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Lessons learned in preventing COVID-19 within a skilled nursing facility during the early pandemic

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ABSTRACT

Objective: Guided by the vulnerable population framework, the aim was to describe the risks and protective strategies for COVID-19 spread and infections in a Skilled Nursing Facility (SNF).
Method: We conducted a retrospective cohort (March 1st−August 31st, 2020) study. Data were collected from internal COVID-19 documents and resident electronic health records. Data were summarized and analyzed using descriptive statistics, relative risk calculations, and cases charted by week onset.
Results: There were 325 residents who lived in and 296 staff who worked at the SNF during the study period. There was a total of 2 confirmed cases among residents and 4 confirmed cases among staff. Cases were isolated and all were living at their baseline health status at the end of the study.
Conclusion: Understanding the vulnerability to and protective strategies for COVID-19 within SNFs could strengthen resident care, resiliency among the SNF community, and improve health policies.

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Introduction

Skilled nursing facilities (SNFs) or nursing homes are healthcare settings that provide 24-hour supervised care and a home for people who are aging, have physical or mental disabilities, or who have complex medical or social needs. In addition to the residents or the people who live and receive care in SNFs, the SNF community is composed of a myriad of healthcare workers and the people who visit residents. Since the start of the coronavirus 2019 (COVID-19) pandemic, SNFs were identified as high-risk settings vulnerable to the rapid spread of COVID-19 and increased mortality due to COVID-19.[1,2] As a result, the SNF community has experienced some of the strictest social distancing requirements and most dire health consequences.[1,3,4] The COVID-19 pandemic has substantially impacted the lives of people who are part of the SNF community. Understanding the vulnerability to and protective strategies for COVID-19 in SNFs could strengthen resident care, resiliency among the SNF community, and improve health policies.

Background

In the United States, approximately 1.4 million people live in over 15,000 SNFs.[5−7] Residents of SNFs composed of approximately 3% of

the 65 years and older population and 10% of the 85 years and older population, nationwide.[5] In the United States, the average SNF has a bed census of 107 (range 2−1,389) and most SNFs are owned by corporations (69%) or for-profit individuals or partnerships (20%).[7] In a recent CMS inspection where SNFs are rated based on health inspections, staffing, and quality measures on a one-to-five rating scale, most SNFs received an average score and received one citation (range 0−22) from the infection control inspection.[7] Researchers exploring the rating system and COVID-19 case counts found SNFs with lower-than-average star ratings had higher COVID-19 cases.[8−10] Additionally, researchers found SNFs with over 50 beds, for-profit ownerships, resident populations that included >25% of people who identify as Black or African American and facilities that were located in urban locations had higher probabilities of having COVID-19 outbreaks as of May 11, 2020.[11]

The SNF community is vulnerable to COVID-19 for a myriad of reasons, including residents often are of advanced age and have underlying health conditions, there are large amounts of staff and visitors with diverse beliefs about COVID-19, and SNFs often have shared living environments.[1,2] Due to the increase vulnerability to COVID-19, the SNF community has been subjected to comply with several social distancing requirements, such as restricted visitation, cancelled communal activities, and limited movement throughout and outside of SNFs.[4,12] The social distancing requirements went into effect on March 13, 2020 and were mandatory among SNFs that care for residents who had either Medicare or Medicaid insurances.[12] However,

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despite strict and early implementation of social distancing requirements, nationwide, there have been over 662,000 COVID-19 cases and 133,000 COVID-19 deaths among SNF residents; and over 593,000 COVID-19 cases and 1,900 COVID-19 deaths among SNF staff.[13] Additionally, within the United States, there have been three substantial waves of COVID-19 cases among residents of SNF with peaks occurring during the weeks of May 31st at 10,988 cases, July 26th at 12,067 cases, and the weeks of December 13th through December 20th at over 33,000 cases.[1,13]

Guided by the vulnerable population conceptional framework,[14,15] the purpose of this study was to describe and test a model of risks and protective strategies for COVID-19 in a single SNF, noting the lessons learned and broader perspectives on societal stigma, policy considerations, and ongoing research possibilities. The vulnerable populations conceptual model provides community health perspectives to understand the susceptibility of population groups to different risks or outcomes.[14,15] The three interrelated key constructs guiding the framework are resource availability, relative risk, and health status.[14,15] It was hypothesized that in periods of limited resources there would be an increased risk of contracting COVID-19 among residents and staff who live or work in the SNF.

Methods

Design and setting

We conducted a retrospective cohort study of data describing the COVID-19 planning and epidemiology in the context of resources availability, relative risk, and health status within a single SNF between March 1st and August 31st, 2020. The SNF is in the second largest county of a Western, mostly rural state. During the study period, the county reported approximately 41 cases of COVID-19 daily, with over 100 cases reported on 12 separate days.[16] The SNF is owned by a local for-profit partnership and has occupancy for 180 residents and 210 staff. Residents of the SNF include people who need both short-term and long-term care services, with approximately 75% receiving long-term care services. The University of Nevada, Reno Institutional Review Board gave this research an exempt determination.

