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Frances Fuks Date

Examining the Association between Job and Demographic Characteristics and Vaccine Uptake among Long Term Care Facility Staff Early in the COVID-19 Pandemic

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By

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Abstract

Examining the Association between Job and Demographic Characteristics and Vaccine Uptake among Long Term Care Facility Staff Early in the COVID-19 Pandemic

By

Frances D. Fuks

Background: Long term care facilities (LTCF) have faced numerous challenges since the start of the COVID-19 pandemic. LTCF staff and residents were prioritized for vaccine allocation; however, reports suggested many staff were reluctant, leading to low vaccine uptake rates. We evaluated the relationship between certain demographic and job-specific characteristics and vaccine hesitancy among staff working in a sample of LTCFs in Georgia.

Methods: Primary data collection occurred during site visits at 14 LTCFs between February and May, 2021**.** Consenting staff completed questionnaires of demographic and occupational information, including exposure to COVID-19 infections. Survey data were linked to two external dataset. First, Center for Medicare and Medicaid Services (CMS) case data to estimate facility-specific cumulative incidence of resident COVID-19 infection, and second community COVID-19 cases from Georgia Department of Public Health (GDPH) to estimate community burden of disease. Univariate and multivariable logistic regression were used to evaluate whether demographic, occupational characteristics, or LTCF characteristics were predictive of vaccine hesitancy.

Results: There were 447 vaccinated and 310 unvaccinated voluntary participants included in the study. Both demographic factors (age and race) occupational factors (job role) and LTCF factors (Cumulative incidence of resident COVID-19 infection) were associated with vaccine hesitance. Independent predictors of vaccine hesitance include job categories certified nursing assistants (CNAs) (aOR = 3.23) and Nurses (aOR= 2.22) compared to non-patient care or healthcare administration. Older staff were found to be less vaccine hesitant (60+, aOR = .36; 50-59, aOR= .41) compared to staff younger than 40.

Conclusions: Accounting for age, race, and amount of COVID-19 disease among facility residents, the most patient-facing job roles, specifically CNAs were least likely to have received the vaccine. Targeted messaging to these groups of workers is of paramount importance to prevent SARS-CoV-2 transmission in LTCF.

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Introduction

Problem Statement

Even though creation of the vaccine has been successful and large portions of the United States has received >1 inoculation, the threat of COVID-19 is still present and increasing as the new variants emerge and increase in prevalence within the nation. Even minor gaps in vaccination coverage among populations at increased risk for severe disease, such as nursing home residents, is a continued risk; thus, vaccination efforts remain ongoing. Although reasons for vaccine hesitancy are complicated, epidemiologic analysis linking community-based and facility-based factors will be helpful to target interventions to improve vaccine uptake as the pandemic progresses, while providing useful for any future pandemics.

Purpose Statement

The present study will shed light on the risk factors and potential reasons why long term care facility (LTCF) staff have not received the Covid-19 vaccine in the months following the vaccine's release. This research will help to inform future directions for developing, implementing, and evaluating vaccine related promotional programs and policies to improve vaccine coverage and ensure patient safety in nursing homes in facilities where staff vaccination is an issue. It has been evident that vaccine coverage varies from state to state and among counties; the present research will inform on risk factors for non-vaccination in LTCF staff in Georgia.

Background

COVID in LTCFs

The COVID-19 pandemic has disproportionately affected LTCF residents and staff; in the early stages of the pandemic, 40% of all COVID-19 deaths occurred in a LTCF[20]. Infection control practices such as social distancing, masking requirements, and personal protective equipment have been mandated while vaccine development was in progress, but these measures did little to alleviate the burden of COVID-19[6]. LTCFs are locations that require frequent and close contact between healthcare practitioners and residents. Nationally, an estimated 4.5 million LTCF staff work in close frequent contact with residents, whom are typically older adults with underlying medical conditions at higher risk of more severe outcomes from COVID-19[20]. This makes asymptomatic transmission from staff to resident a larger threat, especially among CNAs whom routinely bathe residents and assist in other regular daily function. Early in the pandemic, facilities stopped accepting new residents to help mitigate the spread; thus, the main source of transmission of SARS-CoV-2 in LTCFs was staff and resident interaction.

Residents and staff of skilled nursing facilities have faced challenges throughout the pandemic in terms of infections, supply shortages and fatalities[14]. Furthermore, much of LTCF staff deal with compounded health disparities; CNAs comprise 53% of the LTCF workforce, more than 90% are female, 49% black or Latino, 44% live in low-income households, and 36% are uninsured or on public health care[7]. As of January 30th 2022, the percentage of all deaths due to COVID-19 that occurred in LTCFs has decreased to 23%. Enhanced infection control measures were put into place around September of 2020 therefore, this decrease in deaths occurring in LTCFs can be

attributable to the vaccination of residents and staff highlighting the importance of increased vaccine uptake[7].

Release of the Vaccine

Since the pandemic became a global concern, government and pharmaceutical companies were quick to allocate funding and resources to vaccine research and development[13]. In late 2020, the FDA approved two COVID-19 vaccines for distribution. Through the Pharmacy Partners for Long Term Care Program, the first wave of vaccine allocation prioritized healthcare personnel and LTCF residents[3]. When the vaccine was released two of the largest nursing home trade groups, the American Health Care Association and LeadingAge, set a target to vaccinate at least 75% of LTCF staff by June 2021[19]. However, when June 2021 arrived, only 4% of facilities in Georgia had reached the proposed target with an average vaccination rate of 45%. As of January 30th 2022, the percent of vaccinated LTCF staff in Georgia has increased to above 80%. Unfortunately, Georgia, with 18% of LTCF staff boosted, remains one of the states with lowest rates of booster shot uptake[4].

