Assessing the Relationship Between Infection Citations and COVID-19 Infections in Nursing Homes

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Background

Nursing homes (NHs) bear the responsibility of caring for our more vulnerable geriatric population. As of 2016, there are 15,600 nursing homes across the United States with 1.7 million licensed beds.[1] In order to maintain guidelines to care for this population, the Centers for Medicare and Medicaid have regulations for all aspects of NHs, including infection control, in order to remain within the Medicare and Medicaid programs.[2] The regulations regarding infection control denote various aspects of the infection prevention plans NHs must take in order to minimize the spread of infections, including the implementation of an infection preventionist, reducing direct and indirect transmissions, and documenting and monitoring infections, among others.[3] NHs are surveyed by the Centers for Medicare and Medicaid to ensure adherence to the regulations, risking citations of various degrees of harm if they are found to be noncompliant.[3] As of June 28, 2020, the total number of reported deaths from COVID-19 in NHs in the US had reached 35,517.[4] At that time, fatalities from COVID-19 in NHs made up roughly 40% of all fatalities from the virus in the United States, demonstrating a significant need for containing the spread of infection in these facilities.[5] During CMS inspections, NHs most commonly faced citations for deficient infection prevention and control practices, with 82% of these facilities receiving a citation between 2013 and 2017, according to a study conducted by the United States Government Accountability Office.[6] An article discussing NHs specifically in Ohio cited low staffing as a major determinant of deficient infection control practices, and suggested a connection between these variables and COVID-19 cases.[7]

Introduction

The emphasis placed upon regulation of NHs suggests a potential link between the number of citations a nursing home receives for improper infection control, and the number of COVID-19 cases and deaths among residents that a NH faces. This study focused on nursing homes in the West Coast, assessing:

1. **the relationship between staff COVID-19 cases and resident COVID-19 infections**
2. **the relationship between staff shortages in nursing homes and COVID-19 infections and deaths**
3. **the potential relationship between nursing home citations for various infection control related deficiencies and the number of COVID-19 cases and deaths.**

Methods

- **Data Collection**
  - Data regarding deficiency citations and COVID-19 cases/deaths for six states (Nevada, New Mexico, Arizona, Idaho, Utah, and California) was obtained from CMS' Nursing Home Compare Dataset and COVID-19 Nursing Home Dataset, respectively.
  - Citations for deficiencies pertaining to infection control as defined by the CMS[8] were selected based on standards updated in May 2020.
  - Citation data was collected for the period between March 1, 2019 and February 29, 2020.
  - COVID-19 data was collected for the period between January 1, 2020 to June 21, 2020.
- **Analysis**
  - The relationship between staff confirmed-COVID cases and resident cases was examined using a Fisher's exact test.
  - A linear model with binomial error was used to explore how prior citations and staff shortages affected the number of cases (relative to the number of occupied beds in the facility), and the number of occupied beds was included in the model as a covariate. In the model looking at predictors of COVID-19 deaths, only NHs with at least one case were included. The model predicting COVID-19 deaths was otherwise identical to that for COVID-19 cases.
  - Additional models were fit to look at the relationship between each specific citation type and COVID-19 cases and deaths for the state of California.

Results

- NHs with at least one COVID-19 positive staff member were 14.1 to 27.8 times more likely to have at least one COVID-19 positive resident (Table 1).
- No significant association was found between staffing shortages and COVID-19 cases or deaths for any state.
- A positive correlation was found between citations received for the five deficiency categories in the previous year and the number of COVID-19 cases in Californian NHs (Figure 1, *p<0.001)*.
- Previous citations regarding infection prevention and control specifically was also strongly associated with COVID-19 cases (Figure 1, *p<0.006*), as well as deaths (Figure 2, *p<0.08*) in Californian NH residents.
- A negative correlation was found between citations in the past year and the number of COVID-19 cases and deaths in a facility in Arizona (Figure 1, *p<0.05* and Figure 2, *p≤0.005* respectively). A negative relationship between citations and COVID-19 cases was observed for Utah NHs as well (Figure 1, *p<0.001*).
- In California, one or more citations for problems related to implementing a program monitoring antibiotic use, preventing urinary tract infections, and preventing or caring for ulcers, but not pneumococcal vaccinations, were positive predictors of COVID-19 cases (Figure 3, *p≤0.001*).

