Final Research Report

Predictors of and Strategies to Mitigate COVID-19 Cases and Death Among Older Adults in Nursing Homes and Residential Care Facilities

Submitted By

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1. Introduction

1.1 Significance of the Problem

Community members in long-term care facilities have been disproportionately impacted by high COVID-19 cases and deaths across the United States and globally. This population is particularly vulnerable to the deleterious effects of COVID-19 due to numerous factors existing both inside and outside their facility settings. Older adults residing in congregate settings typically have physical, emotional, and functional ability challenges that make them particularly vulnerable to higher rates of infection and death (Campbell-Enns et al. 2020; D'Adamo et al. 2020). Residents in long-term care settings may experience multiple chronic health conditions along with progressive diseases that impact symptomatology and complicate the ability to discern how COVID-19 presents differently in this population (D'Adamo et al. 2020; McMichael et al. 2020).

1.2 Literature Review

1.2.1 Risk and Protective Factors for Older Adults

Research has begun globally and within the United States to better understand the risks and protective factors for infection and mortality risk related to COVID-19. Based on this research, older adults face risk and protective factors, which can be unique to this demographic. Age has itself been identified as a serious risk factor demonstrated consistently through research and is shown in COVID-19 infection and mortality metrics (Bernabeu-Wittel et al. 2020; Li et al. 2020; Rozenfield et al. 2020; Sun et al. 2020). Researchers have noted that clear and transparent communication is critical to understanding and implementing effective protective measures (Sun et al. 2020). One study identified that women are more likely to respond to and understand risks and safety measures related to COVID-19 while men tend to be more resistant to protective measures (Sun et al. 2020).

When combined with age, certain underlying medical conditions, such as diabetes and chronic kidney disease, increase the mortality risk for those older adults who contract COVID-19 (Bernabeu-Wittel et al. 2020; Rozenfield et al. 2020). Research suggests that, in the general population, older adults perceiving a high risk of infection (e.g., those with 10 or more prescription medications; those with multiple comorbidities) was associated with lower risk for infection, presumably because these individuals engaged in more protective measures (Rozenfield et al. 2020). One gap in the research is whether this information holds true for community members in skilled nursing facilities or other long-term care settings.

The level of self-care, along with sex and age, was found to be influential in the level of understanding related to COVID-19 risk factors and preventive measures (Sun et al. 2020). When looking at this from a long-term care perspective, this could be a significant risk factor for older adults in a long-term care facility due to the reduced level of self-care experienced by the residents of such facilities. Another long-term risk factor identified through research is that those older adults who do participate in strict social and physical distancing preventive measures face a higher risk of decreased mental health (Gustavsson and Beckman 2020). There has been extensive anecdotal evidence of this mental health concern; more research will be needed to ascertain the impact on mental health for community members in long-term care facilities.

1.2.2 Risk and Protective Factors of Adult Long-Term Care Facilities

In a facility protective factors meta-analysis, Rios et al. (2020) found that, to reduce the spread of infectious diseases such as COVID-19, facilities must establish surveillance, monitoring, and evaluation. For surveillance and monitoring, the digital contact tracing system outperformed any other method of tracking the spread of COVID-19 (Wilmink et al. 2020). Symptom-based screening was the least effective method of preventing the spread (Callahan et al. 2020; Kimball et al. 2020; Wilmink et al. 2020). The digital contact tracing system method tracks staff by using a digital monitor, and all workers and staff

would have to wear the device. However, manual contact tracing was second most effective. Yet, due to human error, it was not as reliable as digital contact tracing. The digital tracking was an electronic simulation and still needs to be implemented. With monitoring, Hatfield et al. (2020), suggested that facility-wide testing of both staff and residents after the first case of COVID-19 was proven to reduce the spread. Timing is important and must be done after the first positive case. Facility-wide testing helps identify unrecognized cases by 79 percent compared to other methods (Hatfield et al. 2020).

Rios et al. (2020), found through meta-analysis that there were several infection prevention and control recommendations that were most helpful in preventing the spread of COVID-19. These recommendations included:

> *"the use of PPE [personal protective equipment], employing physical distancing/isolation or cohorting measures among residents of a facility, disinfecting surfaces, promoting hand hygiene, promoting respiratory hygiene/cough etiquette, implementing policies regarding staff sick leave or restricting staff movement, establishing clear communication means and consulting with or notifying relevant healthcare authorities and ensuring appropriate action is taken, educating staff and/or residents on infection control and hygiene, ensuring adequate supplies for facilities, mandating droplet precautions, and policies restricting visitors to long-term care." (Rios et al. 2020:6)*

However, Houghton et al. (2020) found that health care workers' adherence to these policies were not effective due to many variables. Most health care workers felt they could not keep up with the local guidelines as they changed over time. Additionally, the added cleaning and work created by policies caused the workers to feel overwhelmed and fatigued. Workers also stated that there was a lack of support from management in strategies in isolating, finding space, and having effective PPE on hand at all times. Houghton et al. (2020) found that workers were more likely to adhere to policies when they understood the value of policies, felt educated in the policies, and had a supportive culture at their job.

One risk factor for facilities was outpatient visits. Bigelow et al. (2020) studied a facility in Maryland where there was a spike in COVID-19 among patients who had to seek dialysis services outside of the facility. Bigelow et al. (2020) stated that more research would need to be conducted on outpatient visits. This could be a risk factor due to the facility being unable to control how other outpatient services are implementing preventive measures. Specifically, it would be best practice for facilities and outpatient services to communicate about safety and COVID-19 adherence or outbreaks (Bigelow et al. 2020).

Staffing conditions and foot traffic within a facility, particularly in areas with high community infection rates, also impact the potential for COVID-19 spread within long-term care facilities (McMichael et al. 2020). Research points to high movement of staff and visitors in and out of facilities where high rates of COVID-19 are found in the surrounding communities as a factor in high rates of COVID-19 in long-term care facilities (McMichael et al. 2020). A recent study indicated that about 60 percent of staff working in long-term care facilities also have additional caregiving roles in their homes and communities, while roughly 70 percent of those surveyed felt pressured to work even when they were ill (Van Houtven et al. 2020). Additionally, in facilities where nurses were working long hours, higher rates of infection were likely; however, they also found that as nurse aid hours increased, the likelihood of infection decreased indicating the important role that optimal staffing levels play in infection mitigation efforts (Gorges and Konetzka 2020).

1.2.3 Community Adherence to COVID-19 Policies and Procedures

Throughout the COVID-19 pandemic, the consistent message has been that community adherence to social distancing guidelines and other safety measures was and is critical to reducing the impact of the pandemic, and research has proven this to be true (Bargain and Aminjonov 2020; Hsiehchen, Espinoza, and Slovic 2020; Miguel et al. 2020). Further studies during the COVID-19 pandemic have found that

there are several factors that relate to whether communities and individuals comply with government-imposed measures. These factors range from trust in government to political partisanship.

In a study of European countries during the COVID-19 pandemic, researchers found that where there is a high level of trust in government there has been a corresponding, higher level of compliance with public health guidelines (Bargain and Aminjonov 2020). For example, one study found that "the decline in mobility around mid-March 2020 is significantly stronger in high-trust regions" (Bargain and Aminjonov 2020: 2). Considering the political unrest and public discourse surrounding the lack of faith in government in the United States, this could be an important factor in assessing community adherence to public health guidelines and directly impact the infection and mortality rates in the United States. In turn, this may impact outbreaks in long-term care facilities.

On a similar note, political affiliation was also found to have an impact on compliance with public health guidelines in a study in the United States (Hsiehchen, Espinoza, and Slovic 2020). Mobility data was used as a means to assess a link between political affiliation and compliance with social distancing guidelines (Hsiehchen et al. 2020). This study found that "for every 10% increase in the proportion of Republicans in a state, NPI (non-pharmaceutical interventions) compliance declines 8%" (Hsiehchen et al. 2020: 112). As a connection to public trust in government, one of the conclusions from this study was that the results could help inform the content of public health policies and by what methods public health policies are disseminated (Hsiehchen et al. 2020).

2. Study Methodology

2.1 Multi-Level Explanatory Factors

As demonstrated in the literature review, multiple levels of factors impact COVID-19 cases and deaths. Our project examines multiple levels of factors that perpetuated or mitigated long-term care facilities having COVID-19 cases and deaths in North Carolina and South Carolina. This includes factors at the state-level, community-level, and facility-level. State-level policies impact community-level response. Community-level factors are important because facility staff reside in the community and are carriers bringing COVID-19 into facilities. Facility-level factors include quality of care in facilities as well as the service profile of facilities.

2.2 Overall Approach to Research Questions

Our research questions include:

- **RQ1:** What policy-, community-, and facility-level factors predict whether or not long-term care facilities have COVID-19 cases and deaths?
- **RQ2:** What are actionable strategies that can be implemented to mitigate COVID-19 cases and deaths in long-term care facilities?

To answer the first research question, we compiled data from existing secondary data sources. We then conducted bivariate and multivariate statistical analyses of these data sources (see ***Section 2.3*** for additional details). To answer the second research question, we convened a Stakeholder Advisory Board with six key stakeholders. The purpose of the Board was to provide feedback on the approach and analysis interpretation and help develop actionable recommendations for strategies that can be implemented to mitigate COVID-19 cases and deaths in long-term care facilities. The Board also provided feedback on deliverable formats that can best meet the needs of our local community partners, their constituents, policymakers, and decision makers, so that our research can be translated to inform practice (see ***Section 2.4*** for additional details). A study logic model is illustrated in ***Figure 1*** and the study's institutional review board approval is provided in ***Appendix A***.

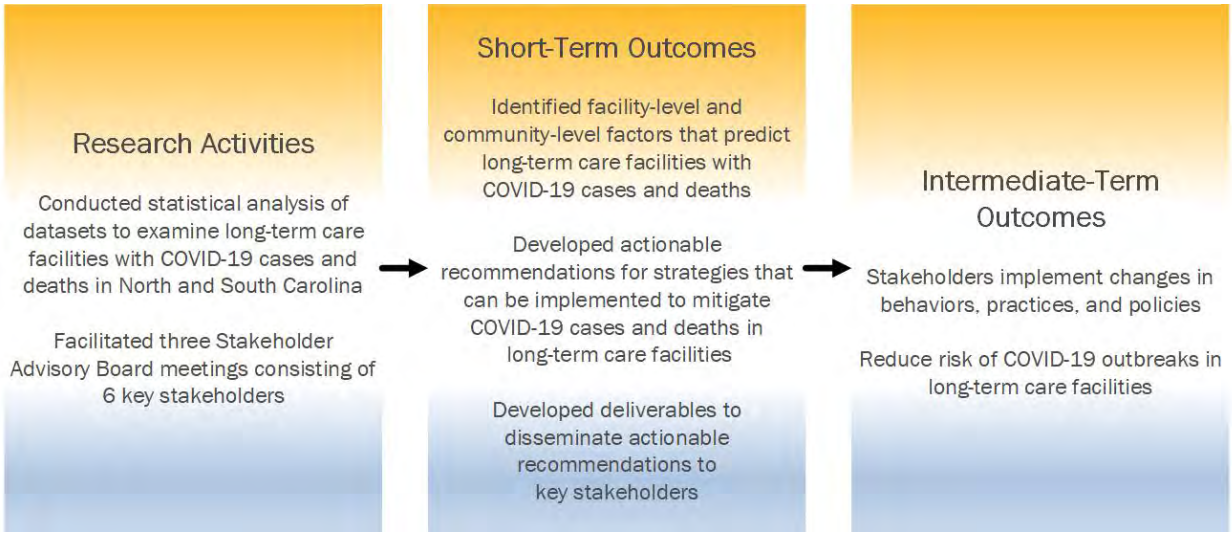

Figure 1. Study Logic Model

2.3 Methodology for Quantitative Analyses

2.3.1 Dependent Variables

The dependent variables examined whether or not long-term care facilities had COVID-19 cases and deaths. Among the 1,411 long-term care facilities included in the analyses, 59 percent were skilled nursing facilities, 17 percent were home health, 11 percent were hospice, 6 percent were assisted living, 3 percent were residential care facilities, and the remainder were other or non-specified types of long-term care facilities (see ***Figure 2***).

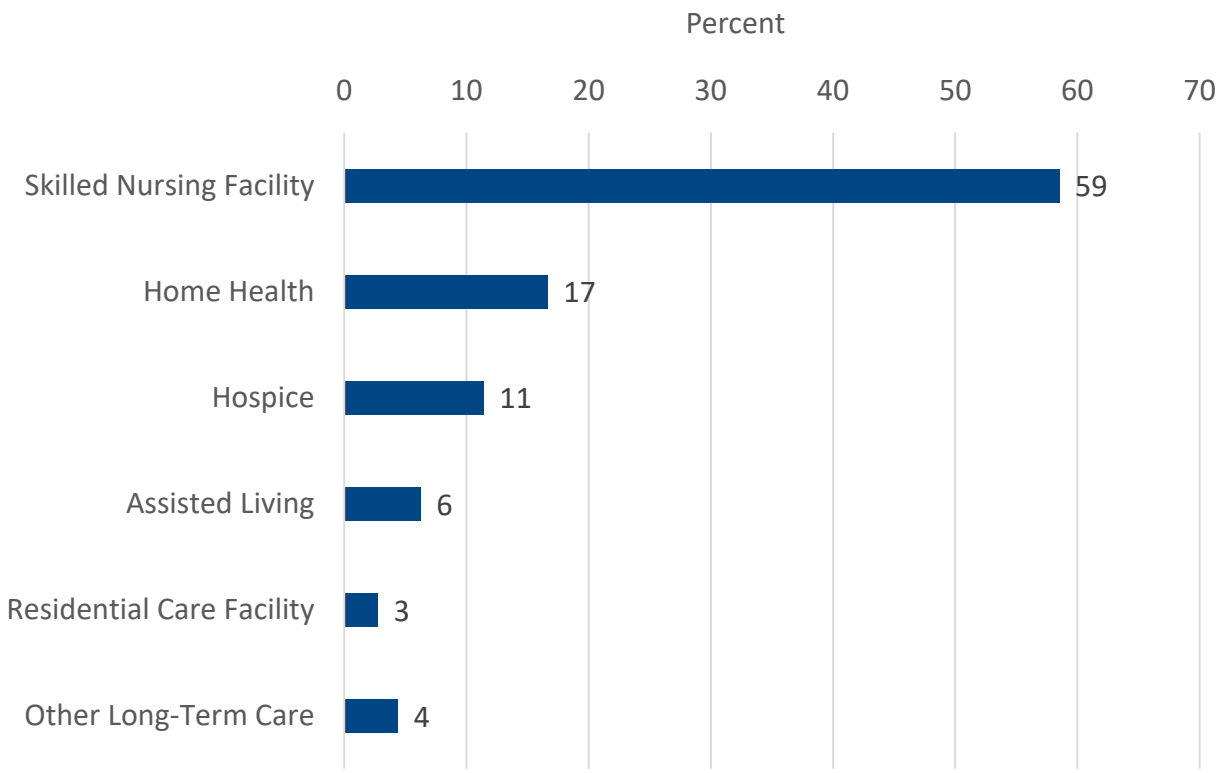

Figure 2. Types of Facilities Included in Analyses

We measured whether or not facilities had COVID-19 cases or deaths. For COVID-19 cases, we separately explored whether or not facilities had any COVID-19 cases, staff cases, or resident cases. For COVID-19 deaths, we separately examined whether or not facilities had any COVID-19 deaths, staff deaths, or resident deaths. ***Appendix B*** provides detailed information about how these data were compiled.

Among the 1,411 long-term care facilities included in the analyses, more than half had COVID-19 cases in their facilities by September 2020 (see *Figure 3*). Forty-nine percent of facilities had staff cases, and 44 percent had resident cases. Additionally, 25 percent of facilities had any COVID-19 deaths. Two percent of facilities had staff deaths, and one-quarter of facilities had resident deaths.

