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COVID outbreak after the 1st dose of COVID vaccine among the nursing home residents: What happened?

Ping Ye, DNP^{a,d,*}, Liam Fry, MD^{b,d}, Haiyan Liu, MSN^d, Savannah Ledesma^d, Jane Dimmitt Champion, PhD, DNP^c

^a The College of Nursing, Texas A&M University, Round Rock Campus, TX 78665, United States

^b Dell Medical School, the University of Texas at Austin, Austin, TX, United States

^c School of Nursing, the University of Texas at Austin, Austin, TX, United States

^d Austin Geriatric Specialists, Austin, TX, United States



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ABSTRACT

The purpose of this study was to assess the effectiveness of Pfizer-BioNTech COVID19 vaccine among nursing home residents by exploring the outcomes of a major COVID-19 outbreak following COVID-19 vaccination in a nursing home located at a metropolitan area of South-Central Texas. 91 residents resided in this nursing home during the outbreak, and 86 residents received the 1st dose of COVID-19 vaccine on January 4th, 2021. A retrospective chart review explored outcomes of this outbreak by accessing the electronic medical records from January 4th, 2021 thru February 28th, 2021. Residents partially vaccinated with COVID-19 vaccine were found less likely to be symptomatic during this outbreak. The risk of SARS-CoV-2 infection was significantly lower among residents who received both doses of the COVID-19 vaccine. Completion of both doses of COVID vaccination for all nursing home residents is essential and can prevent future COVID-19 outbreaks in nursing homes.

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Introduction

The COVID-19 pandemic has significantly impacted nursing home residents with over 650,000 residents thus far diagnosed with COVID-19, and over 132,000 residents deceased due to Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) (CMS, 2021).¹ Nursing home residents, primarily frail and elderly, with more than three chronic illnesses, are at a much higher risk for morbidity and mortality associated with SARS-CoV-2 infections compared to the general population.^{2,3} In December 2020, the U.S. Food & Drug Administration (FDA) issued an Emergency Use Authorization (EUA) for two mRNA vaccines, BNT 162b2 by Pfizer-BioNTech and mRNA-1273 by Moderna. The Pfizer-BioNTech vaccine requires two doses administered 21 days apart,⁴ while the Moderna vaccine requires at least 28 days between two doses of vaccination.⁵ Both vaccines reported approximately 95% effectiveness against COVID-19 during clinical trials following full vaccination.^{4,5} Therefore, the Advisory Committee on Immunization Practices (ACIP) recommended that

nursing home residents receive COVID-19 vaccine in the initial phase of the vaccination program.⁶

Furthermore, the incidence of COVID-19 infections was less frequent among individuals 14 days after receiving the first dose of Pfizer-BioNTech vaccine in the clinical trials.^{4,7} The first dose Pfizer-BioNTech vaccine was also helpful in preventing symptomatic COVID cases with 52.4% effectiveness.^{4,7} Limited evidence is available regarding the effectiveness of COVID-19 vaccine among nursing home residents as they were not included in these clinical trials. One recent retrospective cohort analysis found about 63% effectiveness among nursing home residents in Connecticut, who had partial vaccination with Pfizer-BioNTech COVID-19 vaccine (> 14 days after 1st dose through 7 days after 2nd dose).⁸ Another study found significantly decreased COVID-19 cases among nursing home residents beginning three weeks after administration of the first dose of COVID-19 vaccine.⁹ Additional study for evaluation of COVID-19 vaccine effectiveness among nursing home population is imperative.

Therefore, we conducted a pilot study evaluating the initial impact of COVID-19 immunizations in a nursing home setting. We hypothesized that (1) fewer symptomatic COVID cases occurred among partially vaccinated residents compared to those who were in the limited vaccine protective effect phase (within 14 days after 1st dose of COVID vaccine); (2) the incidence of

*Corresponding author at: The College of Nursing (Round Rock Campus), Texas A&M University 3950 North A.W. Grimes Blvd, Round Rock, TX, 78665.

E-mail addresses: pye@tamu.edu (P. Ye), lmfry@agsaustin.com (L. Fry), hliu@agsaustin.com (H. Liu), sledesma@agsaustin.com (S. Ledesma), jdchampion@mail.nur.utexas.edu (J.D. Champion).

COVID infections would decrease among those received both doses of COVID vaccine compared to those who only received the 1st dose of COVID vaccine.