Vaccine Hesitancy

Vaccine hesitancy is a complex phenomenon that does not solely depend on vaccine efficacy and safety, but has a psychological basis. One's assessment of risk and benefit and perceived safety and efficacy of a vaccine have large effects on the decision to get vaccinated. Vaccine hesitancy is defined as the refusal or delay in vaccination despite readily available means of vaccination services[12]. Vaccine hesitancy and subsequent lack of vaccination poses a threat to both the individual and the community. While vaccine hesitancy has been present in society since the creation of the first vaccine,

public health programs often succeed at vaccination coverage sufficient to reach herd immunity for many vaccine preventable diseases. Herd effect is defined as the protection among those who are not immunized indirectly by those who are immunized. It is likely that not everyone in the population will receive the vaccine; thus, herd effect is a frequently cited goal of vaccination campaigns[9].

Vaccine hesitancy has been demonstrated in past pandemics such as, the influenza pandemic. Therefore, it is crucial to understand and reflect on vaccine hesitancy to the influenza vaccine both historically and currently in LTCF staff[24]. The main concepts cited among LTCF staff when asked about accepting the influenza vaccine inoculation are confidence, complacency, and convenience[16]. The largest indicator of lack of influenza vaccine uptake is confidence, a perceived ineffectiveness in the vaccine. Belief that the vaccine not only does not protect from influenza, but that itself causes influenza[18]. Complacency and convenience come into light when asked about risk and severity of influenza in their homes and at their work place. LTCF staff respond neutrally stating that they do not perceive risks of influenza in their homes or in their workplace leading to low vaccine uptake.

COVID-19 Vaccine Hesitancy LTCF Workers

With what is already known about vaccine hesitancy in LTCF staff from the influenza pandemic it was expected for COVID-19 vaccine hesitancy to exist. However, the rates of vaccine uptake which were displayed during the initial rollout suggest that there are additional factors besides those surrounding the influenza vaccine. In terms of the current COVID-19 pandemic, convenience unlikely plays a large factor into the current vaccine hesitancy issue as many facilities have created partnerships with

pharmacies, give employees time off work to receive their vaccine and offer on-site vaccinations[3]. Therefore, confidence and complacency are likely to be the main drivers of COVID-19 vaccine hesitancy.

To further understand the concepts of confidence and complacency and their effect on COVID-19 vaccine hesitancy, qualitative studies utilizing virtual townhalls were performed to gain personal insights from healthcare personnel. Resulting concerns regarding the vaccine were categorized in four themes; mistrust of the vaccine efforts, misinformation, general and personal concerns about vaccine safety and need for increased vaccine uptake by those categorized as similar to themselves[7]. Healthcare workers have years of education and training to prepare for their roles and despite knowledgeable in their role, researchers frequently assert that insufficient knowledge or understanding of the vaccine as a reason for hesitancy[23]. Willingness to receive the vaccine is heavily connected to roles within the healthcare system with research scientists and physicians leading the charge in terms of vaccination rates[22].

In November 2020, prior to release of the vaccine, surveys were administered to gauge LTCF staff's willingness to be vaccinated upon release. 45% of respondents claimed willing to receive immediately, and 24% were willing to in the future once more information was known[6]. Despite increased research showcasing vaccine efficacy and safety, hesitancy remains widespread among LTCF staff. Potential underlying risk factors that lead one to these concerns include high staff member turnover, staff members working in multiple facilities, and limited resources for staff member outreach and education[6]. Vaccine uptake among CNAs, the largest job category in LTCFs, was the group with the lowest vaccine uptake, but was also the group with the largest percentage

of SARS-CoV-2 infection[10]. Further exploration highlighted the impacts of 4 social vulnerability matrices among LTCF personnel, and indicate that those who reside in a zip code with a higher percentage or racial and ethnic minorities, percentage of those living in poverty, and percentage without a high school diploma are groups with the lowest vaccination rates. Conversely, those living in a residential zip code with high median income had lowest rates of vaccination among those living in moderate to low median incomes zip codes[10].

Race and Vaccine Hesitancy

Data consistently shows that Black or African Americans in the United States have higher rates of either being unsure about receiving the vaccine or refusing vaccination entirely. Studies note that a history of unethical and misuse of Black people in medical research and medical care as reasons for hesitancy among this population, going as far as claiming it has led to generations of mistrust of the medical field[11]. A cross sectional study, investigating predictors of COVID-19 vaccine hesitancy, focused on socio-demographic factors, co-morbidity and previous experiences of discrimination as possible explanatory variables. Discrimination was categorized based on race, gender, religion, and sexual orientation. The only variable that was significant after accounting for all other factors was experiencing discrimination that was attributable to race[21]. Furthermore, another study done to explore the differences in vaccine hesitancy among healthcare personnel found that compared to White healthcare personnel, Black healthcare personnel were 5 times as likely to express vaccine hesitant sentiments such as refusal, being unsure about or plans to delay vaccination[15]. Therefore, race is a key variable of interest for vaccine uptake in LTCF in the present analysis.

A step to better refine educational efforts or COVID-19 vaccine policy involving identification of the subset of LTCF staff that are at highest risk of deferring or refusing vaccine administration is needed. We utilized an existing dataset from a prospective assessment of healthcare worker SARS-CoV-2 Infection risk which occurred during the winter months of the 2020/2021 pandemic.