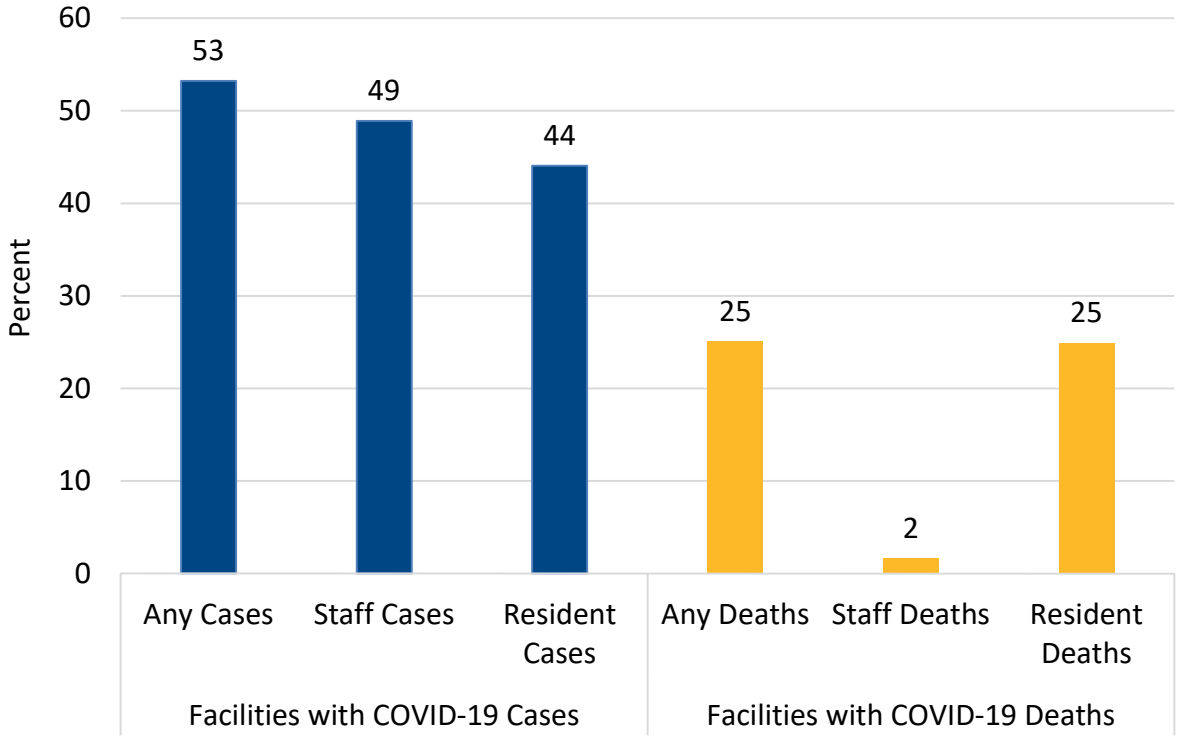

Figure 3. Percent of Facilities in North and South Carolina with COVID-19 Cases and Deaths By September 2020

2.3.2 Independent Variables

At the state-level, we compiled state policy context on stay-at-home orders, mask orders, gatherings, and nursing home visitation. At the community-level, we examined community spread of COVID-19, community adherence to COVID-19 policies and best practices, community demographics, community political climate, and community resiliency. At the facility-level, we explored the service profile of facilities as well as the quality of care in facilities. (see *Table 1* for detailed information on the independent variables).

2.3.3 Data Sources

This study examines state-, community-, and facility-level factors that may have an impact on COVID-19 cases and deaths in long-term care facilities. Throughout the study, we gathered data from state and federal agencies such as the North Carolina Department of Health and Human Services, the South Carolina Department of Health and Environmental Control, the U.S. Centers on Medicare and Medicaid Services, the U.S. Department of Agriculture, and the U.S. Census Bureau. Data were also compiled from other organizations, such as Unacast (see *Table 1* for a list of data sources).

Table 1. Data Sources

Concept	Data Source	Description	Variables	Data Month/Year
Dependent Variables				
Facilities with COVID-19 cases and deaths	North Carolina Department of Health and Human Services COVID-19 Weekly Dashboard	Information compiled weekly from report entitled "COVID-19 Ongoing Outbreaks in Congregate Living Settings"	➢ Facilities with any COVID-19 cases ➢ Facilities with any COVID-19 deaths ➢ Facilities with staff cases ➢ Facilities with staff deaths ➢ Facilities with resident cases ➢ Facilities with resident deaths	Data from March 2020 to September 2020
	South Carolina Department of Health and Environmental Control COVID-19 Weekly Dashboard	Information compiled weekly from report entitled "Cumulative COVID-19 in Long Term Care Facilities Year to Date"		
State Level Factors				
State policy context	COVID-19 U.S. State Policy Database (see here)	State-level policies across numerous domains affecting movement, healthcare, and community well-being during the pandemic	➢ Stay-at-home orders ➢ Mask orders ➢ Gatherings ➢ Nursing home visitation	Data began in March 2020 and continues to be updated regularly with new state-by-state policies as new orders are issued
Community Level Factors				
Community spread of COVID-19	North Carolina Department of Health and Human Services COVID-19 Statistics Dashboard (see here)	Dashboards that provide updates, policies, and guidelines on the status of COVID-19 throughout North Carolina	➢ COVID-19 cases per 10,000 population in the county	September 2020
	South Carolina Department of Health and Environmental Control COVID-19 Statistics Dashboard (see here)	Dashboards that provide updates, policies, and guidelines on the status of COVID-19 throughout South Carolina	➢ COVID-19 cases per 100,000 population in the county (team converted to per 10,000 population for comparability with NC)	

(continued)

Table 1. Data Sources (continued)

Concept	Data Source	Description	Variables	Data Month/Year
Community Level Factors				
Community adherence to COVID-19 policies and best practices	Unacast Social Distancing Scoreboard (see here)	Social distancing is a CDC recommended practice for slowing the spread of COVID-19. Also referred to as "physical distancing" by the CDC, social distancing refers to staying at least 6 feet away from people, both indoors and outdoors, with whom you do not share a household	➢ Social distancing grade ➢ Grade for reduction in average mobility ➢ Grade for reduction in non-essential visitation ➢ Grade for decrease in human encounters	September 2020
Community demographics	U.S. Department of Agriculture Rural-Urban Continuum Codes (see here)	Codes that distinguish metropolitan counties by the population size of their metro area, and nonmetropolitan counties by degree of urbanization and adjacency to a metro area	➢ Rural/urban status	2013
Community political climate	Politico (see here for NC and here for SC)	Information on the percent of county residents who voted for candidates from particular political parties in the last Presidential election	➢ Percent who voted for the Republican candidate ➢ Percent who voted for the Democratic candidate	November 2020
Community resiliency	United States Census Bureau (see here)	Information on the ability of communities across the nation to recover from the impact of community disasters, including pandemics, as a measure of variation in individual and household vulnerabilities	➢ Percent of residents in county with 0 risk factors ➢ Percent of residents in county with 1-2 risk factors ➢ Percent of residents in county with 3+ risk factors	Initial release date of data was June 22, 2020

(continued)

Table 1. Data Sources (continued)

Concept	Data Source	Description	Variables	Data Month/Year
Facility Level Factors				
Service profile of facilities	U.S. Centers for Medicare and Medicaid Services (CMS) Post-Acute Care and Hospice Provider Utilization and Payment Public Use Files (see PAC-PUF here)	Information on services provided to Medicare beneficiaries by home health agencies, hospices, skilled nursing facilities, inpatient rehabilitation facilities, and long-term care hospitals	➢ Percent dual beneficiaries ➢ Percent Black beneficiaries ➢ Average Hierarchical Condition Category (HCC) risk score ➢ Average number of chronic conditions of residents	October 2019
Quality of care in facilities	U.S. CMS Nursing Home Provider Information (see here)	Information compiled from Care Compare from sources (1) CMS's health inspection database (2) Payroll-Based Journal system (3) The Minimum Data Set national database (4) Medicare claims data	➢ Overall five-star quality rating ➢ Health inspection rating ➢ Quality measure rating ➢ Long-stay quality measure rating ➢ Short-stay quality measure rating ➢ Staffing rating ➢ Registered Nurse staffing rating ➢ Number of fines ➢ Total number of penalties ➢ Number of substantiated complaints ➢ Reported licensed staffing hours ➢ Reported total nurse staffing hours	Data reported for FY 2020 with baseline period (FY 2016) and performance period (FY 2018)

2.3.4 Analytic Technique

We ran univariate analyses of each variable in *Table 1*. Then we conducted bivariate analyses to examine the state-, community-, and facility-level factors associated with COVID-19 cases and deaths. Bivariate analyses included chi-square tests (or Fisher's exact tests because of low cell sizes) for independent variables that were categorical and simple logistic regression models for independent variables that were continuous. All independent variables that were statistically ($p<0.05$) or marginally significant ($0.05<p<0.10$) were considered for inclusion in multivariate models. Independent variables were assessed for multicollinearity (variance inflation factor > 2.50; correlation>0.60) before making the final decision of inclusion in multivariate models. We estimated mixed-effects logistic regression models to examine the relationship of state-, community-, and facility-level factors with each of the following outcomes: (1) facilities having staff cases, (2) facilities having resident cases, and (3) facilities having resident deaths. All models were three-level models with random intercepts for counties and states; in other words, the facilities were nested in community contexts (measured as counties) nested in state policy contexts (measures as states).

2.4 Methodology for Stakeholder Advisory Board

2.4.1 Identifying Stakeholder Regions

We examined various maps to identify a method for dividing the State of North Carolina into regions to ensure that members of the Stakeholder Advisory Board optimally represented the State. Map foci included data monitoring, geographic boundaries, health response, and trauma planning. With its emphasis on preparation and response to public health emergencies, we used the four North Carolina Public Health Preparedness Regions consisting of western, central, eastern, and the cities readiness initiative region (see *Figure 4*). These regions would serve as the boundaries for determining representation across the areas.

Figure 4. North Carolina Public Health Preparedness Regions
(Source: North Carolina Department of Health and Human Services 2020c)

2.4.2 Identifying Stakeholders within Regions

Each region was assessed for county rurality and urbanicity. To achieve a balance among rural and urban areas, we examined numerous sources to identify a mix of counties for inclusion. Though overlap

exists among sources that define urban and rural regions, we used the Office of Management and Budget definition to select at least one urban and one rural county for each region. Counties were also reviewed for outbreak status to identify a balance between those that were experiencing a high level of outbreak, or a hotspot, and those that were not experiencing a high outbreak level.

Once the balance of high/low outbreak and rural/urban county characteristics were achieved, we searched the internet and the Division of Health and Human Services licensed nursing home listings to identify a list of prospective contacts to invite to participate in the Stakeholder Advisory Board. The search included facilities identified as nursing homes, congregate facilities with memory care units, all-inclusive programs for older adults who meet criteria for nursing home admissions and maintain onsite congregate services, hospice, skilled nursing, and ombudsman programs who advocate on behalf of residents in long-term care facilities.

With a goal of 6 to 8 members for the Stakeholders Advisory Board (SAB), which is in line with research on optimal focus group sizing (Kreuger and Casey 2015), we conducted an internet search of counties within the regions of interest to develop a list of prospective contacts that would give us a mix of diverse professional backgrounds, agency settings, income levels, and socio-demographic characteristics. Prospective members were contacted by email with IRB approved templates and invited for participation over Zoom informational meetings. An initial contact list was compiled based on inclusion criteria and subsequent lists followed over the beginning phase of the project. A large portion of potential agencies were screened out for insufficient contact information that would meet IRB communication requirements. A first cycle of email contact went out with a follow up contact for non-responses (see ***Appendix C*** for the initial contact email script). This process continued for three additional cycles over a three-month period. A total of six contacts agreed to participate on the SAB.

2.4.3 Facilitating Onboarding Meetings with Stakeholders

After each community member responded to our initial invitation to participate on the Stakeholder Advisory Board, we invited them to participate in a virtual onboarding meeting with the study co-PIs based on their preferred availability. We developed a brief presentation for use during informational meetings with prospective stakeholders (see ***Appendix D***). We started with brief introductions and proceeded to discuss information about study parameters, scope of the problem, goals, and purpose of the SAB. Each member was invited to ask clarifying questions and confirm their interest during the onboarding session. We convened six informational meetings with prospective stakeholders who responded to the project email invitation to participate, and all agreed to participate in the SAB.

Members of the Stakeholder Advisory Board are a diverse set of professionals from across the state of North Carolina who are committed to safe, high quality care for residents of long-term care facilities (see ***Figure 5***):

- Carol Hallisey is a Nurse and Director of Onslow County Hospice and Home Health who concentrates her efforts on the outpatient side of client care by addressing problems in organizing care for clients and issues in home health services that arise.

- Kashima Jones is an Assistant Professor of Clinical Adult Health at NC A&T School of Nursing and a Nurse who provides care for adult clients in community settings and educates the next generation of nurses in best practices for safe and competent adult nursing care.

- Aimee Kepler is the Regional Long Term Care Ombudsman with the Triad J Council of Governments with a background in Human Relations and Gerontology and who has served and advocated for the well-being of residents in congregate facilities for 18 years.

- Sandy Nasbaum is the retired Chair for the Moore County Nursing/Adult Care Home Advisory Committee which is responsible for overseeing the work of volunteer members of the community in advocating for people residing in long term care facilities.

- Larry Alan Reeves is a social worker with experience working in long-term care facilities and as an Alzheimer's Disease caregiver whose current role as Regional LTC Ombudsman with the Area Agency on Aging focuses on advocating for the needs of residents in nursing and adult care homes living in a seven-county region of western North Carolina and among the Eastern Band of Cherokee Indians.

- Ursula Robinson is the Executive Director for Pace of the Triad whose breadth of experience spans 30 years within the field of Aging services including nursing homes, hospice, and other community-based settings.

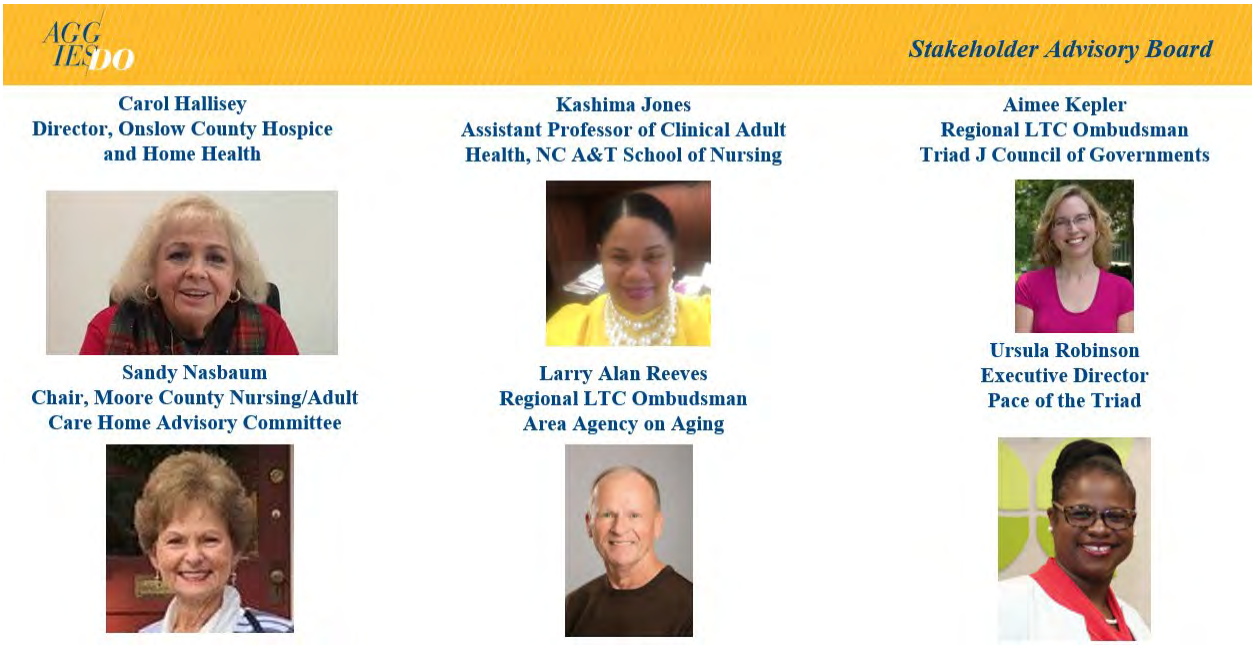

Figure 5. Stakeholder Board Members

2.4.4 Facilitating Stakeholder Board Meetings

Once the group of six members for the SAB was established, we proposed three team meetings and distributed a Doodle poll to all team members to identify their availability. There were several scheduling challenges to overcome, but the SAB members were able to reach consensus for our first meeting.