Data collection

The data to extract were determined by the study team based on literature describing strategies for COVID-19 prevention and control and clinical characteristics of COVID-19 susceptibility and illness.[1,3,4,12,17] Data collected consisted of two sources. First, we extracted data from internal COVID-19 planning and response documents, policies, and community memos to collect information on timeline, strategies, and staff demographics, testing, and symptoms for staff who worked at the SNF at any point during the study period. The internal COVID-19 data will be referred to as data from COVID-19 documents from this point forward. A researcher reviewed COVID-19 documents to extract key strategies and timeline and consulted with a second researcher to assess data accuracy. Second, we extracted electronic health record (EHR) data on residents who were at the SNF at any point during the study period. The EHR data collection instrument was piloted and revised using an a priori coding scheme. A researcher extracted the EHR data and a second researcher assessed for data accuracy. Data extracted from COVID-19 documents and EHR included data on race and sex which were a single-response option and self-reported, age, resident International Statistical Classification of Diseases (ICD)-10 diagnoses, staff departments, COVID-19 symptoms, COVID-19 test dates and results, length of time living or working in the SNF, hospitalizations, deaths, and COVID-19 prevention strategies.

We operationalized the vulnerable population model's key concepts based on literature describing potential risk and protective factors for COVID-19. Resource availability, the first construct of the vulnerable population conceptual framework, represents the environmental and social resources needed to prevent COVID-19 spread and illness. Environmental resources were defined as the availability of COVID-19 prevention and testing resources; and social resources were defined as the availability of resources to prevent marginalization and social isolation. Relative risk, the second construct, was defined as vulnerability to or risk factors for acquiring COVID-19. Health status, the final construct, was defined as COVID-19 disease incidence by onset date, epidemiological linkage to known cases, COVID-19 mortality rates, and end of study period status.

Residents and staff were characterized as a *confirmed case* of COVID-19 if they had evidence of SARS-CoV-2 RNA detected on a polymerase chain reaction (PCR) molecular test. Residents and staff were characterized as a *suspect case* of COVID-19 if they had no evidence of receiving a PCR molecular test within 10 days of having new onset of (a) any two of the following symptoms: fever >99°F, chills, rigors, fatigue, myalgia, headache, sore throat, nausea or vomiting, diarrhea, fatigue, congestion or running nose, poor appetite, skin rash, pink eye, or altered mental status; or, (b) any one of the following symptoms: fever > 100.4, cough, shortness of breath, difficulty breathing, or new olfactory or taste disorder.[18] Residents and staff were characterized as a *no case* if they met the suspect case definition and did not have evidence of SARS-CoV-2 RNA detected on a PCR molecular test 10 days before or after their symptom onset. Residents and staff could be categorized as confirmed or suspect cases more than once if their profile met the case definition after 3 months from the initial confirmed or suspect case onset.[18]

Analysis

Data were entered in Microsoft Excel and analyzed using Stata v. 16.1 (StataCorp, 2019). COVID-19 documents data were summarized to capture activities and timeline. To analyze environmental resource availability, we searched COVID-19 documents to capture personal protective equipment (PPE) and SARS-CoV-2 PCR molecular testing availability and shortages. We summarized PPE availability and shortages and both summarized and used descriptive statistics to analyzes SARS-CoV-2 PCR molecular tests. To analyze social resource availability, we summarized interventions to prevent marginalization and social isolation.

We analyzed relative risk by first calculating the resident at-risk days as the cumulative sum of days residents were within the SNF during the study period. Anytime residents left the facility for an overnight acute transfer, this time was subtracted from the total resident at-risk days. To calculate staff at-risk days, we calculated the cumulative sum of days staff worked in the SNF with full-time staff estimated at working 5 days per week, part-time staff estimated at working 2 days per week, and per-diem staff estimated at working 1 day per week. Incidence rates were calculated as the number of confirmed and suspect cases divided by the at-risk days. We generated several relative risk calculations defined as the incidence of confirmed and suspect cases by resident or staff characteristic divided by incidence of confirmed and suspect cases by resident or staff who did not have the characteristic.

To analyze health status, residents and staff who were coded as suspect or confirmed cases were charted by week of onset. Using the COVID-19 documents, we summarized confirmed cases exposures, contact tracing, and illness outcome. We described the end of the study period status across the resident sample and cases using descriptive statistics.

For the entire study period and for each month, we ran separate logistic regression models between residents and staff to test the relationship between risk factors to confirmed and suspect cases. We compared the odd ratios during periods of low and normal resource

availability. In the models, age was calculated as a continuous variable. Additionally, among the resident models, we created a binary variable to test the relationship of living with the sample's average number of comorbidities, compared to living with less than the average number of comorbidities. Regression models results ranged from R^2=0.02−0.16. Model results are reported in odd ratios.

Results

A total of 325 residents and 296 staff lived and worked in the SNF at some point between March 1st and August 31st, 2020 (Table 1). Most residents identified as white or Caucasian (88%) and male (52%); most staff identified as white or Caucasian (49%) and female (79%). Residents were approximately 77 years (Standard Deviation [SD]=12; range=31−100), were living with 4 comorbidities (SD=2; range=0−10) and were living at the SNF for 1 years (SD=2; range=0−16). Staff were approximately 38 years (SD=14; range=18−76) and most (n=205; 69%) worked in the Nursing department.

Resource availability

Environmental Resources. PPE was continuously inventoried during the study period. On March 15th, an inventory of surgical masks revealed the SNF had enough surgical masks to give one mask to every employee. On this day surgical masks were distributed to staff, and staff were asked to wear masks during their entire shift and reuse the mask following guidelines outlined in a PPE shortage policy. By March 16th, SNF leadership asked volunteers to make over 100 reusable cloth masks with felt fabric surrounded by two layers of cloth fabric. On March 24th, cloth masks were distributed to residents and a memo was sent asking residents to wear masks as much as tolerated. By April 9th, there were over 200 cloth masks and over 2,000 disposable surgical masks available for staff and residents. From this point forward, staff received new surgical mask for each shift and residents received new surgical masks three times a week. Stocks of N95 masks were preserved for staff caring for residents who had COVID-19 and for staff who conducted COVID-19 testing. In July, there was a supply shortage of refills for the wall-units of alcohol-based hand sanitizers. To address hand sanitizer shortages, staff were given pocket-size hand sanitizers until wall-units could be restocked. On May 6th, leadership purchased ultraviolet-C portable disinfectant sanitizing cases to disinfect PPE and other commonly touched items, such as cellphones and stethoscopes. Sanitizing cases were provided at each nursing station and within every manager's office. There were no other PPE shortages identified in the facility during the study period.