Methods

COVID-19 Prevention in Nursing Homes (COPING) serologic survey study

The data used for this paper come from a study designed to estimate rates of infection through serologic testing of nursing home staff. COPING is a prospective longitudinal cohort study with participants recruited in fall 2020. Participants were followed and assessed for seroconversion after 5-6 months. The data from the second survey and self-reported exposures including vaccination status were used for the present analysis.

Study Population and Primary Data Collection

Participants were recruited from 14 LTCFs selected from 54 facilitates associated with 4 healthcare systems in Georgia. Eligible staff were 18 years or older and employed or contracted by one of the fourteen participating facilities. Recruitment included emails, flyers, and conversations between leadership and staff departments. Study staff visited each facility for two to three days to administer surveys. The second round of assessments were conducted from February 11th to May 6th, 2021 There were 783 subjects that consented and completed the second round assessment; however, 26 participants had incomplete surveys leaving 757 available for this analysis.

External Data Sources

Confirmed COVID-19 case data from GDPH was used to evaluate community level exposure to COVID-19. Community cases were the number of documented COVID-19 cases occurring in a participant's residential zip code tabulation area (ZCTA) from March 2nd, 2020, the date the first case was reported in Georgia, to two weeks prior

to the subject's second assessment is referred to as community exposure. ZCTA-specific population estimates were obtained from the 2019 American Community Survey to provide a population denominator. We defined community-incidence as the number of cases occurring in a subjects ZCTA divided by the ZCTA-specific population estimates and rescaled to represent the incidence per 100 residents. To assess a participant's exposure to COVID-19 within their facility we used case data from CMS.

Statistical Analysis

Data management was done using R studio software and statistical analysis was done using SAS statistical software and a SAS Macro created and approved of use in the current research by Dr. Yuan Lui.

Descriptive analysis was performed on age, job role, study week, known COVID-19 contacts at work, race, and time employed. Univariate analysis, using logistic regression, was done to estimate unadjusted ORs for each *a priori* identified variable and vaccine receipt including an additional variable of interest, cumulative incidence of resident COVID-19 infection.

To examine the relationship between a participant's community-incidence and vaccine receipt a Wilcoxon Signed Rank Test, a nonparametric statistical test, was performed.

Multivariable Analysis

For the multivariable logistic regression model, due to small numbers in certain levels, variables were further grouped together. This analysis was done using SAS statistical software and a macro, developed by Dr. Yuan Lui, which performed a multivariable logistic regression with backwards elimination utilizing a cutoff point of p-

value =.1. Since univariate analysis revealed that both levels of the variable ‘known contacts at work’ were insignificant, and interactions were not investigated, it was not included for eligibility in the multivariable mode. All other variables were eligible for inclusion and include job role, age category, race, time employed at main facility, study week, facility cumulative incidence, and community-incidence. To account for facility-specific differences which could present a clustering effect, primary facility of work was placed in the model as a random effect.

Description of Variables

Vaccine Receipt is a dichotomous categorical variable that was self-reported by participants at time of second survey collection. Those who said they were unsure of vaccine receipt due to participation in a clinical trial were grouped with those who said yes to self-reported vaccine receipt because participation in a clinical trial required the subject to accept being vaccinated or not prior to entrance in the trial.

Job role is a categorical variable that reflects a staff member’s position within an LTCF. Roles are grouped based on anticipated nature of their interactions with residents. Non-patient care includes healthcare administration jobs such as human resources and staffing and is used as the reference group due to minimal or no interaction with residents. Peripheral patient care represents low interaction with residents and includes positions such as activity workers, environmental workers, and food services. Furthermore, physical therapy, occupational therapy, speech and language therapy, social work, and physicians were grouped together and deemed intermittent patient care. Nurses including registered nurse, and licensed practical nurse represent moderate contact with residents. Finally, CNAs represent high contact with residents.

Study Week represents time at which the survey was conducted. Thus, this variable indicates the date the subject was asked whether he or she was vaccinated; not representative of date of vaccination. Timing of assessment was split into 6 discrete biweekly categories based on facility visit date. The dates of each study week are as follows:

Week 1 – February 11th 2021 – February 24th 2021

Week 2 – February 25th – March 10th 2021

Week 3 – March 11th 2021 – March 24th 2021

Week 4 – March 25rd 2021 – April 7th 2021

Week 5 – April 8th 2021 – April 21st 2021

Week 6 – April 22nd 2021 – May 6th 2021

Race is a self-reported categorical variable, split into three categories White, Black, and Other. Due to small sample sizes of certain races, 'other' includes Asian, American Indian or Alaskan Native, Native Hawaiian or Other Pacific Islander.

Time Employed is a categorical variable that represents how long, in months and years, an employee has been working in their main facility of employment.

Known Contacts at Work is defined as having close contact with someone at work. Close contact includes 20 minutes or more of caring for someone, speaking with, or touching any persons with confirmed of suspected COVID-19 within the last 3 months.

Cumulative incidence of resident COVID-19 infection is defined as the number of residents with SARS-CoV-2 infection reported between the two time points divided by the mean interval census. Mean interval census is the mean occupancy of each facility over the 5-6 month period between timepoints.

Results

Characteristics of LTCF Staff

The study population consists of 757 subjects from 169 zip codes across Georgia, with a large portion of subjects residing around Atlanta and the next largest group residing around Albany Georgia (Figure 1). Participants' ages were approximately uniformly split among the 4 categories. The largest age group is 50-59 years (n= 214, 28.3%) and the smallest group is 60+ (n=138, 18.2%). Subjects worked in non-patient care (n=109, 14.4%), peripheral patient care (n=169, 22.3%), intermittent patient care (n= 114,14.1%), nurse (including RN, LPN) (n=186, 24.6%) and CNA (n=177, 23.4%) (**Table 2**). A majority (445, 58.8%) were surveyed within the first 4 weeks of study period. About two-third (503, 67%) of subjects identified as Black or African American. The largest group for time employed at main facility was those who have been working at the same facility for 10 or more years with 192 subjects (25.4%). All characteristics of interest contained less than 10% missing values. The variable with the largest amount of missingness is known work contacts with 61 (8.1%) subjects either skipping the question or stating 'unknown'.