The initial SAB meeting focused on icebreaker questions, team building, role clarification, and input from the SAB on their thoughts on potential project variables, their experience with COVID-19 in their facilities and surrounding communities, trends they are seeing, and what they feel are the most important targets to consider. Subsequent meetings focused on reviewing preliminary results from data analyses and

brainstorming interpretation of results, suggestions for additional analyses, actionable recommendations, and deliverable formats for data dissemination.

We conducted a debriefing session among the research team after each SAB meeting. We also compiled notes outlining key takeaways after each meeting. After the first SAB meeting was held, key takeaways that emerged included themes of community spread, patient advocacy, testing, infection control, staffing, communication/messaging, what's working, and funding and economic factors. Preliminary results were introduced to the SAB members at the second meeting for discussion and feedback and the key themes that emerged from that meeting included reactions to the results, possible explanations for the findings, staffing related challenges and preferred formats for deliverables. The third, and final, SAB meeting concluded with a discussion of additional findings and thoughts on results, current and desired deliverables, review and feedback for design and content, and recommendations for connecting with additional community stakeholders for data dissemination (see ***Section 4*** for additional details on the content and results of the SAB meetings). Members were invited to follow up as new developments emerged or ongoing interest in project activities were expressed.

3. Results of Quantitative Analysis

3.1 Trends Across States

We used chi-square tests to examine differences between North Carolina versus South Carolina in facilities having any COVID-19 cases, any deaths, staff cases, staff death, resident cases, and resident deaths. North Carolina had a statistically significantly lower percent of facilities with any COVID-19 cases or any deaths than South Carolina (see ***Figure 6*** and ***Table 2***). Forty-nine percent of facilities in North Carolina had any COVID-19 cases compared to 60 percent of facilities in South Carolina (X^2 (1, N = 1411) = 16.58, p = <0.001). Additionally, one-fifth of facilities in North Carolina had any COVID-19 deaths compared to one-third of facilities in South Carolina (X^2 (1, N = 1411) = 31.632, p = <0.001). A similar, statistically significant pattern followed when examining facilities with COVID-19 staff deaths, resident cases, and resident deaths. The relationship between state and facilities with staff cases was also marginally significant (0.05 < p < 0.10).

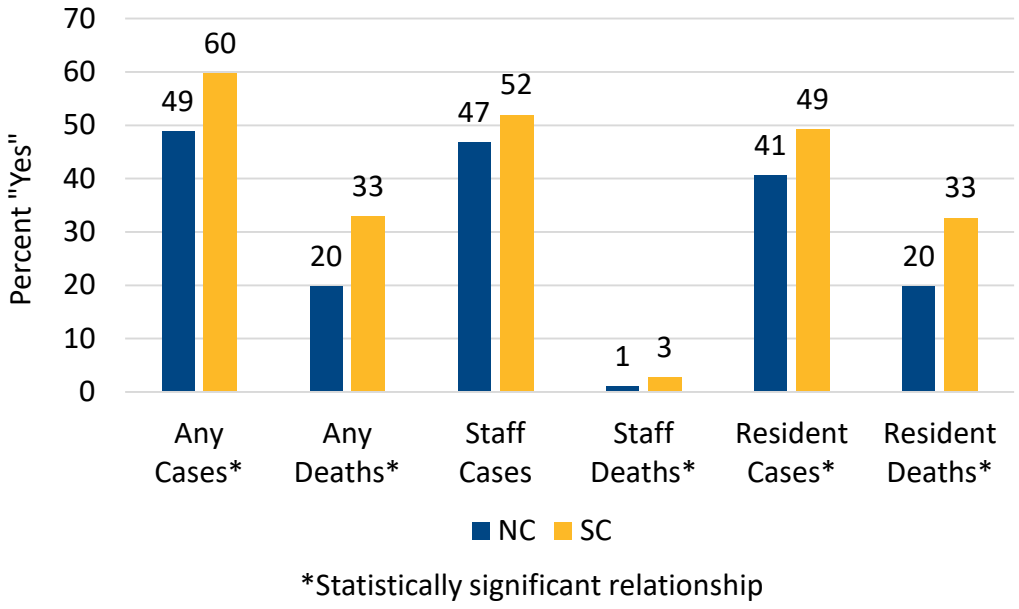

Figure 6. Percent of Facilities with COVID-19 Cases and Deaths by State

Table 2. Facilities with COVID-19 Cases and Deaths by State

State	Bivariate Analyses				p-value
	No	Yes	No	Yes	
	N	N	Row Percent		
Facilities with Any Cases					
NC	429	408	51.25	48.75	<0.001
SC	231	343	40.24	59.76	
Facilities with Any Deaths					
NC	672	165	80.29	19.71	<0.001
SC	385	189	67.07	32.93	
Facilities with Staff Cases					
NC	445	392	53.17	46.83	0.061
SC	276	298	48.08	51.92	
Facilities with Staff Deaths					
NC	829	8	99.04	0.96	0.016
SC	559	15	97.39	2.61	
Facilities with Resident Cases					
NC	497	340	59.38	40.62	0.002
SC	292	282	50.87	49.13	
Facilities with Resident Deaths					
NC	672	165	80.29	19.71	<0.001
SC	387	187	67.42	32.58	

3.2 State-Level Factors

One explanation for the differences in facilities with COVID-19 cases and deaths across North Carolina and South Carolina may be state-level contextual factors. We compared and contrasted policies related to COVID-19 for North Carolina and South Carolina. North Carolina and South Carolina responded to the pandemic in different ways, including policies regarding stay-at-home orders, whether masks were required or suggested in different settings, limitations on community mass gatherings, limitations on visitations with residents in facilities, and recommendations on resident and staff travel for holidays (see ***Figure 7*** for a comparison of policies across North Carolina and South Carolina).

Figure 7. Comparison of Policies Between North Carolina and South Carolina

The North Carolina Department of Health and Human Services issued a series of protocols and informational tools to enhance the safety and well-being of residents in long-term care facilities. They maintain a comprehensive website with various dashboards that provide updates on the status of COVID-19 throughout the state and for populations residing in these facilities (NCDHHS 2020a). The "COVID-19 Outbreak Toolkit for Long-Term Care Settings" was issued to provide guidance on ways to address various needs that may arise in these facilities and to increase the use of recommended measures to reduce virus exposure and spread (NCDHHS 2020b). Policies reflected current Centers for Disease Control and local Public Health guidelines for reporting, triaging, testing, staff shortage mitigation, return-to-work procedures, and visitation to long-term care facilities.

South Carolina's Department of Health and Environmental Control also maintains a website that provides similar information for community members and impacted staff to assist with precautionary measures and decision making in controlling the spread of COVID-19 across the state and within congregate settings (SCDHEC 2020a). Policy and executive order amendments and additions are continuously updated to meet the needs of an evolving pandemic environment. Extensive county-level and facility data is provided on their new dashboard, which went live on August 11, 2020 (SCDHEC 2020b). Guidelines and information for testing, vaccination, community resources, quarantine, travel, and high-risk groups are also included among the various resources provided on these sites.

The response to the pandemic has differed in several ways for these two states. At the start of the pandemic, the two states followed a similar nationwide pattern of closures and stay-at-home orders that were issued across states nationally, with both states also closing schools for the remainder of the spring semester (State of North Carolina 2020; South Carolina Office of the Governor 2020). However, the emphasis in reopening has seen different approaches to recommendations for businesses and individuals. North Carolina has maintained tighter restrictions for gatherings, while South Carolina has maintained language in many guidelines that are "recommended", "encouraged", or "urged" (South Carolina Emergency Management Division 2020; South Carolina Office of the Governor 2020). While North Carolina still maintains limitations on restaurant occupancy with concurrent CDC recommended practices for indoor dining (State of NC 2020), South Carolina allowed restaurants to operate at 100% capacity in October 2020, contrary to CDC recommendations that indicated this presents the "highest risk" for COVID-19 transmission (CDC 2020).

One of the most notable differences between North and South Carolina is their approach to face coverings. North Carolina's Governor, Roy Cooper, laid out a mask mandate in June 2020 (State of North Carolina 2020) while South Carolina's Governor, Henry McMaster, has yet to order a mandate for universal face coverings across the state. In fact, South Carolina's Executive Order 2020-63 only requires face coverings in state government or office buildings, restaurants, and in large crowds or gatherings (South Carolina Office of the Governor 2020). South Carolina's leadership leaves it up to local counties and municipalities to create their own policies. As it stands, South Carolina currently has 10 counties and 56 municipalities with mask ordinances ranging from "required" to "suggested use" (South Carolina County and Municipality Mask Ordinances 2020). Conversely, Governor Cooper has tightened penalties for violating mask orders and issued another modified stay-at-home order that will be in effect until the beginning of 2021 (State of North Carolina 2020).

3.3 Community-Level Factors

We explored community-level factors to determine whether they were associated with facilities having any COVID-19 cases, any deaths, staff cases, staff death, resident cases, and resident deaths. Community-level factors were all measured at the county-level; factors included: rural/urban status, overall social distancing, reduction in average mobility, reduction in non-essential visitation, decrease in human encounters, community spread of COVID-19, political climate of the county, and community resiliency.

3.3.1 Rural/Urban Status

Rural/urban status of the county was measured using the USDA Beale rural-urban continuum codes. The Beale codes classify counties on a scale from one to nine. Categories one through three were collapsed to create a category reflecting "metropolitan" counties. Categories four through seven were collapsed to create a category reflecting "nonmetropolitan urban" counties. Categories eight and nine were collapsed to create a category reflecting "nonmetropolitan rural" counties. We used chi-square tests to examine whether metropolitan, nonmetropolitan urban, and nonmetropolitan rural counties had differences in the percent of facilities with any COVID-19 cases, any deaths, staff cases, staff death, resident cases, and resident deaths.

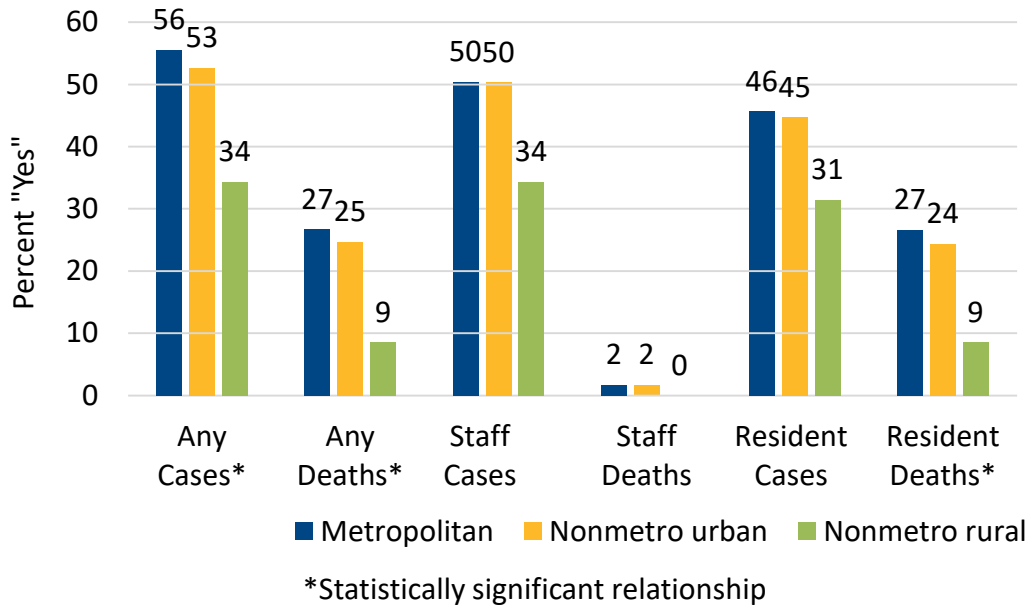

Figure 8. Percent of Facilities with COVID-19 Cases and Deaths by Rural/Urban Status

Nonmetropolitan rural counties had a significantly lower percent of facilities with any COVID-19 cases and deaths compared to metropolitan and nonmetropolitan urban counties (see ***Figure 8*** and ***Table 3***). Thirty-four percent of facilities in nonmetropolitan rural counties had any COVID-19 cases compared to more than half of facilities in metropolitan and nonmetropolitan urban counties (X^2 (2, N = 1369) = 6.58, p = 0.037). Additionally, nine percent of facilities in nonmetropolitan rural counties had any COVID-19 deaths compared to more than one-quarter of facilities in metropolitan and nonmetropolitan urban counties (X^2 (2, N = 1369) = 6.06, p = 0.048).

The relationships between rural/urban status and staff cases, staff deaths, and resident cases were not statistically significant. Yet, the relationship between rural/urban status and resident deaths was statistically significant. Nonmetropolitan rural counties had a significantly lower percent of facilities with resident deaths than metropolitan and nonmetropolitan urban counties, respectively. Nine percent of facilities in nonmetropolitan counties had resident deaths compared to more than one-quarter of facilities in metropolitan and nonmetropolitan urban counties (X^2 (2, N = 1369) = 6.11, p = 0.047).

Table 3. Facilities with COVID-19 Cases and Deaths by Rural/Urban Status

Rural/Urban Status	Bivariate Analyses				p-value
	No	Yes	No	Yes	
	N	N	Row Percent		
Facilities with Any Cases					
Metropolitan	460	574	44.49	55.51	0.037
Nonmetro urban	142	158	47.33	52.67	
Nonmetro rural	23	12	65.71	34.29	
Facilities with Any Deaths*					
Metropolitan	758	276	73.31	26.69	0.048
Nonmetro urban	226	74	75.33	24.67	
Nonmetro rural	32	3	91.43	8.57	
Facilities with Staff Cases					
Metropolitan	513	521	49.61	50.39	0.171
Nonmetro urban	149	151	49.67	50.33	
Nonmetro rural	23	12	65.71	34.29	
Facilities with Staff Deaths					
Metropolitan	1016	18	98.26	1.74	1.000
Nonmetro urban	295	5	98.33	1.67	
Nonmetro rural	35	0	100.00	0.00	
Facilities with Resident Cases					
Metropolitan	562	472	54.35	45.65	0.248
Nonmetro urban	166	134	55.33	44.67	
Nonmetro rural	24	11	68.57	31.43	
Facilities with Resident Deaths*					
Metropolitan	759	275	73.40	26.60	0.037
Nonmetro urban	227	73	75.67	24.33	
Nonmetro rural	32	3	91.43	8.57	

*Fisher's exact tests were used instead of chi-square tests due to low cell sizes.

3.3.2 Social Distancing

Social distancing was measured using data compiled from Unacast's social distancing scoreboard. Social distancing is measured as an overall grade that averages grades from three measures: (1) percent change in average distance traveled; (2) percent change in non-essential visitation; and (3) decrease in human encounters compared to a national baseline. We used chi-square tests to explore whether counties with a failing grade versus passing grade for social distancing had differences in the percent of facilities with any COVID-19 cases, any deaths, staff cases, staff death, resident cases, and resident deaths.