SARS-CoV-2 PCR molecular tests were performed facility-wide or targeted when residents or staff had known exposures, in the week prior to new staff starting their job, or on occasion when residents had an acute transfer. The first facility-wide testing for SARS-CoV-2 RNA among residents and staff occurred on May 12th and May 21st, respectively. During the study period, a total of 1,471 tests were performed, representing 756 tests among residents and 715 tests among staff. Residents received an average of 2.3 tests (SD = 2.1; range 0−7) and staff received an average of 2.4 tests (SD = 2.5; range 0−7). A total of 99 residents and 152 staff were never tested for COVID-19 either due to refusal or testing was unavailable.

Social Resources. Video conferencing with visitors, medical care providers, and behavioral and mental health providers became available on March 14th. On March 30th, a volunteer student pen-pal program was set up between nursing students at a local university and SNF residents. Volunteer students' video-conferenced their pen-pals and residents received a letter from nursing students. To improve video-conferencing capacity, the SNF partnered with a local hospice company to request that staff help set up video-conferencing accounts for visitors of residents who were receiving hospice care.

Table 1
Demographic characteristics of residents who lived in and staff who worked in the Skilled Nursing Facility (SNF) at any point between March 1−August 31, 2020.

Characteristics	Residents n = 325 n (%)	Staff n = 296 n (%)
Race or Ethnicity		
American Indian or Alaska Native	6 (2%)	2 (1%)
Asian	11 (3%)	67 (23%)
Black or African American	7 (2%)	23 (8%)
Hispanic or Latina/o/x	11 (3%)	56 (19%)
White or Caucasian	287 (88%)	145 (49%)
Something Else	3 (1%)	3 (1%)
Sex		
Female	157 (48%)	234 (79%)
Male	168 (52%)	62 (21%)
Age [a]		
≤ 19 years	-	8 (3%)
20−29 years	-	102 (34%)
30−39 years	1 (0.3%)	73 (25%)
40−49 years	3 (1%)	42 (14%)
50−60 years	22 (7%)	47 (16%)
60−69 years	60 (18%)	21 (7%)
70−79 years	103 (32%)	3 (1%)
80−89 years	83 (26%)	-
≥ 90 years	53 (16%)	-
Comorbidities [b,c]		
Alzheimer's Disease or Dementia	74 (23%)	-
Asthma	18 (6%)	-
Cerebrovascular accident (CVA)	68 (21%)	-
Chronic Lung Disease	39 (12%)	-
Chronic Obstructive Pulmonary Disease (COPD)	74 (23%)	-
Congestive Heart Failure (CHF)	64 (20%)	-
Coronary Artery Disease (CAD)	57 (18%)	-
Depression or Anxiety	144 (44%)	-
Diabetes	107 (33%)	-
Hyperlipidemia (HLD)	154 (47%)	-
Hypertension (HTN)	220 (68%)	-
Immunocompromised Condition	6 (2%)	-
Kidney Disease	83 (26%)	-
Liver Disease	29 (9%)	-
Obesity [d]	58 (18%)	-
Severe Obesity [d]	30 (9%)	-
Smoke Cigarettes	42 (13%)	-
Staff Department		
Administrative	-	20 (7%)
Dietary	-	30 (10%)
Housekeeping	-	26 (9%)
Nursing	-	205 (69%)
Social Work and Activities	-	8 (3%)
Other department	-	7 (2%)

Note. - = not applicable; Race or Ethnicity category of Something Else includes people who identify as Native Hawaiian or Other Pacific Islander; Immunocompromised conditions include HIV, rheumatoid disease, or histories of malignancies; Obesity was defined as having and adult body mass index (BMI) score between 30−39; Severe obesity was defined as having an adult BMI score > 40; and, Smoke Cigarettes was defined as someone who smoked cigarettes at the start of the pandemic.
[a] The average age of residents was 77 years (SD = 12.0; range = 31−100). The average age of staff was 38 years (SD = 13.6; range = 18−76).
[b] Reflects the number and percentage of residents who were living with each comorbidity.
[c] On average, residents were living with 3.9 comorbidities (SD = 1.9; range = 0−10).
[d] n = 312

Activities were provided to residents 1:1, within hallways, and groups of 5 socially distanced residents. Residents were also provided nicotine patches due to the cancellation of outdoor communal smoking. To prevent marginalization of staff, the leadership team provided all staff with company sweatshirts and distributed hero bonus pay.

