THE EFFECT OF EARLY IMPLEMENTATION OF INFECTION PREVENTION AND CONTROL OUTBREAK MANAGEMENT INTERVENTIONS ON THE OUTBREAK DURATION, ATTACK RATE, MORBIDITY, AND MORTALITY OF LONG-TERM CARE RESIDENTS DURING THE COVID-19 PANDEMIC

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Dedication and Acknowledgments

I want to dedicate this project to the active Military and Veterans' service and sacrifices for our country. Also, I would like to dedicate this project to my wife, Angie, and daughters, Avery, and Addison, for supporting me throughout my career and always being there during this DNP program.

I want to acknowledge my research mentor Dr. Charles de Comarmond, for his continued support for my professional and personal growth.

Abstract

BACKGROUND/OBJECTIVE: Long-Term Care Facilities (LTCFs) all around the world were highly susceptible to disproportionate adverse patient outcomes during the COVID-19 pandemic, accounting for over 78% of total deaths in the United States. This project aims to answer if the LTCFs created the tragic results of the COVID-19 pandemic due to an absent state of preparedness, a lack of resources, and a deficient understanding of the importance of early implementation of critical Infection Prevention and Control (IPC) interventions. This project will determine the efficacy of timely implementation of IPC outbreak management interventions and their effect on patient outcomes.

DESIGN AND SETTING: This study utilized a quantitative design to evaluate four measures of two separate SARS-CoV-2 (COVID-19) outbreaks to investigate the effect of early implementation of multiple infection prevention and control (IPC) outbreak management interventions. The four measures consisted of the length of the outbreak in days, the transmission rate of the virus, the increased morbidity, and mortality rates during each outbreak. The Iowa Evidenced-based practice model was employed for this project. This method assisted with identifying the practice gaps of the LTCFs' contributing to late or non-implementation of outbreak management strategies. The inclusion criteria included any resident admitted to the LTCFs during the initial confirmed COVID-19-positive case through the outbreak resolution. There were no exclusion criteria utilized with this study population. Two LTCFs (Facility "A" & Facility "B") with COVID-19 outbreaks occurring during the initial pandemic year of 2020 provided similar healthcare environmental settings and were chosen for this project. Both facilities are in the Piedmont region of North Carolina.

PARTICIPANTS: The census at the time of the outbreak was utilized, consisting of 168 residents, 82 from Facility "A" and 86 from Facility "B". The two facility outbreaks were

selected due to similarities of the populations in Age, Gender, Race & Ethnicity, and the presence of comorbidity illnesses. (Refer to *Table 3* for the data).

MEASUREMENTS: Four outcome measurements were analyzed, including outbreak duration, attack rate (rate of transmission of disease among a set population), morbidity rate, and mortality rate. The analysis was derived from the utilization of on-site tri-weekly observations during the outbreaks, which were documented within the epidemiological investigations, and retrospective chart reviews. This project utilized a literature research analysis component to assist in determining the ten (10) most "essential" IPC interventions and the measurement focused on each LTCF's date of full implementation of each intervention. For the purposes of this project, full implementation is defined as no deficiencies or non-compliance observed during the tri-weekly rounds on two consecutive rounds and then total compliance with the intervention on subsequent observational rounds.

RESULTS: Facility "A" implemented the ten interventions later, specifically, days thirteen (13), fifteen (15), eighteen (18), twenty-five (25), forty (40), and fifty-five (55), as seen in *Table 4*. This late implementation significantly affected the four measures as seen in *Table 2.* Facility "B" implemented the interventions on day one (1), as seen in *Table 5,* and had significantly lower adverse patient-outcome rates. Facility "A" had a twenty-six percent (26%) higher attack rate, a twelve percent (12%) higher morbidity rate, and a sixteen percent (16%) increased death rate.

CONCLUSIONS: The LTCF that implemented the ten "essential" IPC outbreak management interventions on day one of the outbreak significantly reduced the attack rate, mortality, morbidity, and duration of the outbreak. This evidence suggests that adequately prepared facilities that implement IPC outbreak management strategies early will decrease transmission of COVID-19 and, therefore, improve patient outcomes during an outbreak situation.

Background and Significance

During the COVID-19 pandemic, the elderly population has been more severely impacted than any other demographic with tragic outcomes. This is evident in the CDC's Data Tracker, as of September 2021, reporting that the age group of 65 years and older accounts for only 12.7% of the total cases in the United States, yet 78% of total deaths (CDC, 2020b). Pan et al., 2020, revealed a substantial increase in disease severity for the elderly. Their study showed that out of 32,325 cases of persons aged 60+ years, there was a severe disease rate of 29.6% to 41.1%, while 20- to 50-year-olds had rates of 12.1% to 17.4%. This impact has resulted from multiple variables universal to the elderly population, including the decreased functionality of the immune system, increased incidence of multiple comorbidities, decreased cognitive function, decreased mobility, and altered disease-specific symptomatic presentation (Pan et al., 2020). Centers for Disease Control and Prevention (CDC) data indicate that the risk of hospitalization and death rises considerably with age (Miller, 2021). Furthermore, many older adults manifest COVID- 19 with low-grade temperatures, diarrhea, or fatigue, and may not have overt respiratory symptoms, causing rapid spread without detection (Lester et al., 2020). A research review by Dykgraaf et al., 2021 utilized over 713 articles with 77 studies that provided results that the factor of age in COVID-19-related disease for persons 80 years and older increased the mortality rate to over 15%.