Methods

Design

A skilled nursing long-term care facility located within a metropolitan area of South-Central Texas experienced a major COVID-19 outbreak in January 2021. Most residents received the 1st dose of Pfizer-BioNTech COVID-19 vaccine on January 4th, 2021, one day prior to the 1st positive COVID case in the facility. We examined the electronic medical records from January 4th thru February 28th, 2021, to evaluate the effectiveness of COVID-19 vaccine by assessing the outcomes during this COVID-19 outbreak. This was a retrospective cohort study. The Institutional Review Board of a South-Central Texas University approved this retrospective chart review as an exempt study of secondary use submission with waiver of HIPAA authorization.

Sample

All residents who stayed at this nursing home between January 4th 2021 and February 28th 2021, were included in this retrospective cohort study. Any resident who was discharged home during the period was excluded in the final data analysis due to inability of following. No new residents were admitted to the facility during this period due to the COVID-19 outbreak.

Procedure

Prior to the COVID-19 outbreak, all nursing home residents received the nasal SARS-CoV-2 Polymerase chain reaction (PCR) testing on a weekly basis per guidance from the Centers for Disease Control and Prevention (CDC) and Texas Health and Human Services.^{10,11} The COVID-PCR surveillance testing was increased to twice a week for closer monitoring following identification of the 1st positive case. Rapid COVID antigen tests were also performed immediately for any residents with possible COVID-19 exposures or who developed COVID-19 symptoms. Most residents received the 1st dose of Pfizer-BioNTech COVID-19 vaccine via partnership with a local pharmacy on January 4th, 2021. Residents who remained COVID negative three weeks after the 1st dose of COVID vaccine were able to receive the 2nd dose on January 25th, 2021.

Measures

Two Advanced Practice Registered Nurses (APRNs) examined the electronic medical records during the period from January 4th, 2021 thru February 28th, 2021. Measures included in data collection were age, sex, date of 1st and 2nd dose of COVID vaccine, date of COVID-19 diagnosis, presence of COVID-19 symptoms (yes/or), and other outcomes such as hospitalization or death.

In this study, any resident with positive PCR or rapid Antigen-based SARS-CoV-2 test result was considered as a positive case. Residents with at least one of the COVID symptoms such as fever, chills, cough, shortness of breath, headache, muscle ache, nausea, vomiting, diarrhea, loss of taste or smell or nonspecific symptoms including fatigue, weakness, lethargy, and decreased appetite, were considered symptomatic cases. The date of the first available positive SARS-CoV-2 test result was defined as the case diagnosis date. During this COVID outbreak, the first positive COVID-19 case was diagnosed on January 5th, 2021 and the last positive COVID-19 case was diagnosed on January 29th, 2021.

Data analysis

The research team reviewed and summarized the data to explore outcomes of this COVID-19 outbreak. Data analyses were performed using SPSS Premium, Version 26 (IBM Corp., Armonk, N.Y., USA).

We compared the frequency of COVID cases among residents who received the 1st dose of the COVID vaccine and those who received both doses of the COVID vaccine. The relative risk of COVID infection between residents who received only the 1st dose of vaccine and those who received both doses of the vaccine was calculated. We also divided the COVID positive cases into two groups. One group included residents who were diagnosed with COVID-19 within 14 days of the 1st dose of COVID vaccine. This period is considered as one with very limited protective effects from the vaccine.⁴ The other group included residents diagnosed with COVID-19 between the period of the 15th day after the 1st dose and 7th day after the 2nd dose of COVID-19 vaccine. This is considered to be the partially vaccinated period.⁴ We compared the frequency of asymptomatic cases, symptomatic cases, hospitalization, and death between these two groups. The relative risk of symptomatic COVID cases between the partially vaccinated group and the group with limited vaccine protective effects was calculated as well.

Results

This retrospective cohort study included a total of 91 residents. None of the residents had a positive COVID-19 diagnosis within 180 days prior to the outbreak. Residents were primarily female (= 59, 64.8%) and age ranged from 25 years to 101 years (mean = 76.44 years). Five residents declined the COVID-19 vaccine. All of them received a diagnosis of COVID-19 during the outbreak (Table 1).

Eighty-six residents received the 1st dose of COVID-19 vaccine on January 4th, 2021. Sixty-eight residents were diagnosed positive for COVID-19 within three weeks after receiving the 1st dose of COVID-19 vaccine. Only 18 residents remained COVID negative, and 17 residents received the 2nd dose of COVID-19 vaccine on January 25th, 2021 (one resident was discharged prior to January 25th, 2021). Among the residents who received the 2nd dose of COVID-19 vaccine, 5 residents were positive for COVID-19 within 4 days of receiving the 2nd dose of COVID-19 vaccine (Table 1). The relative risk of infection with COVID-19, for residents who received both doses of COVID-19 vaccine, as compared to those who received only the 1st dose of COVID-19 vaccine, was 0.37 (Fisher's exact test, $p < 0.01$). Furthermore, none of the fully vaccinated residents (> 7th day after 2nd dose of COVID-19 vaccine) were diagnosed with COVID-19 during the study period (up to four weeks after the 2nd dose of COVID-19 vaccine).