Facility-specific Measures

To examine facility-specific measures for use in modeling, staff vaccination rates and cumulative incidence of COVID-19 infection were calculated and detailed in Table 3. Facilities assessed in study week 1 had the highest cumulative incidence, while those assessed in the later weeks, 5 and 6, had low cumulative incidence and high percentage of vaccinated staff (**Table 3)**. Furthermore, facilities assessed in weeks 1 and 2 had highest changes in resident total confirmed COVID-19 infection.

Univariate Analysis

Several subject characteristics were associated with vaccine hesitancy. These variables include age, job role, Black race, time employed greater than 2 years, and high cumulative incidence of resident COVID-19 infection (Table 2). Younger subjects (<40 years) were less likely vaccinated (104, 48.8%) than those over 60 years (93, 67.4%) (OR = .46, 95% CI .30 -.72) (**Table 2**). Eighty (73.4%) subjects with non-patient care roles were vaccinated and 29 (26.6%) of non-patient care participating subjects were not vaccinated. Meanwhile, CNAs, those with the most contact with residents, consisted of 95 (53.7%) subjects who were not vaccinated and 82 (46.3%) subjects who were vaccinated (OR=3.2, 95%CI 1.91-3.12). Lastly, the subject's cumulative incidence of resident COVID-19 infection was a significant predictor. Those whose primary facility of employment had a high cumulative incidence of resident COVID-19 infection, over the course of the study period, had higher odds of not being vaccinated (OR=1.92, 95% CI 1.42-2.58) (**Table 2**).

The subject's community-incidence rate was not a significant predictor of vaccine hesitancy. The median zip code cumulative incidence for vaccinated staff is 8.86 cases per 100 residents and the median zip code cumulative incidence for not vaccinated staff is 8.77. The Wilcoxon Signed Rank two-sample test produced a one direction P-value of .198 and a 2-tailed p-value of .384 (**Table 5**).

Interfacility Variability by Study Week

To see the examine the relationship between study week and facility level vaccination rates the percent of vaccinated staff per facility were plotted against study week (Figure 2). Over the course of the study period, of 12 weeks, the variability between

the percent of vaccinated staff decreases between facilities surveyed during the same study week. The range in percent of vaccinated staff in study week 1 is 26.8%, while the range between the two facilities whose data collection occurred in week 6 is 2.3%. The variability in percentage of vaccinated staff reached a peak in week 2 with a range of 31.6%. Similarly, there is an increase in percent of vaccinated staff over the course of study period. The largest increases occurred from week 5-6 to week 7-8 with a change of 9.6% and another increase of 9.5% in week 9-10 with a 9.5% (Figure 3).

Multivariable Logistic Regression

Study week was not eligible for inclusion in the backwards elimination model process based on the cutoff point of .1. However, due to the importance of study week on vaccine eligibility and perceived effectiveness of the vaccine, and subsequent vaccine uptake, study week was retained in the model. Second, community-incidence rate was not eligible for the multivariable model since the Wilcoxon Signed Rank test produced a p-value greater than .05. The final model includes 2 levels. The first level includes participant specific variables, these include job role, age, time employed at main facility and race. The second level includes facility-specific variables, these include facility interval infection rate and study week. 757 subjects were observed, due to missing values of exposure 684 subjects were analyzed for analysis. In the multivariable analyses for full study group job roles peripheral patient care, Nurse, CNA and Black race showed increased odds of vaccination relative to their reference group while age categories 50-59 and 60+ and employed at main facility great than 2 years showed decreased odds of vaccination relative to their reference group (**Table 2**).

Discussion

Agreeing to receive vaccination is an individual choice made based on a variety of factors. However, rarely has the risks of infection among patients, such as residents in LTCFs, been so closely tied to healthcare workers choice to be vaccinated as we have experienced during this pandemic; unvaccinated staff have been the primary point-source for many LTCF outbreaks[20]. Our study findings support findings from other settings that age and race are associated with vaccine receipt. However, we identified that the occupational activity with close interactions with patients, CNAs, are the most reluctant to be vaccinated, independent of established risk factors for vaccine hesitancy. The activities of the CNAs and Nurses are those that require close patient contact and likely transmission of respiratory viruses. Combining the delayed or lack of vaccination among staff with such close patient contact puts both staff and residents at risk for occupationally acquired SARS-CoV-2 if infected staff become infectious from outside community exposures. Positively, our results display a smaller proportion of unvaccinated CNAs than previous research. However, in comparison to non-patient care positions in this study such as staffing and healthcare administration, CNAs are 3.2 time as likely to be vaccine hesitant after accounting for facility factors. Large amounts of literature cites that CNA is a position that has dramatic turnover rates and burnout throughout their career[8]. Personal accounts of poor treatment by facility or residents, poor pay, and benefits often lead to these workers seeking other employment opportunities[8]. Our findings also suggest that working at a facility for more than 10 years is associated with a smaller likelihood of not being vaccinated against COVID-19. Thus, there is potential for interaction between these groups that will require further inquiry.