COVID-19 has proven to have an even more significant impact within residential or community healthcare settings like Long-Term Care Facilities (LTCF) compared to the rest of the independently living elderly US population. According to Centers for Medicaid & Medicaid Services, as of October 25, 2021, there have been 710,264 confirmed COVID-19 Cases with 138,205 deaths that have been reported since the inception of the pandemic (*COVID-19 Nursing Home Data - Centers for Medicare & Medicaid Services Data*, n.d.). By early 2021, almost all U.S. nursing homes had experienced at least one COVID-19 case, and most (more than 80%) had experienced at least one death (Konetzka RT et al., 2021). The risk factor of increased severe

disease and death in elderly long-term care facility residents has remained consistent throughout international borders. A study by Fisman et al., July 2020, showed that out of 627 LTCF residents 269 died from COVID-19-related illness due to factors linked to living in an LTCF in Canada. This represents a death rate thirteen (13) times higher than the same age group not living in a communal setting. The enhanced impact on the elderly is further apparent by a recent study that showed that LTCFs COVID-19 attack rate (42.9%) is significantly higher than other care environments (Gmehlin & Munoz-Price, undefined/ed). There are also non-Aged related significant factors for the increased impact in the care delivery environment of LTCFs, which include PPE misuse/non-use during the early stages of the pandemic, unavailability of testing platforms, the increase of pathogen bioburden in the communal areas and the absence or late implementation of IPC outbreak management interventions. Asymptomatic transmission seems to be the major contributing factor to skilled nursing facilities (SNF) outbreaks due to the high-touch care and communal living environment (White et al., 2020).

Compounding this predisposed risk for the elderly was the fact that there was a nationwide lack of available resources and preparedness for LTCF, specifically with the implementation of Infection Prevention and Control outbreak management interventions. A study conducted by Latta and Massey, 2018 revealed that while 90% of the LTCFs had outbreak management plans available to utilize, only 25% of those facilities had surveillance protocols in place. A review by Stratil et al., 2021, looked at 22 studies regarding non-pharmacological measures in LTCF environments and their impact on disease transmission. Their research concluded that implementing non-pharmacological measures, such as isolating infectious residents from healthy ones, new admission 14-day quarantine, enhanced environmental cleaning, nursing barriers (PPE), and routine resident and staff testing could substantially decrease the transmission of COVID-19 within LTCF settings. The literature review identified that the LTCF's lack of preparedness was more than just a trait in the US. A study conducted by

Zollner-Schwetz et al., 2021 of three LTCFs in Austria concluded the same attribute to those facilities. The study showed that the post-implementation of some IPC outbreak management interventions discussed earlier assisted these LTCFs in quickly containing their outbreaks within four weeks of onset. The infection prevention and control outbreak management interventions have been proven to decrease the attack rate, morbidity, and mortality rates not only during the COVID-19 pandemic but for all highly infectious disease outbreaks.

The predisposition for severe disease and mortality from COVID-19 infection in the elderly population was compounded by the enhanced virus transmission within communal care settings like LTCFs, nursing homes, and assisted living centers. When those contributing factors are introduced with the identified deficiency of these facilities' preparedness and resources for outbreak management, the stage was set for an international tragedy that the world witnessed in early 2020 with devastating outcomes for the vulnerable elder population.

Purpose

This project will identify current gaps within the preparedness status and response to the COVID-19 pandemic that led to the significant impact of the SARS-CoV-2 virus on LTCF residents within the non-governmental-operated urban facilities. Additionally, the project will show that early outbreak implementation of disease-specific transmission-based interventions for LTCF can significantly reduce the attack rate, morbidity, and mortality for those residents. This project will research the effect of early implementation versus late or non-implementation of ten (10) critical IPC interventions (see *Table 1*). Also, a smart-device application will be developed containing these interventions, along with multiple others, to develop an easily accessible and comprehensive outbreak management plan focusing on transmission-based protocols. This application will be developed and fashioned into the familiarized CDC's Healthcare Associated Infection (HAI) prevention bundle format that has been proven to reduce the HAIs resulting from device and procedural evidence-based practices (EBPs). This 'Outbreak Assist' bundle will

organize the EBPs into three (3) main classifications for ease of selection, which will enhance preventing pathogen-specific transmissions in the residential care setting. These main classifications will be entitled administrative, environmental, and engineering.

Review of Current Evidence

Literature Review Process

PubMed, Cochrane Library, CINAHL, ProQuest & Scopus research databases were reviewed in a systematic fashion by utilizing the terms: COVID-19, SARS-CoV-2 virus, outbreak management, infection prevention & control measures, Long-Term Care Facilities, skilled nursing facilities and residential assisted living centers. The databases of CDC's COVID-19 Data Tracker & CMS's COVID-19 Nursing Home were also utilized while reviewing current evidence. Permission was obtained by the University of Iowa Hospitals and Clinics to utilize the Iowa Model Revised: Evidence-Based Practice to Promote Excellence in Health Care (Iowa Model Collaborative et al., 2017).

The comprehensive review included thirty-one research articles and 2 US government agency databases. Out of the 31 research articles, fourteen were not included in the literature review due to needing to meet the date requirement of being conducted after 2015. These articles were initially reviewed to provide pre-pandemic outbreak management interventional implementation statistical inferences. The concept was to compare pre-pandemic outbreak management implementation efforts to the early pandemic interventions to identify the historical preparedness baseline of the LTCFs.