Table 1

	Odds Ratio	95% CI	P-value
AZ	14.6	6.6, 35.2	<0.001
CA	14.1	10.3, 19.5	<0.001
ID	27.5	6.4, 172.6	<0.001
NM	20.6	5.8, 95.9	<0.001
NV	27.8	3.7, 1255.4	<0.001
UT	25.9	7.9, 113.6	<0.001

Table 1 Odds ratios (95% confidence intervals) reflecting how a COVID-19 positive nursing home staff member relates to having a positive test for residents within the nursing home. The presence of COVID-19 positive staff increases the risk of residents testing positive for COVID-19. P-values are based on Fisher's exact tests.

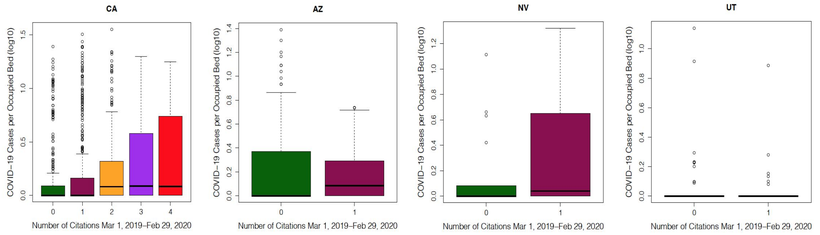

Figure 1 Boxplots for COVID-19 cases per occupied bed relative to the number of citations between March 1, 2019 and February 29, 2020 for four states. For all states other than California, the last class for citations was grouped to include those who had more than the listed number of citations, such that "0" denoted no citations, and "1" denotes one or more citations. For the boxplots, the line within the box represents the median (50th percentile), the box is bounded by the interquartile range (25th to 75th percentiles), and outliers are indicated by dots. Boxplots for New Mexico and Idaho are omitted as no significant association was found for these states. California showed a significant positive correlation (*p<0.001)* between number of citations and number of COVID-19 cases, whereas Arizona and Utah showed a significant negative correlation *(p<0.05 and p<0.001,* respectively*)*. Nevada showed no significant correlation but appeared to display the same trend as California.

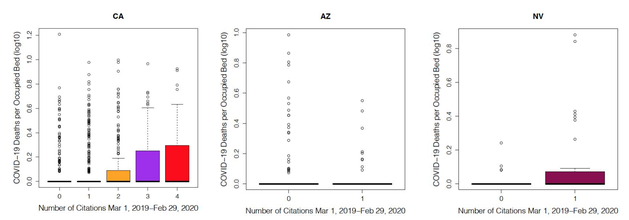

Figure 2 Boxplots for COVID-19 deaths per occupied bed relative to the number of citations between March 1, 2019 and February 29, 2020 for three states. Details for boxplots follow Figure 1. Boxplots for Utah, New Mexico and Idaho are omitted as they were not significant. California showed a significant positive correlation (*p<0.08)* between number of citations and number of COVID-19 deaths, whereas Arizona showed a significant negative correlation *(p<0.005)*. Nevada showed no significant correlation but appeared to display the same trend as California.

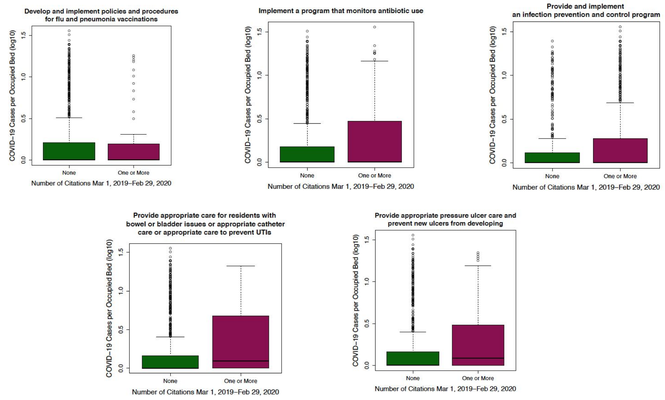

Figure 3 Boxplots for COVID-19 cases per occupied bed relative to the presence of five different infection control-related citations California between March 1, 2019 and February 29, 2020. Details for boxplots follow Figure 1. A significant positive correlation *(p≤0.001)* was found for all citations except "Develop and implement policies and procedures for flu and pneumonia vaccinations."