It is not surprising younger staff were more hesitant to receive the COVID-19 vaccine. Widespread misinformation plays a large role in the present vaccine hesitancy crisis and targeting women's infertility has been a strategy for anti-vaccination campaigns that health professionals are not immune to[1]. Considering that a large proportion of LTCF staff are female, a major concern for receiving the COVID-19 vaccine for this group is infertility[1].Thus, targeting LTCF staff less than 40 years old through specific messaging, education, and one-on-one conversations tackling misinformation to address their concerns can be a strategy to increase vaccine uptake.

Race is another individual characteristic that was associated with increased likelihood of vaccine hesitance. The COVID-19 pandemic has highlighted the structural and systematic racism that exists in the United States through case and mortality counts displaying disproportionate impact of the pandemic on Black and African Americans[11]. Therefore, it is of great concern that this group of LTCF staff presents with higher rates of not being vaccinated. As previously suggested, Black and African Americans are a group with large amounts of mistrust in the healthcare system and medical research that may have led to high rates of not vaccinated Black LTCF staff. However, there are strategies to combat this issue; many claim that having a community champion is a productive means of increasing acceptability and uptake of vaccines[2]. Interestingly, according to DataUSA, 35.3% of CNAs are Black (Non-Hispanic) which may produce similar interaction as theorized between CNA and time employed at main facility of employment[17]. Future research should explore the possibility of a 3-way interaction between race, job role and time employed at a facility.

Study Week has a large impact on vaccination rates. Many LTCF staff felt the vaccine development was rushed, leading to safety concerns. Therefore, the first few weeks of the study saw similar frequencies of vaccinated and unvaccinated staff, while, the latter portion of the study saw drastically increased frequency in vaccinated staff. However, the multivariable logistic regression model found no significant impact of study week on vaccine hesitance. This can be attributed to other measures in the study are also facility-specific measures such as cumulative incidence of resident COVID-19 infection. This can also be due to low numbers of subjects assessed in the latter portion of the study.

Limitations

Survey instruments that contain questions based on subject self-report are susceptible to recall bias, a systematic error that impacts accuracy and completeness of the survey. Furthermore, the instrument attempted to extract sensitive information from the subjects that may have led to social desirability bias. This bias is a tendency of respondents to answer questions in a manner that he or she thinks the researchers, or viewers of the responses, may find favorable. The present research is a secondary analysis of an existing dataset. Therefore, the only residential information that was able to be extracted was zip code level data and subsequent ZCTA level case counts to approximate community level burden of disease. However, this may not accurately represent a subject's community exposure to COVID-19. In future research, a more precise unit of geographical location, such as census tract, may better represent community burden of disease. Lastly, the present research may suffer from selection bias by evaluating only those staff who consent to participation.

Conclusions

The present research highlights key characteristics that increase one's odds for vaccine hesitance during a 6 month period early in the Pandemic, when vaccines were first introduced. The most prominent findings are that CNAs, those who are less than 40 years old, and identifying as Black are among the LTCF staff with the highest likelihood of vaccine hesitance after controlling for facility-specific characteristics. Educational efforts or vaccine requirement policy changes may need to be target these staffing groups to maximize vaccine coverage among LTCF staff as the pandemic progresses.

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Table 1: Baseline characteristics of study population of staff from 14 nursing homes in GA

Baseline characteristics	Population (N= 757) N(%)
Age group	
<40	213 (28.1)
40-49	192 (25.4)
50-59	214 (28.3)
+60	138 (18.2)
Job role	
Non-patient care	109 (14.4)
Peripheral patient care	169 (22.3)
Intermittent patient care	114 (14.1)
Nurse (including RN, LPN)	186 (24.6)
Clinical Nurse Assistant	177 (23.4)
Study week	
Week 1-2	222 (29.3)
Week 3-4	223 (29.5)
Week 5-6	73 (9.6)
Week 7-8	73 (9.6)
Week 9-10	111 (14.7)
Week 11-12	55 (7.3)
Known COVID-19 contact at work	
No	395 (52.2)
Contact with 1 person	45 (5.9)
Contact with more than 1 person	256 (33.8)
Race	
White	165 (22.0)
Black	503 (67.0)
Other	35 (4.6)
Time employed	
Less than 6 months	105 (13.9)
6 months to 1 year	53 (7.0)
1 to 2 years	109 (14.4)
2 to 5 years	150 (19.9)
5 to 10 years	139 (18.4)
10 or more years	192 (25.4)

* All variables of interest had less than 10% missing values

* Non-patient care includes healthcare administration and staffing

Peripheral patient care includes activities and environmental services

* Intermittent patient care includes physical therapists, occupational therapists, social work, physicians and speech therapists

Table 2: Unadjusted and adjusted odds ratios of risk factors for self-reported vaccine receipt at 14 nursing homes in Georgia between February and May 2021