Effect of COVID-19 on the Elderly Population

The increased frailty of the elderly's immune system has been widely researched and proven within the medical community as an increased morbidity and mortality risk for most invasive disease processes for quite some time. The evidence of this increased risk of severe disease and death was amplified by the emergence of the SARS-CoV-2 virus (COVID-19) in late

December 2019. Multiple studies have reviewed the impact of COVID-19 on the elderly population with overwhelming negative conclusions. Compared to the younger age group, the rate of death is 95, 230, and 600 times higher among people aged 65 to 74, 75 to 84, and 85 years and older (Miller, 2021). This increased risk has been consistent across international borders. In France, as of 15 March 2020, people older than 75 years accounted for 20% of the confirmed cases but 79% of the deaths (Etard et al., 2020).

Physical Environment Contributing Factors

Along with the elderly's contributing factors of comorbidities and decreased immune function, multiple studies have revealed that the LTCF physical environment & preparedness can play a significant role in the increased risk of severe disease and death from COVID-19. Residents' older age, high rates of comorbidities, dependence on staff members (staff) for care, difficulties practicing hand hygiene and physical distancing owing to cognitive impairment, and crowded environment have all been implicated in increased risk of outbreaks and high mortality (Kain et al., 2021). Looking at congregate living settings more broadly, it has been estimated that even though only 4% of all cases were among residents and staff in nursing homes, assisted living facilities, memory care facilities, retirement and senior communities, and rehabilitation facilities, these individuals represented 31% of all COVID-19 deaths (Times, 2020).

LTCF Preparedness Insufficiency

The research has even provided insight into the non-existent preparedness due to the need for more knowledge regarding the novel emerging pathogen. At the start of the pandemic, decisions around PPE were particularly influenced by a lack of supply supporting the use of masks only for activity involving COVID-19 patients (Lucey et al., 2021). This example of a lack of preparedness provides evidence that the Infection Prevention and Control practices should have been implemented promptly to help terminate active COVID-19 outbreaks and

highlights the need for LTCFs to have an evidence-based protocol with infection prevention and control outbreak management interventions.

Literature Appraisal and Gap Identification

The current literature available provides a snapshot of the devastation that the COVID-19 pandemic caused to LTCF residents. However, significant questions remain from the limitations within the research at this point in the pandemic. Several articles used a Meta-analytic approach focusing on different aspects of how the pandemic has affected LTCF and their residents. These different aspects included systematic/preparedness issues of LTCFs, personal perspectives of staff and residents, end-of-life concerns without compassionate care visits, the technology utilized, and innovations developed because of the COVID-19 Pandemic. Additionally, several studies used retrospective comparative analysis showing correlations between the initial infection rates to subsequential infection rates seen later in the pandemic. Longitudinal studies were utilized, looking at several key components to study the transmission of COVID-19 throughout medical facilities.

The articles reviewed by the Cochrane Library could not state proven statistical facts from non-pharmacological intervention effectiveness, only that these interventions are *"likely"* to positively affect the transmission spectrum of the SARS-CoV-2 virus. Furthermore, there have not been any studies conducted to pinpoint a timeline of when critical IPC outbreak management interventions were implemented within an ongoing outbreak. Specific research for residential living centers has not been conducted to definitively prove the effectiveness of non-pharmacological intervention implementation. Research is just now emerging regarding the impact of vaccination on the severity of disease and death rates for the elderly in LTCFs.

Although several intercountry comparisons of aged care outcomes and multiple guidelines and recommendations were available, there was little synthesized evidence available regarding the effectiveness of specific strategies (Dykgraaf et al., 2021). Additionally, Lester et al., 2020,

proposed that prevalent research gaps include identifying transmission patterns and how specific resident factors affect the healthcare outcomes for LTCF residents. The imitations of research have been internationally consistent, with multiple research studies concluding the need for more information. While risks for the elderly and those in Residential Aged Care Facilities (RACFs) are well described, there is limited literature documenting effective public health responses to COVID-19 in RACF settings (Zheng et al., 2021).

Evidence Summary

The current research evidence on the tragic effects of the COVID-19 pandemic on the elderly population provides significant evidence that the LTCFs were not prepared to implement IPC outbreak management strategies. This non-preparedness was created from a lack of current knowledge about the novel emerging pathogen and the lack of appropriate implementation of existing IPC measures early in the outbreak setting. The combination of the elderly's predisposition to severe disease from infectious pathogens, the LTCFs lack of preparedness, and the introduction of a rapidly spreading viral respiratory pandemic set the stage for devastating and tragic healthcare outcomes for hundreds of thousands of elderly nursing home residents. The development of a transmission-based bundled IPC outbreak management interventional protocol could have saved countless long-term care facility residents worldwide.