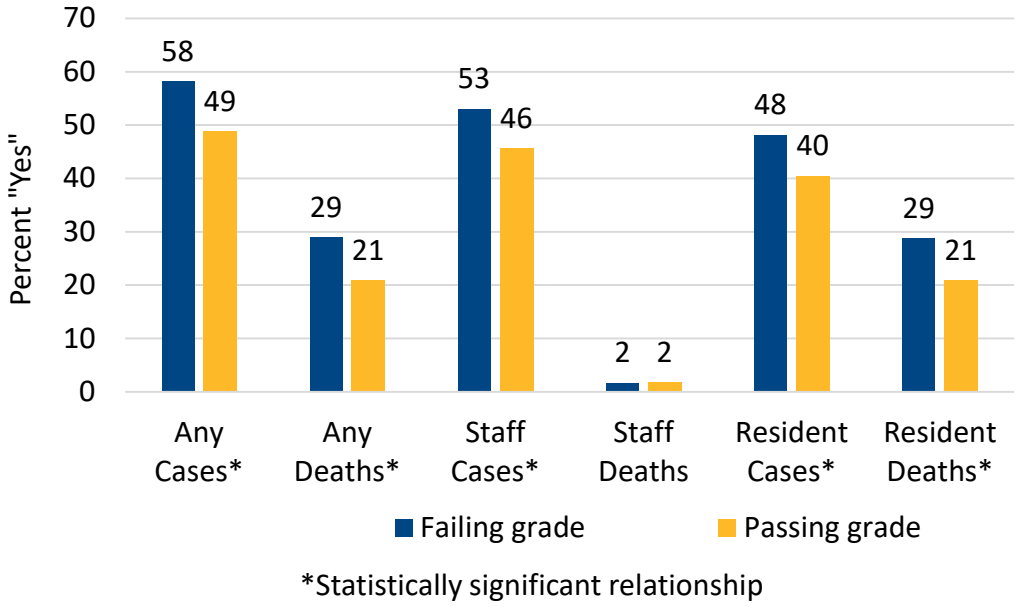

Figure 9. Percent of Facilities with COVID-19 Cases and Deaths by Social Distancing Grade

Counties with failing social distancing grades had a significantly higher percent of facilities with any COVID-19 cases and deaths compared to counties with passing social distancing grades (see ***Figure 9*** and ***Table 4***). Fifty-eight percent of facilities in counties with failing social distancing grades had any COVID-19 cases compared to 49 percent of facilities in counties with passing social distancing grades (X^2 (1, N = 1357) = 11.48, p = 0.001). Additionally, 29 percent of facilities in counties with failing social distancing grades had any COVID-19 deaths compared to 21 percent of counties with passing social distancing grades (X^2 (1, N = 1357) = 10.88, p = 0.001). A similar, statistically significant pattern followed when examining facilities with COVID-19 staff cases, resident cases, and resident deaths.

Table 4. Facilities with COVID-19 Cases and Deaths by Social Distancing Grade

Social Distancing Grade	Bivariate Analyses				p-value
	No	Yes	No	Yes	
	N	N	Row Percent		
Facilities with Any Cases					
Failing grade	357	496	41.85	58.15	0.001
Passing grade	258	246	51.19	48.81	
Facilities with Any Deaths					
Failing grade	606	247	71.04	28.96	0.001
Passing grade	399	105	79.17	20.83	
Facilities with Staff Cases					
Failing grade	401	452	47.01	52.99	0.009
Passing grade	274	230	54.37	45.63	
Facilities with Staff Deaths					
Failing grade	839	14	98.36	1.64	0.842
Passing grade	495	9	98.21	1.79	
Facilities with Resident Cases					
Failing grade	442	411	51.82	48.18	0.006
Passing grade	300	204	59.52	40.48	
Facilities with Resident Deaths					
Failing grade	608	245	71.28	28.72	0.001
Passing grade	399	105	79.17	20.83	

3.3.3 Reduction in Average Mobility

Reduction in average mobility in the county was measured using data compiled from Unacast's social distancing scoreboard. Reduction in average mobility was measured using the percent change in average distance traveled, where grades corresponded to the following percent decreases:

- A: >70% decrease
- B: 55-70% decrease
- C: 40-55% decrease
- D: 25-40% decrease
- F: <25% decrease or increase

We collapsed these categories and used chi-square tests to explore whether counties with failing grades versus passing grades for reduction in average mobility had differences in the percent of facilities with any COVID-19 cases, any deaths, staff cases, staff death, resident cases, and resident deaths.

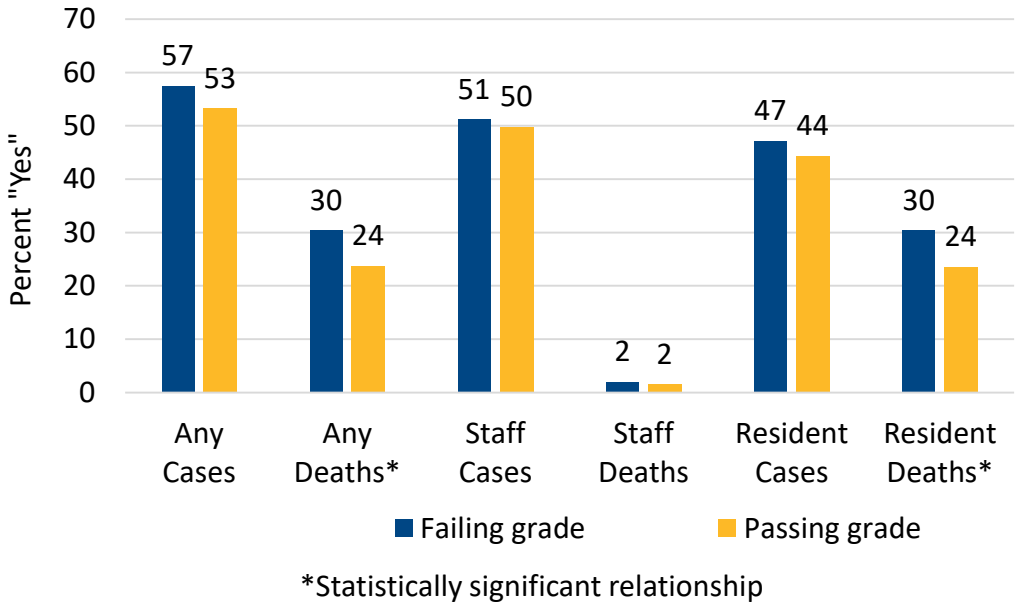

Figure 10. Percent of Facilities with COVID-19 Cases and Deaths by Grade for Reduction in Average Mobility

Counties with failing grades for reduction in average mobility had a significantly higher percent of facilities with any COVID-19 deaths and resident deaths (see ***Figure 10*** and ***Table 5***). Thirty percent of facilities in counties with failing grades had any COVID-19 deaths compared to 24 percent of facilities in counties passing grades (X^2 (1, N = 1357) = 6.98, p = 0.008). A similar, statistically significant pattern was found for the relationship between reduction in average mobility and facilities with resident deaths (X^2 (1, N = 1357) = 7.47, p = 0.006).

Table 5. Facilities with COVID-19 Cases and Deaths by Grade for Reduction in Average Mobility

Grade for Reduction in Average Mobility	Bivariate Analyses				p-value
	No	Yes	No	Yes	
	N	N	Row Percent		
Facilities with Any Cases					
Failing grade	190	257	42.51	57.49	0.144
Passing grade	425	485	46.70	53.30	
Facilities with Any Deaths					
Failing grade	311	136	69.57	30.43	0.008
Passing grade	694	216	76.26	23.74	
Facilities with Staff Cases					
Failing grade	218	229	48.77	51.23	0.616
Passing grade	457	453	50.22	49.78	
Facilities with Staff Deaths					
Failing grade	438	9	97.99	2.01	0.524
Passing grade	896	14	98.46	1.54	
Facilities with Resident Cases					
Failing grade	236	211	52.80	47.20	0.329
Passing grade	506	404	55.60	44.40	
Facilities with Resident Deaths					
Failing grade	311	136	69.57	30.43	0.006
Passing grade	696	214	76.48	23.52	

3.3.4 Reduction in Non-Essential Visitation

There was little variation in reduction in non-essential visitation among counties in our dataset; nearly 97 percent of counties had a failing grade for reduction in non-essential visitation (data not shown). Because of this limited variation, we did not further explore reduction in non-essential visitation.

3.3.5 Decrease in Human Encounters

Decrease in human encounters in the county was measured using data compiled from Unacast's social distancing scoreboard. Decrease in human encounters was measured as decrease in human encounters compared to a national baseline, where grades corresponded to the following percent:

- **A:** >94%
- **B:** 82%-94%
- **C:** 74%-82%
- **D:** 40%-74%
- **F:** <40%

We collapsed these categories and used chi-square tests to explore whether counties with failing grades versus passing grades for decrease in human encounters had differences in the percent of facilities with any COVID-19 cases, any deaths, staff cases, staff death, resident cases, and resident deaths.

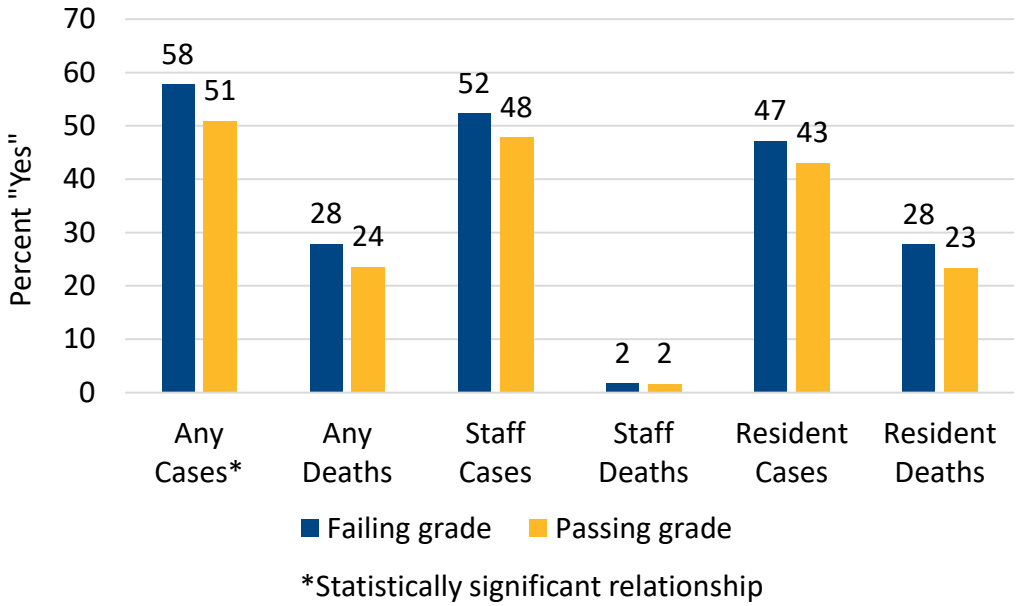

Figure 11. Percent of Facilities with COVID-19 Cases and Deaths by Grade for Decrease in Human Encounters

Counties with failing grades for decreases in human encounters had a significantly higher percent of facilities with any COVID-19 cases than counties with passing grades for decreases in human encounters (see ***Figure 11*** and ***Table 6***). Fifty-eight percent of facilities in counties with failing grades for decreases in human encounters had any COVID-19 cases compared to 51 percent of facilities in counties with passing grades (X^2 (1, N = 1357) = 6.41 p = 0.011). The relationships between grades for decreases in human encounters and facilities with any COVID-19 deaths and resident deaths were also marginally significant ($0.05 < p < 0.10$).

Table 6. Facilities with COVID-19 Cases and Deaths by Grade for Decrease in Human Encounters

Grade for Decrease in Human Encounters	Bivariate Analyses				p-value
	No	Yes	No	Yes	
	N	N	Row Percent		
Facilities with Any Cases					
Failing grade	315	431	42.23	57.77	0.011
Passing grade	300	311	49.10	50.90	
Facilities with Any Deaths					
Failing grade	538	208	72.12	27.88	0.071
Passing grade	467	144	76.43	23.57	
Facilities with Staff Cases					
Failing grade	356	390	47.72	52.28	0.100
Passing grade	319	292	52.21	47.79	
Facilities with Staff Deaths					
Failing grade	733	13	98.26	1.74	0.880
Passing grade	601	10	98.36	1.64	
Facilities with Resident Cases					
Failing grade	394	352	52.82	47.18	0.127
Passing grade	348	263	56.96	43.04	
Facilities with Resident Deaths					
Failing grade	539	207	72.25	27.75	0.069
Passing grade	468	143	76.60	23.40	

3.3.6 Community Spread of COVID-19

Community spread of COVID-19 was measured using COVID-19 cases per 10,000 population in the county. Simple logistic regression models were performed to examine the relationship between the extent of community spread and facilities having any COVID-19 cases, any deaths, staff cases, staff death, resident cases, and resident deaths. Facilities in counties with greater community spread had higher odds of having any COVID-19 cases, any COVID-19 deaths, staff cases, resident cases, and resident deaths ($p<0.05$). However, there was no relationship between community spread and facilities having staff deaths.

3.3.7 Political Climate of the County

Political climate of the county was measured using a proxy of the percent of county residents who voted for the Republican candidate versus the Democratic candidate in the last Presidential election. Simple logistic regression models were performed to examine the relationship between the political climate in the county and facilities having any COVID-19 cases, any deaths, staff cases, staff death, resident cases, and resident deaths. None of these relationships were statistically or marginally significant (data not shown).

3.3.8 Community Resiliency

Community resiliency relied on measures developed by the United States Census Bureau to assess the ability of communities to recover from the impact of community disasters, including pandemics. These measures capture variations in individual and household vulnerabilities at the county-level. The three

measures examined include: (1) percent of residents in county with zero risk factors; (2) percent of residents in county with one to two risk factors; and (3) percent of residents in county with three or more risk factors. Simple logistic regression models were performed to examine the relationship between these three measures of community resiliency and facilities having any COVID-19 cases, any deaths, staff cases, staff death, resident cases, and resident deaths, respectively. Facilities in communities with higher percent of residents with three or more risk factors had lower odds of having any COVID-19 cases, staff cases, resident cases, and resident deaths ($p<0.05$). One explanation is that facilities in communities with more risk factors were more also likely to be located in rural areas with greater ability to decrease human encounters and prevent COVID-19 (see evidence below).

3.4 Facility-Level Factors

We explored facility-level factors to determine whether they were associated with facilities having any COVID-19 cases, any deaths, staff cases, staff death, resident cases, and resident deaths. Facility-level factors included measures of the service profile of the facility as well as the quality of care in the facility.

3.4.1 Service Profile

The service profile of the facility was measured using variables from the U.S. Centers for Medicare and Medicaid Services' Post-Acute Care and Hospice Provider Utilization and Payment Public Use Files. Measures of the service profile included the percent dual beneficiaries (i.e., Medicare and Medicaid) in the facility, the percent Black beneficiaries in the facility, the average Hierarchical Condition Category (HCC) risk score in the facility, and the average number of chronic conditions of facilities residents. Service profile data were available for a subset of facilities in our overall sample, which represented about 77 percent of the facilities in North Carolina and about 54 percent of facilities in South Carolina. The availability of data represents a limitation of the study.

3.4.1.1 *Percent Dual Beneficiaries*

The percent of dual beneficiaries in the facility is measured as the "percent of Medicare beneficiaries qualified to receive Medicare and Medicaid benefits. Beneficiaries are classified as Medicare and Medicaid entitlement if in any month in the given calendar year they were receiving full or partial Medicaid benefits." We used simple logistic regression models to explore the relationship between percent of dual beneficiaries in facilities and facilities having any COVID-19 cases, any COVID-19 deaths, staff cases, staff deaths, resident cases, and resident deaths. Facilities with higher percent dual beneficiaries had higher odds of having any COVID-19 cases, any COVID-19 deaths, staff cases, resident cases, and resident deaths ($p<0.05$). However, there was no relationship between percent dual beneficiaries in facilities and facilities having staff deaths.

3.4.1.2 *Percent Black Beneficiaries*

Percent Black beneficiaries in the facility is measured as "percent of beneficiaries who are non-Hispanic Black or African American." We used simple logistic regression models to explore the relationship between percent Black beneficiaries in facilities and facilities having any COVID-19 cases, any COVID-19 deaths, staff cases, staff deaths, resident cases, and resident deaths. Facilities with higher percent Black beneficiaries had higher odds of having any COVID-19 cases, any COVID-19 deaths, staff cases, staff deaths, resident cases, and resident deaths ($p<0.05$).

3.4.1.3 *Average Hierarchical Condition Category (HCC) Risk Score*

Hierarchical Condition Category (HCC) coding is a risk adjustment model designed by the U.S. Centers for Medicare and Medicaid Services to estimate health care costs for patients. The model uses ICD-10 coding to assign risk scores to patients; higher risk scores typically represent patients who have more complex health conditions and higher expected health care costs. We used simple logistic regression models to explore the relationship between average HCC risk scores and facilities having any COVID-19

cases, any COVID-19 deaths, staff cases, staff deaths, resident cases, and resident deaths. Facilities with residents with higher average HCC risk scores had higher odds of having any COVID-19 cases, any COVID-19 deaths, staff cases, resident cases, and resident deaths ($p<0.05$). However, there was no relationship between average HCC risk score among residents and facilities having staff deaths.