Overall, 73 residents were diagnosed with COVID-19 during the period of January 5th (first case) thru January 29th, 2021 (last case) (Fig. 1). Forty-three residents were diagnosed with COVID-19 within 14 days of the 1st dose of COVID vaccine, which is considered to be the period of limited vaccine protective effects. Twenty-four of these residents remained asymptomatic through the COVID-19 course, while 19 individuals were symptomatic. Among the symptomatic cases, 10 residents were hospitalized and 3 of them died in the hospital. An additional 6 symptomatic

Table 1
COVID-19 Cases Summary (1/4/2021 – 1/29/2021).

	Did not Receive Vaccine	Received 1st COVID Vaccine on 1/4/2021	Received 2nd COVID Vaccine on 1/25/2021
Number of Residents	5	86	17
Age (years)	80.6	76.19	74.94
Female	3	56	13
Male	2	30	4
COVID-Negative Cases (%)	0 (0)	18 (21)	12 (71)
COVID-Positive Cases (%)	5 (100)	68 (79)	5 (29)

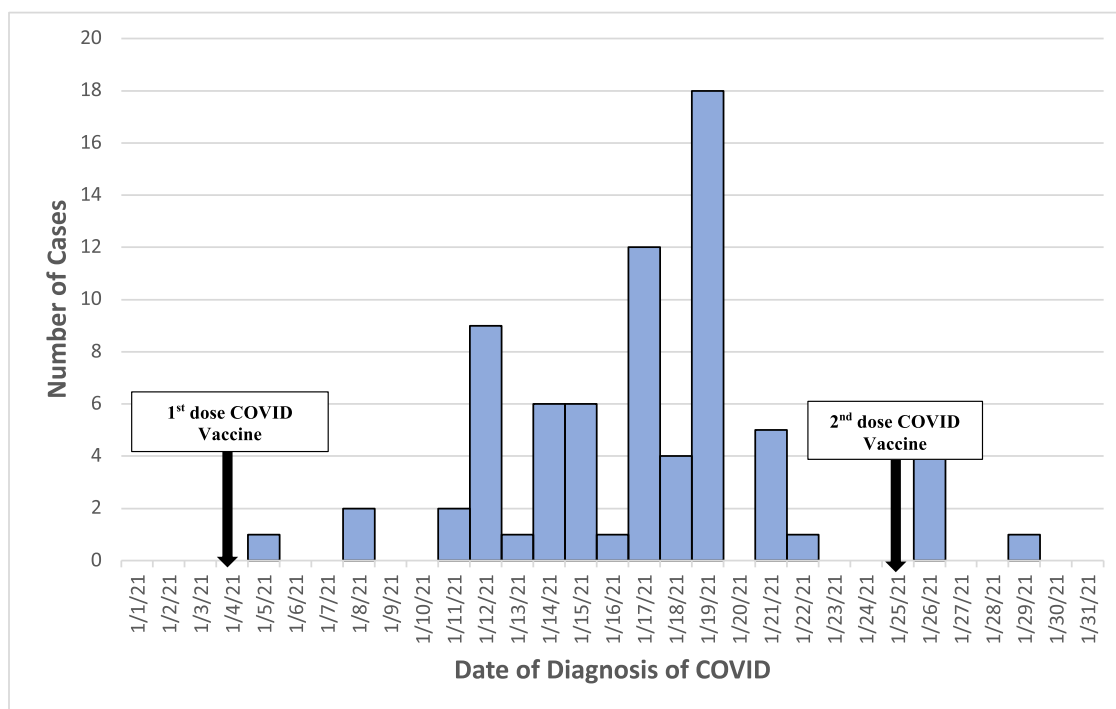


Fig. 1. COVID Cases by Date of Diagnosis, January 2021.

residents died in the nursing home due to their care preference of "Do Not Resuscitate and Do Not Hospitalize." In total, there were 9 deaths. Thirty residents were diagnosed with COVID-19 during the period of the 15th day after the 1st dose and 7th day after the 2nd dose of COVID-19 vaccine. Of these residents, 21 were asymptomatic, and 9 residents were symptomatic. Among those who were symptomatic, none were hospitalized. Three symptomatic residents died of COVID-19 in the nursing home (all of their care preference were "Do Not Resuscitate and Do Not Hospitalize") (Table 2). The relative risk of COVID-19 infection during the outbreak was not lower in the partially vaccinated group, however the relative risk of being symptomatic among partially vaccinated positive cases compared to those positive cases that occurred within 14 days of the 1st dose of COVID-19 vaccine was 0.68 ($\chi^2 = 1.504, p = .220$).