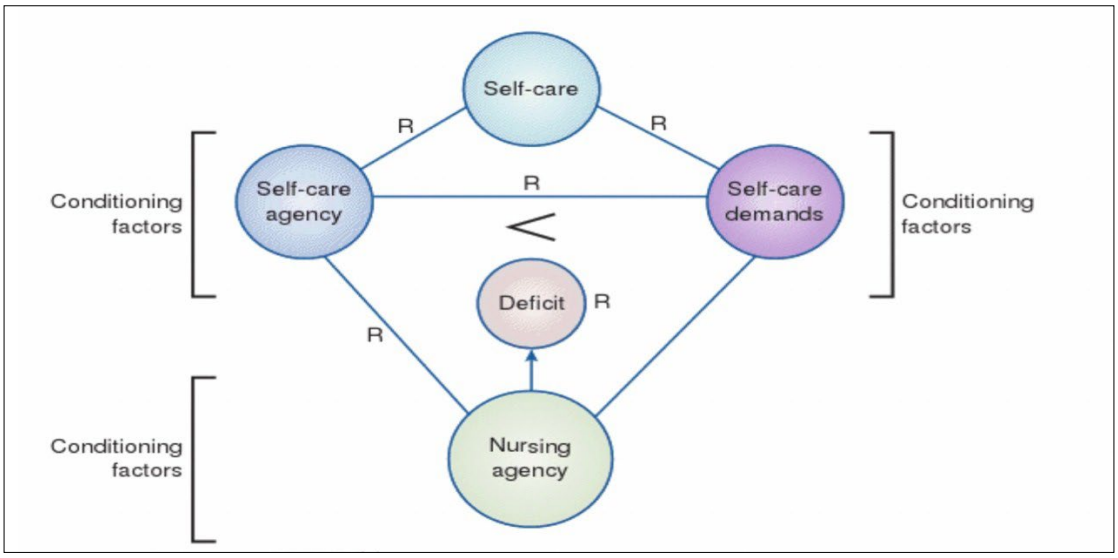
Conceptual Framework / Theoretical Model

This project will incorporate the theory of Orem's Self Care Deficit due to the significant correlation between this project's purpose and the population of elderly residents of Long-Term Care Facilities. The typical resident of an LTCF cannot independently perform the normal activities of daily living, which creates a self-care deficit for the person and, thus, the need for a self-care agency (LTCF). The fact that most LTCF residents need assistance with care consequently places them into a higher-risk environment when dealing with emerging pathogens and outbreak situations, such as the COVID-19 pandemic. This project will illuminate the need

for LTCFs lack of preparedness and need for concise direction for an Infection Prevention and Control outbreak management interventions checklist and standard operating procedure bundle.

Figure 1 demonstrates the conceptual components of the Self-Care Deficit Nursing Theory (SCDNT) (Smith & Parker, 2015).

Figure 1:



*R is defined as the relationship for the purposes of figure 1

Methods

This project was guided by the Iowa Evidenced-Based Practice Model. This proven method provides the ideal framework to incorporate the best infection prevention and control outbreak management interventions into a quickly adopted protocol for LTCFs. This method will assist in clearly identifying the practice gaps of LTCFs lack of preparedness for outbreak management situations, collecting the best evidenced-based prevention interventions into one manageable set of protocols, testing those outbreak protocols, and providing evidence of improved patient outcomes with their use. The Iowa model for evidenced-based Practices was utilized as the research method for this study (Burns, n.d.). Used/reprinted with permission from the University of Iowa Hospitals and Clinics, copyright 2015. The model's format is observed below:

1. The significant impact of the COVID-19 pandemic on the vulnerable LTCF population identified a need for increased preparedness and response protocols in these communal care environments.

2. The severe impact and tragic morbidity and mortality of the vulnerable elderly population witnessed in the early stages of the COVID-19 pandemic created the highest priorities for facilities to develop strategies to prevent and control the SARS-CoV-2 virus.

3. A multidisciplinary team consisting of a Hospital Epidemiologist, two Geriatricians, one Geriatric Nurse Practitioner, two Infection Preventionist, one Nurse Manager, one Environmental Management staff and one facility administrator was developed to respond to and investigate the outbreak from the first facility, which is entitled as Team A. A multidisciplinary team consisting of a Hospital Epidemiologist, two Geriatricians, two Geriatric Nurse Practitioners, one Chief Nurse, two Infection Preventionists, four Nurse Managers, four Environmental management staff, one Engineering Service staff, two Clinical Pharmacists and two Dieticians was developed to respond to and investigate the outbreak from the second facility, which is entitled as Team B.

4. The teams met and investigated the outbreak situation at least three times per week throughout the outbreak. These meetings included environmental rounds of the facility looking for outbreak measure compliance, deficiencies, and needs. After the rounds were completed, the team would meet to discuss the environmental findings, changes in the prevalence of positive cases, personal protective equipment (PPE) burn rates and availability, testing needs for residents and staff, patient movements needed for cohorting, staffing status and treatment options required for residents with severe disease. Throughout the investigations, a primary question was identified, which transitioned into the PICO(T) question below:

In LTCF residents (P), how does the early implementation of Infection Prevention and Control Outbreak management interventions (I), compared to absent or late implemented IPC interventions(C), affect the duration of the outbreak, attack rate, morbidity, and mortality rates (O) during the first twelve months of the COVID-19 pandemic (T).

5. A literature review was conducted that included analysis through critiquing multiple studies regarding the causes of the elderly's significant vulnerability towards the SARS-CoV-2 virus, the status of LTCF's preparedness and response capabilities, and the lack of appropriate guidance for outbreak management. This analysis was synthesized with a determination that there was enough evidence that identified the need for further investigation into the research question and the need for developing a bundled approach of evidence-based practices to guide LTCFs with outbreak management.

6. **STOP** and **DECIDE** if there is sufficient research to implement a practice change:
    1. **Yes** - Move to Step 7.

7. Team B immediately implemented the appropriate IPC outbreak management interventions upon confirmation of the first COVID-19-positive LTCF resident. In comparison, Team A did not fully implement the IPC outbreak management interventions until 55 days after confirming the first COVID-19 positive resident. Team B's early implementation will be identified as this study's 'pilot program.'