Discussion and Conclusions

- **COVID-19 positive staff members strongly predicted COVID-19 cases in residents, suggesting community spread was taking place (Table 1).** This may be due, in part, to the fact that although the CMS provided recommendations to State and local officials in March 2020 regarding the monitoring and restricting of visitors and/or staff, the agency has ultimately left these decisions up to the discretion of the state, local government, or nursing homes themselves.[9, 10, 11] This suggests community spread, as nursing home staff are not confined to the facilities as residents are; staff then may have encountered the virus within the community and introduced it to the residents in the facility.
- **Staff shortages did not appear to be a predictor in COVID-19 cases or related deaths in these states.** However, a previous study conducted in Connecticut showed that nursing homes with higher registered nurse staffing had the potential to better control the spread of COVID-19.[12]
- **Previous infection control citations could either positively or negatively predict COVID-19 cases and deaths (Figure 1 and Figure 2, respectively).** The variability observed in the different states also suggests the possibility that there are different responses to infection control citations.
- **Overall infection prevention best practices, such as maintaining good hygiene, keeping catheters and wounds clean, and preventing overprescription of antibiotics help mitigate the risk of transmitting and contracting infectious diseases such as COVID-19.** An analysis of California showed that one or more citations for problems related to implementing an infection prevention and control program, preventing urinary tract infections, implementing an antibiotic use monitoring program, and/or preventing or caring for ulcers was positively associated with the number of COVID-19 cases per occupied bed (Figure 3). Data from other states was insufficient to draw any conclusions.
- **Study Limitations:** First, the CMS was criticized for the number of errors in the COVID-19 Nursing Home Dataset in early June, though the CMS has acknowledged that the data was preliminary and may contain data entry and reporting errors, as nursing homes had the option to either retroactively report cases from January 1, 2020 to May 17, 2020, or report cases from May 1, 2020.[13] The data from the COVID-19 Nursing Home Dataset we accessed was the most current as of July 5, 2020, so it is possible that not all corrections have been made. Additionally, nursing home data was insufficient for states that we looked at, namely Idaho and New Mexico, as they had low numbers overall which hindered statistical power. This may be due to the reporting rules implemented by CMS as well.

Future Directions and Recommendations

- **A thorough exploration into the relationship between staff shortages and COVID-19 infections with more states is warranted.** Although our data showed no significant association between shortages and infection, there may be variation between many states due to a multitude of factors.
- **With increasing data availability, further research may elucidate the relationship between citation history and COVID-19 cases in different states.** A history of previous infection control citations between March 1, 2019 and February 29, 2020 predicted different trends in the number of COVID-19 cases between states. An exploration of the oversight and correction process of deficiencies between states is necessary in order to determine the cause of variation. Our study provides a preliminary glance at the trends occurring in these states.
- **The breakdown of citations within California provides important information regarding best infection control practices that may be of increased importance during a pandemic.** Many of these violations were classified as isolated cases or patterns in the facilities that may not have caused actual harm to the residents, but had the potential to more than minimally harm them. Seemingly small oversights regarding infection control may unnecessarily expose residents to undue disease transmission, justifying the need for stricter infection control policies.
- **Future studies can analyze the effectiveness of nursing home infection prevention policies in other nations.** Hong Kong provides anecdotal evidence, for example. At the time of this research, the nation reported no COVID-19 deaths in nursing homes, and officials reported they were prepared for a novel coronavirus outbreak after experiencing the devastating effects of the SARS epidemic in 2003.[14]

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Approval & Disclaimer

The views expressed on this poster are those of the authors only and do not reflect the official policy of Touro University Nevada, College of Osteopathic Medicine or the Touro University System.

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