3.4.1.4 *Average Number of Chronic Conditions*

Average number of chronic conditions of residents was measured as the "average number of chronic conditions as determined by the 16 Chronic Conditions Data Warehouse (CCW) chronic conditions: atrial fibrillation, Alzheimer's, asthma, cancer (Includes breast cancer, colorectal cancer, lung cancer and prostate cancer), CHF, chronic kidney disease, COPD, depression, diabetes, hyperlipidemia, hypertension, IHD, osteoporosis, RA/OA, schizophrenia, and stroke". We used simple logistic regression models to explore the relationship between average number of chronic conditions and facilities having any COVID-19 cases, any COVID-19 deaths, staff cases, staff deaths, resident cases, and resident deaths. Facilities with higher average number of chronic conditions had higher odds of having any COVID-19 cases, any COVID-19 deaths, staff cases, resident cases, and resident deaths ($p<0.05$). However, there was no relationship between average number of chronic conditions among residents and facilities having staff deaths.

3.4.2 Quality of Care

The quality of care in the facility was measured using variables from the U.S. Centers for Medicare and Medicaid Services' Nursing Home Provider Information dataset. Measures of the quality of care in the facility explored included the overall five-star quality rating, health inspection rating, quality measure rating, long-stay quality measure rating, short-stay quality measure rating, staffing rating, Registered Nurse staffing rating, number of fines, total number of penalties, number of substantiated complaints, reported licensed staffing hours, reported total nurse staffing hours. Quality of care data were only available for skilled nursing facilities. Out of these types of facilities in our overall sample, the quality of care data represented about 97 percent of the facilities in North Carolina and about 46 of facilities in South Carolina. The availability of data in South Carolina represents a limitation of the study.

We ran simple logistic regressions to explore whether the quality of care in facilities was associated with facilities having any COVID-19 cases, any deaths, staff cases, staff death, resident cases, and resident deaths. Several measures of quality of care were not statistically or marginally significantly related to facilities having COVID-19 cases or deaths, overall, among staff, or among residents; these included: overall five-star quality rating, health inspection rating, short-stay quality measure rating, staffing rating, Registered Nurse staffing rating, number of fines, and total number of penalties. Thus, these measures were not further explored. Overall quality measure rating, total long-stay quality measure rating, number of substantiated complaints, reported licensed staffing hours, and reported total nurse staffing hours were associated with one or more of our outcome measures; these measures are presented below.

3.4.2.1 *Overall Quality Measure Rating*

Overall quality is measured using a five-star scale where 1 represents the lowest quality and 5 represents the highest quality; this measure is a summation of the total long-stay quality measure rating and the total adjusted short-stay quality measure rating (U.S. Centers for Medicare and Medicaid Services, 2021). In simple logistic regression models, facilities with higher quality measure ratings had lower odds of having any COVID-19 deaths and resident deaths than facilities with lower quality measure ratings ($p<0.05$). More than half of facilities with an overall quality measure rating of one had any COVID-19 deaths and resident deaths compared to less than 40 percent of facilities with overall quality measure ratings of two or more (see ***Figure 12***).

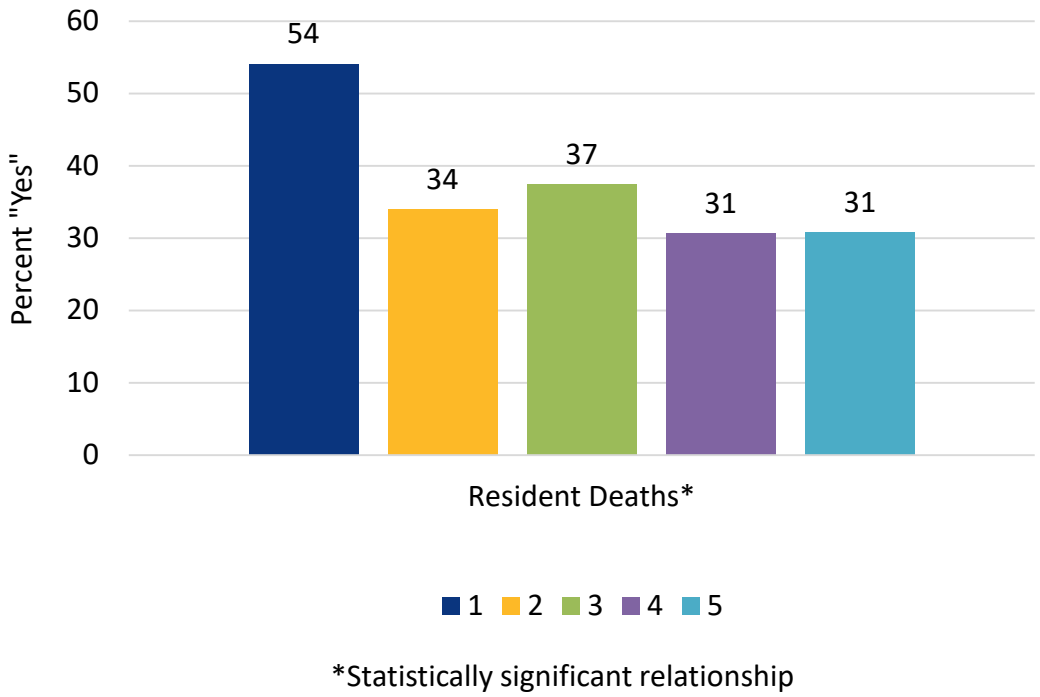

Figure 12. Percent of Facilities with COVID-19 Resident Deaths by the Overall Quality Measure Rating

3.4.2.2 *Total Long-Stay Quality Measure Rating*

Long-stay is defined as "residents who are in the nursing home for greater than 100 days" (U.S. Centers for Medicare and Medicaid Services, 2021: 12). Long-stay quality is measured using a five-star scale where 1 represents the lowest quality and 5 represents the highest quality. In simple logistic regression models, facilities higher in long-stay quality measure ratings had higher odds of having staff deaths (statistically significant; $p<0.05$). Possible interpretations of these findings may be that staff are less compliant with safety protocols because (a) these facilities are understaffed, or (b) perhaps staff in these facilities get complacent because they have increased comfort after having long-term exposure to the same residents over time.

3.4.2.3 *Number of Substantiated Complaints*

Number of substantiated complaints is measured as the number of "substantiated findings from the most recent 36 months of complaint investigations" (U.S. Centers for Medicare and Medicaid Services, 2021: 1). In simple logistic regression models, facilities with higher number of substantiated complaints had statistically significantly lower odds of resident deaths ($p<0.05$). One interpretation of this finding is that facilities with substantiated complaints had recently experienced oversight in order to substantiate the complaints; therefore, they may have had stronger quality assurance procedures in place following the incidents.

3.4.2.4 *Licensed Staffing Hours*

Licensed staffing hours is reported per resident per day. In simple logistic regression models, facilities with higher reported licensed staffing hours had statistically significantly lower odds of having resident cases ($p<0.05$).

3.4.2.5 *Total Nurse Staffing Hours*

Total nursing staffing hours is measured as the reported "sum of RN, licensed practical nurse (LPN), and nurse aide hours per resident per day" (U.S. Centers for Medicare and Medicaid Services, 2021: 1). In simple logistic regression models, facilities with higher reported total nurse staffing hours had marginally lower odds of having resident cases ($0.05<p<0.10$).

3.5 Analysis of Multi-Level Factors Predicting Facilities with COVID-19 Cases and Deaths

The previous sections examined multi-level factors associated with facilities having any COVID-19 cases, any COVID-19 deaths, staff cases, staff deaths, resident cases, and resident deaths. Community- and facility-level factors that were associated with one or more of the outcome measures were considered for inclusion in multivariate models (see *Table 7*).

Table 7. Factors Associated with Outcomes in Bivariate Analyses

Level	Concept	Variables
Community-Level Factors	Community spread of COVID-19	➢ COVID-19 cases per 10,000 population in the county
	Community adherence to COVID-19 policies and best practices	➢ Social distancing ➢ Reduction in average mobility ➢ Decrease in human encounters
	Community demographics	➢ Rural/urban status
	Community resiliency	➢ Percent of residents in the county with 3+ risk factors
Facility-Level Factors	Service profile of facilities	➢ Percent dual beneficiaries ➢ Percent Black beneficiaries ➢ Average Hierarchical Condition Category (HCC) risk score ➢ Average number of chronic conditions of residents
	Quality of care in facilities	➢ Overall quality measure rating ➢ Total long-stay quality measure rating ➢ Number of substantiated complaints ➢ Licensed staffing hours ➢ Total nurse staffing hours

We performed collinearity diagnostics to assess for multicollinearity between the independent variables (variance inflation factor > 2.50; correlation > 0.60) before making the final decision of which independent variables to retain in multivariate models. In the multicollinearity analyses, we identified a strong, positive correlation between average HCC risk score and percent dual beneficiaries. We also found a strong, positive correlation of score on the rural-urban continuum code with (a) decrease in

human encounters, and (b) percent of residents in the county with three or more risk factors. Specifically, rural communities had greater ability to decrease human encounters, but less resiliency to recover from the impact of community disasters. We found that licensed staffing hours had a strong, positive relationship with total nurse staffing hours. Finally, we found a strong, positive relationship between overall quality measure rating and total long-stay quality measure rating. To address multicollinearity, we removed average HCC risk score, total nurse staffing hours, total long-stay quality measure rating, rural/urban location, and community resiliency from subsequent analyses.

We estimated mixed-effects logistic regression models to examine the relationship of the remaining factors in ***Table 7*** with each of the following outcomes: (1) facilities having staff cases, (2) facilities having resident cases, and (3) facilities having resident deaths.[1] All models were three-level models with random intercepts for counties and states; in other words, the facilities were nested in community contexts (measured as counties) nested in state policy contexts (measures as states).

3.5.1 Regression Models with Community and Service Profile Factors

In the first set of models, we sought to include as many facilities as possible. Models included service profiles of the facilities and community-level factors because data were available for multiple types of facilities (N=661 facilities). Service profile variables included the percent dual beneficiaries, percent Black beneficiaries, and the average number of chronic conditions. Community-level variables included a measure of social distancing as well as a measure of community spread of COVID-19.

Factors that predicted whether or long-term care facilities had COVID-19 staff cases included: the percent dual beneficiaries, average number of chronic conditions, and social distancing (see ***Table 8***). Facilities with a higher percent of dual beneficiaries and residents with a higher average number of chronic conditions had higher odds of having staff with COVID-19 than facilities with lower percent of dual beneficiaries and residents with lower average number of chronic conditions – respectively. Although community spread of COVID-19 is statistically significant, it is not practically significant; the odds ratio of near 1 suggests that the effect is small when controlling for the other factors in the model. Facilities in communities with passing grades for decreasing human encounters had lower odds of having staff with COVID-19 than facilities in communities with failing grades.

Two takeaways are key here. First, an interpretation of the service profile findings is that staff caring for the most vulnerable individuals (i.e., those who are poor and have multiple comorbidities) are the ones most likely to bring COVID-19 into facilities. This is concerning because these are the populations which theoretically need most protection from COVID-19. Policy implications are to deploy resources to the most vulnerable groups and facilities and the need for targeted mitigation strategies to address deficiencies in facilitates.

Second, an interpretation of the community-level findings is that staff practicing social distancing outside of work is important for reducing the likelihood of bringing COVID-19 into facilities. Taken together, it is pivotal to encourage staff to engage in preventive measures both at work and in the community. This includes engaging in campaigns and providing incentive programs for staff to get COVID-19 vaccinations, engage in social distancing, wear masks, and hand wash. This also highlights the importance of state policymaking to prioritize staff vaccination along with resident vaccination.

[1] We did not run regression models examining facilities having staff deaths because of the low N.

Table 8. Factors Associated with Long-Term Care Facilities Having COVID-19 Staff Cases

Variables	Odds Ratio	Std. Error	p-value	95% Confidence Interval
Service Profile				
Percent dual beneficiaries	7.638	5.623	0.006***	1.804 - 32.335
Percent Black beneficiaries	0.202	0.170	0.057	0.039 - 1.049
Average number of chronic conditions	7.205	1.606	<0.001***	4.654 - 11.152
Community Factors				
Passing grade for decrease in human encounters (Reference category=failing grade)	0.608	0.146	0.038***	0.380 - 0.972
COVID-19 cases per 10,000 population in the county	1.004	0.001	0.005***	1.001 - 1.007

*p<0.10 **p<0.05 *** p<0.01

Factors that predicted whether or long-term care facilities had COVID-19 resident cases and deaths included: the percent dual beneficiaries, average number of chronic conditions, and social distancing (see ***Tables 9 and 10***). As in the previous model, facilities with a higher percent of dual beneficiaries and residents with a higher average number of chronic conditions had higher odds of having resident cases and deaths. Note that community spread of COVID-19 was not significant in either of these models. Yet, facilities in communities with passing grades for decreasing human encounters had lower odds of having resident cases and deaths. We also ran models that included the same variables as in ***Tables 9 and 10***, but also added in staff cases (data not shown); in the model predicting resident deaths, staff cases and social distancing were the only predictors of resident deaths. Facilities with staff cases had higher odds of having resident deaths, and facilities in communities practicing social distancing had lower odds of having resident deaths.

Table 9. Factors Associated with Long-Term Care Facilities Having COVID-19 Resident Cases

Variables	Odds Ratio	Std. Error	p-value	95% Confidence Interval
Service Profile				
Percent dual beneficiaries	11.637	8.346	0.001***	2.853 - 47.458
Percent Black beneficiaries	0.484	0.387	0.364	0.101 - 2.315
Average number of chronic conditions	5.169	1.089	<0.001***	3.420 - 7.812
Community Factors				
Passing grade for decrease in human encounters (Reference category=failing grade)	0.604	0.134	0.023***	0.391 - 0.933
COVID-19 cases per 10,000 population in the county	1.000	0.002	0.821	0.997 - 1.004

*p<0.10 **p<0.05 *** p<0.01

Table 10. Factors Associated with Long-Term Care Facilities Having COVID-19 Resident Deaths

Variables	Odds Ratio	Std. Error	p-value	95% Confidence Interval
Service Profile				
Percent dual beneficiaries	7.459	5.436	0.006***	1.788 - 31.121
Percent Black beneficiaries	0.814	0.669	0.802	0.162 - 4.077
Average number of chronic conditions	3.353	0.735	<0.001***	2.183 - 5.152
Community Factors				
Passing grade for decrease in human encounters (Reference category=failing grade)	0.526	0.118	0.004***	0.339 - 0.817
COVID-19 cases per 10,000 population in the county	1.001	0.002	0.510	0.998 - 1.005

*p<0.10 **p<0.05 *** p<0.01

3.5.2 Regression Models with Community, Service Profile, and Quality of Care Factors

In the second set of models, we included quality of care of the facilities, service profiles of the facilities, and community-level factors as predictors. Since quality of care data were only available for skilled nursing facilities, the number of facilities in the second set of models is smaller than the number of facilities in the first set of models (N=387). Quality of care variables included overall quality measure rating and licensed staffing hours. Service profile variables included the percent dual beneficiaries, percent Black beneficiaries, and the average number of chronic conditions. Community-level variables included a measure of social distancing as well as a measure of community spread of COVID-19.

In the models in the previous section, factors that predicted whether or long-term care facilities had COVID-19 staff cases included: percent dual beneficiaries, average number of chronic conditions, and social distancing (see ***Table 8***). Yet, when we control for the quality of care of the facilities, percent dual beneficiaries, average number of chronic conditions, and social distancing are no longer statistically significant (see ***Table 11***). Community spread of COVID-19 remains statistically significant but is not practically significant; the odds ratio of near 1 suggests that the effect is small when controlling for the other factors in the model. When controlling for the quality of care in the facility, licensed staffing hours is marginally significantly associated with skilled nursing facilities having staff cases. Skilled nursing facilities that have higher licensed staffing hours per resident per day have lower odds of having staff cases. One interpretation is that understaffing may lead to staff rushing and taking unnecessary risks, including regarding preventive and safety measures for COVID-19. This emphasizes the importance of remaining appropriate staffing levels and avoiding understaffing during biological threats. A policy implication is to create strong staff incentives for job retention, hazard exposures, and staying home when ill.