8. Evaluate results. Is the change feasible, and does it result in improved outcomes? Is the change appropriate for full adoption within the department/practice/organization?
    1. **Yes** – The early implementation of the IPC outbreak management measures was fully adopted by Team B's facility. There have been two outbreaks since this protocol was adopted, and the outbreak's length, attack rate, morbidity, and

mortality rates were significantly reduced in both outbreaks. Introduce the change across the department/unit/practice/organization.

Design

This study utilized a quantitative design to measure four aspects of two separate SARS-CoV-2 (COVID-19) outbreaks to investigate the effect of early implementation of multiple infection prevention and control (IPC) outbreak management interventions. The four measures consisted of the length of the outbreak in days, the attack rate of the virus, and mortality rates during each outbreak. The two outbreaks involved Long-Term Care Facility Residents with similar population characteristics. This population data was collected using retrospective chart reviews. The inclusion criteria included any resident admitted to the LTFC during the initial confirmed COVID-19-positive case through the outbreak resolution. There were no exclusions utilized with this study population. A demographical comparison of the two LTCFs can be found in Table 3 below. The investigated facilities are very similar to those found in the current literature and seen within the literature review and analysis of this project. One discrepancy, and obvious limitation to the project, is the gender discrepancy due to all of the study participants being Veterans, which in turn are mostly a male population. This limitation will be discussed in detail later. The inclusion criteria included any resident admitted to 'Facility A' or 'Facility B'LTFCs during the initial confirmed COVID-19-positive case through the outbreak resolution. There were no exclusions utilized with this study population.

Project Implementation

The intervention for this project is the development of multiple infection prevention and control outbreak management interventions in a bundled approach that will be readily available for all LTCFs to utilize as EBP for outbreak management across each type of

transmission-based precaution criteria. These interventions will be placed into three categories: Administrative controls, Engineering controls, and environmental controls. Please refer to Table 1 for a draft of the IPC Outbreak Management Bundle:

Table 1:

10 Essential Infection Prevention & Control Measures During a COVID-19 Outbreak			
Administrative Control Measures			
Intervention	**Compliant**	**Non-Compliant**	**MISC**
Positive COVID-19 patients are cohorted together by both diagnosis & location on unit.			
Dedicated staff are being utilized for the COVID-19 unit.			
All staff have been trained and are adhering to the correct PPE Donning & Doffing procedure according to CDC Guidance.			
Social distancing, including cancellation of activities inside and outside of facility.			
Symptom screening for staff and residents increased.			
Environmental Control Measures			
Intervention	**Compliant**	**Non-Compliant**	**MISC**
Dedicated patient care equipment being utilized for COVID-19 positive patients ONLY.			
High-touch surface disinfection frequency increased.			
Hand hygiene stations adequately placed and filled.			
Personal Protective Equipment (PPE) carts are clean and correctly stocked.			
Engineering Control Measures			
Intervention	**Compliant**	**Non-Compliant**	**MISC**
Entrance screening for exposure and symptoms			

Data Analysis

The data source is from the Epidemiological Outbreak Investigation reports conducted by both Team A & Team B. The measurements will be conducted as follows and viewed in Table 2 below:

1. Attack Rate: number of confirmed positive COVID-19 Cases / Total number of Facility residents during the outbreak x 100.
2. Morbidity: The number of residents needing hospitalization / Total number of Facility residents during the outbreak x 100. Also, the Charlson Co-morbidity Index (CCI) was utilized for added validity with the facility comparison (*Charlson Comorbidity Index (CCI) - MDCalc*, n.d.).
3. Mortality: The number of resident deaths (COVID-19 related) / Total number of Facility residents during the outbreak x 100.
4. Length of Outbreak: The number of days from the first confirmed COVID-19-positive case to the resolution of the outbreak. The resolution of the outbreak is set at no new confirmed positive cases past two full incubation periods of the SARS-CoV-2 virus. One incubation period will be set at 14 days for Facility A's outbreak (Due to the CDC guidance for incubation timeframe at the time of the outbreak) and ten days for Facility B's outbreak, due to the CDC guidance at for incubation timeframe at the time of the outbreak (CDC, 2020a, February 11).
5. An additional measurement will be conducted for both Facility A & B's outbreak periods with a notation of when they FULLY implemented all of the ten essential outbreak management interventions seen within Table 1.

Table 2:

Project Data Analysis Comparison Between Facility "A" and Facility "B"		
Data Analysis	**Facility A**	**Facility B**
Attack Rate	48%	22%
Morbidity	18%	6%
Mortality	21%	5%
Length of Outbreak (days)	116	44
Number of Deaths	17	4
Number of Outbreak Days Until Full Implementation of IPC Interventions	39	1

The Data collection process utilized was the epidemiological outbreak investigation tool developed by the Infection Prevention & Control Service at a Veterans Affairs Medical center (infection prevention and control service) in the southeastern region of the US. It is an Excel spreadsheet platform that consists of the following tabs:

6. Chronological Data
7. Positive Chronological Data
8. Epidemiological Comments (Index Case Investigation and other data)
9. Epidemiological Linkage Analysis
10. Environmental Survey Data
11. Epidemiological Curve Graphic Representation

12. Epidemiological Curve Data page
13. Facility Floor Plan Heat Map of Positive Cases

2. The infection prevention and control team members on both Team A & Team B will provide the population demographic (refer to *Table 3* below) and clinical data onto two spreadsheets. One with Private Health Information (PHI) that will be stored on the Veterans Health Administration (VHA) secure databases and IT infrastructure and can only be accessed by Facility B's infection prevention and control service Federal VHA employee's PIV badge. Also, one spreadsheet without PHI will be available for review for this project. There will be no identifiable data allowed on this spreadsheet.