Relative risk

Among the residents, there was a total of 30,796 resident at-risk days with 2 confirmed COVID-19 cases and 87 suspect COVID-19 cases. Two resident cases met the suspect case definition twice over

Table 2
Count and relative risk of COVID-19 confirmed and suspect cases by resident and staff characteristics

Characteristics	Resident Cases n = 87 [a,b] n (%)	Relative Risk of Resident Cases [b] RR Estimate (CI)	Staff Cases n = 38 n (%)	Relative Risk of Staff Cases RR Estimate (CI)
Race or Ethnicity				
American Indian or Alaska Native	2 (2%)	1.25 (.40−3.94)	0	
Asian	5 (6%)	1.74 (.89−3.41)	3 (8%)	.29 (.09−.92)
Black or African American	2 (2%)	1.02 (.33−3.50)	1 (3%)	.32 (05−2.23)
Hispanic or Latina/o/x	1 (1%)	.33 (.05−2.17)	7 (18%)	.99 (.46−2.13)
White or Caucasian	77 (89%)	1.02 (.58−1.79)	27 (71%)	2.52 (1.30−4.89)
Something Else	0		0	
Sex				
Female	49 (56%)	1.38 (1.00−1.98)	28 (74%)	.74 (.38−1.44)
Male	38 (44%)	.72 (.50−1.04)	10 (26%)	1.35 (.69−2.62)
Age				
≤ 19 years	-	-	1 (3%)	.97 (.15−6.24)
20−29 years	-	-	14 (37%)	1.11 (.60−2.05)
30−39 years	0	-	13 (34%)	1.59 (.86−2.94)
40−49 years	1 (1%)	1.25 (.25−6.25)	5 (13%)	.92 (.38−2.21)
50−60 years	7 (8%)	1.21 (6.34−2.29)	3 (8%)	.45 (.15−1.42)
60−69 years	12 (14%)	.71 (.41−1.21)	2 (5%)	.73 (.19−2.81)
70−79 years	29 (33%)	1.08 (.74−1.58)	0	-
80−89 years	23 (26%)	1.05 (.70−1.57)	-	-
≥ 90 years	15 (17%)	1.07 (.67−1.71)	-	-
Comorbidities				
Alzheimer's Disease or Dementia	21 (24%)	1.08 (.71−1.64)	-	-
Asthma	4 (5%)	.82 (.34−1.99)	-	-
Cerebrovascular accident (CVA)	17 (20%)	.92 (.58−1.45)	-	-
Chronic Lung Disease	14 (16%)	1.41 (.88−2.24)	-	-
Chronic Obstructive Pulmonary Disease (COPD)	21 (24%)	1.01 (.77−1.64)	-	-
Congestive Heart Failure (CHF)	19 (22%)	1.14 (.74−1.75)	-	-
Coronary Artery Disease (CAD)	17 (20%)	1.14 (.73−1.78)	-	-
Depression or Anxiety	37 (43%)	.93 (.64−1.34)	-	-
Diabetes	32 (37%)	1.19 (.82−1.71)	-	-
Hyperlipidemia (HLD)	36 (41%)	.78 (.54−1.13)	-	-
Hypertension (HTN)	53 (61%)	.74 (.52−1.07)	-	-
Immunocompromised Condition	1 (1%)	.62 (.10−3.73)	-	-
Kidney Disease	18 (21%)	.76 (.48−1.20)	-	-
Liver Disease	12 (14%)	1.63 (1.01−2.63)	-	-
Obesity	17 (20%)	1.12 (.71−1.75)	-	-
Severe Obesity	8 (9%)	1.00 (.53−1.86)	-	-
Smoke Cigarettes	10 (11%)	.88 (.49−1.56)	-	-
Staff Department	-	-	-	-
Administrative	-	-	3 (8%)	1.18 (.40−3.51)
Dietary	-	-	6 (16%)	1.66 (.76−3.65)
Housekeeping	-	-	5 (13%)	1.57 (.67−3.68)
Nursing	-	-	23 (61%)	.68 (.37−1.24)
Social Work and Activities	-	-	1 (3%)	.97 (.15−6.24)
Other department	-	-	0	-

Note. - = not applicable; RR = relative risk; CI = confidence interval

[a] Two residents met the suspect case definition twice over the study period. Characteristics of two residents were white or Caucasian (n=2), female (n=1), male (n=1), between 80−90 years (n=1), ≥ 90 years (n=1), and were living with chronic lung disease (n=1), COPD (=1), depression or anxiety (n=1), diabetes (n=1), HLD (n=1), HTN (n=1), and kidney disease (n=1).

[b] The two residents who met the suspect case definition twice were counted once.

the study period. The resident incidence rate for confirmed and suspect cases was 0.1 and 2.8 per 1,000 resident at-risk days, respectively. Among the staff, there was a total of 21,370 staff at-risk days with 4 confirmed and 34 suspect COVID-19 cases. The staff incidence rate for confirmed and suspect cases was 0.2 and 1.6 per 1,000 staff-at-risk days, respectively.

Table 2 displays the case count and relative risk (RR) of COVID-19 cases by resident and staff characteristics. Compared to the other characteristics, residents who identified as Asian (RR = 1.7), female (RR = 1.4), were between 40−49 years (RR = 1.3) and were living with liver disease (RR = 1.6) had the highest risk of having a confirmed or suspect case of COVID-19. Compared to the other characteristics, staff who identified as white (RR = 2.3), male (RR = 1.4), were between 30−39 years (RR = 1.6) and were working in the dietary department (RR = 1.7) had the highest risk of having a confirmed or suspect case of COVID-19.