		Vaccine Receipt			
Characteristic	Value	Yes N(%) N= 447	No N(%) N= 310	Odds Ratio OR(95%CI)	Adjusted Odds Ratio aOR(95% CI)
Age	<40	104 (48.8)	109 (51.2)	1.00 Ref	1.00 Ref
	40-49	107 (55.7)	85 (44.3)	.76 (.51, 1.12)	.70 (.45, 1.10)
	50-59	143 (66.8)	71 (33.2)	.47 (.32, .70)	.41 (.26, .65)
	60+	93 (67.4)	45 (32.6)	.46 (.30, .72)	.36 (.21, .62)
Job Role	Non-patient care	80 (73.4)	29 (26.6)	1.00 Ref	1.00 Ref
	Peripheral patient care	98 (58.0)	71 (42.0)	2.0 (1.18, 3.37)	2.5 (1.34, 4.65)
	Intermittent patient care	76 (67.3)	39 (32.7)	1.43 (.81, 2.55)	1.60 (.81, 3.15)
	Nurse (Including RN, LPN)	111 (59.7)	75 (40.3)	1.86 (1.11, 3.12)	2.22 (1.20, 4.08)
	Clinical Nurse Assistant	82 (46.3)	95 (53.7)	3.20 (1.91, 5.36)	3.23 (1.74, 6.00)
Study week	Week 1-2	121 (54.5)	101 (45.5)	1.00 Ref	-
	Week 3-4	118 (52.6)	105 (47.1)	1.07 (.73. 1.55)	-
	Week 5-6	40 (54.8)	33 (45.2)	.99 (.58, 1.68)	-
	Week 7-8	47 (64.4)	26 (35.6)	.66 (.38, 1.15)	-
	Week 9-10	82 (73.9)	29 (26.1)	.42 (.26, .70)	-
	Week 11-12	39 (70.9)	16 (29.1)	.49 (.26, .93)	-
Known Work Contacts	No	248 (63.8)	147 (37.2)	1.00 Ref	-

	Contact with one person	25 (55.6)	20 (44.4)	1.35 (.72, 2.52)	-
	Contact with more than 1 person	137 (53.5)	119 (46.5)	1.47 (1.00, 2.02)	-
Race	White	112 (67.9)	53 (32.1)	1.00 Ref	-
	Black	286 (56.9)	217 (43.1)	1.60 (1.11, 2.32)	2.01 (1.28, 3.16)
	Other	28 (80.0)	7 (20.0)	0.30 (.09 1.06)	-
Time Employed	Less than 6 months	52 (49.5)	53 (50.5)	1.00 Ref	-
	6 months to 1 year	30 (56.6)	23 (43.40)	1.33 (.68, 2.58)	-
	1 to 2 years	60 (55.0)	49 (45.0)	1.25 (.73, 2.14)	-
	2 to 5 years	94 (62.7)	56 (37.3)	1.71 (1.03, 2.84)	.68 (.47, .98)
	5 to 10 years	88 (63.3)	51 (36.7)	1.76 (1.05, 2.94)	-
	10 or more years	120 (62.5)	72 (37.5)	1.70 (1.05, 2.75)	-
Cumulative incidence of resident COVID-19 infection	Low	231 (67.5)	111 (32.5)	1.00 Ref	1.00 Ref
	High	216 (52.0)	199 (48.0)	1.92 (1.42 2.58)	2.18 (.99, 4.78)

* Non-patient care includes healthcare administration and staffing
* Peripheral patient care includes activities and environmental services
* Intermittent patient care includes physical therapists, occupational therapists, social work, physicians and speech therapists
* Cumulative incidence of resident COVID-19 infection is defined as the number of residents with SARS-CoV-2 infection reported between the two time points divided by the mean interval census. Mean interval census is the mean occupancy of each facility over the 5-6 month period between timepoints
* Low Cumulative incidence of resident COVID-19 infection are rates was less than 50 cases per 100 residents; Cumulative incidence of resident COVID-19 infection are rates greater than 50 cases per 100 residents
*for multivariate modeling purposes White race and Other Race were combined, study weeks 9-12 were combined and time employed 2 to 10 or more years were combined

Table 3. Interval resident infection rate per 100 residents by facility from 1st timepoint to 2nd timepoint

Study week	Facility	Change in Resident Total Confirmed COVID-19	Interval Average Census	Cumulative incidence	Percent staff vaccinated
3	Facility 1	0	56	0.0	85.7%
6	Facility 2	5	107	4.7	71.9%
4	Facility 3	6	117	5.1	66.7%
5	Facility 4	6	94	6.4	72.0%
4	Facility 5	7	85	8.2	56.3%
6	Facility 6	7	58	12.1	69.6%
5	Facility 7	14	105	13.3	75.4%
2	Facility 8	17	98	17.3	76.7%
3	Facility 9	33	150	22.0	47.5%
2	Facility 10	77	146	52.7	45.1%
2	Facility 11	47	85	55.3	58.3%
1	Facility 12	68	116	58.6	56.9%
1	Facility 13	42	69	60.9	36.7%
1	Facility 14	72	114	63.2	63.5%