Table 11. Factors Associated with Skilled Nursing Facilities Having COVID-19 Staff Cases

Variables	Odds Ratio	Std. Error	p-value	95% Confidence Interval
Quality of Care of Facilities				
Overall quality measure rating	1.081	0.121	0.484	0.869 - 1.346
Licensed staffing hours	0.534	0.179	0.061*	0.277 - 1.030
Service Profile				
Percent dual beneficiaries	0.385	0.372	0.323	0.058 - 2.557
Percent Black beneficiaries	1.578	1.609	0.655	0.214 - 11.651
Average number of chronic conditions	1.527	0.474	0.173	0.831 - 2.807
Community Factors				
Passing grade for decrease in human encounters (Reference category=failing grade)	0.761	0.223	0.351	0.429 - 1.351
COVID-19 cases per 10,000 population in the county	1.005	0.002	0.004***	1.002 - 1.009

*p<0.10 **p<0.05 *** p<0.01

In the model in the previous section, factors that predicted whether or long-term care facilities had COVID-19 resident cases included: the percent dual beneficiaries, average number of chronic conditions, and social distancing (see ***Table 9***). When controlling for quality of care of facilities, these factors are no longer statistically significant, yet licensed staffing hours is marginally significantly associated with facilities having resident cases. Skilled nursing facilities that have higher licensed staffing hours per resident per day have lower odds of having resident cases (see ***Table 12***). This finding is not surprising because staffing cases drive resident cases, and understaffing was a main predictor in the model predicting staffing cases.

Table 12. Factors Associated with Skilled Nursing Facilities Having COVID-19 Resident Cases

Variables	Odds Ratio	Std. Error	p-value	95% Confidence Interval
Quality of Care of Facilities				
Overall quality measure rating	0.957	0.100	0.676	0.780 - 1.175
Licensed staffing hours	0.552	0.177	0.063*	0.294 - 1.034
Service Profile				
Percent dual beneficiaries	0.620	0.556	0.594	0.107 - 3.600
Percent Black beneficiaries	3.055	2.880	0.236	0.481 - 19.388
Average number of chronic conditions	1.373	0.392	0.267	0.785 - 2.402
Community Factors				
Passing grade for decrease in human encounters (Reference category=failing grade)	0.698	0.179	0.161	0.422 - 1.154
COVID-19 cases per 10,000 population in the county	1.001	0.002	0.580	0.997 - 1.005

*p<0.10 **p<0.05 *** p<0.01

In the models in the previous section, factors that predicted whether or long-term care facilities had COVID-19 resident deaths included: the percent dual beneficiaries, average number of chronic conditions, and social distancing (see ***Table 10***). When controlling for quality of care of facilities, percent dual beneficiary and average number of chronic conditions are no longer statistically significant, yet social distancing remains statistically significant. Skilled nursing facilities in communities with passing grades for decreasing human encounters had lower odds of having resident deaths (see ***Table 13***).

An interpretation of this finding has to do with the differences in policies and related outcomes in North and South Carolina. These states have a statistically significant difference in grade for decreasing human encounters; 66 percent of facilities in South Carolina are in communities with failing grades for decreasing human encounters compared to 48 percent of facilities in North Carolina (X^2 (1, N = 1,357) = 44.097, p = <0.001). The policies guiding COVID-19 preventive measures was different in these states, with North Carolina providing stricter policies limiting mass gatherings and guidance on outdoor nursing home visitation (see ***Section 3.2***). Taken together with the regression findings, a recommendation is to provide universal mandates modeled by leadership at all levels of government. Consistent messaging and recommendation may help build community trust and foster adherence.

Table 13. Factors Associated with Skilled Nursing Facilities Having COVID-19 Resident Deaths

Variables	Odds Ratio	Std. Error	p-value	95% Confidence Interval
Quality of Care of Facilities				
Overall quality measure rating	0.861	0.090	0.152	0.702 - 1.057
Licensed staffing hours	0.704	0.232	0.288	0.369 - 1.344
Service Profile				
Percent dual beneficiaries	0.749	0.663	0.744	0.132 - 4.242
Percent Black beneficiaries	2.447	2.268	0.334	0.398 - 15.051
Average number of chronic conditions	1.003	0.290	0.991	0.570 - 1.768
Community Factors				
Passing grade for decrease in human encounters (Reference category=failing grade)	0.548	0.140	0.018***	0.333 - 0.904
COVID-19 cases per 10,000 population in the county	1.002	0.002	0.259	0.998 - 1.006

*p<0.10 **p<0.05 *** p<0.01

4. Results from Stakeholder Advisory Board

We scheduled three Stakeholder Advisory Board (SAB) meetings, one for November 2020 and two for December 2020. We developed slides and activities to guide discussion for all three SAB meetings.

4.1 Results from First Meeting

The purpose of the first SAB meeting was to introduce SAB members; provide an overview of the project and overall approach, datasets, and variables; and better understand the context that SAB members are experiencing within their communities and partner facilities. Discussion raised by SAB members centered around four key themes: community spread, patient advocacy, testing, and infection control (see ***Table 14***). Results from the first SAB meeting included useful feedback that informed the expansion of our variables and datasets used. For example, the discussion of a lack of consistent cleaning led us to explore health inspection rating of the facilities in additional analyses.

Table 14. Key Takeaways from First Meeting

Community Spread:

- Concerns COVID-19 spreading in nursing homes via family members coming in
- Concerns staff are bringing COVID-19 into facilities
- Concerns about community "attitude", with some areas of the community not taking COVID-19 seriously and not observing CDC guidelines to reduce incidence of COVID-19 spread
- Inconsistency among houses of worship, with some having video service and some having full services with lack of attention to CDC recommended guidelines

Patient Advocacy:

- Community advocates for this population report challenges in getting into facilities and facilitating COVID-19 information with families
- Concerns about patient rights and quality of life issues regarding visitation and contact
- Questions about different methods to facilitate contact between residents and their families (e.g., tablets)
- Some residents with COVID-19 transferred to other facilities – leaving families, induces trauma
- Concerns that residents may not self-advocate to avoid "making waves"

Testing:

- Concern that people getting screened on "suspicion" of risk based on screening questions, which may miss asymptomatic and pre-symptomatic cases
- Concerns of no mandate for nursing home testing if there are no symptoms

Infection Control:

- Concerns about lack of consistent cleaning
- Concerns of consistent availability of personal protective equipment and supplies

4.2 Results from Second Meeting

The second SAB meeting focused on reviewing preliminary results; brainstorming the interpretation and implications of preliminary results; brainstorming additional analyses to complete; and brainstorming relevant audiences and the most helpful deliverable formats. For preliminary results, we discussed differences between the percent of facilities with COVID cases and deaths between NC and SC; the impact of quality of care / star ratings on facilities with COVID cases and deaths; the impact of the care setting / resident characteristics on facilities with COVID cases and deaths; and the impact of community spread and social distancing on facilities with COVID cases and deaths. Results from the second SAB meeting included useful feedback on the interpretation of the preliminary findings and additional variables to consider including in additional analyses; and feedback that an issue brief would be a useful deliverable format (see ***Table 15***). Based on these recommendations, we drafted an issue brief displaying key findings and preliminary recommendations for review during the third meeting of the SAB.

Table 15. Key Takeaways from Second Meeting

Interpretation of Analyses / Hypothesized Explanations of Results:

- Is COVID-19 politicized?
- Urban/rural differences?
- Smart tablets / technology availability
- Staff not wearing masks correctly-infection control issue
- Need more signs
- People are getting comfortable, letting their guard down
- Dual beneficiaries mirroring what's in community data

Staffing:

- Staffing very hard to manage - not sure how to limit staff activities outside of facilities
- Higher quality = higher incidence of deaths - size of facility, more staff?
- Staff with longer tenure, more comfortable, more time with residents, more time for virus exposure?

Recommended Deliverables:

- Issue Brief / pamphlet
- Infographics

4.3 Results from Third Meeting

The third SAB focused on presenting a draft issue brief for review and feedback; brainstorming additional actionable recommendations; and identifying additional methods of dissemination. Results of the third SAB meeting were useful feedback on the issue brief's organization, format, and content; feedback to disseminate the issue brief electronically to facility leadership and other key stakeholders; and feedback that a webinar would be another helpful deliverable format for facility leadership and other key stakeholders (see ***Table 16***). We discussed additional opportunities to develop a manuscript from the project and invited the SAB members to be co-authors on the manuscript.

Table 16. Key Takeaways from Third Meeting

Support for Policies:

- Inconsistent support locally and nationally - some support COVID-19 measures and others do not
- Public support for policies impact acceptance of policy measures and vaccine uptake
- Concern with lack of supportive services and leadership at various public health departments

Recommended Changes to Issue Brief Deliverable:

- Different layout/content options can be geared towards different audiences
- Balance of easy to read plus enough scientific data to build credibility
- Dissemination plan should include providers on the front lines and leaders in long-term and health and human services organizations
- Mix of interest for quick read with graphic representations to more text rich presentation
- Recommended page length varied from 2 to 4
- Emphasis on content and deliverables that are "functional, practical, and usable"
- Title should be short and to the point
- Call out boxes were suggested to balance content with recommendations

Additional Recommended Deliverable:

- Webinar

5. Dissemination of Results

5.1 Dissemination Strategy

Our dissemination strategy involves creating deliverables in multiple formats for multiple audiences. This strategy is outlined in ***Table 17*** and described in greater detail in the sections below.

Table 17. Dissemination Strategy

Deliverable Format	Primary Audience				
	Public	Academic Scholars	Health Policy Analysts / Decision-makers	Facility Admin./Staff	Advocates for Older Adults
➢ News release	✓				
➢ Conference presentations		✓	✓		
➢ Manuscripts		✓			
➢ Issue brief			✓	✓	✓
➢ Webinar			✓	✓	✓

5.2 Deliverable for the Public

We collaborated with the university to develop a news release on our project (see ***Appendix E*** for the news release). The news release was featured on the home page of the NC A&T State University website (see ***Figure 13*** for screenshot).

Figure 13. Screenshot of NC A&T University Website Home Page Featuring Study

5.3 Deliverables for Academic Scholars and Health Policy Analysts

We submitted abstracts to present our work at two academic conferences. To reach scholars and clinical practitioners focusing on the interventions to improve health outcomes, we submitted an abstract to present at the annual meeting of AcademyHealth. To reach scholars focusing on social determinants of health within the State of North Carolina, we also submitted an abstract to present at the annual meeting of the North Carolina Sociological Association.

We are also working to transform the content of our final report for the NC Policy Collaboratory into scholarly journal articles. One of the target journals will be the *Journals of Gerontology*, which is organizing a special issue on "COVID-19 and Aging 2.0".

5.4 Deliverables for Facility Administrators, Staff and Advocates for Older Adults, and Health Policy Decision-makers

The Stakeholder Advisory Board (SAB) recommended that we develop an issue brief that could be electronically disseminated to key stakeholders throughout the state, including facility administrators and staff, advocates for older adults, and decision-makers. We developed an issue brief, reviewed the issue brief with SAB members to obtain feedback, and then revised the issue brief content and format to address feedback received. ***Figure 14*** presents the working version of the issue brief. Several SAB members have offered to help us disseminate the issue brief within their professional networks. In our last SAB meeting, SAB members recommended that we offer a webinar highlighting key findings. We will advertise the webinar through similar methods as the issue brief.

