus disease outbreak (COVID-19) [10]. In the next few weeks, COVID-19 became the main headline worldwide, and daily cases and deaths increased considerably [11]. As of the end of November 2020, more than 14 million infections and 279,000 deaths have been confirmed nationally, making the United States the highest number of cases in the world to date [12]. With more than 368,000, 4,500 daily cases and death, Tennessee has been identified as one of the hardest-hit states in the U.S. [12]. Vaccinations and social distancing are essential factors for the COVID-19 Prevention [13]. COVID-19 Vaccination rollout in Tennessee started on December 17, 2020, and by March 3, 13.3% of the population had already received mRNA vaccines such as the Pfizer BNT162b2 (Tozinameran) and the Moderna mRNA-1273 [1;2]. In addition to reduced interpersonal contact and physical distancing, vaccination programs positively influence controlling the virus's spread and reducing deaths [3]. While COVID cases and deaths had the highest rates in January 2021 in the U.S., manufacturers

currently cannot cover the enormous demand. As the vaccine supply is limited, it is crucial to prioritize who gets the vaccine; therefore, groups at the highest risk of getting the virus or individuals who are seriously ill receive the vaccine first. Previous research showed that prioritizing younger populations will significantly impact reducing COVID-19 cases relative to prioritizing older age groups. However, prioritizing younger age groups is associated with the lowest reduction in COVID-19 mortality compared to other approaches [16]. Besides, Tennesseans are eligible for vaccines based solely on their age, and these age-based phases have run simultaneously with those at high-risk health conditions. This paper has modeled how the vaccination program in Tennessee is likely to change COVID-19-related daily cases, deaths, and hospitalization among adults.

## Data

This study used publicly available data of COVID-19, including vaccination rates, positive cases, hospitalizations, and death from the health department of Tennessee in the state level. All data used in this study are available at <https://www.tn.gov/health/cedep/ncov/data>. The rates also were adjusted by data from U.S. Census Bureau (2019) [4].

**Measures.** This study started from the first date of vaccinations, December 17, 2020, to March 3, 2021. The health department of Tennessee provides statistics of first and second doses of vaccinations, cases, hospitalization, and death every day. The data were stratified based on ten-year intervals from the age of 21 to 81 and more.

**Statistical Analysis.** The methodology for generating a descriptive time series of vaccinations, daily cases, deaths, and hospitalizations involved two steps. The first was to convert aggregate data to daily data to create time series data. The second was to adjust data for each age group by the census data, including the percentage of Tennesseans who received vaccines, had COVID-19, hospitalized, and died. The goal is to produce a series of trends over consecutive time intervals to understand the changes in COVID-19 cases, hospitalizations, and death after the onset of vaccinations. The data

were analyzed with the R programming language (version 3.5.2) (R Core Team 2018) [14].

## Result

During the first 78 days of vaccination in Tennessee, there were 953,568 individuals vaccinated by the 1st dose, and 495,032 individuals received their 2nd dose. 18.2% and 30.3% of vaccines were for people of age 81+ and 71-80, respectively, which shows that half of the vaccination has been for those older than 71. Figure 1 indicates the percentage of those who received the first vaccine from December 17, 2020, to March 3, 2021. Individuals who had less than 70 had a higher vaccination rate before January; however, from January to March 3, 40%, 36% of 80+, and 71-80 have been vaccinated receptively, which shows most of the daily vaccines were used for these two age groups. Figure 2 shows that just 25% of Tennesseans who were older than 81 received the second vaccine dosage, while a small percentage of other age groups have been vaccinated. Although the age group of 71-80 had a very close rate of receiving the first vaccine dosage compared to the 81+ age group, they received the second dosage similar to other age groups.

Daily cases for all age groups decreased inevitably after the onset of vaccination to day 78 (Figure 3). Daily cases were decreased for younger from around 0.2% at the end of January to less than 0.05% at the end of the study period. This percentage was considerably higher for the older people in the study periods (from 0.1% to close to 0.01% daily cases). Before starting the vaccinations, older

age groups were considerably had the highest hospitalization rates. Their hospitalizations decreased at the end of the study period from 0.010% of Tennessee's older population to 0.003%. There was no substantial change in other age groups' hospitalization rates, although, on some days, age groups of 51-60 and 61-70 had high hospitalization rates. From the middle of February, age groups of 70+ did not experience high hospitalization rates, and age groups of 51-60 had almost the highest rate of daily hospitalization. Lastly, the death rates of 71+ age groups decreased, while there was no change in death rates of other age groups during the study period. Although Tennesseans over 71 faced 0.015% of daily death by COVID at the end of 2020, this percentage decreased substantially to 0.003% at the end of the study period. The results show that the gap between the older and younger was high before starting vaccination, and after vaccination, the differences diminished, which indicates all age groups had the same death rates.