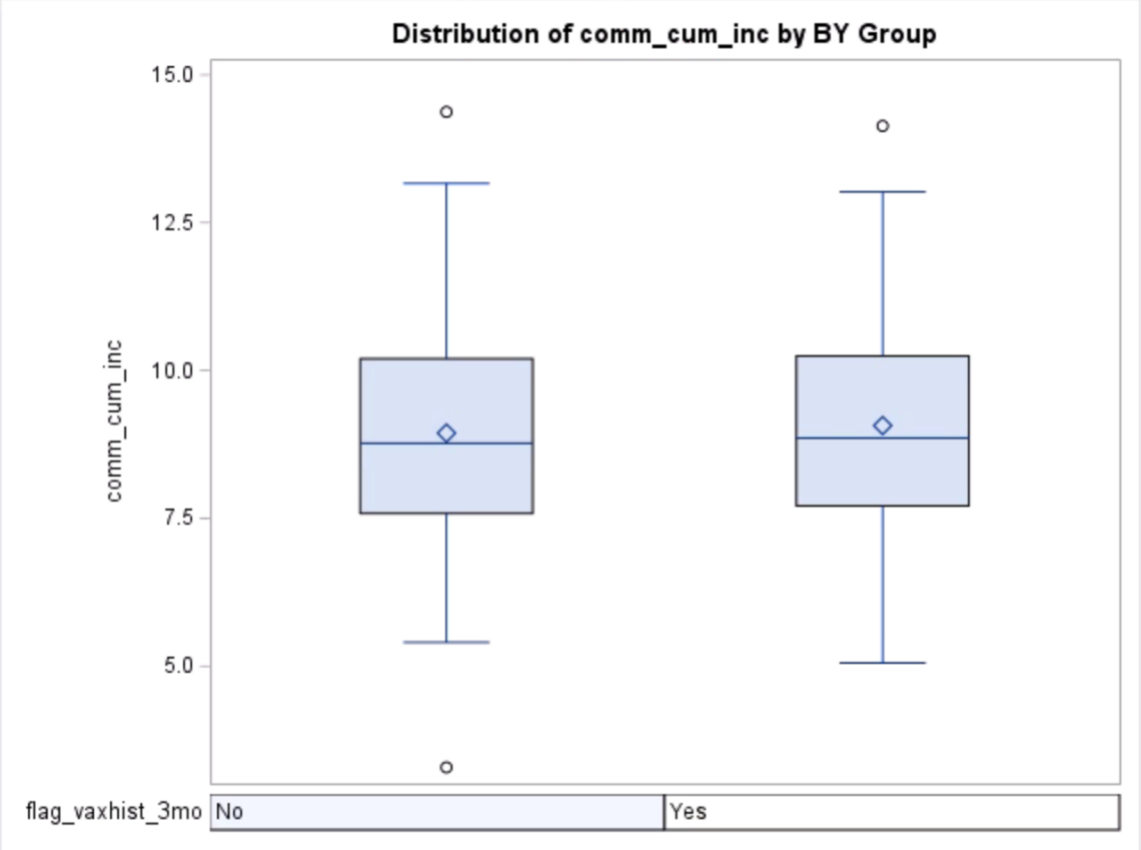
*Ordered by increasing cumulative incidence

Table 4. Wilcoxon Sign Rank test of Medians for Community COVID-19 incidence between vaccinated and unvaccinated staff per 100 residents

	N	25th Percentile	Median	75th Percentile	Mean Rank	Sum Ranks
Vaccinated	447	7.71	8.86	10.24	381.54	170547.50
Not Vaccinated	304	7.58	8.77	11.71	367.86	111828.50

Test Statistics

	Vaccinated
Test Statistic	170547.50
Z-score	-.848
P-value	.396



Figures

Figure 1: Map of the 169 zip codes that the participants reported reside from

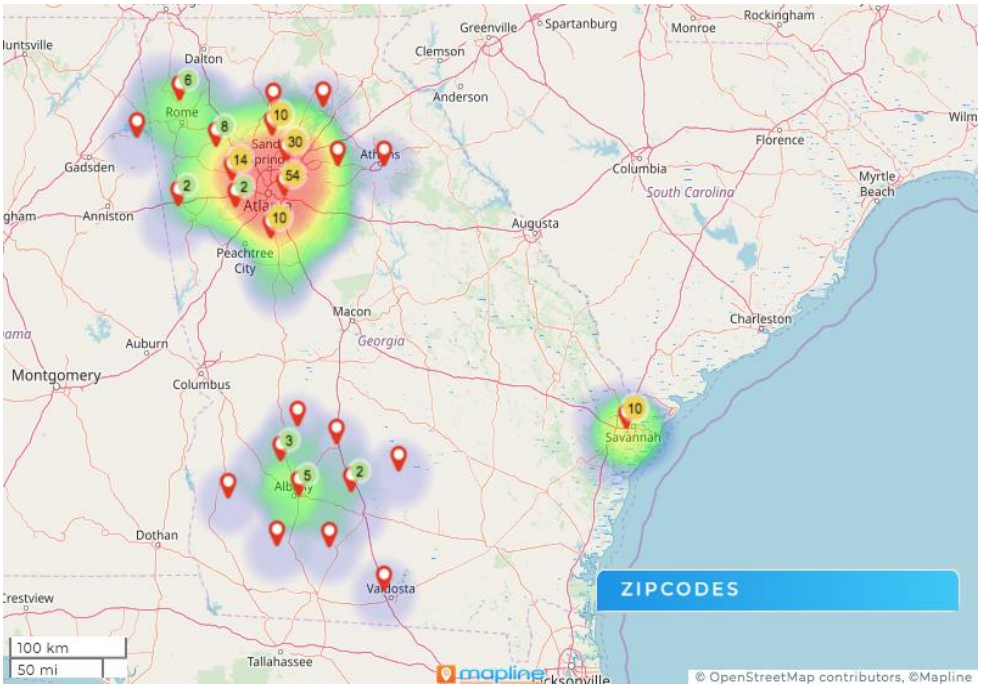


*figure created by Mapline software at Mapline.com
*red shading represents high density area (20 mile radius) of staff
*yellow shading represents moderate density outside of the 20 mile radius
*green shading represents low density of staff
*green and yellow pins with number signal how many zip codes are in that area of the map staff members reside in
*red pin represents a single zip code

Figure 2: Percent of surveyed staff vaccinated at each facility (open circles) by study week