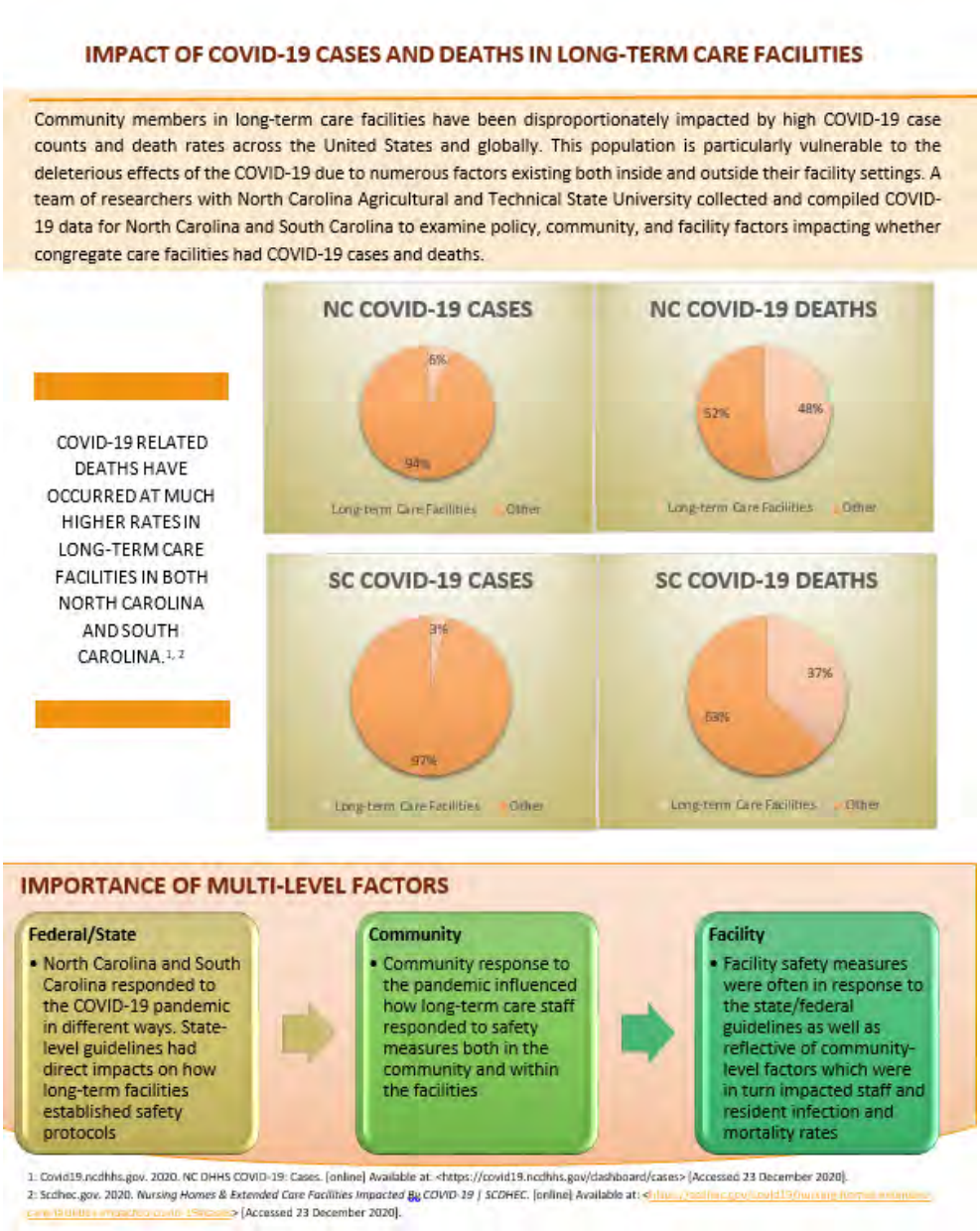

Figure 14. Issue Brief: Page 1

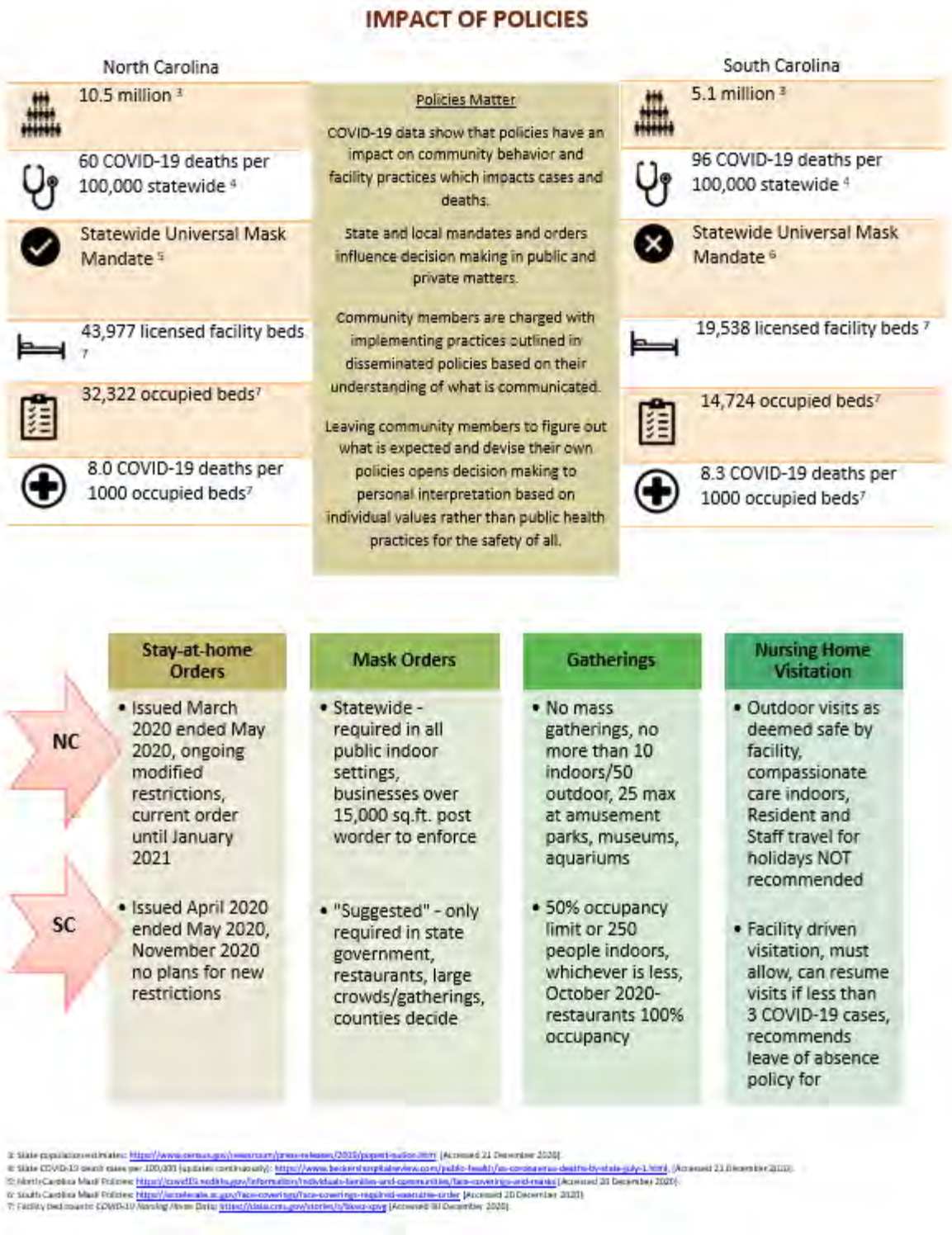

Figure 14. Issue Brief (continued): Page 2

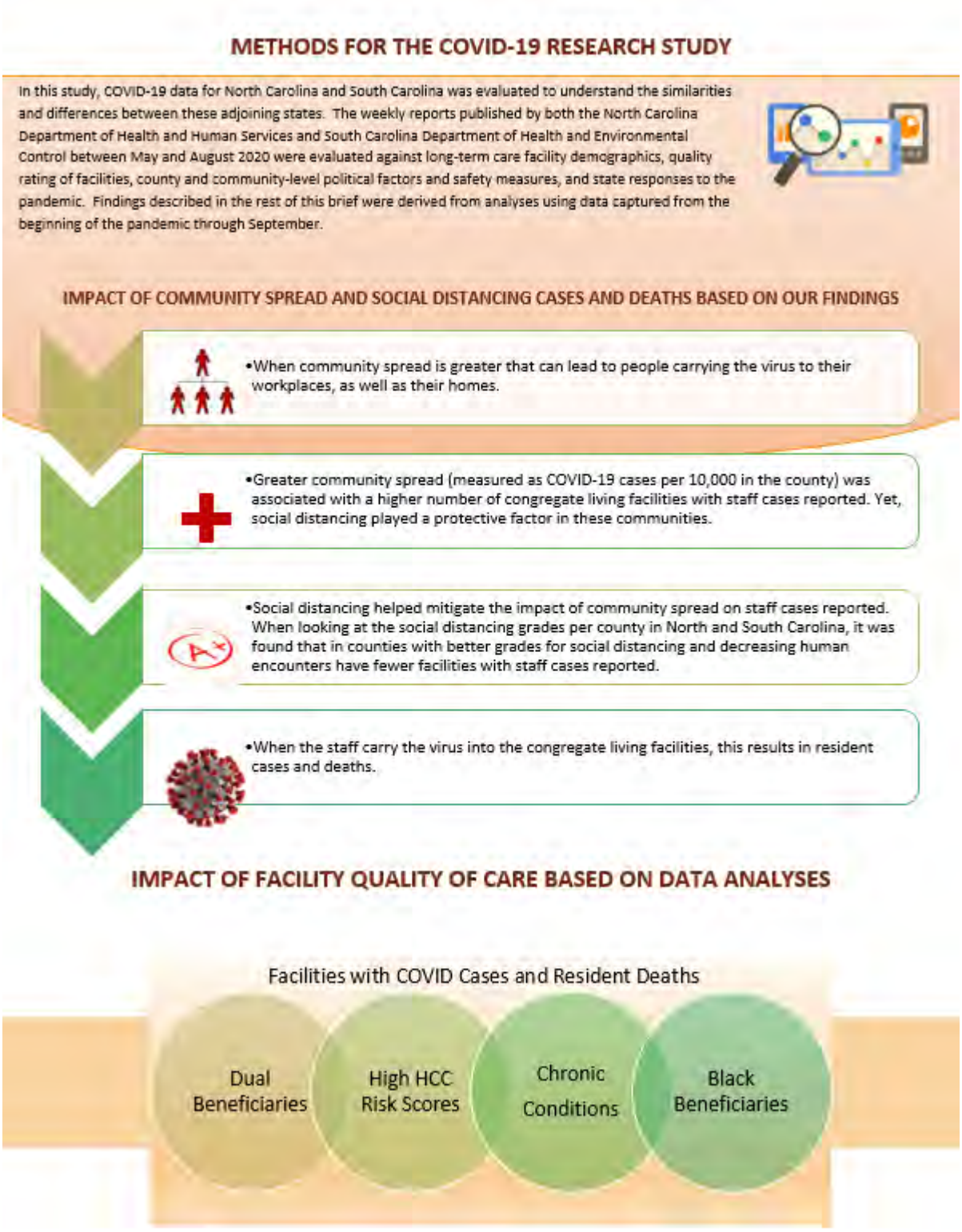

Figure 14. Issue Brief (continued): Page 3

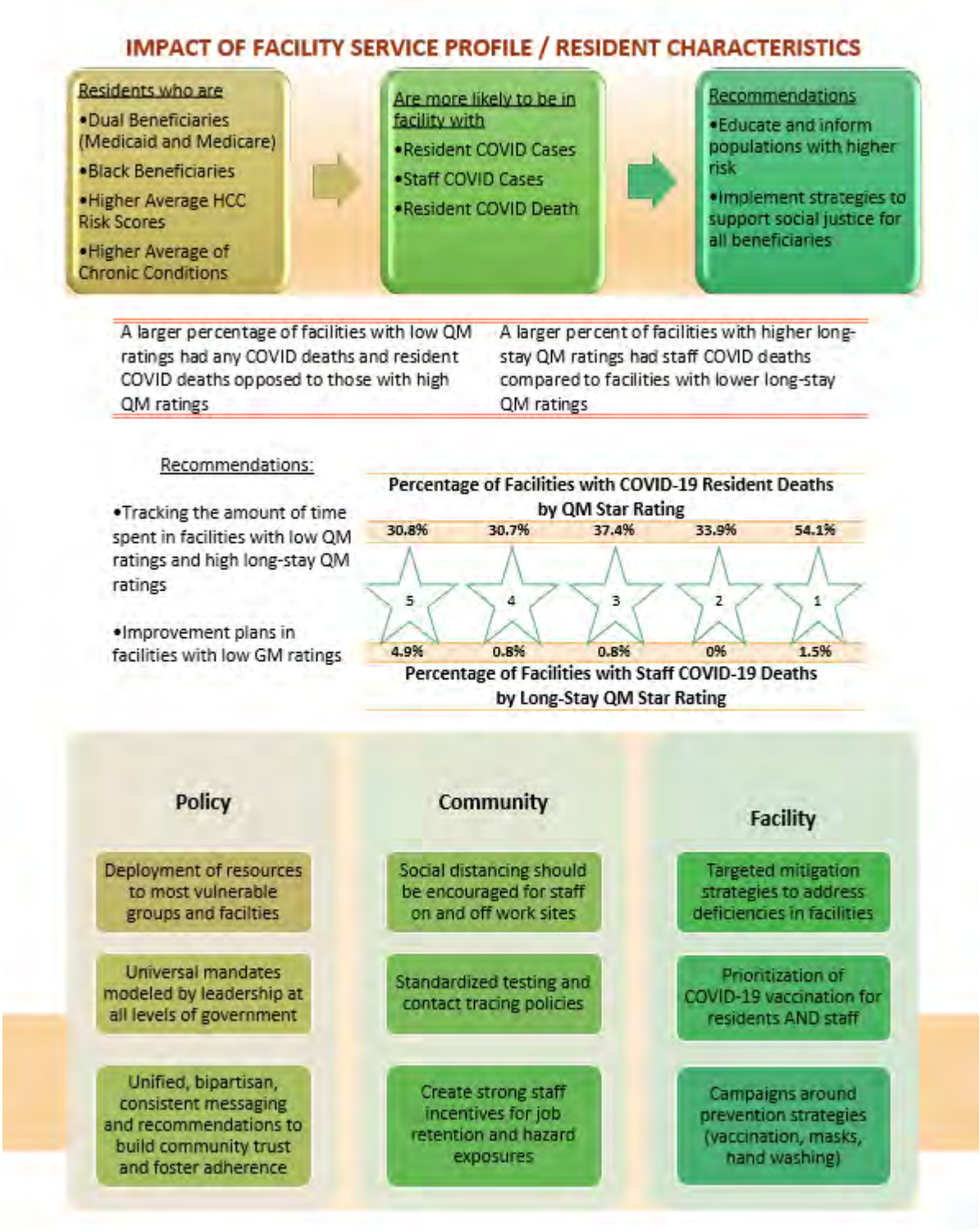

Figure 14. Issue Brief (continued): Page 4

6. Conclusion

Our research objective was to examine policy, community, and facility determinants of long-term care facilities having COVID-19 cases and deaths. Community members in long-term care facilities have been disproportionately impacted by high COVID-19 cases and deaths across the United States. This population is particularly vulnerable to the effects of COVID-19 due to existing health conditions and social determinants of health including policies, exposure within the community, built environment, quality of health care, and socioeconomic conditions.

Using a multi-layered approach, this project examined North and South Carolina policy, community, and facility data to understand some of the root causes of this health inequity. Our research questions were: What policy-, community-, and facility-level factors predict whether or not long-term care facilities have COVID-19 cases and deaths? What are actionable strategies that can be implemented to mitigate COVID-19 cases and deaths in long-term care facilities? To answer these questions, we conducted bivariate analyses and multivariate regression analyses using data compiled from existing federal, state, and mobility secondary data sources. Policy-level variables included stay-at-home orders, mask orders, gatherings, and nursing home visitation. Community-level variables included community spread of COVID-19, community adherence to COVID-19 policies and best practices, community demographics, community political climate, and community resiliency. Facility-level variables included the service profile of facilities and quality of care in facilities.

Findings show that North Carolina had a smaller percentage of long-term care facilities with COVID-19 cases and deaths than South Carolina. Forty-nine percent of long-term care facilities in North Carolina had any COVID-19 cases compared to 60 percent of long-term care facilities in South Carolina. North Carolina and South Carolina responded to the pandemic in different ways, including policies regarding stay-at-home orders, whether masks were required or suggested in different settings, limitations on community mass gatherings, limitations on visitations with residents in facilities, and recommendations on resident and staff travel for holidays. Additional community- and facility-level factors that impacted facilities having COVID-19 cases and deaths included having more vulnerable residents in the facilities (e.g., poorer, multiple comorbidities), understaffing facilities, and being in communities that fail to social distancing.

Following a community-based participatory research approach, a Stakeholder Advisory Board provided feedback on findings, outlined points of advocacy for their constituents, and helped developed recommendations to mitigate COVID-19 cases and deaths. Discussions of findings emphasize the need for a multi-prong policy approach to mitigate the impact of these factors on COVID-19 cases and deaths. Policy-level recommendations include: (1) deploying resources to the most vulnerable groups and facilities; (2) providing universal mandates modeled by leadership at all levels of government; and (3) providing consistent messaging and recommendation may help build community trust and foster adherence. Community-level recommendations include: (1) encouraging social distancing for staff on and off work sites; (2) standardizing testing and contract policies; and (3) creating strong staff incentives for job retention, hazard exposures, and staying home when ill. Facility-level recommendations include (1) targeting mitigation strategies to address deficiencies in facilities; (2) prioritizing staff vaccination along with resident vaccination (along with supporting state and facility policies); and (3) engaging in campaigns and providing incentive programs for staff to get COVID-19 vaccinations, engage in social distancing, wear masks, and hand wash.

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Appendix A. IRB Determination

NC A&T DIVISION OF RESEARCH AND ECONOMIC DEVELOPMENT
1601 East Market Street
Greensboro, NC 27411
336-334-7995
Web site: http://www.ncat.edu/research/dored/irb.html
Federalwide Assurance (FWA) #00000013

To: Stephanie Teixeira Poit
Social Work and Sociology Department

From: IRB

Date: 8/05/2020

RE: Determination that Research or Research-Like Activity does not require IRB Approval
Study #: 21-0003
Study Title: Predictors of and Strategies to Mitigate COVID-19 Cases and Death Among Older Adults in Nursing Homes and Residential Care Facilities

This submission was reviewed by the above-referenced IRB. The IRB has determined that this submission does not constitute human subjects research as defined under federal regulations [45 CFR 46.102 (d or f) and 21 CFR 56.102(c)(e)(l)] and does not require IRB approval.

Study Description:

Older adults in congregate living facilities have higher rates of death from COVID-19 than the general population. In North Carolina, 18% of COVID-19 cases and 61% of COVID-19 deaths were in long-term care facilities; nationally, there is wide variability in state guidelines regarding visitation, screening staff, and PPE use in these facilities (Chidambaram, 2020). Our project examines which pre-COVID-19 quality of care measures predict COVID-19 cases and deaths in congregate living facilities. We also examine community-level factors that perpetuated or mitigated disparities in the number of COVID-19 cases and deaths among older adults in congregate living facilities. Community-level risk factors are important because care providers reside in the community and are carriers bringing COVID-19 into congregate living facilities. Our *research questions include*: What facility-level and community-level factors predict the number of COVID-19 cases and deaths in congregate living facilities? What are actionable strategies that can be implemented to mitigate COVID-19 cases and deaths in congregate living facilities? We will conduct secondary data analyses of existing data sources to examine facility-level and community-level factors that predict the number of COVID-19 cases and deaths in congregate living facilities. Following community-based participatory research, we will use Zoom to virtually convene a Stakeholder Advisory Board with 6-8 key stakeholders during the research process. The Board will provide feedback on the approach, analysis interpretation, and help **develop actionable recommendations** for strategies that can be implemented to mitigate COVID-19 cases and deaths in congregate living facilities. The Board will provide feedback on deliverable formats that can best meet the needs of our local community partners, their constituents, policymakers, and decision makers (e.g., issue briefs, reports, community presentations), so that research can be translated to inform practice. We will also develop manuscripts and conference presentations for academia.

If your study protocol changes in such a way that this determination will no longer apply, you should contact the above IRB before making the changes.