Discussion

Our study found the incidence of COVID-19 cases among nursing home residents who received both doses of the Pfizer-BioNTech COVID-19 vaccine was much lower than those who only received the 1st dose of COVID-19 vaccine during this COVID outbreak. This finding was consistent with another study, which showed a decreased rate of COVID-19

Table 2
COVID positive cases comparison among different vaccine groups during the outbreak (1/4/2021 – 1/29/2021).

	Group 1 ^a	Group 2 ^b
Age (years)	75.70	77.26
Female	21	24
Male	9	19
Total Positive Cases	30	43
Asymptomatic (%)	21 (70)	24 (55.8)
Symptomatic (%)	9 (30)	19 (44.2)
Hospitalization	0	10
Death	3	9

^a Partially vaccinated (> day 14 after 1st dose of vaccine through day 7 after 2nd dose)

^b Limited vaccine protective effects (day 0 through day 14 after 1st dose of vaccine)

spread beginning three weeks after receiving the 1st dose of COVID-19 vaccine among the nursing home residents.⁹ The relative risk of COVID-19 infection after receiving both doses of Pfizer-BioNTech COVID-19 vaccine was approximately one third of the risk compared to those who received only the 1st dose of COVID-19 vaccine.

It was surprising that the relative risk of COVID-19 infection was not lower among the residents who were partially vaccinated (day 15th after 1st dose of vaccine through 7th day after 2nd dose of vaccine) compared to those within 14 days of their first dose of vaccine. In reviewing, 18 residents (60%) in the partially vaccinated group were diagnosed with COVID-19 on January 19th, which was 15th day after the 1st dose of COVID-19 vaccine. We suspected that these residents might have developed COVID-19 within 14 days of their 1st dose of COVID-19 vaccine but were not formally diagnosed due to limitations in testing schedules at the facility. In other words, these residents might have developed COVID-19 earlier than the test-based diagnosis date. Therefore, the incidence of COVID-19 among the nursing home residents within 14 days receiving the 1st dose of COVID-19 vaccine might actually be much higher than data indicated. Nevertheless, the majority of the residents who were diagnosed with COVID-19 during the period between the 15th day of receiving the 1st dose of COVID-19 vaccine and the 7th day after receiving the 2nd dose of COVID-19 vaccine were asymptomatic. There were less hospitalizations and deaths in this group of residents as well. We believe that residents who were partially vaccinated with the Pfizer-BioNTech COVID-19 vaccine had fewer symptomatic cases and relatively better outcomes during the COVID-19 outbreak in this nursing facility.

There are limitations for this retrospective cohort study. First, the onset date of case was based on the first positive COVID-19 test result date. There might have been a delay in diagnosis due to the limitations of testing at the facility. Secondly, the sample size in this study was small, and statistical analysis could not be performed to compare hospitalization and mortality rates. Third, the observation period included only two months, beginning from the 1st COVID case to ending 4 weeks after the last COVID case occurred in this facility. Future study with a larger sample size to assess the effectiveness of COVID-19 vaccine among nursing home residents over longer time period is needed.

Conclusions and implications

These retrospective cohort study findings indicated that residents partially vaccinated with the Pfizer-BioNTech COVID-19 vaccine had fewer symptomatic cases and hospitalizations during this outbreak, however the incidence rate was not lower compared to those developing COVID-19 within the first two weeks of 1st dose of COVID-19 vaccine. Routine infection prevention and control practices recommended by the Centers for Disease Control and Prevention remain essential for nursing home residents and staff. The risk of SARS-CoV-2 infection was much lower among nursing home residents receiving both doses of COVID-19 vaccine as compared to those receiving only the 1st dose of vaccine. Completion of both doses of COVID vaccination for all nursing home residents is essential and can prevent future COVID-19 outbreaks in nursing homes.

In addition to guiding policy and practice for long-term care residents of nursing homes, this data should also guide policy and practice for short-term rehabilitation residents of Skilled Nursing Facilities (SNF). Policies long adapted for influenza, namely aggressive vaccination campaigns of hospitalized patients prior to discharge to SNF, would not be sufficient for short-stay residents with length of stays of average of 2–3 weeks at the SNF. Skilled Nursing Facilities need to be well aware of the vulnerability these patients still face during the pandemic. In addition, continued and aggressive community-wide vaccination, not waiting until an incident hospitalization, will be important for the protection of the short-stay skilled nursing population.

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