Health status

Fig. 1 displays the epidemiological curve for confirmed and suspect COVID-19 cases within the SNF. Among residents, the highest wave of suspect cases occurred between March 1st−April 4th with 56 suspect cases identified. Among staff, the highest wave of suspect and confirmed cases occurred between April 5th−May 9th with 17 suspect and 1 confirmed case identified. Among the residents identified as confirmed cases (n=2), both residents did not have a known exposure in the 14 days prior to having evidence of SARS-CoV-2 RNA detected on a PCR molecular test, were identified as part of facility-wide surveillance, had asymptomatic infections, received 2 non-detected PCR molecular tests within 10 days case onset, and close contacts had non-detected PCR molecular tests in the 14 days following exposure to the confirmed cases. Among the staff identified as confirmed cases (n=4), 2 had a known exposures in the 14 days prior
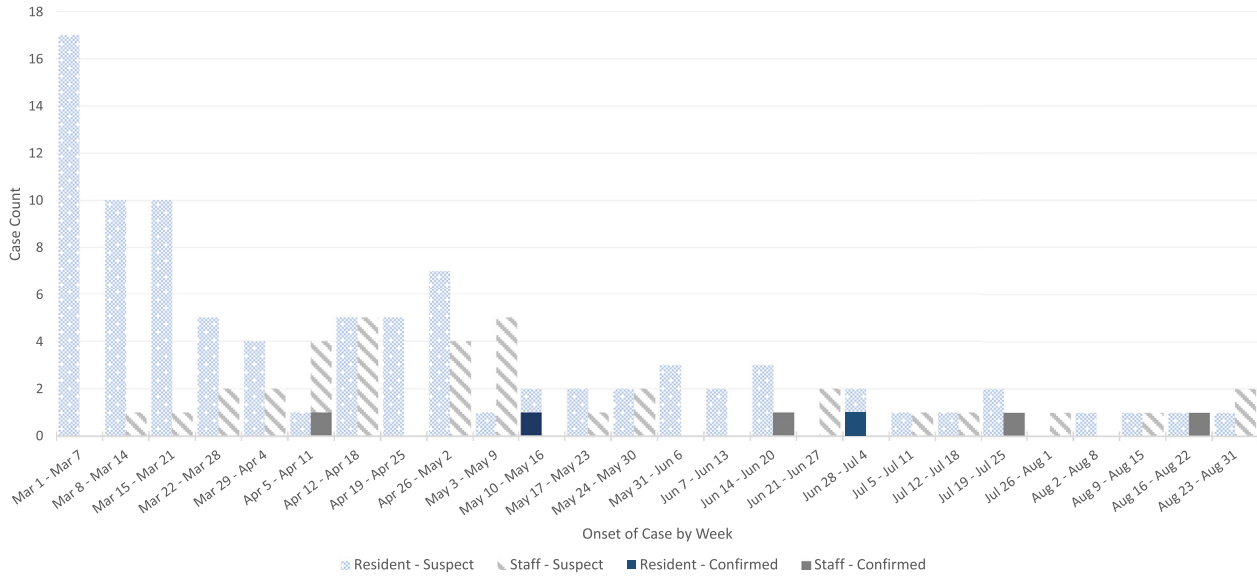
Fig. 1. Epidemiology curve of COVID-19 suspect and confirmed cases among residents and staff by week onset. Note. Confirmed and suspect cases of COVID-19 among residents and staff are charted by date of symptom onset or date of evidence of SARS-CoV-2 RNA detected on a PCR molecular test, whichever came first. Confirmed cases were defined as residents or staff who had evidence of SARS-CoV-2 RNA detected on a PCR molecular test. Suspect cases were defined as residents or staff who had no evidence of receiving a PCR molecular test within 10 days of having new onset of (a) any two of the following symptoms: fever >99°F, chills, rigors, fatigue, myalgia, headache, sore throat, nausea or vomiting, diarrhea, fatigue, congestion or running nose, poor appetite, skin rash, pink eye, or altered mental status; or, (b) any one of the following symptoms: fever > 100.4, cough, shortness of breath, difficulty breathing, or new olfactory or taste disorder.

to having evidence of SARS-CoV-2 RNA detected on a PCR molecular test, 2 identified potential sources of exposure in the 14 days prior to having evidence of SARS-CoV-2 RNA detected on a PCR molecular test, 2 had asymptomatic infections, all 4 staff received 2 non-detected PCR molecular tests within 20 days of case onset, and facility close contacts had non-detected PCR molecular tests in the 14 days following exposure to the confirmed case.

By the end of the study period, all the resident and staff confirmed COVID-19 cases (n=6) were living at their baseline health status, with the two resident confirmed cases living in the facility. By the end of the study period, most of the suspect resident cases were living in the facility (n=47; 55%). Among the remaining suspect resident cases, 14 were discharged home or to another long-term care setting, 12 were hospitalized and never returned to the facility, seven passed away within 10 days of being identified as a suspect case, four passed away after 10 days of being identified as a suspect case, and one left against medical advice. Across the entire resident sample (n=325), by the end of the study period, 150 (46%) residents were living in the facility, 114 (35%) were discharged home or to another long-term care setting, 27 (8%) were hospitalized and never returned to the facility, 22 (7%) passed away, and 12 (4%) left against medical advice.

Low Resource Availability, Risks, and Health Status

Table 3 and 4 demonstrates odd ratios of separate logistic regression models of overall cases and cases observed within each month by characteristics. In the facility, PPE resources were low during the months of March and July and testing resources were low in the months of March through May. Social resources remained stable across the study period. During the months of low resources, residents who identified as American Indian or Alaska Native, Asian, and Hispanic or Latina/o/x had higher than the overall study period odds of being a confirmed or suspect case of COVID-19. Additionally, during the first three months, residents who were living with ≥ 3.9 comorbidities had a 1.0 or above odds of being a COVID-19 confirmed or suspect case, whereas the odds were below 1.0 during the last three months. During the months of low resources, staff who identified as Asian and Hispanic or Latina/o/x had higher than the overall study period odds of being a confirmed or suspect case of COVID-19. Additionally, the odd ratios by month and department demonstrate that staff cases were often occurring within the same department over the month.