Appendix B. Detailed Methodology for Dependent Variables

COVID-19 DATA IN NORTH CAROLINA

The process utilized in identifying the infection and mortality rates for staff and residents within long-term care facilities in North Carolina incorporated data from the North Carolina Department of Health and Human Services (NC DHHS) COVID-19 weekly dashboard. The weekly report was titled "COVID-19 Ongoing Outbreaks in Congregate Living Settings", and these reports were downloaded weekly from the NC DHHS website, beginning with the report on 5.29.2020 until 9.8.2020, for a total of 14 reports. The data from these reports was exported to Excel beginning with the 9.8.2020 report. This information was then merged with a set of data titled "The U.S. Centers for Medicare and Medicaid Services' Post-Acute Care and Hospice Provider Utilization and Payment Public Use Files ('PAC PUF'), which included facility type, provider ID, name of facility, city, and zip code. After the reported data from the 9.8.2020 report was merged with the PAC PUF, the facilities at the end of each prior report, listed as "Previous Outbreaks", were then added in a receding timeline (beginning with 9.8.2020 and ending with 5.29.2020) so that the most recent data for each facility was included.

Two areas of concern were noted early in the process of merging this data. The first being that the facility names listed in the weekly reports often did not match the facility name in part or in whole of that in the PAC PUF. This required a tedious, one-by-one process where each facility name listed in the weekly report was searched independently for its match within PAC PUF. Occasionally, an internet search was required to verify the correct facility was being identified. For each instance where the facility names did not match, this discrepancy was documented. The second area of concern was that there were a number of facilities listed in the weekly report which were not in the PAC PUF. The additional facilities with their infection and mortality rates were added to the list of data; however, these entries were missing data such as provider ID, city, and zip code. To reconcile this, three tables were located and downloaded from the NC DHHS website, NC Division of Health Service Regulation, Licensed Facilities. The three tables included: Adult Care Home Listing, Hospice Listing, and Nursing Home Listing Alphabetical. The .txt file was exported to Excel for each of these three tables as this was the only file which included the provider/facility ID.

For each entry from the weekly report which did not have a corresponding set of data in PAC PUF, the NC Licensed Facilities tables (Adult Care Home Listing, Hospice Listing and Nursing Home Listing Alphabetical) were searched. When the matching facility name was found, the needed data of facility ID, city, and zip code were then added to the main table of facilities with their infection and mortality rates. One final step of compiling the data was to then search for any duplicate provider/facility ID numbers within the final list of data. This search returned a list of approximately 15 entries; in these cases the facility name in the PAC PUF was completely different from the facility name provided on the weekly report and the NC Licensed Facilities list; for each of these, the data were merged with the PAC PUF dataset and a note of the correct name added. In the final compilation of data, there were 35 entries from the weekly report data for which a corresponding facility ID was not located out of a total of 409 facilities with reported infection and/or mortality rates. To add the county names for each entry, an internet search provided a list of counties based on zip codes, and this information was then cross-referenced with the zip code data in the table and county names added as the final column.

For quality assurance purposes, a research team member compiling South Carolina data double checked every 34th data entry. The number 34 was randomly generated from a number generator from a number between 0 to 100. Two inconsistencies were found, one being a mis-keyed number and the other

being a misnamed facility. Corrections were made to both entrees. After finding one raw data number mis-keyed, the original data collector for North Carolina then went back to check every 15th entry to ensure no other data had been mis-keyed. No other errors were identified.

COVID-19 DATA IN SOUTH CAROLINA

The process utilized in identifying the infection and mortality rates for staff and residents within long-term care facilities in South Carolina incorporated data from the South Carolina Department of Health and Environmental Control (SC DHEC) COVID-19 weekly dashboard. The weekly report was titled "Cumulative COVID-19 in Long Term Care Facilities Year to Date", and these reports were downloaded weekly from the SC DHEC website, beginning with the report on 7.7.2020 until 8.26.2020, for a total of 6 reports. It is important to note that, unlike North Carolina, reports from South Carolina provided year to date instead of weekly data. The data from these reports were exported to Excel beginning with the 8.26.2020 report. This information was then merged with "The U.S Centers for Medicare and Medicaid Services' Post-Acute Care and Hospice Provider Utilization and Payment Public Use Files ('PAC PUF')" which included facility type, provider ID, name of facility, city, and zip code. In a receding timeline (beginning with 8.26.2020 and ending with 7.7.2020) weekly reports were searched to ensure the 8.26.2020 report was not missing data. 1 facility out of the 6 data reports sheets had been excluded from the 8.26.2020 report. The missing facility was added to the comparable dataset.

Two issues that arose with the South Carolina data. The first issue was 214 facilities reported on the SC DHEC were not listed on the PAC PUFF dataset. The second issue was that 193 of the additional facilities did not have a provider ID. To address the issue, the 214 additional facilities reported on the SC DHEC reports were added to the bottom of the comparable dataset. These 214 facilities did not have provider ID at first. To find the needed information, SC DHEC was searched for long-term care facilities using Licensed S.C. Healthcare Facilities (Lists) and the subsection Facilities and Activities Listed by Type. Then the subcategories of Community Residential care facilities, Day care facilities for adults, Day Care Facilities for Adults, Hospital and Institutional General Infirmaries, Intermediate Care Facilities for Pearson with Intellectual Disability, Hospice, Nursing lists were searched. Correct information was found on the facility, but the provider ID was only found on 21 facilities. However, those without provider ID did have state licenses numbers. State licenses numbers were substituted for facilities without provider ID. New provider ID and state licenses were imputed into the PAC PUF. 12 of the 214 additional facilities were private establishments and no information was found on the SC DHEC website or the establishment websites regarding provider ID or state licenses numbers. To add the county names for each entry, an internet search provided a list of counties based on zip codes, and this information was then cross-referenced with the zip code data in the table and county names added as the final column.

For quality assurance purposes, a research team member compiling North Carolina data double checked every 23th data entry. The number 23 was randomly generated from a number generator from a number between 0 to 100. No inconsistencies were found in the data.

Appendix C. Initial Contact Script for Stakeholder Advisory Board

NORTH CAROLINA
AGRICULTURAL AND TECHNICAL
STATE UNIVERSITY

www.ncat.edu

A LAND-GRANT UNIVERSITY and A CONSTITUENT INSTITUTION of THE UNIVERSITY of NORTH CAROLINA

(Prospective Board Member's Name and Address)

(Date)

Re: Invitation to Participate on Stakeholder Advisory Board

Dear (Board Member's Name),

We are writing to invite you or a representative from your organization to be a part of a Stakeholder Advisory Board - an exciting component of a new research project developed by faculty at North Carolina A&T State University and funded by the NC Policy Collaboratory. As part of this work, we are conducting a research project using large datasets to examine what facility-level and community-level factors predict the number of COVID-19 cases and deaths in congregate living facilities. We seek to develop actionable strategies that can be implemented to mitigate COVID-19 cases and deaths in congregate living facilities.

Because of your familiarity with care provided to older adults in these settings, we are inviting you or a representative from your organization to serve on a Stakeholder Advisory Board to provide feedback on our research. We anticipate your commitment will include approximately 3 meetings between July and December 2020. Because of COVID-19, all meetings will be held virtually via Zoom.

Being a member of the Stakeholder Advisory Board provides you with a unique opportunity to:

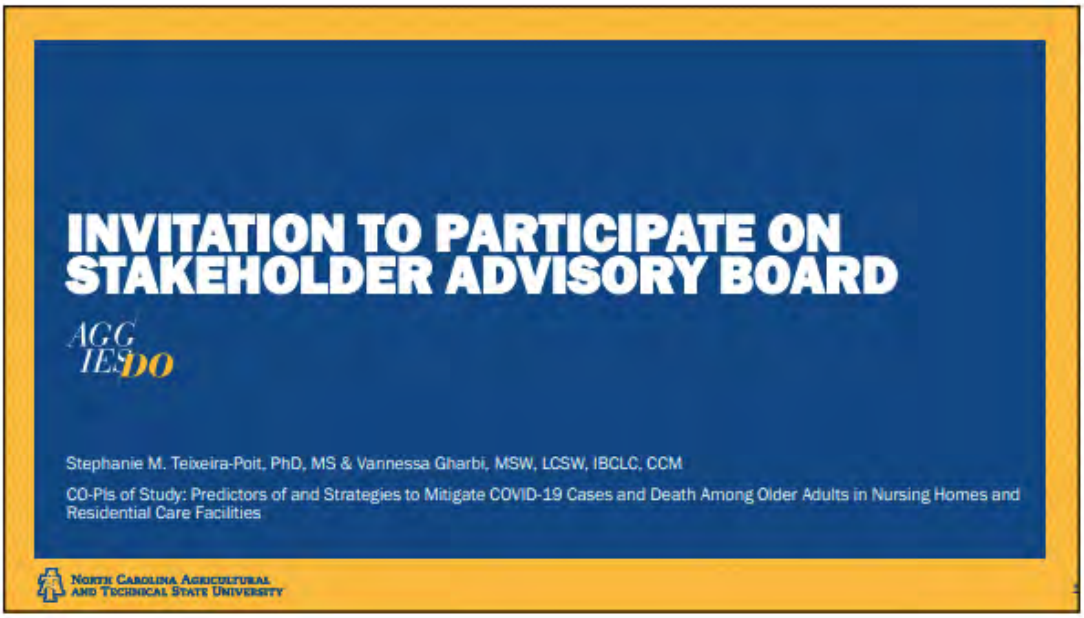
- Inform research questions and the overall approach to the problem
- Enhance interpretation of the analysis
- Provide feedback on actionable recommendations for strategies that can be implemented to mitigate COVID-19 cases and deaths in congregate living facilities
- Provide feedback on deliverable formats that can best meet the needs of key stakeholders
- Continue serving your community in meaningful ways that seek to improve quality of life
- Empower your organization with data to support its mission in serving your consumers
- Expand your network and meet people with similar interests

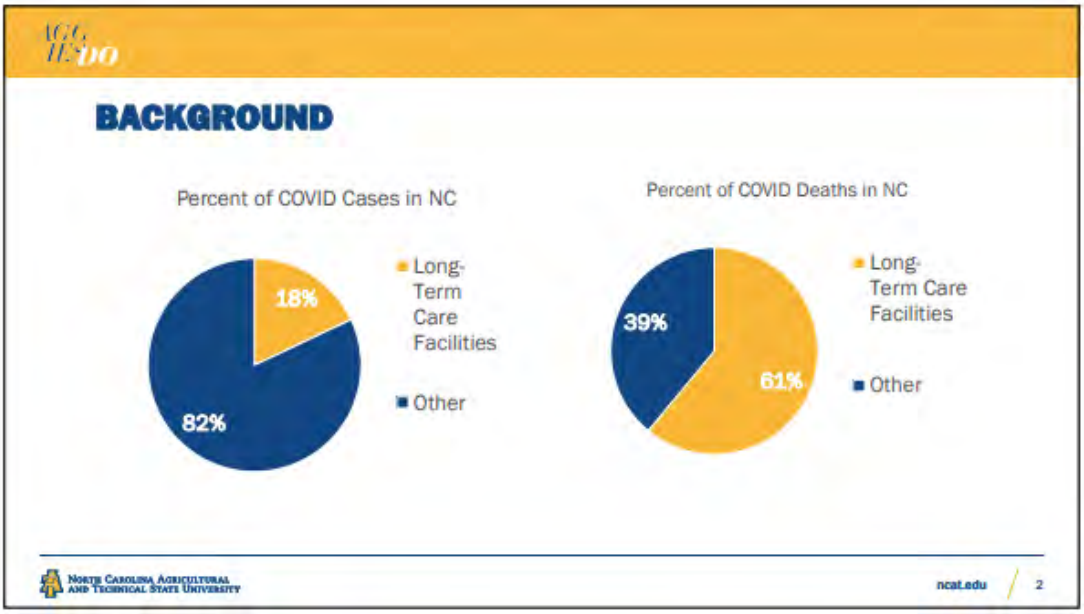
We would like to schedule a brief call with you to discuss your interest. Please let us know what time works best for you. We hope you will join us in this important work!

Thank you,

Stephanie M. Teixeira-Poit, PhD, MS & Vannessa Gharbi, MSW, LCSW, IBCLC, CCM
CO-PIs of Study: Predictors of and Strategies to Mitigate COVID-19 Cases and Death Among Older Adults in Nursing Homes and Residential Care Facilities

Appendix D. Onboarding Session Materials for Stakeholder Advisory Board





RESEARCH QUESTIONS

- RQ1: What facility-level and community-level factors predict the number of COVID-19 cases and deaths in congregate living facilities?
- RQ2: What are actionable strategies that can be implemented to mitigate COVID-19 cases and deaths in congregate living facilities?

APPROACH

- Data Analysis
  - > Uses large datasets to examine what facility-level and community-level factors predict the number of COVID-19 cases and deaths in congregate living facilities
- Stakeholder Advisory Board
  - > Follows model of community-based participatory research
  - > Includes 6-8 key stakeholders

ROLE OF STAKEHOLDER ADVISORY BOARD

- Inform research questions and the overall approach to the problem
- Enhance interpretation of the analysis
- Provide feedback on actionable recommendations for strategies that can be implemented to mitigate COVID-19 cases and deaths in congregate living facilities
- Provide feedback on deliverable formats that can best meet the needs of key stakeholders
- Continue serving your community in meaningful ways that seek to improve quality of life
- Empower your organization with data to support its mission in serving your consumers
- Expand your network and meet people with similar interests

COMMITMENT OF STAKEHOLDER ADVISORY BOARD

- Participate in approximately 3 one-hour meetings
- Because of COVID-19, all meetings will be held virtually via Zoom
- Questions?

CONTACT INFORMATION

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Appendix E. NC A&T Press Release

The following press release was featured on the NC A&T website:

N.C. A&T STUDY AIMS TO LOWER COVID-19 CASES, DEATHS IN RESIDENTIAL CARE FACILITIES

EAST GREENSBORO, N.C. (Dec. 18, 2020) – A study under way by researchers in North Carolina Agricultural and Technical State University's College of Health and Human Sciences aims to reduce the number of COVID-19 cases and deaths in residential care facilities, including nursing homes.

Data have established that older adults in congregate living facilities have higher COVID-19 mortality rates than the general population. In addition, guidelines regarding visitation, screening staff for the novel coronavirus, and the use of personal protective equipment (PPE) vary widely from state to state.

The N.C. A&T study examines which pre-COVID-19 quality of care measures predict COVID-19 cases and deaths in congregate living facilities, as well as community-level factors that perpetuated or mitigated disparities in the number of COVID-19 cases and deaths among older adults in these residences.

"Community-level risk factors are important because care providers reside in the community and are carriers bringing COVID-19 into congregate living facilities," said Stephanie Teixeira-Poit, Ph.D., an assistant professor of sociology in the CHHS and principal investigator (PI) of the study.

Earlier this month, the Centers for Disease Control and Prevention recommended that health care and nursing home workers be among the first to receive COVID-19 vaccines as soon as they become available.

Teixeira-Poit is leading the effort with co-PI Vannessa Gharbi, a student in the Joint Programs in Social Work of A&T and the University of North Carolina-Greensboro. Their team analyzed data from the N.C. Department of Health and Human Services COIVD-19 Ongoing Outbreaks in Congregate Living Settings Report, the U.S. Centers for Medicare and Medicaid Services Post-Acute Care and Hospice Provider Utilization and Payment Public Use Files, the U.S. Agency on Healthcare Research and Quality's Area Health Resources File, and county-level COVID-19 records.

As part of the study, researchers conducted community-based participatory research and convened a stakeholder advisory board (SAB). "To ensure the SAB could address the needs of a wide range of diverse constituents, we aimed to assemble a cohort of leaders in the field representing diverse geographical locations, professional backgrounds, agency settings, income levels, and socio-demographic characteristics," said Teixeira-Poit.

The SAB not only provided feedback on the approach and analysis interpretation, but also help develop actionable recommendations that can be implemented to reduce novel coronavirus cases and deaths in congregate living facilities.

"We will use this information to devise practical strategies that our local community partners, their constituents, policymakers and decision-makers can use to mitigate COVID-19 cases and deaths in these facilities," said Teixeira-Poit. "Our hope is that these strategies can be adapted and implemented in residential care facilities across North Carolina and in other states to slow and stop the spread of COVID-19 among these vulnerable adult populations."

The target completion date for the Predictors and Strategies to Mitigate COVID-19 Cases and Death Among Older Adults in Nursing Homes and Residential Care Facilities study, which received $75,428 in funding from the N.C. Policy Collaboratory, is Dec. 30.