Table 3:

Project population demographic data for comparison between Facility "A" and Facility "B"				
Demographic Type	**Facility A**		**Facility B**	
Mean Age of Individuals (years)	80.64		74.29	
Median Age of Individuals (years)	81		74	
Gender	Male: 100%		Male: 97.65	
	Female: 0%		Female: 2.35%	
Race of Individuals	Black or African American: 25.93%		Black or African American: 24.42%	
	Hawaiian: 0%		Hawaiian: 1.23%	
	Unknown: 9.88%		Unknown: 0%	
	White or Caucasian: 64.19%		White or Caucasian: 74.35%	
Commonality of Pre-existing Comorbidities	**Number**	**Percentage**	**Number**	**Percentage**
AF-Atrial Fibrillation	16	19.75%	17	19.77%
ASx-Asthma	1	1.23%	0	0%

CAP-Community Acquired Pneumonia	0	0%	1	1.16%
CAD-Coronary Artery Disease	9	11.11%	14	16.28%
CHD-Coronary Heart Disease	0	0%	1	1.16%
CHF-Congestive Heart Failure	4	4.94%	3	3.49%
CI-Cerebral Infarction	4	4.94%	8	9.30%
CVA-Cerebral Vascular Accident	9	11.11%	4	4.65%
CVD-Cardiovascular Disease	5	6.17%	1	1.16%
COPD- Chronic Obstructive Pulmonary Disease	7	8.64%	7	8.14%
DM-Diabetes Mellitus	20	24.69%	8	9.30%
HTN-Hypertension	44	54.32%	50	58.14%
HDx-Heart Disease (not specified)	1	1.23%	1	1.16%
IS-Ischemic Stroke	0	0%	1	1.16%
KDx-Kideny Disease / Chronic Renal Insufficiency	13	16.05%	7	8.14%
LDx-Lung Disease (not specified)	4	4.94%	1	1.16%
Lung CA-Lung Cancer	1	1.23%	0	0%
MI-Myocardial Infarction	2	2.47%	0	0%
OBx-Obesity	4	4.94%	2	2.33%
PE-Pulmonary Emphysema	0	0%	1	1.16%
RDS-Respiratory Distress Syndrome	0	0%	1	1.16%
RFx-Respiratory Failure	1	1.23%	2	2.33%
Sx-Stroke	1	1.23%	0	0%
None	9	11.11%	13	15.12%

Presence of Symptoms & Morbidity Comparison		
Asymptomatic	13%	11%
Symptomatic	26%	8%
Charlson Co-morbidity Index Mean Score	3.8	3.6
Charlson Co-morbidity Index Median Score	4	4
Charlson Co-morbidity Index estimated 10-year survival mean	56.54%	59.18%
Charlson Co-morbidity Index estimated 10-year survival median	53%	53%

Total Number of COVID-19 Positives	39%	19%

Results

The results of the retrospective chart reviews and data analysis provide an overwhelmingly positive response to the question of whether early implementation of IPC outbreak interventions affects the attack rate, morbidity, and mortality of the patient population in LTCFs during an outbreak. Facility "A" implemented the ten interventions later on days thirteen (13), fifteen (15), eighteen (18), twenty-five (25), forty (40), and fifty-five (55), as seen in *Table 4* below. This late implementation significantly affected the four measures as seen above in *Table 2.* Facility "B" implemented the interventions on day one (1), as seen in *Table 5,* and had significantly lower negative patient-outcome rates when compared to Facility "A." Facility "A" has a twenty-six percent (26%) higher attack rate, a twelve percent (12%) higher morbidity rate, and a sixteen percent (16%) increased death rate. This is clear evidence that the earlier the IPC outbreak management interventions are implemented, the better the patient outcomes will be during an outbreak.

Table 4:

Facility "A" IPC Intervention Implementation		
Intervention	**Date Implemented**	**Outbreak Day Implemented**
Positive COVID-19 patients are cohorted together by both diagnosis & location on unit.	4/22/20	25
Dedicated staff are being utilized for the COVID-19 unit.	5/31/20	55
All staff have been trained and are adhering to the correct PPE Donning & Doffing procedure according to CDC Guidance.	5/7/20	40
Social distancing, including cancellation of activities inside and outside of facility.	4/10/20	13

Dedicated patient care equipment being utilized for COVID-19 positive patients ONLY.	4/15/20	18
High-touch surface disinfection frequency increased.	4/15/20	18
Hand hygiene stations are adequately placed and filled.	4/15/20	18
Personal Protective Equipment (PPE) carts are clean and correctly stocked.	5/7/20	40
Symptom Screening, staff and residents increased.	4/22/20	25
Entrance screening for exposure and symptoms	5/7/20	40

Table 5:

Facility "B" IPC Intervention Implementation		
Intervention	**Date Implemented**	**Outbreak Day Implemented**
Positive COVID-19 patients are cohorted together by both diagnosis & location on unit.	12/22/20	1
Dedicated staff are being utilized for the COVID-19 unit.	12/22/20	1
All staff have been trained and are adhering to the correct PPE Donning & Doffing procedure according to CDC Guidance.	12/22/20	1
Social distancing, including cancellation of activities inside and outside of facility.	12/22/20	1
Dedicated patient care equipment being utilized for COVID-19 positive patients ONLY.	12/22/20	1
High-touch surface disinfection frequency increased.	12/22/20	1
Hand hygiene stations are adequately placed and filled.	12/22/20	1
Personal Protective Equipment (PPE) carts are clean and correctly stocked.	12/22/20	1
Symptom Screening, staff and residents increased.	12/22/20	1
Entrance screening for exposure and symptoms	12/22/20	1