Table 3
SOdd ratios of overall resident cases and cases observed within each month by characteristics

Characteristics	All Cases OR (CI)	MarchOR (CI)	AprilOR (CI)	MayOR (CI)	JuneOR (CI)	JulyOR (CI)	AugustOR (CI)
Race or Ethnicity[a]							
American Indian or Alaska Native	1.3 (.2−7.6)	1.2 (.1−11.2)	3.4 (.4−32.9)	-	-	-	-
Asian	1.9 (.6−6.6)	1.9 (.5−7.6)	-	2.6 (.3−24.3)	-	-	7.2 (.6−92.3)
Black or African American	1.1 (.2−6.1)	1.1 (.1−9.5)	-	-	6.7 (.6−71.4)	-	-
Hispanic or Latina/o/x	.3 (.0−2.1)	.6 (.1−4.8)	-	-	-	-	-
Sex[b]							
Female	1.5 (.9−2.4)	1.8 (.9−3.5)	1.1 (.4−2.9)	1.8 (.4−8.0)	.8 (.2−3.4)	.3 (.0−2.8)	1.5 (.1−17.9)
Age	1.0 (1.0−1.0)	1.0 (1.0−1.0)	1.0 (1.0−1.0)	1.0 (1.0−1.0)	1.0 (.9−1.0)	1.0 (.9−1.1)	1.1 (1.0−1.3)
Living with ≥ 3.9 Comorbidities	.9 (.5−1.5)	1.0 (.5−1.8)	1.8 (.6−5.2)	1.3 (.0−.5)	.3 (.1−1.5)	.2 (.0−1.5)	.7 (.1−5.3)

Note. - = no observations; OR = odd ratio; CI = confidence interval.
Resident cases include a combine count of suspect and confirmed cases.
[a] Residents who identified as white or Caucasian were defined as the reference group. There were no cases among residents who's Race or Ethnicity identified as Something Else.
[b] Residents who identified as male were defined as the reference group.

Table 4
Odd ratios of overall staff cases and cases observed within each month by characteristics

Characteristics	All Cases OR (CI)	March OR (CI)	AprilOR (CI)	MayOR (CI)	JuneOR (CI)	JulyOR (CI)	AugustOR (CI)
Race or Ethnicity[a]							
Asian	.2 (.1−.7)	1.5 (.2−9.8)	-	.2 (.0−1.8)	-	-	-
Black or African American	.2 (.0−1.4)	-	-	-	-	-	5.1 (.3−100.3)
Hispanic or Latina/o/x	.5 (.2−1.3)	-	.4 (.1−2.0)	.3 (.0−2.9)	.9 (.1−10.8)	.9 (.1−8.6)	1.3 (.1−19.4)
Sex[b]	-	-	-	-	-	-	-
Female	.6 (.2−1.4)	-	.6 (.1−2.7)	.3 (.0−1.3)	.3 (.0−4.6)	.6 (.0−7.7)	.8 (.06−10.7)
Age	1.0 (1.0−1.0)	.9 (.9−1.0)	1.0 (.9−1.0)	.9 (.9−1.0)	1.0 (.9−1.1)	1. (1.0−1.1)	1.0 (.9−1.1)
Department[c]							
Administrative	1.7 (.4−6.8)	3.7 (.4−38.2)	1.2 (.1−11.4)	2.2 (.2−21.9)	-	-	-
Dietary	1.3 (.4−3.9)	-	1.0 (.2−5.6)	.4 (.0−3.9)	-	-	.7 (.0−13.5)
Housekeeping	1.7 (.5−5.3)	-	.7 (.1−6.3)	-	2.2 (.2−31.4)	14.6 (1.3−168.6)	-
Social Work and Activities	1.0 (.2−2.9)	-	-	-	-	-	1.0 (1.0−1.0)

Note. - = no observations; OR = odd ratio; CI = confidence interval.
Staff cases include a combine count of suspect and confirmed cases.

[a] Staff who identified as white or Caucasian were defined as the reference group. There were no cases among staff who's Race or Ethnicity identified as American Indian or Alaska Native and Something Else.
[b] Staff who identified as male were defined as the reference group. There were no cases among staff who identified as male in the month of March.
[c] Staff who worked in the Nursing department were defined as the reference group. There were no cases among staff who worked in Other department.

Discussion

The COVID-19 pandemic has and continues to impact the lives of the SNF community. In our analysis, we described the COVID-19 response and epidemiology in a SNF during the first 6 months of the pandemic—a time when national PPE shortages existed, knowledge of COVID-19 was rapidly emerging, the mass opening of travel nurse assignments adversely impacted the availability of the nursing workforce, and strict government shut-down and social isolation recommendations were put into place. We found the resident population had characteristics that would increase vulnerability to COVID-19 mortality, yet there were many protective strategies that supported preventing COVID-19 spread. There are several key findings from this study that are applicable for strengthening resident care and resiliency among the SNF community.