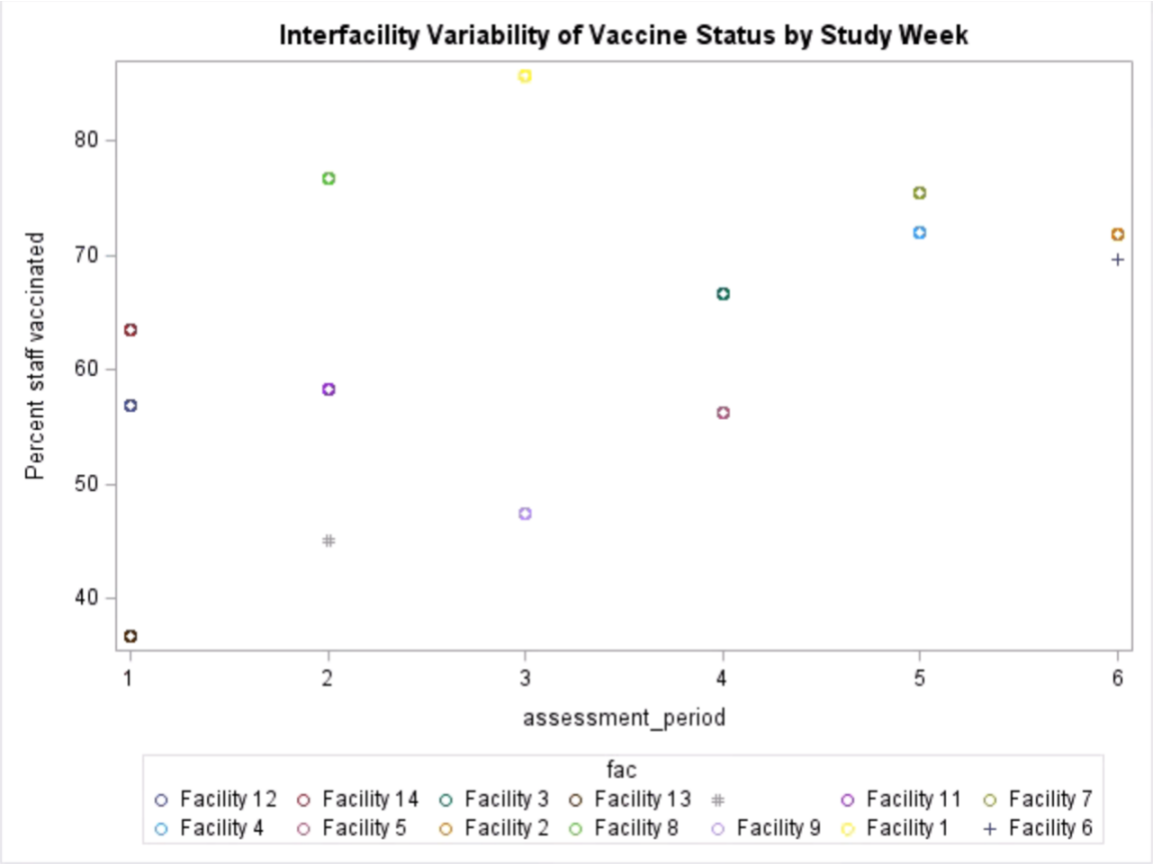
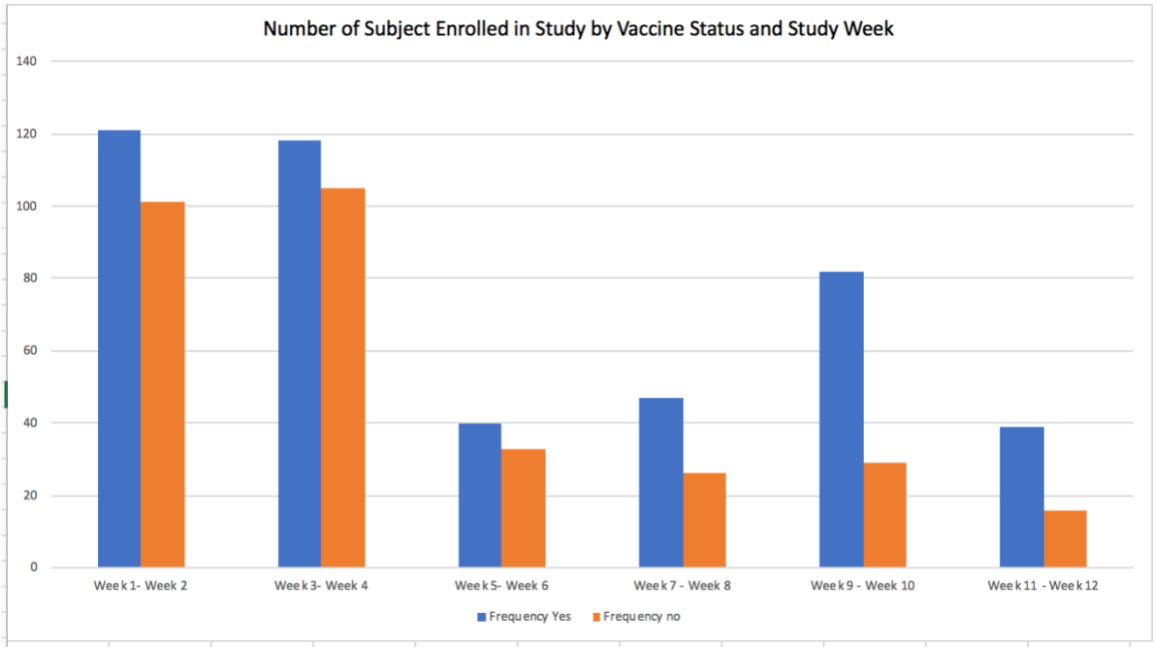


Figure 3: Frequency of vaccinated and unvaccinated staff by study week



Appendices

Appendix A: Acronyms

CMS	Centers for Medicare and Medicaid
CNA	Clinical nurse assistant
COPING	COVID-19 Prevention in Nursing Homes
GDPH	Georgia Department of Public Health
LTCF	Long term care facility
OR	Odds ratio
SNF	Skilled nursing facility
ZCTA	Zip code tabulation area