Discussion

The devastating impact of the COVID-19 pandemic on residents of long-term care residents resulted from multifactorial outbreak management response failures. The most significant of those factors was the untimeliness implementation of Infection Prevention and Control Outbreak interventions. This retrospective chart review and comparison of two LTCF COVID-19 outbreaks during year one of the pandemic sought to reveal if the early implementation of ten selected IPC outbreak management interventions would affect the attack rate, morbidity, and mortality of the residents. The review identified strong evidence to suggest that LTCFs that implemented the ten IPC outbreak interventions at the onset or earlier in the outbreak greatly reduced the severity of resident outcomes and significantly decreased the transmission of COVID-19. The ten IPC interventions seen in *Table 1* were selected based on previous studies that identified a higher compliance rate to these interventions leading to a lower rate of COVID-19 prevalence in LTCF. LTCFs with lower COVID-19 prevalence among residents had significantly greater implementation of IPC recommendations compared to those with higher COVID-19 prevalence, suggesting the utility in adhering to current guidelines to reduce transmission in this vulnerable population (Telford et al., 2021). The study provides a clear correlation between IPC interventional compliance and the prevalence of COVID-19 in LTCFs. The ten essential IPC outbreak management interventions selected for this project's focus are also identified in the Telford et al. study from 2021. From the data of Telford et al., *Table 6* below provides further reinforcement of the criticality of compliance with infection prevention practices. The commonality of these interventions is that their primary intention is on pathogen containment and environmental eradication. This interventional focus is significant in highly communal environments, such as LTCFs.

Table 6:

Facility COVID-19 Prevalence Interventional Compliance Comparison		
Intervention	**Higher Prevalence Facility Compliance**	**Lower Prevalence Facility Compliance**
Positive COVID-19 patients are cohorted together by both diagnosis & location on the unit.	82%	85%
Dedicated staff are being utilized for the COVID-19 unit.	73%	77%
All staff have been trained and are adhering to the correct PPE Donning & Doffing procedure according to CDC Guidance.	36%	85%
Social distancing, including cancellation of activities inside and outside of facility.	54%	74%
Dedicated patient care equipment being utilized for COVID-19 positive patients ONLY.	18%	31%
High-touch surface disinfection frequency increased.	18%	31%
Hand hygiene stations adequately placed and filled.	18%	54%
Personal Protective Equipment (PPE) carts are clean and correctly stocked.	18%	85%
Symptom Screening, staff and residents increased.	64%	82%
Entrance screening for exposure and symptoms	73%	92%

Conclusion

This research has established that the COVID-19 pandemic tragically affected LTCFs disproportionately than any other healthcare environment due to the known vulnerability of the elderly population, the lack of preparedness to respond efficiently as evidenced by the failure to implement critical infection prevention and control (IPC) outbreak management interventions in a timely fashion. It is important to note that both facilities' outbreak comparison and correlating

data were collected during the pre-vaccination era of the COVID-19 pandemic when all patients were equally susceptible to infection and at risk of severe disease, hospitalization, and death. Through the work within this project, early implementation of essential IPC outbreak management interventions has been proven to reduce the attack rate by 26%, morbidity rate by 12%, and mortality rate by 16%. In the two-facility comparison completed within this project, a 26% reduction in the attack rate relates to twenty-one (21) fewer residents contracting COVID-19 out of the population of 83. A 12% reduction in morbidity would mean that ten residents would have a less severe disease process and would be more likely to recover faster. At the same time, a 16% decrease in mortality signifies the saving of 13 residents' lives. The effectiveness of implementing the IPC outbreak interventions seen in Table 1 can be observed within the graphical representation seen in Figures 2 & 3.

Figure 2:

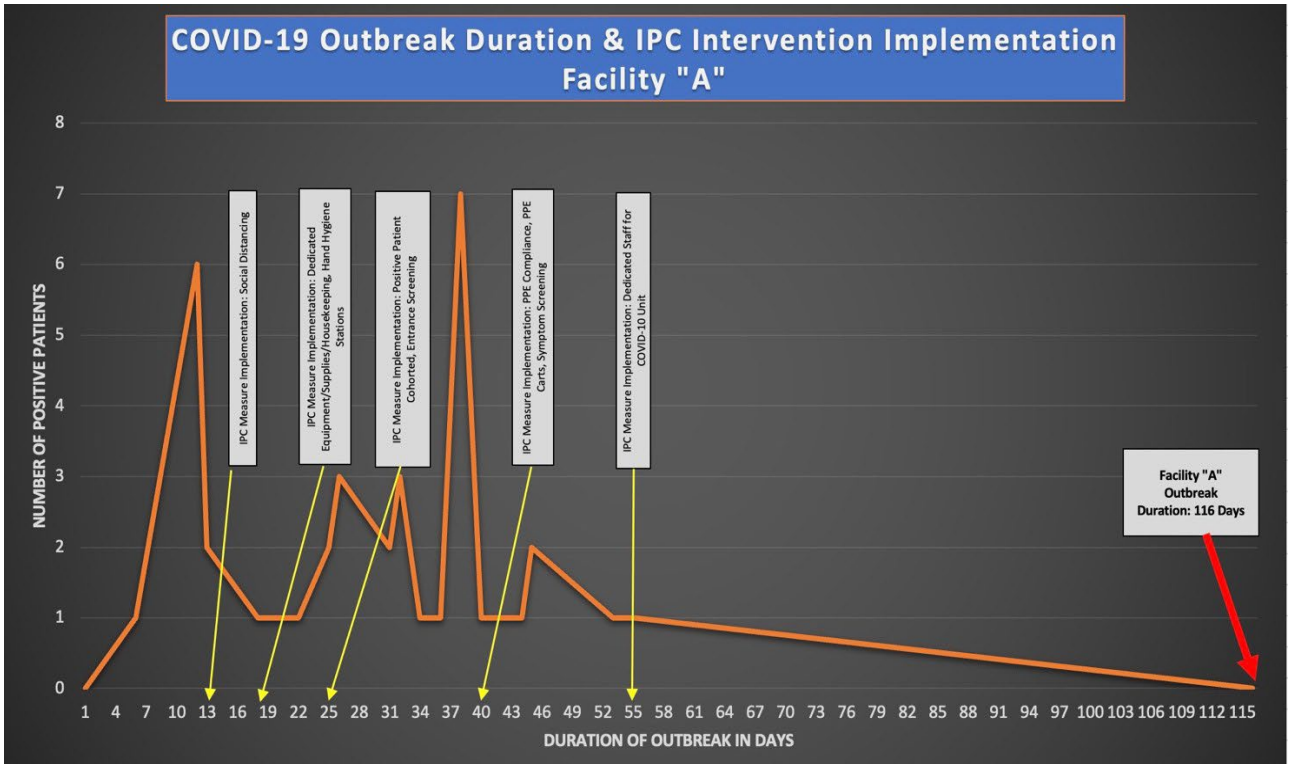
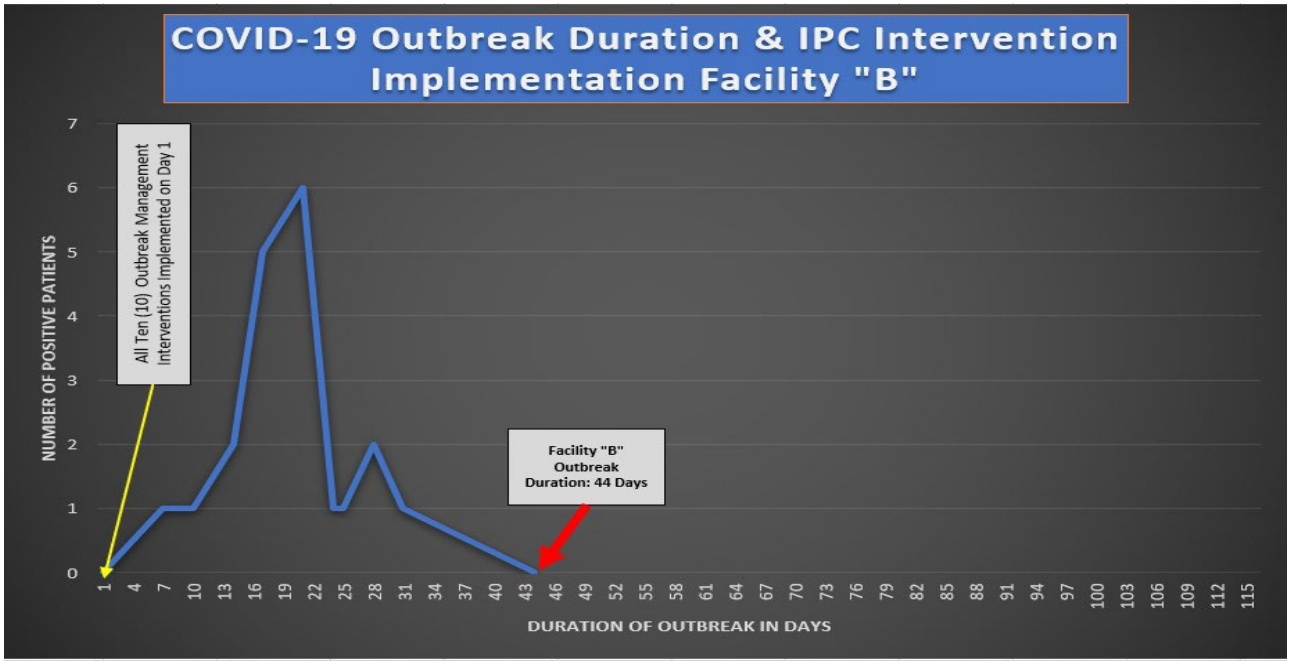


Figure 3:



This project successfully identified the need for early intervention implementation to improve the LTCF residents' outcomes during COVID-19 outbreaks. However, more research still needs to be conducted to understand why most LTCFs were so ill-prepared to handle an outbreak and the development of strategies and technologies to better prepare these types of facilities for any transmission-based outbreak that may emerge in the future. The next step in this project will be to develop a smartphone application that frontline staff and their supervisors can use to provide step-by-step instructions on what interventions should be implemented in a transmission-based format. For example, suppose an LTCF is experiencing the beginning of an outbreak where a Gastrointestinal pathogen is the suspected pathogen. In that case, the tool will show the protocol for implementing interventions based on the contact mode of transmission.

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I have abided by the UNCG Academic Integrity Policy on this assignment.

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Signature (typed if electronic submission) Date