Lessons Learned

In the early days of the pandemic, SNF leaders across the country needed to decide whether to use their stockpiles of masks or to only distribute masks after a case in the facility was identified. This was a time of widespread mask shortages and existing masks were being prioritized within acute care settings.[19] We learned early distribution of surgical masks and adoption of mandatory use among staff helped protect resident and staff from spreading COVID-19.[20,21] We also believe that distributing masks to residents supported residents' safety and further encouraged mask use throughout the entire facility and outside the facility when staff were in public spaces. In March 2020, there was limited information to support cloth masks as a means to prevent COVID-19 spread. Knowing that the filtration ability of cloth masks could be limited, the SNF leadership team requested that volunteers make cloth masks with felt fabric inside two layers of cloth. In retrospect, the SNF leadership mask design might have offered quite a bit of protection, given the material and design.[22]

We also believe that the more resources that SNF leadership offered such as in-house COVID-19 testing, ultraviolet-C portable disinfectant sanitizing cases, and tablets for telemedicine or video conferencing, the more confident residents and staff became in preventing the spread of COVID-19 and that their safety was being prioritized. From the start of the pandemic, SNF leadership had to balance COVID-19 safety and address residents' social needs. Providing residents with volunteer nursing students to video conference was an innovative strategy to prevent marginalization and social isolation. However, there is mixed evidence on the effectiveness of video conferencing in preventing loneliness among residents of SNFs and older adults.[23,24] Residents' social relationships with each other, staff, and visitors provides a sense of belonging and significance and social relationships are important for overall well-being.[25−27] By removing physical relationships with visitors and replacing this relationship with a virtual option, some residents might have felt a lost in their relationships and had a decreased sense of well-being.

Given the high numbers of at-risk days among residents and staff, there was an overall high risk that if a COVID-19 case occurred, there would be rapid spread. From the start of the pandemic, SNF leadership knew caring for residents who are positive for COVID-19 would increase staffing needs and have negative psychological effects, such as fear, depression, and staffing shortages among the SNF community. During our study, there were two confirmed cases of COVID-19 among residents who were asymptomatic, who did not have an epidemiological linkage to a known case, had non-detected PCR molecular tests within 10 days of onset, and who's close contacts never had detected PCR molecular test results. Given the vulnerability to rapid COVID-19 spread within SNFs, it is possible that these confirmed cases had samples that were contaminated during the sampling or testing process.[28] Even though PCR molecular testing is considered the "gold-standard" in COVID-19 testing, results should be interpreted by assessing the probability of having a false-positive or contaminated test result. If repeat PCR molecular tests return as non-detected, the person remains asymptomatic, and there is no epidemiology linkage to another case or the case's close contacts, public health leadership should consider reclassifying the individual as a no case. Without reclassifying the individual, public health officials are potentially overestimating COVID-19 incidence within SNFs, and SNF communities are burdened by increased psychological effects.[28] Due to identifying these two cases of COVID-19 among residents, the SNF leadership learned that the emotional and behavioral responses among staff and residents were fear, as indicated by some staff deciding to leave their position.[29]

In the United States, peaks of substantial waves of reported COVID-19 cases occurred in the weeks of May 31st and July 26th,[1,13] whereas the peak wave of cases in this study occurred in March and April. Potential explanations for the highest number of reported cases occurring in March and April could have been due to staff and residents heightened awareness of COVID-19 given the emerging media stories and policy changes within the SNF. Additionally, this was a time when testing was not available in the SNF. After testing became available, SNF leadership was able to test residents and staff who had

symptoms of COVID-19. Therefore, later in the study period, cases that could have been categorized as suspect due to symptom profile were categorized as no cases if they had non-detected results on a PCR molecular test within 10 days from symptom onset. The availability of testing increased the SNF community's perceptions of safety, as negative test results of someone who was symptomatic eased fears and contributed to identifying other causes of symptoms.

Residents and staff had an overall increased odds of being identified as a confirmed or suspected case of COVID-19 when resources were limited. For example, it was noted that residents who were living with $\geq$ 3.9 comorbidities had a higher odd of being a confirmed or suspect case in the first three months, compared to the second three months. This finding could potentially be explained by residents receiving more testing in the latter months of the study period and symptom presentations were related to comorbidities and not COVID-19. Additionally, noteworthy were identifying that staff working within the same department, often were identified as confirmed or suspect cases within the same month. This finding supports challenges in social distancing requirements among staff who work within the same department. SNF leadership may need to focus education on reinforcing social distancing requirements among staff. An important area for SNF leadership to focus on is staff dining, as eating in proximity with others has ben associated with COVID-19 spread and infections.[30]

The COVID-19 vaccine was not available during our study period and first became available to SNFs in January 2021 through the Centers for Disease Control and Prevention (CDC)'s Pharmacy Partnership for Long-term Care Program.[31] Early research on vaccine acceptance rates within SNFs found only 78% of residents and 38% of staff received at least one dose of the COVID-19 vaccine through this program.[32] More recent findings suggest SNF staff vaccination acceptance rates have increased to 57%.[33] With the availability of vaccination, leadership should focus on improving vaccination acceptance rates within their facilities. Resources on COVID-19 vaccine education and other infection prevention measures are provided to leadership through the Agency for Healthcare Research and Quality − National Nursing Home Project ECHO.[34] By implementing protective strategies described in this paper along with increasing vaccination rates, SNFs can be well equipped to prevent the spread of COVID-19.

Broader perspectives on societal stigma, policy, and future research

As the COVID-19 pandemic is now past the early stage of the pandemic when resources were limited, and COVID-19 knowledge and guidance were rapidly emerging, SNF communities are now at a stage of improving resiliency. SNFs are part of the United States healthcare system, yet were not involved in pandemic planning or resource allocation.[35,36] Additionally, both from other healthcare sectors and the public, SNFs are subjected to negative visibility which is deeply-rooted in systemic structures of ageism, ableism, and classism.[35] These systemic structures are directly harming the SNF community as the structures influence the stigmatizing perceptions of residents who receive care in, the staff who work in, and the visitors who visit residents in SNF. The pandemic continues to expose how society would rather hear stories of SNF neglect, abuse, and death[37] over stories of the reality of what it is like to be a part of the SNF community. The societal stigmatization and oppressive systemic structures are also harming recruitment to SNF, care reimbursement structures, and feelings of residents being a second-class citizen and staff working in a second-class healthcare system.[35] Additionally, stigmatization of SNFs, particularly from media perspectives[37] raised fear from SNF visitors as they were told they could not visit and were not able to see the care provided to residents. To improve the COVID-19 resiliency of the SNF community, stakeholders can look for ways to dismantle the oppressive structures and re-build to a system that values SNFs as a healthcare setting and home to some of the most vulnerable populations in the United States.