## Discussion

The COVID-19 is still spreading in the United States, and the hospitalization and death rate are high. Vaccines offer great hope for better conditions, but an effective vaccination strategy is needed to stop the pandemic and restore people's everyday lives. Unfortunately, vaccine doses are being delivered slowly and sporadically, which means it is difficult for most people to be vaccinated right now, even if they are eligible. Based on the current policy, the high-risk groups such as first responders, the elderly, and individuals with high-risk health conditions should receive the vaccines first [5]. In this study, I used the Tennessee official statistic from the onset of COVID vaccination (17th of December 2021) to understand how age-specific vaccination strategies change daily cases, hospitalization, and death rate. The charts indicate that phase 1 of the vaccination strategy has reduced the numbers of patients in all age groups, with lower hospitalization and death rates for the elderly. The result demonstrates that more than half of vaccines were for more than 70 years old, and it was a practical

approach in blocking the transmission in the elderly population and other age groups. COVID-19 daily cases of older groups decreased to 90 % from the end of 2020 by the end of February 2021. Also, less than half of vaccines were used for less than 70, and they had less than 80% lower daily cases at the end of the study period. Although this study cannot confirm the association between the onset of vaccination and the considerable reduction in Covid-19 transmission in younger age groups, the statistics indicate a significant decrease in daily cases among Tennesseans in all age groups. Moreover, 25% of people who were older than 81 received the vaccines, and around 10% of other age groups received the second dosage. However, this age group did not have better results than their counterparts in the 71-80 age group in hospitalizations and death rate. This study includes 78 days of vaccination statistics; thus, it is too early to conclude the second dosage's influence. Future studies should consist of a longer period to have more accurate results concerning the second dosage.

Vaccines lead to great hospitality and mortality reduction for older age groups in Tennessee. People who older than 80 had a 95% less death rate than in the middle of December. 71-80 age group death rate decreased during the study period; however, the 61-70 age groups had almost the same death rate from the middle of December to the end of February. The statistics show that there was no change in the death rate in other age groups. Tennessean's hospitalization of more than 80 years old were reduced to 80 % in the study period, while people between 50 to 70 had almost the same hospitalization. It is essential to know individuals who were between 51-60 had the highest hospitalization rates in Tennessee. Although the data cannot identify people with higher risk, the higher hospitalization rate among the younger population implies health system in Tennessee could not identify people at higher risk efficiently. A previous study shows that a significant proportion of the people who had two or more chronic conditions simultaneously are more likely to be hospitalized by SARS-CoV-2 [9]. Additionally, while health workers are placed at the highest risk groups, immunizing this population and supplying personal protective equipment will help increase the resiliency of the health system during the epidemic [17].

The findings should be considered in the context of several data limitations. I did not derive individual-level data to estimate hospitalization risks, mortality rate, and COVID-19 transmissions. Moreover, several studies [6; 7] indicate racial and ethnic disparity by health systems increases the risk of getting sick, hospitalized, and dying from COVID-19. Future studies should examine vaccination in different races by age group to estimate who should get the vaccine first. Additionally, the data does not include nonpharmaceutical public health control measures, which would be an essential indicator to control daily cases [8]. Although hospitalization, cases, and death statistics prior to the onset of vaccination could provide a more accurate picture regarding the changes by vaccination, the preliminary analysis showed the gaps between older and younger age groups were consistent before the vaccination onset up to the end of January. Since February, however, the gap between older and younger age groups has diminished considerably. The reason why there were no immediate changes after the vaccination onset could be due to two factors. First, the previous research showed that the effectiveness of vaccines takes a while to protect those who are vaccinated [15]. It has taken a more extended period to show the effectiveness of vaccination as just around 35 percent of the older age group were vaccinated at the end of February. Second, I was not able to distinguish the daily cases, hospitalization, and death rates of those who were vaccinated.

## Conclusion

The vaccination was started at the beginning of a "3rd wave" in Tennessee, and by December, and January SARS-CoV2 positive cases and hospitalizations increased considerably. This work has concentrated on Tennessee's dynamics COVID-19. It concludes that the vaccine should be optimally targeted at the elderly in the first step, indicating that vaccination reduces daily cases for the whole population while reduces hospitalization and death rate in the older population. This study, consistent with the previous studies [8], shows mRNA Covid-19 vaccines have a protective effect for blocking transmission even after a single dose. This study also indicates that prioritizing the vaccination of the

elderly is a practical approach for reducing the number of deaths and hospitalization.

## Code Availability

The code to perform all analyses described in Methods and Usage Notes sections was written in R-3.6.2 and is publicly available at <https://www.tn.gov/health/cedep/ncov/data>.

## Author Approval

All authors have seen and approved the manuscript.

## Declaration of Conflicting Interests

The authors declare that there is no conflict of interest.

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None Reported

## Author Contributions

Ali Roghani designed the study and implemented methods and analyses.

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## Supplementary Files

Untitled.

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