The COVID-19 pandemic has also exposed the potential need to modernize the health policies that govern SNFs. SNFs are highly regulated through state and federal agencies,[7] yet these same agencies did not support or ensure that SNFs had the necessary resources to respond to COVID-19.[35] Rather, CMS directors released memos stating that surveyors will heavily focus on infection control inspections and surveyors could penalize facilities up to $20,000 in fines for infection deficiencies.[38,39] Providing punitive citations and fines for pandemic-related deficiencies, rather than supporting SNFs in addressing the deficiency does not improve the susceptibility of COVID-19 within a SNF. Policy changes that focus on comprehensive funding solutions, investment in multiple care options, and in the current regulations could improve the policies that govern SNFs.[40] Additionally, SNF leaderships need a trustworthy resource to address pandemic-related concerns without triggering punitive responses. This resource should be scientifically-driven and the resource should understand the nuance and complexity within SNF care by providing flexible person- and situation-specific recommendations. Using this resource could be viewed as demonstrating excellent quality of care on a regulatory survey.

Findings reveal opportunities for future research. In our study, we found 22 residents passed away during the study period. Prior to the pandemic, between 1−3 deaths occurred at this facility each month (Z.Gray, personal communication, December 31, 2020). Therefore, during our study period, we found a slightly higher than expected death count. An analysis of deaths and factors contributing to deaths could support understanding of non-COVID deaths that are occurring within SNFs. Experts have expressed that social isolation from COVID-19 social distancing measures may be contributing to higher-than-normal rates of deaths among people who are in their 60s or older.[41] Second, as a response to social distancing rules, the availability of telemedicine and video-conferencing services have increased within SNFs. Researchers could explore whether telemedicine affects access to services and the effectiveness of services provided to residents. Studies examining resident's perspectives of video conferencing could assist SNFs with understanding the sustainability of continuing this intervention.[24] Finally, more research is needed to capture the SNF communities' stories or lived experience[26] during this pandemic. Capturing stories from residents, staff, and visitors would add compelling descriptions of what it has been like to live in and survive the COVID-19 pandemic within one of the most high-risk settings.

Limitations

Our study is subject to at least the following limitations. First, it was not possible to describe the effectiveness of infection control interventions in preventing the spread of COVID-19. However, the interventions described in this study were consistent with national guidelines for preventing the spread of COVID-19.[4,12] Second, analyzing the internal COVID-19 response documents presents a potential for bias or imprecision of information provided on the documents. Dates, interventions, and staff illness could have been misrepresented on the documents. Third, we did not always have information about whether residents were tested for COVID-19 when they were transferred to the hospital or during a death autopsy. However, SNF leadership were never notified of confirmed COVID-19 test results from residents who transferred to the hospital or during autopsy. Fourth, data on visitors to residents were not included in this study as data were not collected on this group. We heard anecdotal stories of visitors to residents who tested positive or who died from COVID-19. Visitors are a part of the SNF community and data on their resource

availability, relative risk, and health status would have strengthened this study. Finally, our study is limited to the COVID-19 response and epidemiology of a single SNF. Generalizability to SNFs with different SNF community characteristics or to other SNF's response and epidemiology may be limited. This being the case, it was still possible to describe lessons learned regarding resource availability, relative risk, and health status of the population as well as broader perspectives on societal stigma, direction for policy, and research consideration.

Conclusions

The first 6 months of the pandemic presented a time of uncertainty, fear, and panic among the SNF community. Our study presents lessons learned to understand vulnerability to and protective strategies for COVID-19 within a SNF. As the negative effects of the COVID-19 pandemic have been largely felt in SNFs, the United States health system needs to support a vulnerable population healthcare setting, which also serves as home for people who are aging, who have physical or mental disabilities, or who have complex medical or social needs. Essentially, the COVID-19 pandemic has highlighted the need to transform the United States healthcare system, with a focus on prioritizing individual and population health equity among people who receive care in SNFs.[36] The recent nationwide availability of rapid COVID-19 antigen testing, the COVID-19 vaccination, and monoclonal antibody treatments provide opportunities to reduce the vulnerability of COVID-19 spread, morbidity, and mortality. Yet, the availability of these resources is still not readily accessible within SNFs. About a year into this pandemic, SNFs continue to be a high-risk setting for rapid COVID-19 spread and dire health consequences. Therefore, by understanding a SNF's resource availability, relative risk, and health status, SNFs can strengthen resident care, resiliency among the SNF community, health policies, and response to future COVID-19 outbreaks.

Authors' contributions

TW should be regarded as the first author. TW, CG, KL, KM, and ZG had roles in research design. TW, MT, and CG had roles in data collection. TW analyzed the data. All coauthors contributed to the manuscript development, revised the manuscript, and approved the final version. The corresponding author attests that all listed authors meet authorship criteria.

Declaration of Competing Interest

The authors have no competing financial or personal interests that could influence the work reported in this paper.

Data Availability Statement

The datasets and any other materials of our study are available from the corresponding author on request.

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